2019-2020, 2022-2023 FTR
Service Manual

FOREWORD

The information printed within this publication includes the latest product information at time of print. The most recent version of this Service Manual is available in electronic format at www.polarisdealers.com.

This Service Manual is designed primarily for use by certified Indian Motorcycle Master Service Dealer® technicians in a properly equipped shop and should be kept available for reference. All references to left and right side of the vehicle are from the operator's perspective when seated in a normal riding position.

Some procedures outlined in this manual require a sound knowledge of mechanical theory, tool use, and shop procedures in order to perform the work safely and correctly. Technicians should read the text and be familiar with the service procedures before starting any repair. Certain procedures require the use of special tools. Use only the proper tools as specified. If you have any doubt as to your ability to perform any of the procedures outlined in this Service Manual, contact an authorized dealer for service.

We value your input and appreciate any assistance you can provide in helping make these publications more useful. Please provide any feedback you may have regarding this manual. Authorized dealers can submit feedback using 'Ask Polaris'. Click on 'Ask Polaris', and then click on 'Service Manual / Service Literature Question'.

Publication Printed November 2022 (PN 9941004 R01)

SAFETY WARNINGS

The following signal words and symbols appear throughout this manual and on the vehicle. Your safety is involved when these words and symbols are used. Become familiar with their meanings before reading the manual.

⚠ DANGER
DANGER indicates a hazardous situation which, if not avoided, WILL result in death or serious injury.

⚠ WARNING
SAFETY ALERT WARNING indicates a hazardous situation which, if not avoided, COULD result in death or serious injury.

⚠ CAUTION
SAFETY ALERT CAUTION indicates a hazardous situation which, if not avoided, COULD result in minor to moderate injury.

NOTICE
NOTICE provides key information by clarifying instructions.

IMPORTANT
IMPORTANT provides key reminders during disassembly, assembly and inspection of components.

TRADEMARKS

INDIAN MOTORCYCLE ACKNOWLEDGES THE FOLLOWING PRODUCTS THAT MAY BE MENTIONED IN THIS MANUAL:

LOCTITE®, is a registered trademark of the Henkel Corporation.

DUNLOP®, is a registered trademark of the Dunlop Tire Corporation.

STA-BIL®, is a registered trademark of Gold Eagle.

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Torx®, is a registered Trademark of Textron.

Garmin®, is a registered trademark of Garmin, Ltd.

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REVISION INDEX

REV	DATE	CHANGES
R01	1/31/2023	MY23 Content added

FEEDBACK FORM

A feedback form has been created for the technician or consumer to provide Polaris with an overall satisfaction rating for this service manual, provide comments on your experience or upload pictures/video. This feedback form is viewable on a mobile device by scanning the QR code or by clicking **HERE** if viewing this document electronically.

2019-2020, 2022-2023 FTR

Service Manual

Chapter Summary

CHAPTER 1
GENERAL / SPECIFICATIONS

VEHICLE INFORMATION

MODEL NUMBER DESIGNATION

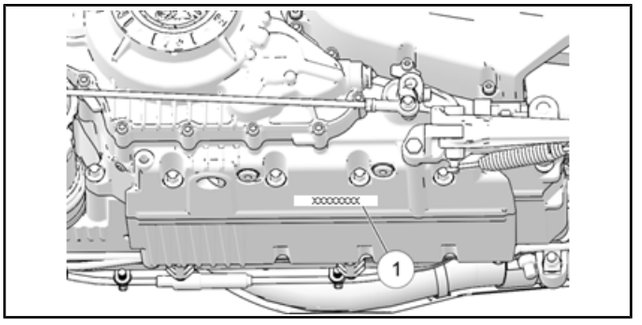
Example: N19RTA22AA

GRP	MY	TYPE	MODEL	LINE	DISP	NET BRAKE HP	MARKET CONFIG	COLOR
1st digit	2nd/ 3rd digit	4th digit*	5th digit*	6th digit*	7th digit*	8th digit*	9th digit	10th digit
N	19 = 2019 20 = 2020 22 = 2022 23 = 2023	R = FTR 3 = FTR (35kW)	T = Tracker U = Tracker 70 kW V = Tracker Street 70 kW Z = Tracker Street	A = Base model w/ABS R = R model S = S model w/ ABS (2022) M = S model w/ABS (2023) T = Rally w/ ABS	2 = 1203 cc (73 ci) V-Twin	2 = 120 hp / 89 kW 4 = 90 hp / 70 kW 5 = 122 hp / 89 kW	A = 49 State B = 50 State C = Canada E = EU (WVTA) J = Japan P = PAC X = China	Paint Color

* = digits that would transfer to 17 digit VIN and are used in digits 4–8 respectively.
First 3 digits, 9th digit, and 10th digit are used in model number only. They are not used with the 17 digit VIN.

ENGINE NUMBER LOCATION

The engine number ① is stamped into the bottom of the left-hand engine case. The stamping identifies the engine model and serial number.



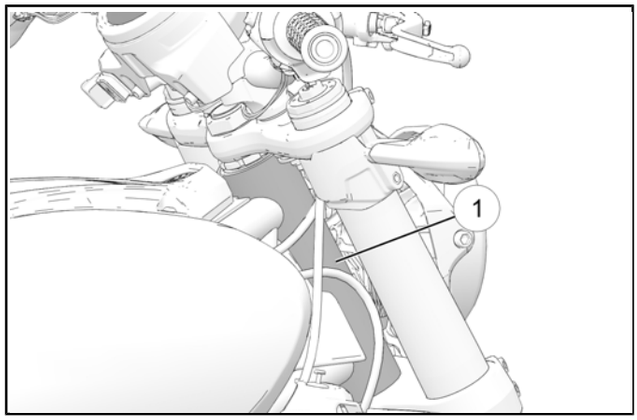
VEHICLE IDENTIFICATION NUMBER (VIN) DESIGNATION

Example: 56KTCAAA0E3000024

World Mfg. ID			Vehicle Descriptors						Vehicle Identifiers							
			Chas-sis	Type	Disp	HP	Series	Chec-k Digit	MY*	Mfg	Individual Serial No.					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
5	6	K	C	C	A	A	A	0	E	3	0	0	0	0	0	0
* Model Year: K = 2019; L= 2020; N = 2022; P = 2023																

VIN LOCATION

The vehicle identification number ① is stamped on the right side of the steering head.



MANUFACTURER LABEL

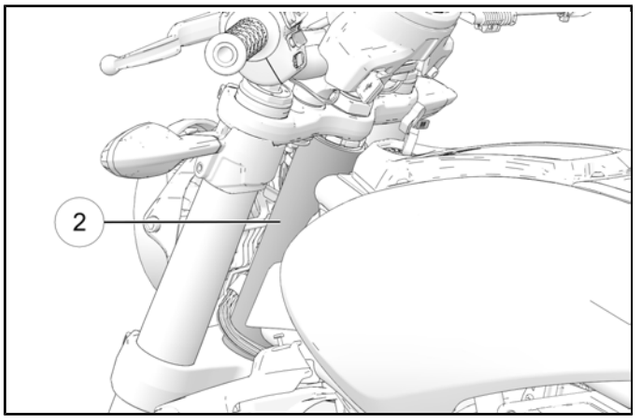
The manufacturer label ② located on the left side of the steering head contains the following information:

Vehicle Identification Number (VIN)

Gross Vehicle Weight Rating (GVWR)

Gross Axle Weight Rating (GAWR)

Tire Type and Load Information.



TIRE INFORMATION LABEL

See Manufacturer label for tire information.

GENERAL SPECIFICATIONS
2019-2020 FTR

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2019-20 FTR	Gloss Black P-266 Thunder Black Smoke P-463	N19RTA22AA N19RTA22BA N19RTA22CA N19RTA22EA N19RTA22XA N19RTA24EA N193TA24EA	N20RTA22EA N20RTA22XA N20RUA24EA N203UA24EA

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2019 FTR S	Indian Red / Black Pearl P-639 / P-666 Gloss Black / Black Pearl P-266 / P666 Gloss Black / Titanium Metallic P-266 / P-653	N19RTS22AA N19RTS22BA N19RTS22CA N19RTS22EA N19RTS22XA N19RTS22AR N19RTS22BR	N19RTS22CR N19RTS22ER N19RTS22XR N19RTS22AC N19RTS22BC N19RTS22CC N19RTS22EC N19RTS22XC
2019 Limited Edition	Pearl White P-566	N19RTS25EX	
2020 FTR S Carbon	Carbon / Indian Red P-1911 / P-639	N20RTR25E8 N20RTR22X8	

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2020 FTR Rally	Titanium Smoke P-1912	N20RTT22A9 N20RTT22B9 N20RTT22C9	N20RTT22E9 N20RTT22X9

MODEL YEAR 2019-2020	49 State with ABS	50 State with ABS	International / China
DIMENSIONS			
Overall Length	90 in. (2287 mm)		
Overall Width	33.9 in. (862 mm)		
Overall Height			
2019–20 FTR Base / S / Carbon	45.9 in. (1167 mm)		
2019 Limited Edition	NA		46.9 in. (1191 mm)
2020 FTR Rally	47.4" (1205 mm)		
Unladen Seat Height	33.6 in. (853 mm)		
Wheelbase	60 in. (1524 mm)		
Ground Clearance	7.2 in. (183 mm)		
Rake (frame)/Trail	26.3 Degrees / 5.1 in. (130 mm)		
WEIGHT			
Dry Weight (without fuel/fluids)			
2019 FTR	495 lbs (225 kg)	496 lbs (226 kg)	
2019 FTR S	497 lbs(226 kg)	498 lbs (227 kg)	
2019 Limited Edition	NA		518 lbs (235 kg)
2020 FTR / S Carbon	502 lbs (228 kg)		
2020 FTR Rally	511 lbs (232 kg)		
Wet Weight (with fuel/fluids)			
2019 FTR	517 lbs (235 kg)		
2019 Limited Edition	NA		540 lbs (245 kg)
2020 FTR / S Carbon	518 lbs (235 kg)		
2020 FTR Rally	529 lbs (240 kg)		
Gross Vehicle Weight Rating (GVWR)	948 lbs (430 kg)		
Gross Axle Weight Rating (GAWR)	Front: 375 lbs. (170 kg) Rear: 595 lbs. (270 kg)		
Maximum Load Capacity (riders, cargo, accessories)			
2019–20 FTR Base / S / S Rally / Carbon	431 lbs (195 kg)		
2019 Limited Edition	NA		408 lbs (185 kg)
CAPACITIES			
Radiator Coolant	2.32 qts. (2.2 L)		
Engine Oil	4.5 qts. (4.25 L) Dry Engine		
Fuel	3.4 gal. (13.0 L)		
Fuel Reserve (fuel light on)	0.5 gal. (1.9 L)		
Fork Oil	FTR RALLY (2019): **Adjustable: 17.2 ± .2 oz508 ± 6 cm³** FTR, FTR S: **Non-Adjustable: 17.5 ± .2 oz519 ± 6 cm³**		
WHEELS / TIRES			
Front Wheel Size/Type			
2019–20 FTR Base / S / S Rally / Carbon	19 in. x 3.00 in. Spoked		

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

2019 Limited Edition	NA	19 in. x 3.00 in. Spoked
Rear Wheel Size/Type		
2019–20 FTR Base / S / S Rally / Carbon	18 in. x 4.25 in. Spoked	
2019 Limited Edition	NA	18 in x 4.25 in. Spoked
Front Tire Type/Size	120/70R19 60V	
Rear Tire Type/Size	150/70R18 70V	
Tire Pressure	Front: 36 psi (248 kPa) Rear: 40 psi (276 kPa)	
CHASSIS		
F Suspension Type/Travel	Inverted Telescopic Fork/ 5.90 in. (150 mm)	
F Fork Tube Diameter	43 mm	
R Suspension Type/Travel	Monotube IFP / 5.90 in. (150 mm)	
Swingarm	Steel	
Front Brakes	Dual / 320 mm Rotor / 4-Piston Caliper	
Rear Brakes	Single/ 260 mm Rotor / 2-Piston Caliper	

MODEL YEAR 2019-20	ALL MODELS
ENGINE	
Engine Type	Liquid Cooled V-Twin (60 Degrees)
Displacement	73 Cid (1203 cc)
Compression Ratio	12.5 : 1
Valve Train	DOHC, 4 Valves Per Cylinder, Graded Buckets
Bore and Stroke	102 x 73.6
Fuel System/Throttle Body Bore	Closed Loop Fuel Injection / Dual 60 mm Bore
Exhaust System	Two O2 Sensors (one in each bank) Single three-way catalyst in resonator
Rev Limit	9000 RPM
Idle RPM	1250 RPM +/- 50 RMP (Fully Warm)
Lubrication System	Semi-Dry Sump
Spark Plug/Gap	NGK MR7F 0.030 in. (0.8mm)
DRIVETRAIN	
Primary Drive	Gear Drive Wet Clutch
Crank Gear	46–Tooth
Clutch Gear	77–Tooth
Clutch Type	Wet, Assist & Slip, Multi-Plate
Primary Reduction Ratio	1.674 : 1
Transmission Type	6 Speed / Constant-Mesh / Foot Shift
1st Gear Ratio	2.769 : 1
2nd Gear Ratio	1.882 : 1
3rd Gear Ratio	1.500 : 1
4th Gear Ratio	1.273 : 1
5th Gear Ratio	1.125 : 1
6th Gear Ratio	1.036 : 1

Gear Shift Pattern	1 Down / 5 Up
Final Drive Type	Chain / 525HV3X
Overall Gear Ratio	
1st Gear	13.361 : 1
2nd Gear	9.082 : 1
3rd Gear	7.237 : 1
4th Gear	6.141 : 1
5th Gear	5.428 : 1
6th Gear	4.658 : 1

MODEL YEAR 2019-20	**ALL MODELS**
ELECTRICAL	
Alternator	460W @ 3000 RPM
Battery	12 Volt, 12AH, 240CCA Maintenance Free AGM
Voltage Regulator	14.5 Volts / 32 Amp
Headlight	Non-Serviceable LED
Tail/Brake Light	Non-Serviceable LED
Turn Signal	Non-Serviceable LED
License Plate	Non-Serviceable LED
Speedometer	Non-Serviceable LED
Indicator Lights	Non-Serviceable LED
Position Bulb	Non-Serviceable LED

2022 FTR

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2022 FTR	Black Smoke P-2034 / P-463	N22RZA22A4 N22RZA22B4 N22RZA22C4	N22RZA22E4 N22RZA22X4

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2022 **FTR S**	Maroon Metallic P-1931 / P-711 White Smoke P-1717 / P–675	N22RZS25AM N22RZS25BM N22RZS25CM N22RZS25EM N22RZS25XM	N22RZS25AF N22RZS25BF N22RZS25CF N22RZS25EF N22RZS25XF
2022 **FTR S Carbon**	Carbon / Silver P-1970 / P-385	N22RZR25A8 N22RZR25B8 N22RZR25C8	N22RZR25E8 N22RZR25X8

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2022 **FTR Rally**	Titanium Smoke P-1828	N22RTT22A9 N22RTT22B9 N22RTT22C9 N22RTT22E9	N22RTT22X9 N22RUT24E9 N223UT24E9

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2022 FTR Championship Edition	Carbon / Indian Red P-1911 / P-639	N22RTE25AV N22RTE25BV N22RTE25CV	N22RTE25EV N22RTE25XV

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS
2022 FTR Stealth Gray Special Edition	Stealth Gray P-804	N22RZS25EG

MODEL YEAR 2022	49 State with ABS	50 State with ABS	International / China
DIMENSIONS			
Overall Length	90 in. (2287 mm)		
Overall Width	33.9 in. (862 mm)		
Overall Height			
FTR, FTR S, FTR R Carbon	45.9 in. (1167 mm)		
FTR Championship Edition	NA		52.6" (1336 mm)
FTR Rally	47.4" (1205 mm)		
Unladen Seat Height	33.6 in. (853 mm)		
Wheelbase	60 in. (1524 mm)		
Ground Clearance	7.2 in. (183 mm)		
Rake (frame)/Trail	FTR, FTR S, FTR R Carbon = 25.3 Degrees / 3.9 in (99.9 mm) FTR Rally, FTR Championship Edition = 26.3 Degrees / 5.1 in (130.0 mm)		
WEIGHT			
Dry Weight (without fuel)			
FTR / FTR S	495 lbs (225 kg)		
FTR Carbon	493 lbs (224 kg)		
FTR Rally	511 lbs (232 kg)		
FTR Championship Edition	NA		490 lbs (222 kg)
Wet Weight (with fuel/fluids)			
FTR / FTR S	514 lbs (233 kg)		
FTR Carbon	513 lbs (232 kg)		
FTR Rally	529 lbs (240 kg)		
FTR Championship Edition	NA		521 lbs (236 kg)
Gross Vehicle Weight Rating (GVWR)	948 lbs (430 kg)		
Gross Axle Weight Rating (GAWR)	Front: 375 lbs. (170 kg) Rear: 595 lbs. (270 kg)		
Maximum Load Capacity (riders, cargo, accessories) All Models	430 lbs (195 kg)		
CAPACITIES			
Radiator Coolant	2.32 qts. (2.2 L)		
Engine Oil	4.5 qts. (4.25 L) Dry Engine		
Fuel	3.4 gal. (13.0 L)		
Fuel Reserve (fuel light on)	0.5 gal. (1.9 L)		
Fork Oil	FTR, FTR S, FTR CHAMPIONSHIP EDITION: **17.2 ± .2 oz508 ± 6 cm³** FTR RALLY: **17.5 ± .2 oz519 ± 6 cm³** FTR R CARBON: **18.4 ± .2 oz544 ± 6 cm³**		
WHEELS / TIRES			
Front Wheel Size/Type			
FTR Rally	19 in. x 3.00 in. Spoked		
FTR, FTR S, FTR R Carbon	17 in. x 3.50 in. Cast		

FTR Championship Edition		19 in. x 3.00 in. Cast
Front Tire Type/Size		
FTR, FTR S, FTR R Carbon	120/70ZR17 58W	
FTR Rally, FTR Championship Edition	120/70R19M/C 60V	
Rear Wheel Size/Type		
FTR Rally, FTR Championship Edition	18 in x 4.25 in. Spoked	
FTR, FTR S, FTR R Carbon	17 in. x 5.50 in. Cast	
Rear Tire Type/Size		
FTR, FTR S, FTR R Carbon	180/55ZR17 73W	
FTR Rally, FTR Championship Edition	150/70R18M/C 70V	
Tire Pressure All wheel and tire combinations	Front: 36 psi (248 kPa) Rear: 40 psi (276 kPa)	
CHASSIS		
F Suspension Type / Travel		
FTR, FTR S, FTR R Carbon	Fully Adjustable Inverted Telescopic Cartridge Fork / 4.72 in. (120 mm)	
Rally	Inverted Telescopic Fork / 5.90 in. (150 mm)	
F Fork Tube Diameter	43 mm	
R Suspension Type / Travel		
FTR, FTR S, FTR R Carbon	Fully Adjustable Piggyback IFP / 5.11 in. (130 mm)	
Rally	Monotube IFP / 5.90 in. (150 mm)	
Swingarm	Steel	
Front Brakes		
FTR, FTR S, FTR R Carbon	Dual / 320 mm Rotor / 4-Piston Caliper	
Rear Brakes		
FTR, FTR S, FTR R Carbon	Single/ 260 mm Rotor / 2-Piston Caliper	

MODEL YEAR 2022	ALL MODELS	TRACKER STREET MODELS
ENGINE		
Engine Type	Liquid Cooled V-Twin (60 Degrees)	
Displacement	73 Cid (1203 cc)	
Compression Ratio	12.5 : 1	
Valve Train	DOHC, 4 Valves Per Cylinder, Graded Buckets	
Bore and Stroke	102 x 73.6	
Fuel System/Throttle Body Bore	Closed Loop Fuel Injection / Dual 60 mm Bore	
Exhaust System	Two O2 Sensors (one in each bank) Single three-way catalyst in resonator	
Rev Limit	9000 RPM	
Idle RPM	1250 RPM +/- 50 RMP (Fully Warm)	
Lubrication System	Semi-Dry Sump	
Spark Plug/Gap	NGK MR7F 0.030 in. (0.8mm)	

DRIVETRAIN		
Primary Drive	Gear Drive Wet Clutch	
Crank Gear	46–Tooth	
Clutch Gear	77–Tooth	
Clutch Type	Wet, Assist & Slip, Multi-Plate	
Primary Reduction Ratio	1.674 : 1	
Transmission Type	6 Speed / Constant-Mesh / Foot Shift	
1st Gear Ratio	2.769 : 1	
2nd Gear Ratio	1.882 : 1	
3rd Gear Ratio	1.500 : 1	
4th Gear Ratio	1.273 : 1	
5th Gear Ratio	1.125 : 1	
6th Gear Ratio	0.966 : 1	
Gear Shift Pattern	1 Down / 5 Up	
Final Drive Type	Chain / 525HV3	
Overall Gear Ratio		
1st Gear	13.361 : 1	12.270 : 1
2nd Gear	9.082 : 1	8.341 : 1
3rd Gear	7.237 : 1	6.646 : 1
4th Gear	6.141 : 1	5.639 : 1
5th Gear	5.428 : 1	4.985 : 1
6th Gear	4.658 : 1	4.278 : 1

MODEL YEAR 2022	ALL MODELS
ELECTRICAL	
Alternator	460W @ 3000 RPM
Battery	12 Volt, 12AH, 240CCA Maintenance Free AGM
Voltage Regulator	14.5 Volts / 32 Amp
Headlight	Non-Serviceable LED
Tail/Brake Light	Non-Serviceable LED
Turn Signal	Non-Serviceable LED
License Plate	Non-Serviceable LED
Speedometer	Non-Serviceable LED
Indicator Lights	Non-Serviceable LED
Position Bulb	Non-Serviceable LED

2023 FTR

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2023 FTR	Stealth Gray: P-804 Onyx Black Metallic: P-800	N23RZA22A1	N23RZA22AG
		N23RZA22B1	N23RZA22BG
		N23RZA22C1	N23RZA22CG
		N23RZA22E1	N23RZA22EG
		N233VA24E1	N233VA24EG
		N23RVA24E1	N23RVA24EG
		N23RZA22P1	N24RZA22PG
		N23RZA22J1	N24RZA22JG
		N23RZA22E6	N23RZA22E4
		N23FZA22P6	N23FZA22P4
		N23FZA22J6	N23FZA22J4
		N23FZA22Z6	N23FZA22Z4

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2023 FTR Carbon R	Carbon Fiber: P-557	N23RZR22AC	N23RZR22XC
		N23RZR22BC	N23RZR221C
		N23RZR22CC	N23RZR22PC
		N23RZR22EC	N23RZR22JC
		N23RZR22E9	N23FZR22J9
		N23FZR22P9	N23FZR22Z9

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2023 FTR Sport	Onyx Black Metallic: P-800	N23RZM22A3	N23RZM22AW
		N23RZM22B3	N23RZM22BW
	White Lightning: P-599	N23RZM22C3	N23RZM22CW
		N23RZM22E3	N23RZM22EW
		N23RZM22X3	N23RZM22XW
		N23RZM2213	N23RZM221W
		N23RZM22P3	N23RZM22PW
		N23RZM22J3	N23RZM22JW
		N23RZM22E7	N23RZM22E8
		N23FZM22P7	N23FZM22P8
		N23FZM22J7	N23FZM22J8
		N23FZM22Z7	N23FZM22Z8

YEAR / MODEL	PAINT COLOR / CODE	MODEL NUMBERS	
2023 FTR Rally	Black Smoke: P-866	N23RTT22PS	N23RTT22JS

MODEL YEAR 2023	49 State with ABS	50 State with ABS	International / China
DIMENSIONS			
Overall Length	90 in. (2287 mm)		
Overall Width	33.9 in. (862 mm)		
Overall Height			
FTR, FTR S, FTR R Carbon	45.9 in. (1167 mm)		
Limited Edition	NA		46.9 in. (1191 mm)
FTR Rally	47.4" (1205 mm)		
Unladen Seat Height	33.6 in. (853 mm)		
Wheelbase	60 in. (1524 mm)		
Ground Clearance	7.2 in. (183 mm)		
Rake (frame)/Trail	FTR, FTR S, FTR R Carbon, FTR Sport = 25.3 Degrees / 3.9 in (99.9 mm) FTR Rally, FTR Championship Edition = 26.3 Degrees / 5.1 in (130.0 mm)		
WEIGHT			
Dry Weight (without fuel)			
FTR / FTR S	495 lbs (225 kg)		
FTR Carbon	493 lbs (224 kg)		
FTR Rally	511 lbs (232 kg)		
Wet Weight (with fuel/fluids)			
FTR / FTR S	514 lbs (233 kg)		
FTR Carbon	513 lbs (232 kg)		
FTR Rally	529 lbs (240 kg)		
Gross Vehicle Weight Rating (GVWR)	948 lbs (430 kg)		
Gross Axle Weight Rating (GAWR)	Front: 375 lbs. (170 kg) Rear: 595 lbs. (270 kg)		
Maximum Load Capacity (riders, cargo, accessories) All Models	430 lbs (195 kg)		
CAPACITIES			
Radiator Coolant	**2.32 qt (2.2 L)**		
Engine Oil	**4.5 qt (4.25 L)**		
Fuel	3.4 gal. (13.0 L)		
Fuel Reserve (fuel light on)	0.5 gal. (1.9 L)		
Fork Oil	FTR, FTR S, , FTR SPORT, FTR CHAMPIONSHIP EDITION: **17.2 ± .2 oz508 ± 6 cm³** FTR RALLY: **17.5 ± .2 oz519 ± 6 cm³** FTR R CARBON: **18.4 ± .2 oz544 ± 6 cm³**		
WHEELS / TIRES			
Front Wheel Size/Type			
FTR Rally	19 in. x 3.00 in. Cast		
FTR, FTR S, FTR R Carbon	17 in. x 3.50 in. Cast		
Front Tire Type/Size			
FTR, FTR S, FTR R Carbon	120/70ZR17 58W		
FTR Rally	120/70R19M/C 60V		

Rear Wheel Size/Type	
FTR Rally	18 in x 4.25 in. Spoked
FTR, FTR S, FTR R Carbon	17 in. x 5.50 in. Cast
Rear Tire Type/Size	
FTR, FTR S, FTR R Carbon	180/55ZR17 73W
FTR Rally	150/70R18M/C 70V
Tire Pressure All wheel and tire combinations	Front: 36 psi (248 kPa) Rear: 40 psi (276 kPa)
CHASSIS	
F Suspension Type / Travel	
FTR, FTR S, FTR R Carbon	Fully Adjustable Inverted Telescopic Cartridge Fork / 4.72 in. (120 mm)
Rally	Inverted Telescopic Fork / 5.90 in. (150 mm)
F Fork Tube Diameter	43 mm
R Suspension Type / Travel	
FTR, FTR S, FTR R Carbon	Fully Adjustable Piggyback IFP / 5.11 in. (130 mm)
Rally	Monotube IFP / 5.90 in. (150 mm)
Swingarm	Steel
Front Brakes	
FTR, FTR S, FTR R Carbon	Dual / 320 mm Rotor / 4-Piston Caliper
Rear Brakes	
FTR, FTR S, FTR R Carbon	Single/ 260 mm Rotor / 2-Piston Caliper

MODEL YEAR 2022	**ALL MODELS**	**TRACKER STREET MODELS**
ENGINE		
Engine Type	Liquid Cooled V-Twin (60 Degrees)	
Displacement	73 Cid (1203 cc)	
Compression Ratio	12.5 : 1	
Valve Train	DOHC, 4 Valves Per Cylinder, Graded Buckets	
Bore and Stroke	102 x 73.6	
Fuel System/Throttle Body Bore	Closed Loop Fuel Injection / Dual 60 mm Bore	
Exhaust System	Two O2 Sensors (one in each bank) Single three-way catalyst in resonator	
Rev Limit	9000 RPM	
Idle RPM	1250 RPM +/- 50 RMP (Fully Warm)	
Lubrication System	Semi-Dry Sump	
Spark Plug/Gap	NGK MR7F 0.030 in. (0.8mm)	
DRIVETRAIN		
Primary Drive	Gear Drive Wet Clutch	
Crank Gear	46–Tooth	
Clutch Gear	77–Tooth	
Clutch Type	Wet, Assist & Slip, Multi-Plate	
Primary Reduction Ratio	1.674 : 1	

Transmission Type	6 Speed / Constant-Mesh / Foot Shift	
1st Gear Ratio	2.769 : 1	
2nd Gear Ratio	1.882 : 1	
3rd Gear Ratio	1.500 : 1	
4th Gear Ratio	1.273 : 1	
5th Gear Ratio	1.125 : 1	
6th Gear Ratio	0.966 : 1	
Gear Shift Pattern	1 Down / 5 Up	
Final Drive Type	Chain / 525HV3X	
Overall Gear Ratio		
1st Gear	13.361 : 1	12.270 : 1
2nd Gear	9.082 : 1	8.341 : 1
3rd Gear	7.237 : 1	6.646 : 1
4th Gear	6.141 : 1	5.639 : 1
5th Gear	5.428 : 1	4.985 : 1
6th Gear	4.658 : 1	4.278 : 1

MODEL YEAR 2022	ALL MODELS
ELECTRICAL	
Alternator	460W @ 3000 RPM
Battery	12 Volt, 12AH, 240CCA, Maintenance Free AGM
Voltage Regulator	14.5 Volts / 32 Amp
Headlight	Non-Serviceable LED
Tail/Brake Light	Non-Serviceable LED
Turn Signal	Non-Serviceable LED
License Plate	Non-Serviceable LED
Speedometer	Non-Serviceable LED
Indicator Lights	Non-Serviceable LED
Position Bulb	Non-Serviceable LED

VEHICLE LOADING

GROSS VEHICLE WEIGHT RATING (GVWR)

⚠ WARNING

Exceeding the gross vehicle weight rating of your motorcycle can reduce stability and handling and could cause loss of control. NEVER exceed the gross vehicle weight rating of your motorcycle.

The *maximum load capacity* of your motorcycle is the maximum weight you may add to your motorcycle *without exceeding the GVWR*. This capacity is determined by calculating the difference between your motorcycle's GVWR and wet weight.

Refer to the specification section of this manual or the Manufacturing Information / VIN/PIN label on the motorcycle frame for model-specific information. Refer to Information label section in this manual for location on the motorcycle.

When determining the weight you will be adding to your motorcycle, to ensure you do not exceed the maximum load capacity, include the following:

- operator body weight
- passenger body weight
- weight of all riders' apparel and items in or on apparel
- weight of any accessories and their contents
- weight of any additional cargo on the motorcycle

PUBLICATIONS AND TECHNICAL LITERATURE

PUBLICATION PART NUMBERS

Some Indian Motorcycle publications, such as Owner's Manuals and Parts Books may be available on-line at the Indian Motorcycle website; http://www.indianmotorcycle.com/

Service Manuals and Owner's Manuals can be purchased through any authorized Indian motorcycle dealer. The part numbers are listed in the following table.

MODEL	SERVICE MANUAL PN	OWNER'S MANUAL PN
2019 Indian Motorcycle FTR (U.S.)	9929391	9928968
2019 Indian Motorcycle FTR (CAN)	NA	9929619
2019 Indian Motorcycle FTR (FRENCH)	9929391–FR	9928968–FR
2019 Indian Motorcycle FTR (GERMAN)	9929391–DE	9928968–DE
2019 Indian Motorcycle FTR (SPANISH)	9929391–ES	9928968–ES
2019 Indian Motorcycle FTR (SWEDISH)	NA	9928968–SV
2019 Indian Motorcycle FTR (NORWEGIAN)	NA	9928968–NO
2019 Indian Motorcycle FTR (FINNISH)	NA	9928968–FI
2019-20 Indian Motorcycle FTR (U.S.)	9931446	9931115
2019-20 Indian Motorcycle FTR (CAN)	NA	9931116
2019-20 Indian Motorcycle FTR (FRENCH)	NA	9931391–FR
2019-20 Indian Motorcycle FTR (GERMAN)	NA	9931391–DE
2019-20 Indian Motorcycle FTR (SPANISH)	NA	9931391–ES
2019-20 Indian Motorcycle FTR (SWEDISH)	NA	9931391–SV
2019-20 Indian Motorcycle FTR (NORWEGIAN)	NA	9931391–NO
2019-20 Indian Motorcycle FTR (FINNISH)	NA	9931391–FI
2019, 2020, 2022-2023 Indian Motorcycle FTR (U.S.)	9941004	9940927
2019, 2020, 2022-2023 Indian Motorcycle FTR (CAN)	NA	9940998

EMISSION INFORMATION

EMISSION CONTROL SYSTEMS

The U.S. Environmental Protection Agency and California Air Resources Board (CARB) require manufacturers to certify that their motorcycles comply with applicable exhaust emissions standards during their useful life, and that motorcycles built after January 1, 1983 comply with applicable noise emission standards for one year or 6,000 km (3,730 mi) after the time of sale to the ultimate purchaser, when operated and maintained according to the instructions provided.

EMISSION SOURCES

An internal combustion engine produces carbon monoxide and hydrocarbons during operation. Hydrocarbons must be controlled because under some conditions hydrocarbons react with sunlight to produce photochemical smog. Carbon monoxide must be controlled because it is toxic.

EXHAUST EMISSION CONTROL

Indian Motorcycles have an electronic engine management system which controls fuel delivery and ignition timing to control hydrocarbon and carbon monoxide emissions. If components are replaced that affect idle speed, no adjustments should be made to the system. The Electronic Fuel Injection (EFI) and Electronic Throttle Control (ETC) systems control idle speed.

NOISE EMISSION CONTROL

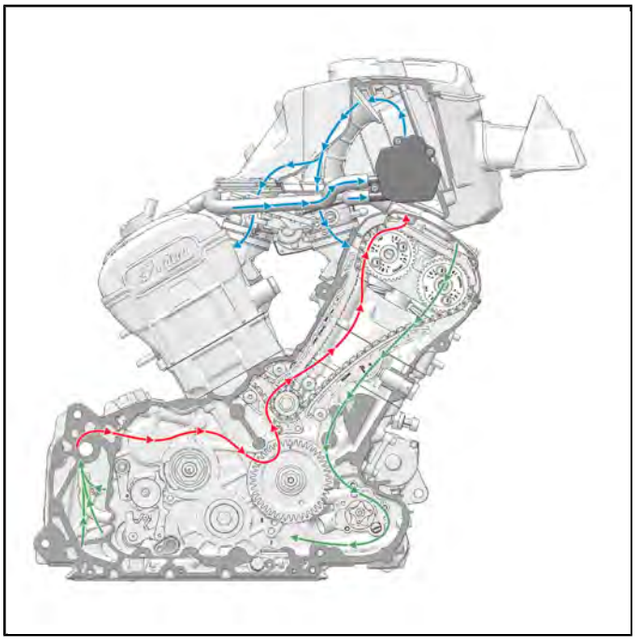
Tampering with Noise Control Systems is Prohibited. Federal law prohibits the following acts or causing thereof:

1. The removal or rendering inoperative by any person other than for purposes of maintenance, repair or replacement, any device or element of design incorporated into the motorcycle for the purpose of noise control prior to its sale or delivery to the ultimate purchaser or while it is in use, or
2. The use of the motorcycle after such device or element of design has been removed or rendered inoperative.

   Among those acts presumed to constitute tampering are the acts listed below:
3. Removal of, or puncturing the muffler, baffles, header pipes or any other component which conducts exhaust gases.
4. Removal or puncturing of any part of the intake system.
5. Lack of proper maintenance.
6. Replacing any moving part of the motorcycle or parts of the exhaust / intake system with parts other than those specified by the manufacturer.

CRANKCASE EMISSION CONTROL

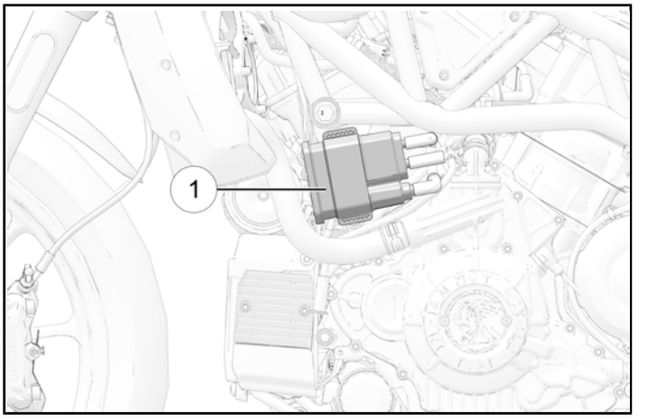
The crankcase emission control system is comprised of a closed system that routes crankcase emissions through the air cleaner into the combustion chamber.



COLOR	DESCRIPTION
Green	Engine Oil (liquid)
Red	Engine Oil (mist)
Blue	Engine Vapors

EVAPORATIVE EMISSION CONTROL

California and International models are equipped with an Evaporative Emissions Canister ①. Activated charcoal inside the canister temporarily stores fuel system vapors until the engine is started and the motorcycle is driven. The Electronic Control Module (ECM) automatically opens a Purge Control Valve under certain conditions, and engine intake vacuum draws vapors out of the canister.



SPECIAL TOOLS

USING SPECIAL TOOLS

Special tools have been designed exclusively for servicing the specialized components found on Indian Motorcycles. By using these tools, service technicians can maximize efficiency and minimize the likelihood of causing damage to the motorcycle during service.

How To Use This Book

The *Special Tools Index* located in this chapter provides a comprehensive list and pictorial representation of the special tools used throughout this service manual. The *Special Tools* section at the beginning of each chapter provides a short list of the tools required to perform procedures specific to that chapter.

TOOL ORDERING INFORMATION

Special tools may be required while servicing this vehicle. Some of the tools listed or depicted are mandatory, while other tools may be substituted with a similar tool, if available. Indian Motorcycle recommends use of the Special Tools referenced in the chapters of this service manual when servicing any Indian Motorcycle product. Dealers may order special tools through Indian Motorcycle's official tool supplier, Bosch Automotive Service Solutions, by phone at 1-800-345–2233 or on-line via your dealer website at https://polaris.service-solutions.com/
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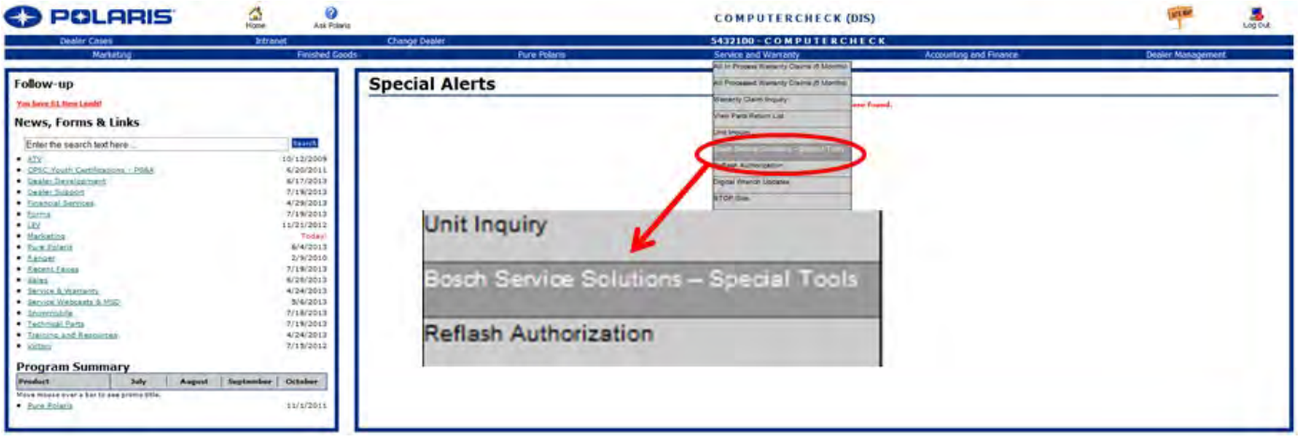
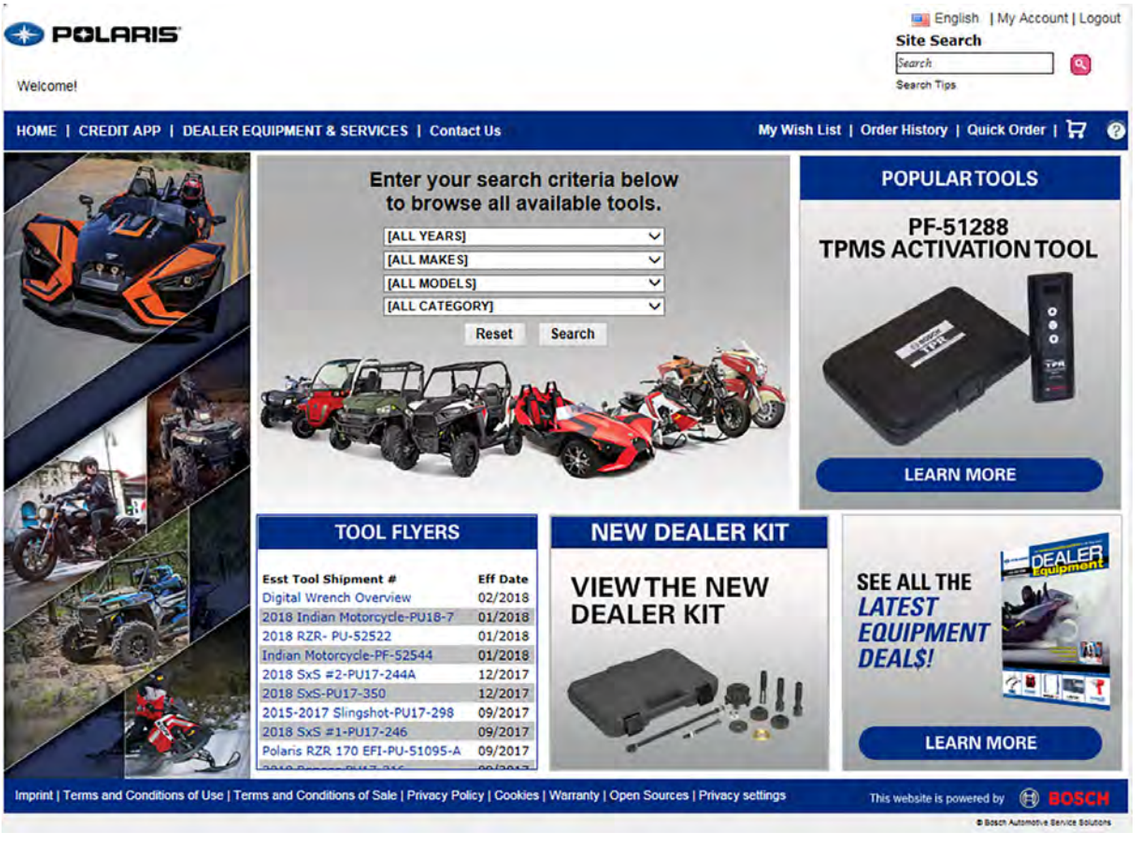




DIGITAL WRENCH II USER MANUAL

Review the Digital Wrench II user manual for information and details regarding the following:

- Software Installation
- Software Updates
- Software Screens/Menus
- Connecting to a Vehicle

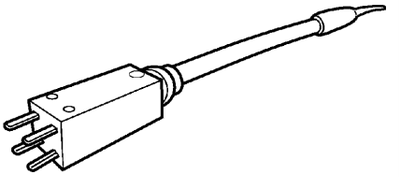
Click HERE to view the Digital Wrench II user manual or visit "Other Publications" on the left navigation menu of the DEX STOP site.

SPECIAL TOOLS INDEX

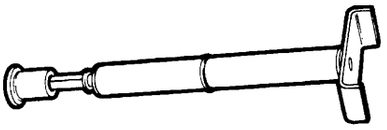
MultiLink XP
PU-52792

Battery Tester
PU-50296

Relay Bypass Tool
PU-49466



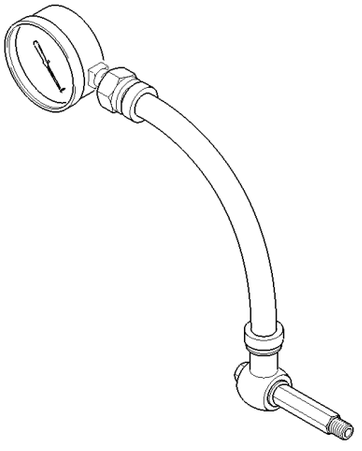
Chain Tension Gauge
PV-43532



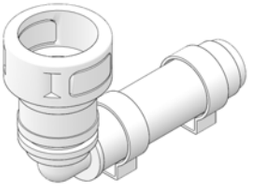
USB to Serial Adapter
PU-50621

Fuel Pressure Gauge
PU-43506-A

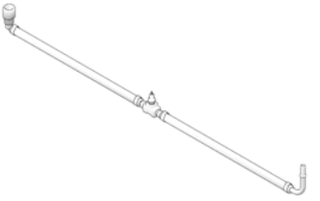
Oil Pressure Gauge
PV-43531

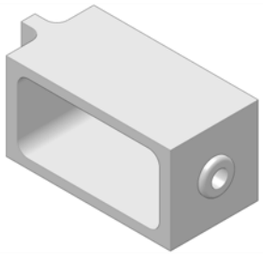
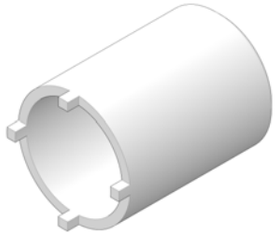
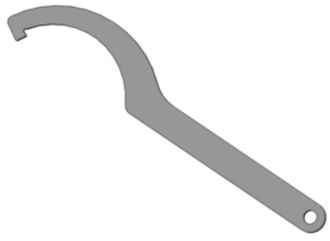
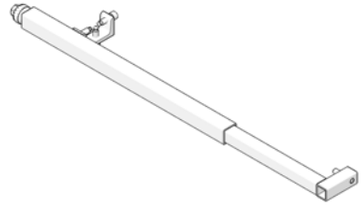
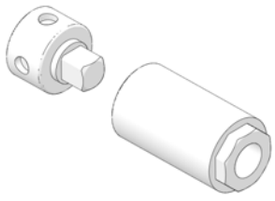
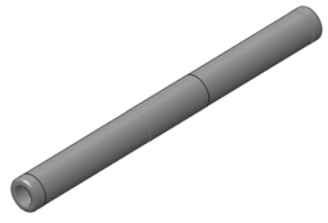


Fuel Tank Fitting Plug 12mm
PV-50567



Fuel Pressure Adapter
PV-48656



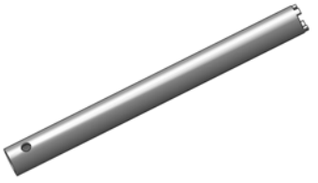
Brake Lever Reserve Tool **PV-50104** 	Steering Head Adjustment Socket **PV-43508** 	Front Axle Adapter (Commercially available)(See example below) 
Chain Breaker Tool (Commercially available) (KM500R) 	Shock Preload Spanner Wrench **2884176** 	Swingarm Bushing Tool **PF-51237** 
Swingarm Lock Ring Tool **PF-52737** 	Swingarm Adjuster Tool **PF-52738** 	Fork Spring Compressor **PV-49463** 
Fork Socket Adapter / Cartridge Tool **PF-51664-2** 	Fork Oil Seal Driver **PF-51610** 	Damper Rod Holder **PF-52747** 

Fork Cap Wrench
PF-52744

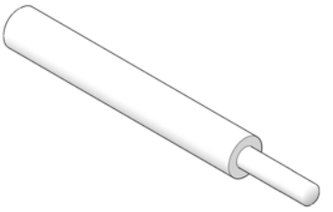
Fork Seal Guide
PV–47037

Inverted Fork Seal Installer
PV-47035

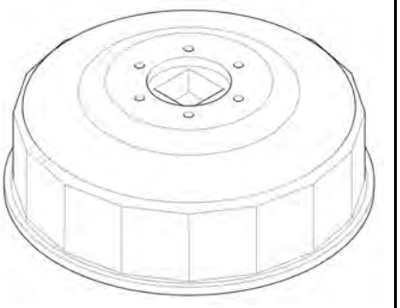
Cartridge Holder
PF-52745



Crankshaft Locking Pin
PF-51235-A

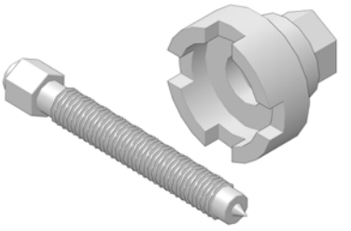


Oil Filter Wrench
PU-50105

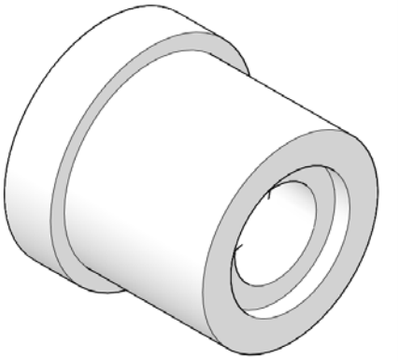


Engine Transmission Lock Tool
PF-51612

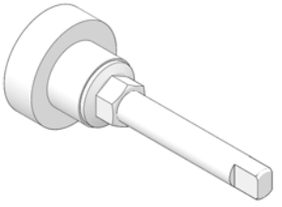
Flywheel Puller
PA-49316–A



Output Shaft Seal Tool
PF-51243

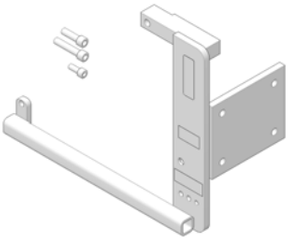


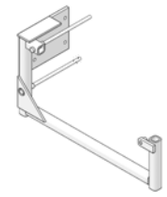
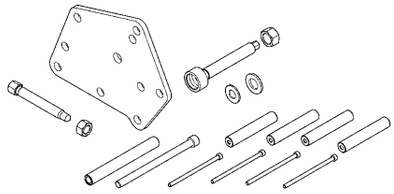
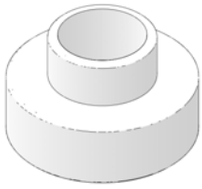
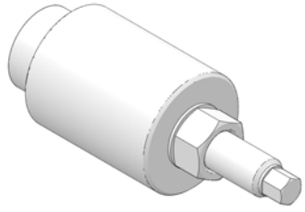
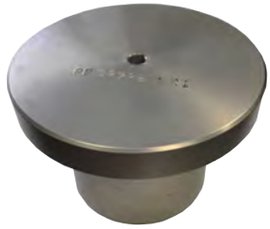
Water Pump Seal Installation Tool
PF-51608

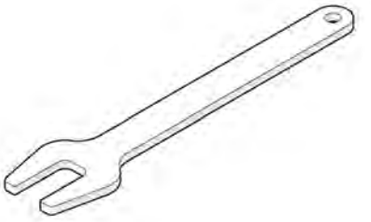


Bearing Removal Kit
PU-51324

Engine Stand Adapter Plate
PF-51240



Engine Stand Adapter **PF-51609** 	Crankcase Separator Tool **PF-51234-A** 	Cup Adapter **PF-51665** 
Engine Case Assembly Cup **PF-51663** 	Mainshaft / Crankcase Installer **PV-45030** 	Crankcase Installation Adapter (5/16) **PV-47429** 
Fork spring compressor adapter PV–49464 	Main Bearing Tool PF-52726 1 	Main Bearing Tool PF-52726 2 

Fork Pull-up Tool (Ohlins) **PF-53159** 	Fork Top Nut Tool (Ohlins) **PF-53158** 	Fork Spanner (Ohlins) **PF-53160** 
Wireless Vehicle Link PU-51435	Electrical Tester Kit **PV-43526**	

REFERENCE

MASTER TORQUE TABLE - FTR

ITEM	TORQUE
MAINTENANCE	
Airbox Bezel Fastener	**36 in-lbs (4 N·m)**
Airbox Cover Fastener	**36 in-lbs (4 N·m)**
Air Filter Access Cover Fasteners	**14 in-lbs (2 N·m)**
Axle Nut (rear)	**92 ft-lbs (125 N·m)**
Battery Terminal Fastener	**25 in-lbs (3 N·m)**
Brake Lever Pivot Fastener	**52 in-lbs (6 N·m)**
Bodywork Alignment Bracket Fastener	**36 in-lbs (4 N·m)**
Cable Guide Jam Nut	**48 in-lbs (5 N·m)**
Camshaft Carrier Bolts	**88 in-lbs (10 N·m)**
Clutch Cable Adjuster Jam Nut	**48 in-lbs (5 N·m)**
Clutch Lever Pivot Nut	**53 in-lbs (6 N·m)**
Front Master Cylinder Cap Screws	**10 in-lbs (1 N·m)**
Headlight Adjustment Fastener	**25 ft-lbs (34 N·m)**
Ignition Coil Fastener	**88 in-lbs (10 N·m)**
Oil Filter	**115 in-lbs (13 N·m) or approximately 3/4 to 1 full turn after seal contacts the filter mount sealing surface.**
Oil Filter Drain Plug	**15 ft-lbs (20 N·m)**
Shift Rod Jam Nuts	**88 in-lbs (10 N·m)**
Side-Stand Pivot Fastener	**35 ft-lbs (47 N·m)**
Spark Plug	**106 in-lbs (12 N·m)**
Swingarm Jam Nut	**12 ft-lbs (16 N·m)**
V-Cover Fastener	**36 in-lbs (4 N·m)**
CHAPTER 3: ENGINE / COOLING / EXHAUST	
Air Box Bezel Fastener	**36 in-lbs (4 N·m)**
Air Box Adapter Fastener	**36 in-lbs (4 N·m)**
Air Box Cover Fastener	**36 in-lbs (4 N·m)**
Air Filter Access Cover Fastener	**14 in-lbs (2 N·m)**
Balance Shaft Gear Fastener	**83 ft-lbs (112 N·m)**
Bearing Retainer Plate Screw	**88 in-lbs (10 N·m)**
Bearing Support Fastener	**14 ft-lbs (19 N·m)**
Bodywork Alignment Bracket Fastener	**36 in-lbs (4 N·m)**
Cam Carrier Bolt (Short)	**88 in-lbs (10 N·m)**
Cam Carrier Bolt (Long)	**88 in-lbs (10 N·m)**
Cam Chain Guide Fastener (upper)	**88 in-lbs (10 N·m)**
Cam Chain Gallery Fasteners	**88 in-lbs (10 N·m)**
Cam Chain Hydraulic Tensioner	**30 ft-lbs (40 N·m)**
Cam Chain Lower Guide Fastener	**88 in-lbs (10 N·m)**
Cam Chain Fixed Guide Shoulder Bolt	**88 in-lbs (10 N·m)**
Cam Drive Fastener	**52 ft-lbs (70 N·m)**
Cam Drive Sprocket Fastener	**11 ft-lbs (15 N·m)**
Heat Shield Base Fastener (Central)	**88 in-lbs (10 N·m)**
Heat Shield Fastener (Central)	**88 in-lbs (10 N·m)**
Clutch Pressure Plate Fastener	**88 in-lbs (10 N·m)**
Connecting Rod Fastener (Single Use Fastener)	**Step 1: Torque both fasteners to 22 ft-lbs (30 N·m) Step 2: Tighten both fasteners an additional 90°**
Coolant Bypass Fitting Fasteners	**88 in-lbs (10 N·m)**
Coolant Line Clip Fastener	**88 in-lbs (10)**

Coolant Recovery Bottle Fasteners	**36 in-lbs (4 N·m)**
Coolant Temperature Sensor	**17 ft-lbs (23 N·m)**
Cooling Fan Fastener (M6 1.0x14)	**36 in-lbs (4 N·m)**
Cooling Fan Fastener (M6 1.0x16)	**36 in-lbs (4 N·m)**
Crankcase Fasteners	**22 ft-lbs (30 N·m)**
Crankshaft Gear Spud	**Step 1: Torque Fastener in counter-clockwise direction to 44 ft-lbs (60 N·m)** **Step 2: Turn fastener in counter-clockwise direction an additional 90°**
Crankshaft Position Sensor Fastener	**88 in-lbs (10 N·m)**
Cylinder Head Fastener (M11)	**Step 1: Torque all fasteners to 18 ft-lbs (25 N·m) in sequence specified** **Step 2: Torque all fasteners to 30 ft-lbs (40 N·m) in sequence specified** **Step 3: Loosen all fasteners, until they are unseated, in sequence specified** **Step 4: Torque all fasteners to 15 ft-lbs (20 N·m) in sequence specified** **Step 5: Torque all fasteners to 26 ft-lbs (35 N·m) in sequence specified** **Step 6: Angle tighten all fasteners 180 degrees in sequence specified** **Step 7: Angle tighten all fasteners another 180 degrees in sequence specified.**
Cylinder Head Fastener (M6)	**88 in-lbs (10 N·m)**
Detent Roller Arm Fastener	**88 in-lbs (10 N·m)**
ECM Mount Fastener	**36 in-lbs (4 N·m)**

Exhaust Clamp (Muffler to Resonator)	**144 in-lbs (16 N·m)**
Exhaust Clamp (Front Headpipe to Rear Headpipe) – 2019 /2020 models	**144 in-lbs (16 N·m)**
Exhaust Clamp (Front Headpipe to Rear Headpipe) – 2022 models	**88 in-lbs (10 N·m)**
Exhaust Clamp (Front Headpipe to Resonator) – 2019 /2020 models	**144 in-lbs (16 N·m)**
Exhaust Clamp (Front Headpipe to Resonator) – 2022 models	**15 ft-lbs (20 N·m)**
Exhaust Clamp (Front Headpipe to Resonator) – 2023 models	**22 ft-lbs (30 N·m)**
Resonator Mount Fasteners – 2022 models	**84 in-lbs (9 N·m)**
Exhaust Clamp (Front Head Pipe to Rear Head Pipe) – 2022 models	**88 in-lbs (10 N·m)**
Exhaust Clamp (Muffler to Resonator) – 2022 models	**15 ft-lbs (20 N·m)**
Exhaust Heat Shield Fastener (Front)	**88 in-lbs (10 N·m)**
Exhaust Heat Shield Fastener (Rear)	**88 in-lbs (10 N·m)**
Exhaust Heat Shield Clamps (upper)	**18 in-lbs (2 N·m)**
Exhaust Heat Shield Fasteners (upper)	**88 in-lbs (10 N·m)**
Exhaust Stud	**88 in-lbs (10 N·m)**
Exhaust Mount Fasteners (mount to chassis)	**19 ft-lbs (26 N·m)**
Exhaust Mount Fasteners (mount to muffler)	**19 ft-lbs (26 N·m)**
Flywheel Fastener	**STEP 1: TIGHTEN FASTENER TO 129 ft-lbs (175 N·m)** **STEP 2: BACK OUT FASTENER 180° AND RE-TORQUE TO SPEC**
Fuel Rail Fastener	**88 in-lbs (10 N·m)**

Fuel Pump Fastener	**80 in-lbs (9 N·m)**
Fuse Box Mounting Fasteners	**36 in-lbs (4 N·m)**
Gear Position Sensor Fastener	**53 in-lbs (6 N·m)**
Headmount Bracket To Cylinder Head Fastener	**26 ft-lbs (35 N·m)**
Headmount To Main Frame Fastener	**74 ft-lbs (100 N·m)**
Headpipe Fastener	**16 ft-lbs (22 N·m)**
Ignition Coil Fastener	**88 in-lbs (10 N·m)**
Inlet Tube to Oil Pump Fastener	**88 in-lbs (10 N·m)**
Knock Sensor Fastener	**14 ft-lbs (19 N·m)**
Engine Mount Fastener (Rear Lower)	**51 ft-lbs (69 N·m)**
Engine Mount Fastener (Rear Upper)	**51 ft-lbs (69 N·m)**
Muffler Cap Fasteners	**45 in-lbs (5 N·m)**
Muffler Bracket Fasteners	**18 ft-lbs (25 N·m)**
Muffler Heat Shield Fastener	**70 in-lbs (8 N·m)**
Muffler Isolator Fastener	**16 ft-lbs (22 N·m)**
Oil Cooler Mount Fastener	**72 in-lbs (8 N·m)**
Oil Cooler Line Fastener	**88 in-lbs (10 N·m)**
Oil Scavenge Pump Fastener	**88 in-lbs (10 N·m)**
Oil Drain Plug	**15 ft-lbs (20 N·m)**
Oil Pump to Crankcase Fastener	**88 in-lbs (10 N·m)**
Oil Pump Pickup Screen Fastener	**88 in-lbs (10 N·m)**
Oil Pump Gear Fastener	**88 in-lbs (10 N·m)**
Oil Filter Spigot Adapter	**22 ft-lbs (30 N·m)**
Oil Filter	**115 in-lbs (13 N·m) or approximately 3/4 to 1 full turn after seal contacts the filter mount sealing surface.**
Oil Pressure Switch	**10 ft-lbs (14 N·m)**

Oil Pickup Fastener	**88 in-lbs (10 N·m)**
Oil Separator Fasteners	**14 in-lbs (2 N·m)**
Oxygen Sensor	**14 ft-lbs (19 N·m)**
Piston Cooling Jet Fastener	**62 in-lbs (7)**
Primary Cover Fastener	**106 in-lbs (12 N·m)**
Radiator Bracket Fastener (M6)	**96 in-lbs (11 N·m)**
Radiator Bracket Fastener (M8)	**96 in-lbs (11 N·m)**
Radiator Cap Set Screw	**12 in-lbs (1 N·m)**
Radiator Isolator Fasteners	**96 in-lbs (11 N·m)**
Radiator Wing Fasteners	**84 in-lbs (9 N·m)**
Regulator / Rectifier Nut	**30 in-lbs (3 N·m)**
Resonator Bracket Fastener	**88 in-lbs (10 N·m)**
Resonator Fastener	**16 ft-lbs (21 N·m)**
Scavenge Inlet Tube Fastener	**88 in-lbs (10 N·m)**
Scavenge Pickup Fastener	**88 in-lbs (10 N·m)**
Scavenge Tube Fastener	**88 in-lbs (10 N·m)**
Shift Star Fastener	**88 in-lbs (10 N·m)**
Side-Stand Switch Fasteners	**60 in-lbs (7 N·m)**
Sight Glass Fastener	**44 in-lbs (5 N·m)**
Spark Plug	**106 in-lbs (12 N·m)**
Stake Nut, Clutch	**125 ft-lbs (170 N·m)**
Starter Motor Fastener	**88 in-lbs (10 N·m)**
Starter Clutch Fasteners	**88 in-lbs (10 N·m)**
Starter Solenoid Bracket Nut	**12 in-lbs (1 N·m)**
Starter Solenoid Terminal Nut	**47 in-lbs (5 N·m)**
Stator Cover Fasteners	**106 in-lbs (12 N·m)**
Stator Mounting Fasteners To Cover	**88 in-lbs (10 N·m)**
Stator Clip Fasteners	**71 in-lbs (8 N·m)**

Oil Plug Transmission Input Shaft	**159 in-lbs (18 N·m)**
Throttle Body Hose Clamp	**17 in-lbs (2 N·m)**
TMAP Sensor Fastener	**53 in-lbs (6 N·m)**
Mid-Frame Fasteners	**47 ft-lbs (64 N·m)**
Valve Cover Fastener	**88 in-lbs (10 N·m)**
Water Pump Driven Gear Fastener	**60 in-lbs (7 N·m)**
Water Pump Impeller	**17 in-lbs (2 N·m)**
Water Pump Shaft Nut	**13 ft-lbs (18 N·m)**
CHAPTER 4: FUEL DELIVERY / EFI	
Wheel Speed Sensor Fastener	**88 in-lbs (10 N·m)**
Air Box Cover Fastener	**36 in-lbs (4 N·m)**
Air Box Bezel Fastener	**36 in-lbs (4 N·m)**
Battery Cover Fasteners	**36 in-lbs (4 N·m)**
Battery Terminal Fastener	**25 in-lbs (3 N·m)**
Bodywork Alignment Bracket Fastener	**36 in-lbs (4 N·m)**
Carbon Canister Bracket Fastener	**48 in-lbs (5 N·m)**
Coolant Temperature Sensor	**17 ft-lbs (23 N·m)**
Crankshaft Position Sensor Fastener	**88 in-lbs (10 N·m)**
Footpeg Bracket Fasteners (Passenger)	**17 ft-lbs (23 N·m)**
Fuel Pump Fastener	**80 in-lbs (9 N·m)**
Fuel Line Retainer Fastener	**43 in-lbs (5 N·m)**
Fuel Rail Fastener	**88 in-lbs (10 N·m)**
Fuel Tank Support Fasteners (Bottom)	**96 in-lbs (11 N·m)**
Fuel Tank Fasteners	**88 in-lbs (10 N·m)**
Gear Position Sensor Fastener	**53 in-lbs (6 N·m)**
Ignition Coil Fastener	**88 in-lbs (10 N·m)**
IMU Sensor Fasteners	**84 in-lbs (9 N·m)**
Knock Sensor Fastener	**14 ft-lbs (19 N·m)**
Oil Pressure Switch	**10 ft-lbs (14 N·m)**
Oxygen Sensor	**14 ft-lbs (19 N·m)**
Regulator / Rectifier Nut	**30 in-lbs (3 N·m)**
Seat Support Bracket Fasteners (front)	**96 in-lbs (11 N·m)**
Seat Support Bracket Fasteners (rear)	**96 in-lbs (11 N·m)**
Sub-Frame Fasteners (M10)	**47 ft-lbs (64 N·m)**
Sub-Frame Fasteners (M6)	**96 in-lbs (11 N·m)**
Side-Stand Switch Fasteners	**60 in-lbs (7 N·m)**
TMAP Sensor Fastener	**53 in-lbs (6 N·m)**
Throttle Body Hose Clamp	**17 in-lbs (2 N·m)**
Tail Light Fasteners	**88 in-lbs (10 N·m)**
V-Cover Fastener	**36 in-lbs (4 N·m)**
CHAPTER 5: CLUTCH / PRIMARY / SHIFT	
Crankshaft Position Sensor Fastener	**88 in-lbs (10 N·m)**
Stake Nut, Clutch	**125 ft-lbs (170 N·m)**
Clutch Pressure Plate Fastener	**88 in-lbs (10 N·m)**
Detent Roller Arm Fastener	**88 in-lbs (10 N·m)**
Flywheel Fastener	**STEP 1: TIGHTEN FASTENER TO 129 ft-lbs (175 N·m) STEP 2: BACK OUT FASTENER 180° AND RE-TORQUE TO SPEC**
Shift Star Fastener	**88 in-lbs (10 N·m)**
Shift Linkage Fastener	**88 in-lbs (10 N·m)**
Sight Glass Fastener	**44 in-lbs (5 N·m)**
Stator Cover Fasteners	**106 in-lbs (12 N·m)**
Stopper Plate Fastener	**88 in-lbs (10 N·m)**
Primary Cover Fastener	**106 in-lbs (12 N·m)**
TRANSMISSION / CRANKSHAFT	

Bearing Retainer Plate Fastener	**88 in-lbs (10 N·m)**
Balance Shaft Gear Fastener	**83 ft-lbs (112 N·m)**
Crankcase Fasteners	**22 ft-lbs (30 N·m)**
Connecting Rod Fastener	**Step 1: Torque both fasteners to 22 ft-lbs (30 N·m)** **Step 2: Tighten both fasteners an additional 90°**
Main Plate Mounting Fasteners (All)	**88 in-lbs (10 N·m)**
Oil Pump Pickup Screen Fastener	**88 in-lbs (10 N·m)**
Piston Cooling Jet Fastener	**62 in-lbs (7)**
Scavenge Inlet Tube Fasteners	**88 in-lbs (10 N·m)**
Stake Nut, Clutch	**125 ft-lbs (170 N·m)**
Starter Clutch Fastener	**88 in-lbs (10 N·m)**
Bearing Retainer Fastener	**88 in-lbs (10 N·m)**
FRAME / BODY	
Cable Guide Jam Nut	**48 in-lbs (5 N·m)**
Chin Fairing Fasteners	**35 in-lbs (4 N·m)**
Chin Fairing Mount Fasteners	**18 ft-lbs (25 N·m)**
Feeler Peg	**96 in-lbs (11 N·m)**
Fender Fasteners (front)	**96 in-lbs (11 N·m)**
Fender Fasteners (rear)	**96 in-lbs (11 N·m)**
Front License Plate Mount Fasteners	**72 in-lbs (8 N·m)**
Footpeg Bracket Fasteners (Driver)	**17 ft-lbs (23 N·m)**
Footpeg Bracket Fasteners (Passenger)	**17 ft-lbs (23 N·m)**
Footpeg Shoulder Fasteners	**50 ft-lbs (68 N·m)**
Fuel Tank Fasteners	**88 in-lbs (10 N·m)**
Fuel Tank Support Fasteners (Bottom)	**96 in-lbs (11 N·m)**

Horn to Frame Bracket Fastener	**96 in-lbs (11 N·m)**
Instrument Panel Fasteners	**84 in-lbs (9 N·m)**
License Plate Fasteners	**72 in-lbs (8 N·m)**
License Plate Mount Fasteners	**96 in-lbs (11 N·m)**
License Plate Light Nuts	**24 in-lbs (3 N·m)**
Light Curtain Nuts	**36 in-lbs (4 N·m)**
Mounting Plate Fasteners	**19 ft-lbs (26 N·m)**
Number Plate, Front	**80 in-lbs (9 N·m)**
Bracket to Number Plate Fasteners	**60 in-lbs (7 N·m)**
Windscreen Bracket Fasteners	**96 in-lbs (11 N·m)**
Mud Guard Mount Fasteners (front)	**96 in-lbs (11 N·m)**
Mud Guard Mount Fasteners (rear)	**96 in-lbs (11 N·m)**
Mud Guard to Bracket Fasteners	**96 in-lbs (11 N·m)**
Passenger Grab Handle Fasteners	**19 ft-lbs (26 N·m)**
Rear Fender Arm Fasteners	**30 ft-lbs (41 N·m)**
Rear License Plate Mount Fasteners	**15 ft-lbs (20 N·m)**
Seat Fasteners	**88 in-lbs (10 N·m)**
Seat Support Bracket Fasteners (front)	**96 in-lbs (11 N·m)**
Seat Support Bracket Fasteners (rear)	**96 in-lbs (11 N·m)**
Shift / Brake Pedal Peg	**15 ft-lbs (20 N·m)**
Shift Linkage Fastener	**88 in-lbs (10 N·m)**
Shift Rod Jam Nuts	**88 in-lbs (10 N·m)**
Side-Stand Fasteners	**25 ft-lbs (34 N·m)**
Side-Stand Pivot Fastener	**35 ft-lbs (47 N·m)**
Adjuster Nut	**54 in-lbs (6 N·m)**
Sub-Frame Fasteners (Rear)	**47 ft-lbs (64 N·m)**

Sub-Frame Fasteners (M10)	**47 ft-lbs (64 N·m)**
Sub-Frame Fasteners (M6)	**96 in-lbs (11 N·m)**
Swingarm Pivot Bolt	**52 ft-lbs (70 N·m)**
Tail Light Fasteners	**88 in-lbs (10 N·m)**
Upper License Plate Bracket Fasteners	**72 in-lbs (8 N·m)**
Upper License Plate Bracket Nuts	**72 in-lbs (8 N·m)**
V-Cover Fastener	**36 in-lbs (4 N·m)**
Wind Deflector Fasteners	**80 in-lbs (9 N·m)**
Windshield Mount Bracket Fasteners, Lower	**96 in-lbs (11 N·m)**
Windshield Mount Bracket Fasteners, Upper	**96 in-lbs (11 N·m)**
Windshield Mount Fasteners	**80 in-lbs (9 N·m)**
STEERING / SUSPENSION	
Axle (front)	**55 ft-lbs (75 N·m)**
Axle Nut (rear)	**92 ft-lbs (125 N·m)**
Axle Pinch Fasteners	**14 ft-lbs (19 N·m)**
Brake Disc Fasteners	**22 ft-lbs (30 N·m)**
Brake Fluid Reservoir Mounting Nut (front)	**44 in-lbs (5 N·m)**
Brake Fluid Reservoir Bracket Fastener (front)	**80 in-lbs (9 N·m)**
Cap Riser Fasteners	**18 ft-lbs (24 N·m)**
Cartridge Fastener	**17 ft-lbs (23 N·m)**
Chain Guard Fasteners	**88 in-lbs (10 N·m)**
Chain Slider Fastener	**88 in-lbs (10 N·m)**
Clutch Perch Clamp Fastener	**96 in-lbs (11 N·m)**
Clutch Switch Fasteners:	**3 in-lbs (0.5 N·m)**
Driven Sprocket Fasteners	**59 ft-lbs (80 N·m)**
Drive Sprocket Nut	**133 ft-lbs (180 N·m)**
Drive Sprocket Cover Fasteners	**88 in-lbs (10 N·m)**

Fork Cap	**12 ft-lbs (16 N·m)**
Fork Triple Clamp Fasteners (Upper)	**18 ft-lbs (24 N·m)**
Fork Triple Clamp Fasteners (Lower)	**18 ft-lbs (24 N·m)**
Fork Cap (Ohlins®)	**11 ft-lbs (15 N·m)**
Fork Cap Lock Nut (Ohlins®)	**15 ft-lbs (20 N·m)**
Handlebar Riser Stud	**18 ft-lbs (24 N·m)**
Handlebar Riser Nut	**18 ft-lbs (24 N·m)**
Handlebar Riser Nut (2023)	**24 ft-lbs (33 N·m)**
Handlebar Cap Fastener	**18 ft-lbs (24 N·m)**
Instrument Cluster Fasteners	**84 in-lbs (9 N·m)**
Instrument Cluster Fasteners (2023)	**9 in-lbs (1 N·m)**
Center Cluster Fastener	**53 in-lbs (6 N·m)**
Cluster Mount Fasteners	**53 in-lbs (6 N·m)**
Mirror Jam Nut	**12 ft-lbs (16 N·m)**
Master Cylinder Clamp Fastener (Front)	**88 in-lbs (10 N·m)**
Steering Stem Nut (top)	**92 ft-lbs (125 N·m)**
Steering Head Nut	**STEP 1: Torque to 29 ft-lbs (40 N·m)** **STEP 2: Turn lower triple clamp from lock to lock five times and *return to full right* position.** **STEP 3: Loosen adjuster nut 90 degrees (1/4 turn).**
Swingarm Lock Ring	**44 ft-lbs (60 N·m)**
Swingarm Pivot Adjuster	**11 (15 N·m)**
Shock Fastener (upper)	**44 ft-lbs (60 N·m)**
Shock Fastener (lower)	**44 ft-lbs (60 N·m)**
Swingarm Adjustment Nut	**12 ft-lbs (16 N·m)**
Throttle Assembly Fastener	**27 in-lbs (3 N·m)**

Tone Ring Fasteners	**84 in-lbs (9 N·m)**
Valve Stem Nut	**44 in-lbs (5 N·m)**
BRAKES	
Wheel Speed Sensor Bracket Fasteners	**97 in-lbs (11 N·m)**
Wheel Speed Sensor Fastener	**88 in-lbs (10 N·m)**
Wheel Speed Sensor Mount Fastener	**88 in-lbs (10 N·m)**
Adjuster Nut	**56 in-lbs (6 N·m)**
Brake Lever Pivot Fastener	**52 in-lbs (6 N·m)**
Brake Pad Retaining Pin	**53 in-lbs (6 N·m)**
Brake Line Junction Fastener (front)	**84 in-lbs (9 N·m)**
Brake Rotor Fasteners	**22 ft-lbs (30 N·m)**
Brake Line Retaining Clip Fastener (rear)	**84 in-lbs (9 N·m)**
Banjo Switch Fastener	**18 (24 N·m)**
Banjo Bolt (to caliper)	**18 ft-lbs (24 N·m)**
Caliper Mounting Fastener (rear)	**18 ft-lbs (24 N·m)**
Caliper Mounting Fasteners (front)	**35 ft-lbs (48 N·m)**
Fastener, Front Brake Lines (rear)	**84 in-lbs (9 N·m)**
Front Caliper Bleeder Screw (on banjo bolt)	**80 in-lbs (9 N·m)**
Master Cylinder Cap Screws (front)	**10 in-lbs (1 N·m)**
Brake Fluid Reservoir Mounting Nut (front)	**44 in-lbs (5 N·m)**
Master Cylinder Bleeder Screw (front)	**10 ft-lbs (14 N·m)**
Master Cylinder Reservoir Mounting Fastener (rear) - 2019,2020	**84 in-lbs (9 N·m)**
Master Cylinder Reservoir Mounting Fastener (rear) - 2022+	**62 in-lbs (7 N·m)**
Master Cylinder Pushrod Nut:	**54 in-lbs (6 N·m)**
P-Clamp Fastener	**84 in-lbs (9 N·m)**
Brake Pedal Pivot Inner Fastener	**18 ft-lbs (24 N·m)**
Brake Pedal Stop Screw Adjustment Nut	**54 in-lbs (6 N·m)**
Rear Caliper Bleeder Screw	**10 ft-lbs (14 N·m)**
Tone Ring Fastener	**84 in-lbs (9 N·m)**
ELECTRICAL	
Battery Cable To Starter Motor Nut	**60 in-lbs (7 N·m)**
Battery Cover Fasteners	**36 in-lbs (4 N·m)**
Battery Terminal Fastener	**25 in-lbs (3 N·m)**
Battery Tray Base Fastener	**96 in-lbs (11 N·m)**
Battery Tray Through Bolt	**96 in-lbs (11 N·m)**
Crankshaft Position Sensor Fastener	**88 in-lbs (10 N·m)**
Headlight Adjustment Fasteners	**25 ft-lbs (34 N·m)**
Headlight Carrier Bolts	**84 in-lbs (9 N·m)**
Headlight Cover Fastener	**18 in-lbs (2 N·m)**
Headlight Cover Mount Faster	**36 in-lbs (4 N·m)**
Headlight Mount Fasteners (Lower) (2019–2020)	**84 in-lbs (9 N·m)**
Headlight Mount Nut (2022)	**84 in-lbs (9 N·m)**
Headlight Mount Fasteners (Upper)	**84 in-lbs (9 N·m)**
Horn to Frame Bracket Fastener	**96 in-lbs (11 N·m)**
Ignition Fastener	**88 in-lbs (10 N·m)**
Ignition Coil Fastener	**88 in-lbs (10 N·m)**
Instrument Cluster Housing Fastener	**84 in-lbs (9 N·m)**

License Plate Mount Fasteners	**96 in-lbs (11 N·m)**
Oil Cooler Mount Fastener	**72 in-lbs (8 N·m)**
Regulator / Rectifier Nut	**30 in-lbs (3 N·m)**
Speedometer Fastener, speedometer to case	**10 in-lbs (1 N·m)**
Speedometer Fastener, speedometer to riser cap	**55 in-lbs (6 N·m)**
Speedometer (touch screen) Fastener	**54 in-lbs (6 N·m)**
Wheel Speed Sensor Fastener	**88 in-lbs (10 N·m)**
Wheel Speed Sensor Bracket Fastener	**97 in-lbs (11 N·m)**
Starter Motor Fastener	**88 in-lbs (10 N·m)**
Starter Solenoid Bracket Nut	**12 in-lbs (1 N·m)**
Starter Solenoid Terminal Nut	**47 in-lbs (5 N·m)**
Stator Cable Retainer Fasteners	**108 in-lbs (12 N·m)**
Stator Mounting Fastener to Cover	**88 in-lbs (10 N·m)**
Stator Clip Fastener	**71 in-lbs (8 N·m)**
Turn Signal Mount Fastener (Front)	**36 in-lbs (4 N·m)**
Turn Signal Fastener (Front)	**36 in-lbs (4 N·m)**
Turn Signal Fastener (Rear)	**48 in-lbs (5 N·m)**
Tail Light Fasteners	**84 in-lbs (9 N·m)**

SAE TAP DRILL SIZES

THREAD SIZE / DRILL SIZE		THREAD SIZE / DRILL SIZE	
#0-80	3/64	1/2-13	27/64
#1-64	#53	1/2-20	29/64
#1-72	#53	9/16-12	31/64
#2-56	#51	9/16-18	33/64
#2-64	#50	5/8-11	17/32
#3-48	5/64	5/8-18	37/64
#3-56	#45	3/4-10	21/32
#4-40	#43	3/4-16	11/16
#4-48	#42	7/8-9	49/64
#5-40	#38	7/8-14	13/16
#5-44	#37	1-8	7/8
#6-32	#36	1-12	59/64
#6-40	#33	1 1/8-7	63/64
#8-32	#29	1 1/8-12	1 3/64
#8-36	#29	1 1/4-7	1 7/64
#10-24	#24	1 1/4-12	1 11/64
#10-32	#21	1 1/2-6	1 11/32
#12-24	#17	1 1/2-12	1 27/64
#12-28	#15	1 3/4-5	1 9/16
1/4-20	7	1 3/4-12	1 43/64
1/4-28	3	2-4 1/2	1 25/32
5/16-18	F	2-12	1 59/64
5/16-24	I	2 1/4-4 1/2	2 1/32
3/8-16	O	2 1/2-4	2 1/4
3/8-24	Q	2 3/4-4	2 1/2
7/16-14	U	3-4	2 3/4
7/16-20	25/64		

METRIC TAP DRILL SIZES

TAP SIZE	DRILL SIZE	DECIMAL EQUIVA-LENT	NEAREST FRAC-TION
3x.50	#39	0.0995	3/32
3x.60	3/32	0.0937	3/32
4x.70	#30	0.1285	1/8
4x.75	1/8	0.125	1/8
5x.80	#19	0.166	11/64
5x.90	#20	0.161	5/32
6x1.00	#9	0.196	13/64
7x1.00	16/64	0.234	15/64
8x1.00	J	0.277	9/32
8x1.25	17/64	0.265	17/64
9x1.00	5/16	0.3125	5/16
9x1.25	5/16	0.3125	5/16
10x1.25	11/32	0.3437	11/32
10x1.50	R	0.339	11/32
11x1.50	3/8	0.375	3/8
12x1.50	13/32	0.406	13/32
12x1.75	13/32	0.406	13/32

DECIMAL EQUIVALENTS

1/64 in = .0156 in

1/32 in = .0312 in [1 mm = .0394 in]

3/64 in = .0469 in

1/16 in = .0625 in

5/64 in = .0781 in [2 mm = .0787 in]

3/32 in = .0938 in

7/64 in = .1094 in [3 mm = .1181 in]

1/8 in = .1250 in

9/64 in = .1406 in

5/32 in = .1563 in [4 mm = .1575 in]

11/64 in = .1719 in

3/16 in = .1875 in [5 mm = .1969 in]

13/64 in = .2031 in

7/32 in = .2188 in

15/64 in = .2344 in [6 mm = .2362 in]

1/4 in = .25 in

17/64 in = .2656 in [7 mm = .2756 in]

9/32 in = .2813 in

19/64 in = .2969 in

5/16 in = .3125 in [8mm= .3150 in]

21/64 in = .3281 in

11/32 in = .3438 in [9 mm = .3543 in]

23/64 in = .3594 in

3/8 in = .375 in

25/64 in = .3906 in [10 mm = .3937 in]

13/32 in = .4063 in

27/64 in = .4219 in [11 mm =.4331 in]

7/16 in = .4375 in

29/64 in = .4531 in

15/32 in = .4688 in [12 mm = .4724 in]

31/64 in = .4844 in

1/2 in = .5 in [13mm = .5118 in]

33/64 in = .5156 in

17/32 in = .5313 in

35/64 in = .5469 in [14 mm = .5512 in]

9/16 in = .5625 in

37/64 in = .5781 in [15 mm = .5906 in]

19/32 in = .5938 in

39/64 in = .6094 in

5/8 in = .625 in [16mm=. 6299 in]

41/64 in = .6406 in

21/32 in = .6563 in [17 mm = .6693 in]

43/64 in = .6719 in

11/16 in = .6875 in

45/64 in = .7031 in [18 mm = .7087 in]

23/32 in = .7188 in

47/64 in = .7344 in [19 mm = .7480 in]

3/4 in = .75 in

49/64 in = .7656 in

25/32 in = .7813 in [20 mm = .7874 in]

51/64 in = .7969 in

13/16 in = .8125 in [21 mm =. 8268 in]

53/64 in = .8281 in

27/32 in = .8438 in

55/64 in = .8594 in [22 mm = .8661 in]

7/8 in = .875 in

57/64 in = .8906 in [23 mm = .9055 in]

29/32 in = .9063 in

59/64 in = .9219 in

15/16 in = .9375 in [24 mm = .9449 in]

61/64 in = .9531 in

31/32 in = .9688 in [25 mm = .9843 in]

63/64 in = .9844 in

1 in = 1.0 in

FAHRENHEIT TO CELSIUS

°C to °F: 9 (°C + 40) ¸ 5 - 40 = °F

°F to °C: 5 (°F + 40) ¸ 9 - 40=°C

DEGREES F	DEGREES C
32	0
41	5
50	10
59	15
68	20
77	25
86	30
95	35
104	40
113	45
122	50
131	55
140	60
149	65
158	70
167	75
176	80
185	85
194	90
203	95
212	100

MEASUREMENT CONVERSION CHART

UNIT OF MEASURE	MULTIPLIED BY	COVERTS TO
ft-lbs	x 12	= in-lbs
in-lbs	x.0833	= ft-lbs
ft-lbs	x 1.356	= Nm
in-lbs	x.0115	= kg-m
Nm	x.7376	= ft-lbs
kg-m	x 7.233	= ft-lbs
kg-m	x 86.796	= in-lbs
kg-m	x 10	= Nm
in	x 25.4	= mm
mm	x.03937	= in
in	x 2.54	= cm
mile	x 1.6	= km
km	x.6214	= mile
Ounces (oz)	x 28.35	= grams (g)
Fluid Ounce	x 29.57	= CCs
grams (g)	x.035	= Ounces (oz)
cc's	x.03381	= Fluid Ounces (oz)
lbs	x.454	= kg
kg	x 2.2046	= lbs
Cubic Inches	x 16.387	= Cubic Centimeters
Cubic Centimeters	x.061	= Cubic Inches
Imperial pints	x.568	= liters (l)
liters (l)	x 1.76	= Imperial pints
Imperial quarts	x 1.137	= liters (l)
liters (l)	x.88	= Imperial quarts
Imperial quarts	x 1.201	= US quarts
US quarts	x.833	= Imperial quarts
US quarts	x.946	= liters
liters	x 1.057	= US quarts
US gallon	x 3.785	= liter
liter	x .264	= US gallon
Pounds force per square inch (psi)	x 6.895	= Kilo pascals (kPa)
Kilo pascals (kPa)	x .145	= Pounds force per square inch (psi)
Kilo pascals (kPa)	x .01	= Kilograms force per cm^2

UNIT OF MEASURE	MULTIPLIED BY	COVERTS TO
Kilograms force per cm^2	x 98.1	= Kilo pascals (kPa)
p (3.14159) x R^2 x H (height)		= Cylinder Volume

CHAPTER 2
MAINTENANCE

2

MAINTENANCE QUICK REFERENCE GUIDE

MAINTENANCE SPECIFICATIONS

GENERAL SPECIFICATIONS

ITEM	STANDARD	SERVICE LIMIT
Battery Type / CCA	12 Volt / 12 AH / 240CCA	—
Brake Pad Thickness, Front	.16 in (4.0 mm)	.04 in (1.0 mm)
Brake Disc Thickness, Front	.20 in (5.0 mm)	.18 in (4.5 mm)
Brake Pad Thickness, Rear	.16 in (4.0 mm)	.04 in (1.0 mm)
Brake Disc Thickness, Rear	.20 in (5.0 mm)	.18 in (4.5 mm)
Clutch Lever Freeplay	.019 - .059" (0.5–1.5 mm)	—
Compression Pressure (Cylinder)	250–270 Psi (1724–1861 kPa)	Below 230 Psi (1586 kPa)
Drive Chain Deflection (with 10 lbs force)	**35 mm – 40 mm**	—
Fuel Pressure (KOEO)	58 psi (400 kPa)	55 psi (380 kPa)
Idle Speed / Fast Idle Speed	Idle = 1250 RPM / Fast Idle = 1750 RPM Cylinder Deactivation Idle = 1350 RPM	±50 RPM
Oil Pressure, Lubrication @ 3000 rpm	40 PSI (275 kPa) ± 20 % Engine at operating temperature.	32 PSI (220 kPa)
Ride Height (Rear Spring Pre-Load)	See adjustment procedure outlined in this chapter	—
Spark Plug Type / Gap	NGK MR7F GAP - 0.030 in (0.80 mm)	—
Tire Pressure	Front: 36 PSI (248 kPa) Rear: 40 PSI (276 kPa)	—
Tire Tread Depth (Minimum)	—	.063 in (1.6 mm)
Valve Lash (Int. / Ex.)	0.005 in (0.127 mm) / 0.01 in (0.254 mm)	—

FLUID SPECIFICATIONS

DESCRIPTION	FLUID TYPE	CAPACITY
Brake Hydraulic Fluid	DOT 4	—
Engine / Transmission Oil	15W60 Full Synthetic	4.5 qts. (4.25 L) Dry Engine
Fork Oil	Indian Motorcycle Fork Oil OR Fuchs SAF 5113, Öhlins Motorcycle Front Fork Fluid R&T, or approved equivalent	FTR / FTR S: 508 cc FTR Rally: 519 cc FTR R Carbon: 544 cc
Fuel	91 Octane (Recommended)	3.4 gal (13.0 L) / Reserve 0.5 gal (1.9 L)
Coolant / Antifreeze	Polaris Extended Life 50/50	2.77 Qts (2.63 Ltrs)

INDIAN MOTORCYCLE SERVICE PRODUCTS AND LUBRICANTS

MAINTENANCE PRODUCT PART NUMBERS

PRODUCT			PART NUMBER
All Purpose Grease		14 oz	2872187
Anti-Freeze, 50/50 Extended Life		1 quart (32 oz)	2880966
Brake Fluid, DOT 4		12 oz	2880016
Carbon Cleaner, Fuel		12 oz	2881911
Crankcase Sealant (Loctite Ultra Black 598)			Commercially Available
Fork Oil Type	FTR / FTR S / FTR Rally	quart	Indian Motorcycle Fork Oil (PN: 2208093) OR Fuchs SAF 5113, Ohlins fork oil, or approved equivalent
	FTR R Carbon		Indian Motorcycle Fork Oil (PN: 2208873)
Chain Lube		11 oz aerosol	2884172
Starter Grease		2 oz	2871460
Oil Change Kit		15W-60	2884182
Synthetic 15W-60 Engine Lubricant		quart	2880187
		55 gal drum	2880188

MAINTENANCE INTERVALS

The maintenance interval charts outline required maintenance and inspection based on vehicle miles. Each table states the number of miles that service is required on the vehicle. Some items or components may need to be serviced more often due to severe use. When the vehicle goes beyond 50,000 miles, return to the 500 mile chart and start the interval process over.

XU - Perform these procedures more often for vehicles subjected to severe use.

D - Have an authorized Indian Motorcycle dealer perform these services.

E - Emission Control System Service (California / International)

500 MILE (800 KM) SERVICE

ITEM		REMARKS
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Inspect; clean, lubricate
D	Engine Mount Fasteners	Inspect; tighten, adjust
	Engine Coolant	Inspect fluid level, add coolant if necessary
XU	Engine Oil & Filter Change	Change oil and filter, inspect used oil for contaminants
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
	Battery	Check terminals; clean; test
D	Brake Fluid	Change every two years (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Adjust if necessary, lubricate with proper lubricant as directed
D	Front Fork Oil	Inspect
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Head Light	Inspect; adjust if necessary
D	Radiator Rubber Isolators	Inspect isolators for signs of wear or material loss. Replace if any wear is observed.
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

2,500 MILE (4,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Inspect; clean
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Inspect; clean, lubricate
	Engine Coolant	Inspect fluid level, add coolant if necessary
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
	Battery	Check terminals; clean; test
D	Brake Fluid	Change every two years (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Inspect; adjust if necessary, lubricate with proper lubricant as directed
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Head Light	Inspect; adjust if necessary
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Inspect; adjust if necessary, lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

5,000 MILE (8,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Inspect; clean
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Inspect; clean, lubricate
	Engine Coolant	Inspect fluid level, add coolant if necessary
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
	Battery	Check terminals; clean; test
D	Brake Fluid	Change every two years (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Adjust if necessary, lubricate with proper lubricant as directed
D	Front Fork Oil	Replace at specified interval or every 2 years
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Inspect; adjust if necessary, lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

10,000 MILE (16,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Inspect; clean
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Inspect; clean, lubricate
D	Engine Compression	Inspect; correct if necessary
	Engine Coolant	Inspect fluid level, add coolant if necessary
XU	Engine Oil & Filter Change	Change oil and filter, inspect used oil for contaminants
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
D / E	Spark Plugs	Inspect; torque to specification
	Battery	Check terminals; clean; test
D	Brake Fluid	Replace (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Adjust if necessary, lubricate with proper lubricant as directed
D	Front Fork Oil	Replace at specified interval or every 2 years
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Head Light	Inspect; adjust if necessary
D	Radiator Rubber Isolators	Inspect isolators for signs of wear or material loss. Replace if any wear is observed.
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

15,000 MILE (24,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Replace
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Replace
	Engine Coolant	Inspect fluid level, add coolant if necessary
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
	Battery	Check terminals; clean; test
D	Brake Fluid	Change every two years (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Adjust if necessary, lubricate with proper lubricant as directed
D	Front Fork Oil	Replace
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Inspect; adjust if necessary, lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

20,000 MILE (32,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Inspect; clean
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Inspect; clean, lubricate
	Engine Coolant	Inspect fluid level, add coolant if necessary
D	Engine Compression	Inspect; correct if necessary
XU	Engine Oil & Filter Change	Change oil and filter, inspect used oil for contaminants
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
D / E	Spark Plugs	Inspect; torque to specification
D	Valve Lash Clearance	Inspect; adjust if necessary
	Battery	Check terminals; clean; test
D	Brake Fluid	Replace (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Adjust if necessary, lubricate with proper lubricant as directed
D	Front Fork Oil	Inspect
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Head Light	Inspect; adjust if necessary
D	Radiator Rubber Isolators	Inspect isolators for signs of wear or material loss. Replace if any wear is observed.
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

25,000 MILE (40,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Inspect; clean
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Inspect; clean, lubricate
	Engine Coolant	Inspect fluid level, add coolant if necessary
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
	Battery	Check terminals; clean; test
D	Brake Fluid	Change every two years (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Adjust if necessary, lubricate with proper lubricant as directed
D	Front Fork Oil	Inspect
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Inspect; adjust if necessary, lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

30,000 MILE (48,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Replace
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Replace
	Engine Coolant	Inspect fluid level, add coolant if necessary
D	Engine Compression	Inspect; correct if necessary
XU	Engine Oil & Filter Change	Change oil and filter, inspect used oil for contaminants
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
D / E	Spark Plugs	Replace
	Battery	Check terminals; clean; test
D	Brake Fluid	Replace (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Lubricate with proper lubricant as directed
D	Front Fork Oil	Replace
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Head Light	Inspect; adjust if necessary
D	Radiator Rubber Isolators	Inspect isolators for signs of wear or material loss. Replace if any wear is observed.
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

35,000 MILE (52,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Inspect; clean
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Inspect; clean, lubricate
	Engine Coolant	Inspect fluid level, add coolant if necessary
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
	Battery	Check terminals; clean; test
D	Brake Fluid	Change every two years (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Adjust if necessary, lubricate with proper lubricant as directed
D	Front Fork Oil	Inspect
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

40,000 MILE (64,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Inspect; clean
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Inspect; clean, lubricate
	Engine Coolant	Inspect fluid level, add coolant if necessary
D	Engine Compression	Inspect; correct if necessary
XU	Engine Oil & Filter Change	Change oil and filter, inspect used oil for contaminants
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
D / E	Spark Plugs	Inspect; torque to specification
D	Valve Lash Clearance	Inspect; adjust if necessary
	Battery	Check terminals; clean; test
D	Brake Fluid	Replace (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Adjust if necessary, lubricate with proper lubricant as directed
D	Front Fork Oil	Inspect
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Head Light	Inspect; adjust if necessary
D	Radiator Rubber Isolators	Inspect isolators for signs of wear or material loss. Replace if any wear is observed.
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

45,000 MILE (72,000 KM) SERVICE

ITEM		REMARKS
XU	Air Filter	Replace
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Replace
	Engine Coolant	Inspect fluid level, add coolant if necessary
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
	Battery	Check terminals; clean; test
D	Brake Fluid	Change every two years (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Lubricate with proper lubricant as directed
D	Front Fork Oil	Replace
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Inspect; adjust if necessary
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

50,000 MILE (80,000 KM) SERVICE

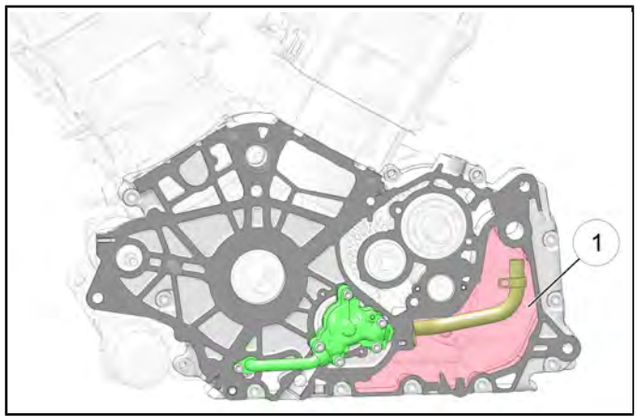
ITEM		REMARKS
XU	Air Filter	Inspect; clean
D	Chain Sliders	Inspect, clean, replace if necessary
D	Cooling System / Radiator	Inspect
D	Crankcase Ventilation System	Inspect; tighten, clean, adjust
D	Drive Chain	Inspect; clean, lubricate
	Engine Coolant	Replace
D	Engine Compression	Inspect; correct if necessary
D	Engine Mount Fasteners	Inspect; tighten, adjust
XU	Engine Oil & Filter Change	Change oil and filter, inspect used oil for contaminants
E	Evaporative Emission Control System	Inspect; clean
E	Exhaust System	Inspect; tighten, adjust
D	Fuel System	Inspect; clean
D	Oil Lines / Oil System Inspection	Inspect; clean, adjust if necessary
D / E	Spark Plugs	Inspect; torque to specification
	Battery	Check terminals; clean; test
D	Brake Fluid	Replace (DOT 4)
XU / D	Brake Pads	Inspect pad wear; replace if worn beyond service limit
D	Clutch Lever	Lubricate with proper lubricant as directed
D	Clutch Cable Freeplay	Inspect; adjust if necessary
D	Control Cable Ends	Lubricate with proper lubricant as directed
D	Fasteners	Inspect; tighten if necessary
D	Front Brake Lever	Adjust if necessary, lubricate with proper lubricant as directed
D	Front Fork Oil	Inspect
D	Front Forks and Front Axle	Inspect; adjust if necessary
D	Gear Shift Pedal	Inspect; lubricate & adjust if necessary
D	Head Light	Inspect; adjust if necessary
D	Radiator Rubber Isolators	Replace
D	Rear Brake Pedal	Inspect; lubricate & adjust if necessary
D	Driver and Passenger Foot Pegs	Inspect; lubricate
D	Rear Shock Absorber	Replace
D	Rear Wheel Alignment	Inspect; adjust if necessary
	Road Test	Perform Road Test
D	Side-Stand	Lubricate with proper lubricant as directed
D	Steering Bearings	Inspect
D	Suspension Linkage, Rear	Inspect
D	Swingarm and Rear Axle	Inspect
D	Tires / Wheels	**ALL TIRES / WHEELS:** Inspect tread depth, sidewall cracking, wear patterns **SPOKED WHEELS:** Inspect both wheels for loose, bent, broken or missing spokes

When the vehicle goes beyond 50,000 miles, return to the 500 mile chart and start the interval process over.

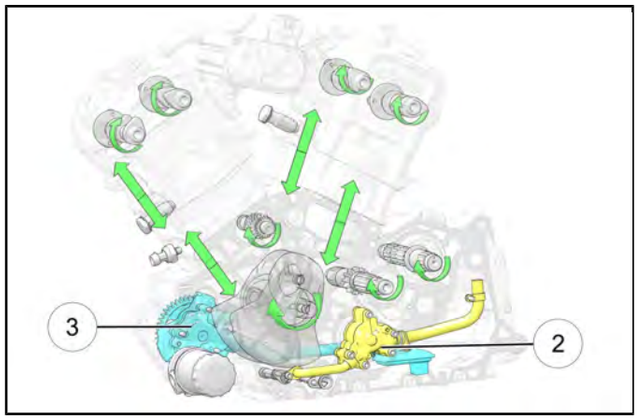
GENERAL INFORMATION

SERVICE NOTES - OILING SYSTEM

The FTR engine uses a semi-dry sump lubrication system. The engine oil is housed in a separate chamber within the engine cases ① as shown in the image below.



The engine has two separate oil pumps, a scavenge pump ② and pressure (lubrication) pump ③. The scavenge pump has two sets of internal gerotors. One set scavenges oil from the right side of the engine crankcase and the second set from the left side. The scavenge pump supplies oil to fill the oil tank area ① of the engine. The oiling system pressure relief valve is located inside the pressure oil pump.



To access the scavenge oil pump, the stator cover must be removed. To access the pressure pump, remove the right engine cover. Before disassembly, review the troubleshooting charts located in this chapter.

If the engine is making irregular noises that appear to be coming from rotating parts, check the lubrication side oil pressure. Check the oil pressure before engine disassembly, and recheck the oil pressure after a repair.

SPECIAL TOOLS - MAINTENANCE

TOOL DESCRIPTION	PART NUMBER
Brake Lever Reserve Tool	PV-50104
Battery Tester	PU-50296
Chain Tension Gauge	PV-43532
Oil Filter Wrench	PU-50105
Shock Spanner Wrench	2884176

Bosch Automotive Service Solutions: 1-800-345-2233 or https://polaris.service-solutions.com/

BREAK-IN PROCEDURE

Engine break-in for Indian Motorcycles occurs in the first 500 miles (800 km) of operation. Indian Motorcycles are manufactured using the best possible materials and manufacturing techniques, but the final machining process is the break-in. During this break-in period, critical engine parts wear and polish to correct operating clearances. Read, understand and follow all break-in procedures to ensure the long-term performance and durability of the engine.

⚠ CAUTION

Failure to properly follow the engine break-in procedures outlined in this manual can result in serious damage to the engine. Follow all break-in procedures carefully. Avoid full throttle operation and other condition that may place an excessive load on the engine during the break-in period.

Observe the following precautions during the break-in period:

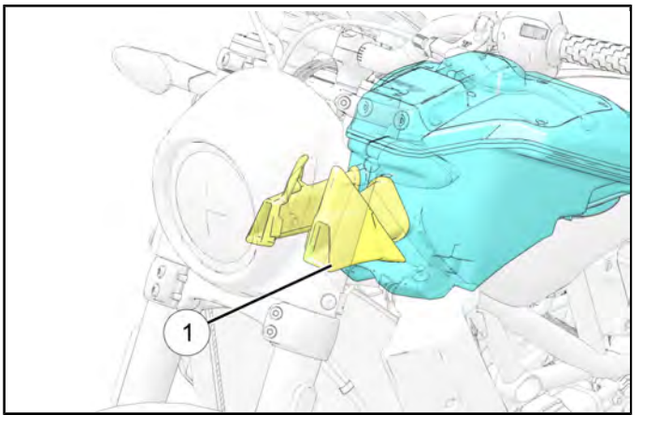
- Upon initial start-up, do not allow the engine to idle for long periods.
- Avoid fast starts with wide open throttle. Drive slowly until the engine warms up.
- Avoid running the engine at extremely low RPM in higher gears (lugging the engine).

Break-In Guidelines

ODOMETER	BREAK-IN PROCEDURE
0–90 Miles (0–145 km)	Do not operate for extended periods above 1/3 throttle or at any one throttle position. Vary engine speed frequently.
91–300 Miles (146–483 km)	Do not operate for extended periods above 1/2 throttle or at any one throttle position. Vary engine speed frequently.
301–500 Miles (484–805 km)	Do not operate for extended periods above 3/4 throttle.
500 Miles (805 km)	Perform the break-in maintenance procedure outlined in the Periodic Maintenance Interval Table located in this chapter.

WASHING PRECAUTIONS

The FTR models have air ducts ① located on the front of the unit that channel air into the airbox.



⚠ CAUTION

Take care when washing unit to avoid water ingestion. Serious engine damage may result if water is ingested.

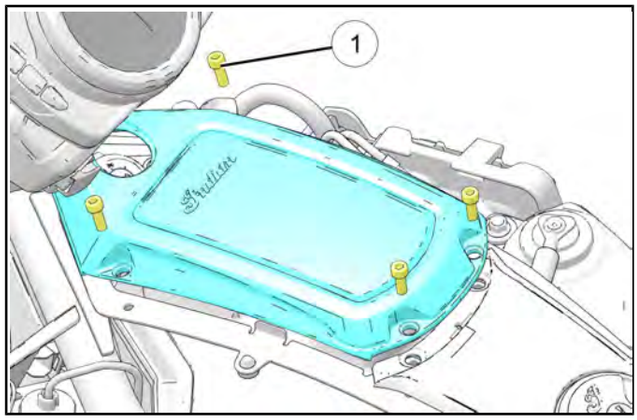
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

ROUTINE MAINTENANCE PROCEDURES

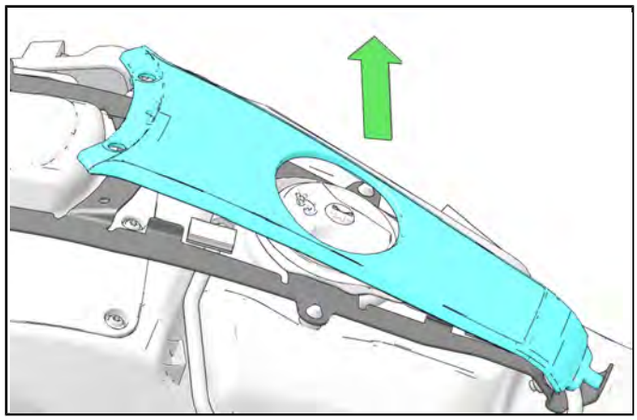
AIR FILTER REPLACEMENT

NOTICE
If the motorcycle is operated in wet or dusty conditions, more frequent servicing is required. The air filter element cannot be cleaned. Replace the filter when necessary.

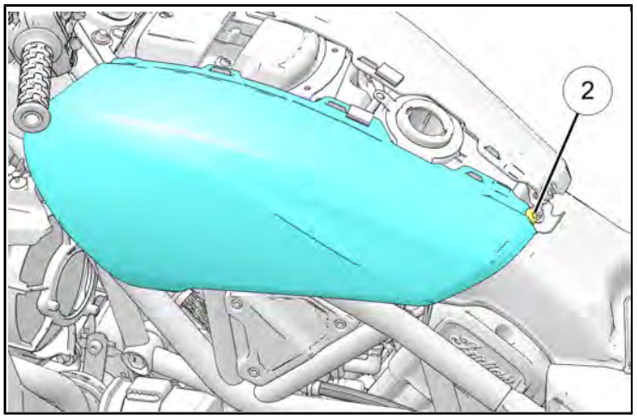
1. Remove the seat. See **Seat Removal / Installation page 7.19**.
2. Remove four fasteners ① securing air box bezel.



3. Remove the center console cover from the alignment bracket.

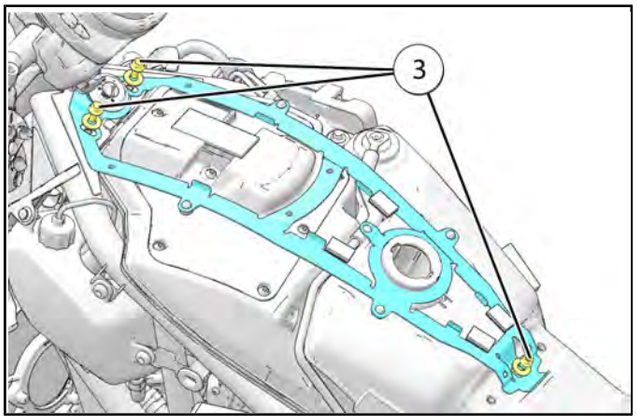


4. Remove the gas cap and relocate to clean, safe location.
5. Remove fastener securing the air box cover ②.

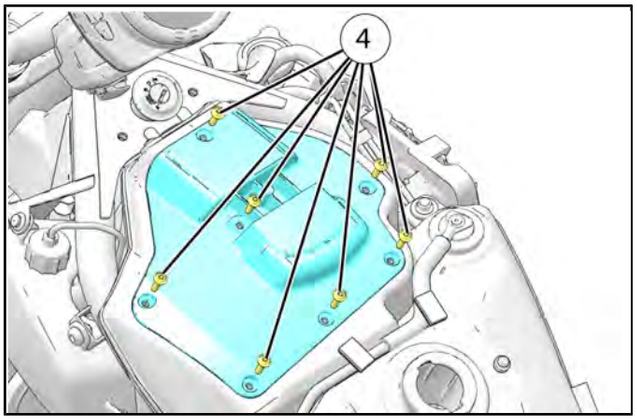


NOTICE
Pull air box cover up and out to remove.

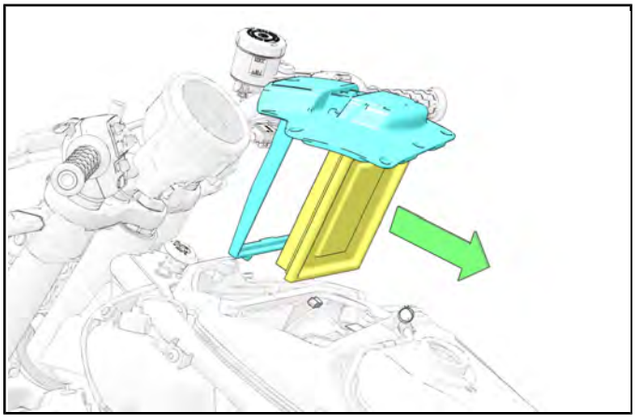
6. Remove three fasteners ③ to remove alignment bracket.



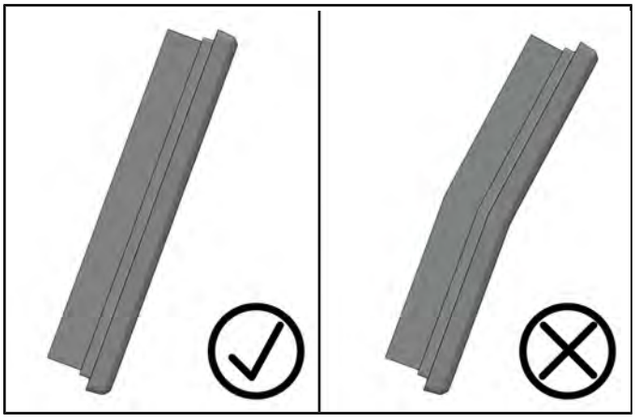
7. Remove seven fasteners ④ securing air filter access cover.



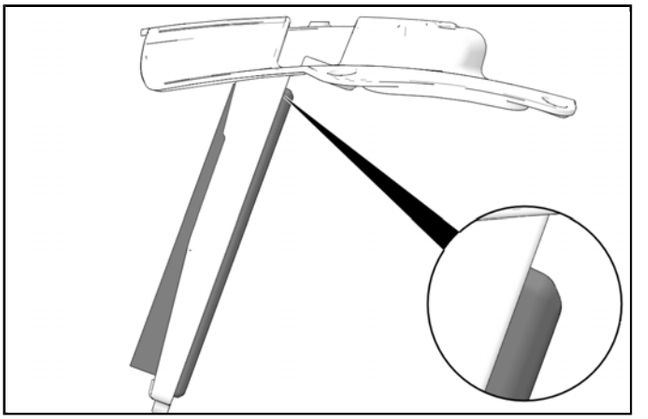
8. Remove the air filter from the airbox.



9. Inspect filter element and replace if dirty, wet, or oil fouled.
10. Install *New* filter with same orientation as old filter.
    - Make sure air filter is not bent prior to installation.



- Make sure air filter is fully seated in air filter cover during installation.



11. Install air filter access cover and secure with seven fasteners.

TORQUE
Air Filter Access Cover Fastener: **14 in-lbs (2 N·m)**

12. Install the alignment bracket and secure with fasteners.

TORQUE
Bodywork Alignment Bracket Fastener: **36 in-lbs (4 N·m)**

13. Install airbox cover.

TORQUE
Airbox Cover Fastener: **36 in-lbs (4 N·m)**

14. Install gas cap.
15. Install center console cover.
16. Install airbox bezel and secure with fasteners.

TORQUE
Airbox Bezel Fastener: **36 in-lbs (4 N·m)**

17. Reinstall seat. See **Seat Removal / Installation page 7.19**

⚠ CAUTION
A loose fitting cover or improperly installed filter element may allow debris to enter the engine which may cause premature engine wear.

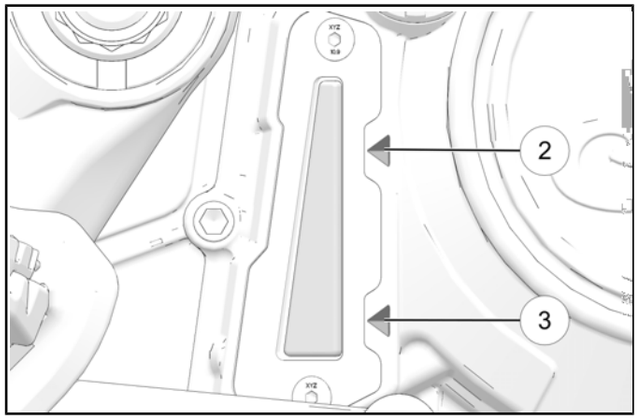
ENGINE OIL LEVEL CHECK

Due to the semi-dry sump lubrication system, the engine oil level shown in the sight glass will fluctuate with movement of the motorcycle from a vertical position and with the temperature of the oil To get an accurate oil level reading follow all inspection procedures closely.

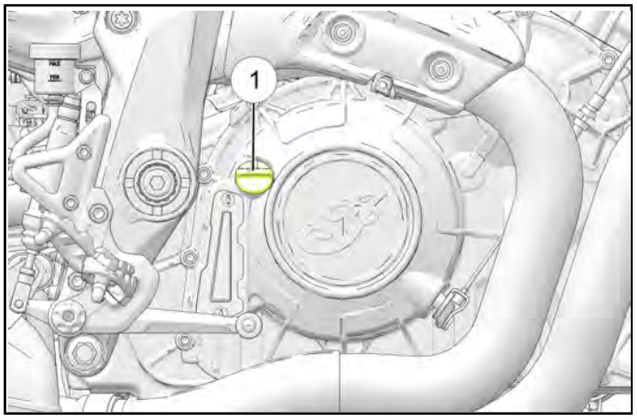
IMPORTANT

Engine MUST BE AT OPERATING TEMPERATURE when checking oil level. Check oil after riding or after idling a cold engine for 5-10 minutes.

1. With the motorcycle in an upright (vertical) position, run the engine for 30 seconds.
2. Stop engine.
3. Place the machine on a level area and hold it in an upright (centered) position.
4. Inspect the oil level by looking at the oil sight glass. The oil level should be in the middle of the sight glass between the FULL ② and ADD ③ marks.



5. Oil level should be in the middle the sight glass. If oil level is low, remove engine oil fill plug ① and add Indian Motorcycle 15W–60 Full Synthetic engine oil. Repeat steps 1- 4 until the reading is within the safe operation range.



⚠ CAUTION

Oil level will NOT be accurate if checked on a cold engine. DO NOT ADD oil to raise level to middle of sight glass on a cold engine, as this can result in overfilling.

Do not overfill! The approximate volume is in the middle of the sight glass between the FULL ② and ADD ③ marks.

ENGINE OIL & FILTER CHANGE

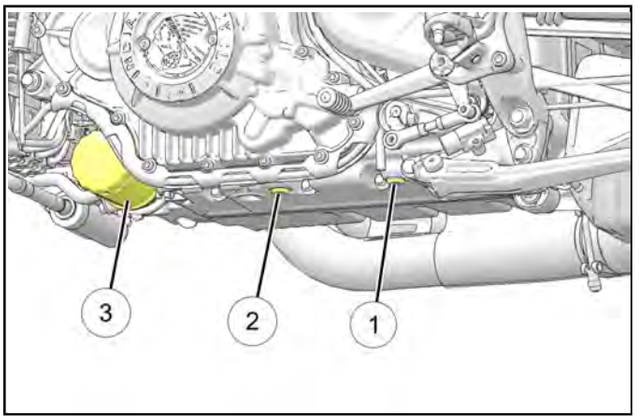
IMPORTANT

Engine MUST BE WARMED before performing the following procedure.

⚠ CAUTION

HOT COMPONENTS
Wear insulated gloves and use caution handling these parts.

1. Run engine until warm, then turn engine off.
2. Securely support the motorcycle in a vertical "centered" position.
3. Place an oil drain pan under the engine oil drain plugs ① and ②.



4. Remove the drain plugs and sealing washers.
5. Allow oil to drain completely. Dispose of oil properly.
6. Remove oil filter ③ and allow oil to drain. Dispose of oil filter properly.
7. Clean the engine oil filter mount sealing surface and surrounding area.
8. Place a small amount of oil on the new oil filter seal and spin filter on until the filter seal contacts the sealing surface. Tighten oil filter to specification.

TORQUE

Oil Filter:
115 in-lbs (13 N·m) or approximately 3/4 to 1 full turn after seal contacts the filter mount sealing surface.

9. Use new sealing washers and reinstall the drain plugs. Torque to specification.

TORQUE

Engine Oil Drain Plug:
15 ft-lbs (20 N·m)

10. Use a funnel to add 3 US quarts (2.8 Liters) of Indian Motorcycle 15W–60 Full Synthetic engine oil through the engine oil fill port.

NOTICE

3 US quarts will bring the engine oil level at or near the "FULL" mark on the sight glass. For a new or rebuilt (dry) engine add an additional .5 US quart (.47 Liters).

11. Securely support the motorcycle in a vertical "centered" position, idle engine for approximately 30 seconds.
12. Inspect the oil level by looking at the oil sight glass. The oil level should be in the middle of the sight glass between the two indicator marks.**DO NOT OVERFILL!**

IMPORTANT

Total engine oil fill volume with oil filter change will be approximately 3.0 - 4.0 US quarts (2.8 - 3.8 Liters). Total engine oil fill volume with a new or rebuilt (dry) engine will be approximately
4.5 qts. (4.25 L) Dry Engine

13. Refer to the Engine Oil Level Check page 2.21 section in this chapter for setting proper oil level.

⚠ CAUTION

If the low oil pressure indicator remains illuminated longer than usual after an oil change, do not increase RPM above idle until indicator lamp goes out or engine may be damaged.

14. Check for leaks around drain plug and oil filter.

NOTICE

Recycle used oil and oil filter in accordance with local regulations.

TIRE PRESSURE / SPECIFICATIONS

⚠ WARNING

Indian motorcycles are produced using the designated tires listed below as original equipment. This includes field testing to ensure stability and superior handling. The use of tires other than original equipment may cause instability. See Steering / Suspension Chapter for a review of all tire related warnings.

1. Inspect tires for weather checking, cuts, imbedded foreign objects, etc.
2. Inspect front and rear wheels for damage.
3. Measure tread depth at center of tread.
4. Measure in 3-4 places equally spaced around the tire and record the smallest measurement.

⚠ WARNING

It is dangerous to ride with a worn tire. When a tire reaches the minimum tread depth listed below, replace the tire immediately.

Tire Pressure Table (Cold)

NOTICE

Also refer to Manufacturing Information label.

Model:	Location:	Type:	Size:	Rim Size:	PSI:	Minimum Tread Depth:
2019-2020: FTR / FTR S	FRONT	Dunlop DT3R Pirelli Scorpion Trail II Pirelli Scorpion Rally STR	120/70R19	3.0 x 19	36 PSI (248 kPa)	1/16 in (1.6 mm)
	REAR	Dunlop DT3R Pirelli Scorpion Trail II Pirelli Scorpion Rally STR	150/70R18	4.25 x 18	40 PSI (276 kPa)	
FTR Rally	FRONT	Pirelli Scorpion Rally STR	120/70R19	3.0 x 19	36 PSI (248 kPa)	1/16 in (1.6 mm)
	REAR	Pirelli Scorpion Rally STR	150/70R18	4.25 x 18	40 PSI (276 kPa)	
2022: FTR / FTR S / FTR R Carbon	FRONT	Metzeler Sportec M9 RR	120/70ZR17	3.5 x 17	36 PSI (248 kPa)	1/16 in (1.6 mm)
	REAR	Metzeler Sportec M9 RR	180/55ZR17	5.5 x 17	40 PSI (276 kPa)	

2023: FTR / FTR S / FTR R Carbon	FRONT	Metzeler Sportec M9 RR	120/70ZR17	FTR S = 3.5 x 1.7 FTR / FTR Carbon = 5.5 x 17	36 PSI (248 kPa)	1/16 in (1.6 mm)
	REAR	Metzeler Sportec M9 RR	180/55ZR17	5.5 x 17	40 PSI (276 kPa)	
2023: FTR Rally	FRONT	Metzeler Sportec M9 RR	120/70R19M/C	3.0 x 19	36 PSI (248 kPa)	1/16 in (1.6 mm)
	REAR	Metzeler Sportec M9 RR	150/70R18M/C	4.25 x 18	40 PSI (276 kPa)	

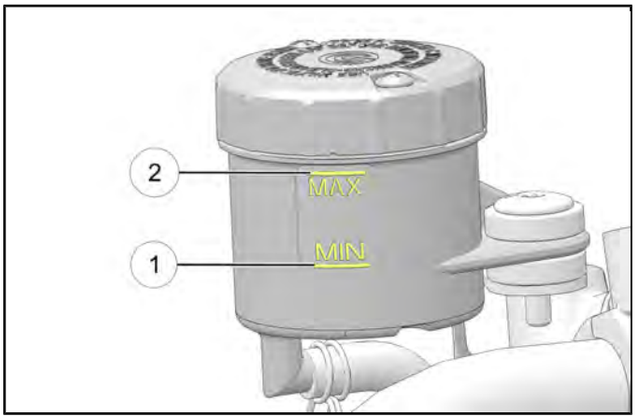
BRAKE FLUID LEVEL INSPECTION

IMPORTANT

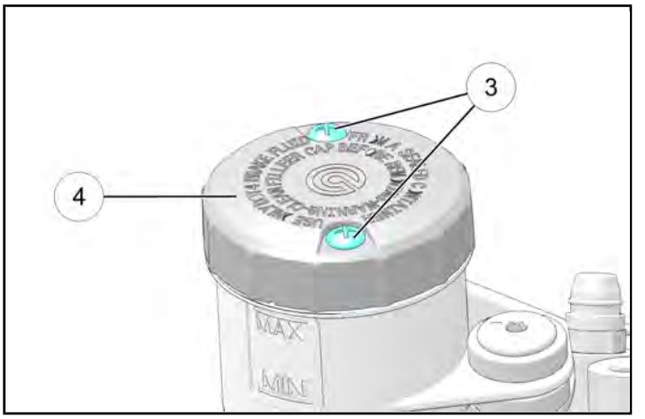
The brake fluid level in the reservoir will go down as brake pads wear. If you notice a constant or sudden lowering of the brake fluid level, inspect brake pads for wear and brake system for leaks.

Front Brake Fluid Inspection

1. Turn handlebars or adjust the motorcycle until top of reservoir is level.



2. View front brake fluid level through the fluid reservoir. The fluid should be clear and between the MIN ① and MAX ② markings.
3. Wipe area around reservoir cover with a clean cloth.
4. Wipe brake fluid container with a clean cloth.
5. Remove screws ③, reservoir cover ④.



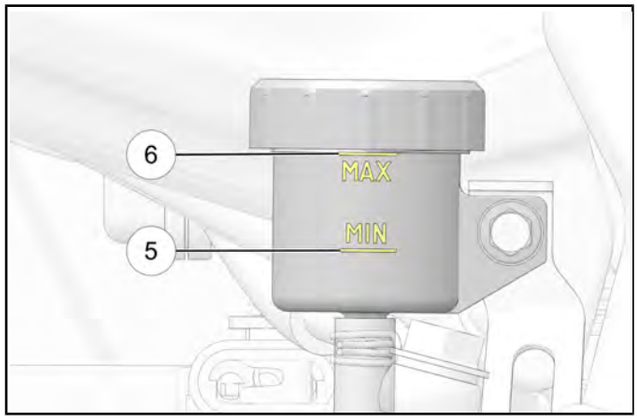
6. Carefully add enough DOT 4 brake fluid to bring level to between the MIN ① and MAX ② markings.
7. Reinstall reservoir cover and torque screws to specification.

TORQUE
Front Master Cylinder Cap Screws: **10 in-lbs (1 N·m)**

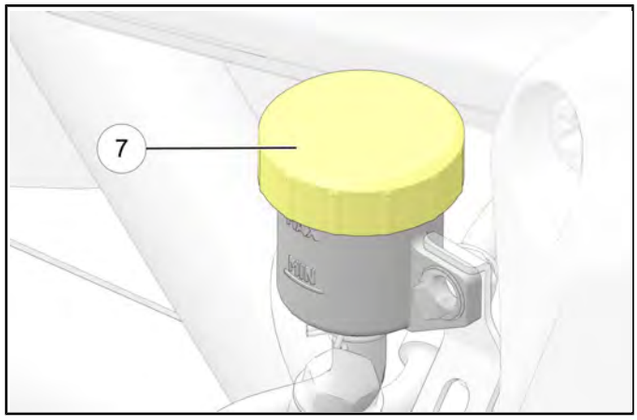
Rear Brake Fluid Inspection

8. Fluid level is checked at the rear brake master cylinder reservoir.

9. View fluid level through the fluid reservoir. The fluid should be clear and between the MIN ⑤ and MAX ⑥ markings.



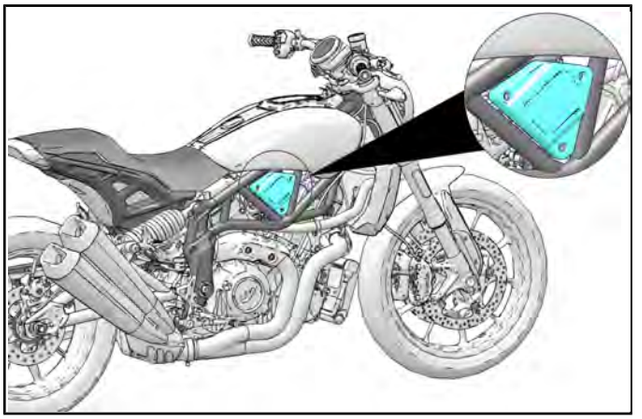
10. Wipe area around reservoir cover with a clean cloth.
11. Wipe brake fluid container with a clean cloth.
12. Remove reservoir cover ⑦.



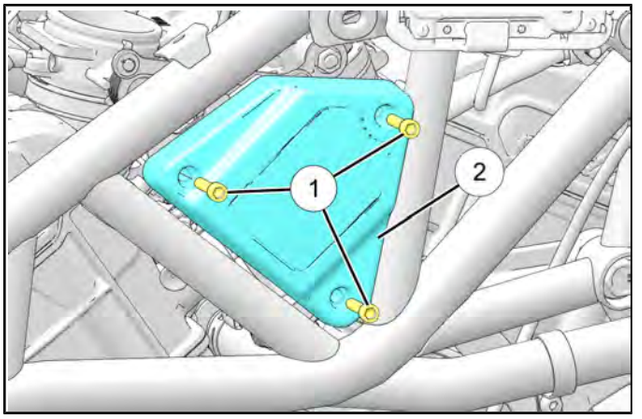
13. Carefully add enough DOT 4 brake fluid to bring level to between the MIN ⑤ and MAX ⑥ markings.
14. Install diaphragm and cover. Tighten by hand.

FUSE REPLACEMENT

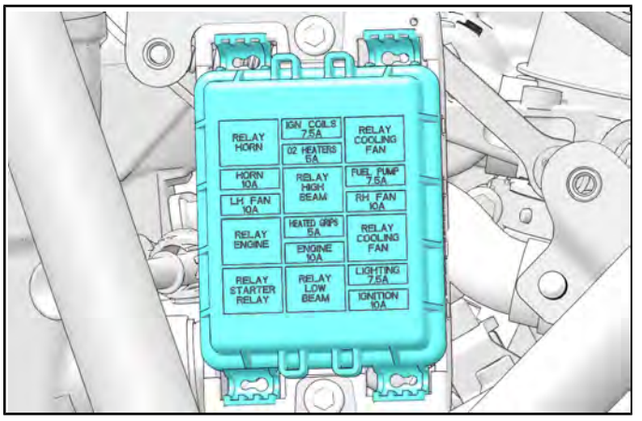
The fuse panel is located on the right side of the unit.



1. Remove three fasteners ① and v-cover② on the right side of the unit to access the fuse panel.



2. Remove the fuse box cover.



3. If any fuse is blown, turn off main switch. Install new fuse of specified amperage. Turn on switches and see if system operates correctly. Repeat fuse failure indicates an electrical problem.

⚠ CAUTION

Do not use fuses of a higher amperage rating than what is specified.
If the correctly rated fuse continues to blow, something is wrong and needs to be corrected.
Substituting a higher amperage fuse can lead to extensive electrical system and vehicle damage.

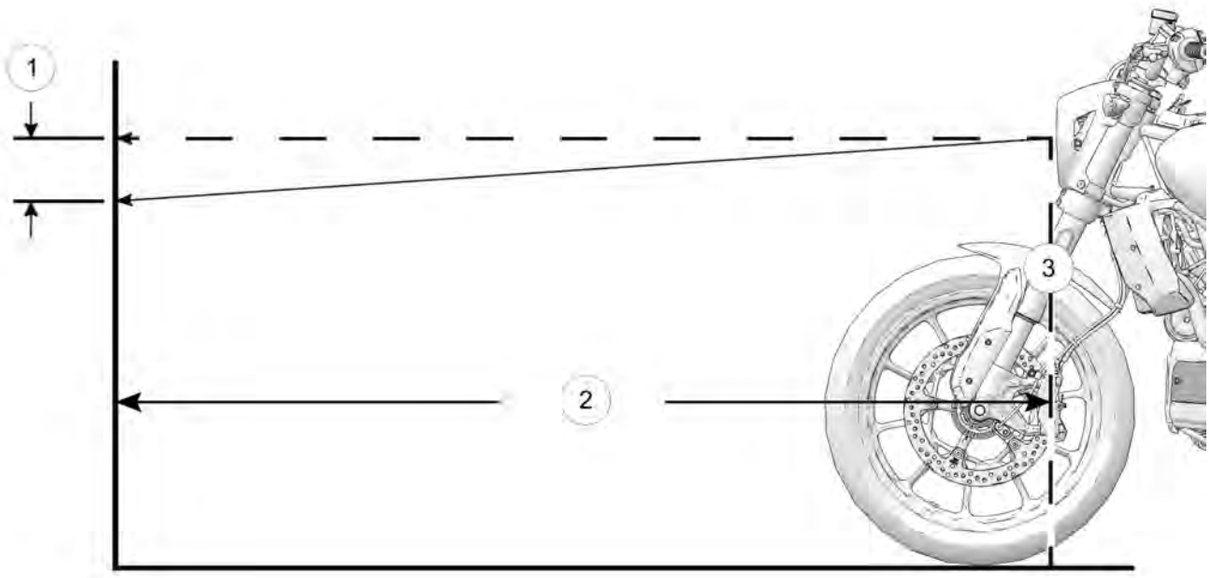
4. Upon reassembly, torque cover fasteners to specification.

TORQUE
V-Cover Fastener: **36 in-lbs (4 N·m)**

HEADLIGHT AIM INSPECTION – FTR MODELS

On LOW beam, the top of the horizontal cut-off of the light beam ① should be 7 in (17.8 cm) lower than the center of the headlight bulb and centered straight ahead at 32 ft 10 in (10 m).

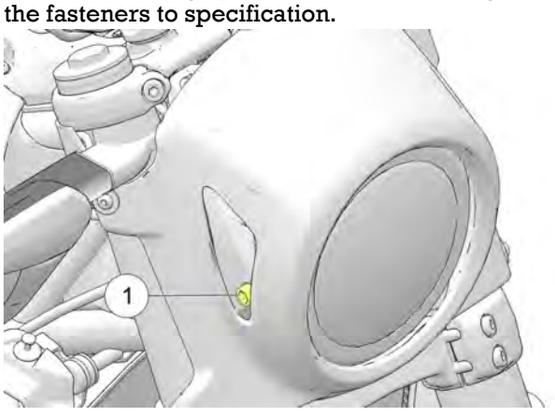
1. Verify that tire pressure is at specification.
2. Verify that rear suspension ride height (preload) is at specification.
3. Position the motorcycle on a level surface with the headlight 32 ft 10 in (10 m) from a wall.
4. With the operator and passenger (if applicable) on board, bring the motorcycle to the fully upright position.
5. Start the engine and switch the headlight to low beam. Observe the headlight aim on the wall.
6. Make any necessary adjustments to headlight aim.



NUMBER	DESCRIPTION
①	Measure distance = 4 in (10.2 cm)
②	Measure distance = 32 ft 10 in (10 m)
③	Headlight Center

HEADLIGHT AIM ADJUSTMENT

1. To adjust the headlamp vertically, loosen the two housing mount fasteners ① (one on each side) and pivot the housing upward or downward. Tighten the fasteners to specification.



TORQUE
Headlight Adjustment Fastener: **25 ft-lbs (34 N·m)**

NOTICE
FTR S Shown

BATTERY CHARGING AND MAINTENANCE

AGM BATTERY CHARGER RECOMMENDATIONS

Indian Motorcycle recommends using the BatteryMINDer® 2012 AGM - 2 AMP battery charger (PN 2830438) to charge and maintain AGM batteries. The charger can be found on the Polaris PG&A website and ordered in DEX – Item Availability.

Batteries that fall below 12.5V run the risk of sulfation, a condition whereby sulfate crystals form inside the battery and significantly reduce performance. AGM chargers are designed specifically for charging AGM type batteries and use high frequency pulses to partially reverse sulfation.

IMPORTANT
The use of non-AGM battery chargers or non-AGM battery tenders may result in a misleading “battery not found” or “open cell” fault message. Please ensure you are using the recommended AGM charger when charging AGM type batteries.

INDIAN MOTORCYCLE RECOMMENDED AGM BATTERY TESTING PROCEDURE:

1. Test battery using the battery tester PU-50296.
2. If the tester indicates a test result other than "Good Battery," follow the steps below before replacing the battery:
   a. Connect battery to the recommended battery charger. If charging sequence begins as normal, fully charge battery and proceed to step 3.

      The time listed on the PU-50296 battery tester printout is an estimate. The recommended automatic charger will indicate when the battery is fully charged on its display.

   b. If charging sequence does not initialize, refer to **AGM Battery Charging Recommendations – Deeply Discharged (below 3 volts)** to attempt to restore the deeply discharged battery. If charging sequence will not finish as intended, the battery needs to be replaced.
3. Re-test battery. If the test results show that battery failed, proceed with battery replacement.

IMPORTANT
If battery is below 10.5 volts before charging, when light turns green on the charger, unplug and plug back in to ensure battery is fully charged.

AGM BATTERY CHARGING RECOMMENDATIONS – LOW CHARGE

The nominal voltage for an Indian Motorcycle battery is 12.8 Volts when fully charged. The battery will self-discharge when disconnected from a vehicle, and will discharge at a faster rate when connected. If the battery voltage falls below 12.5V, it should be charged immediately using the recommended battery charger. Listed below are the recommended battery inspection schedules.

- Batteries which are not connected to a vehicle should be inspected every 60 days. The battery must be charged if found to be below 12.5 volts.
- Batteries which are connected to motorcycles should be inspected when they arrive at your dealership and at least once every month thereafter. The battery must be charged if found to be below 12.5 volts.
- Showroom bikes used to demonstrate radio, display and infotainment features should be charged daily. If possible, these bikes should be connected to the recommended battery charger continuously.

Always use the recommended automatic battery charger, and wait for the charger to complete the charge cycle before disconnecting it.

AGM BATTERY CHARGING RECOMMENDATIONS – DEEPLY DISCHARGED (BELOW 3 VOLTS)

AGM batteries discharged to a voltage of 3 volts or less may not be recognized by the recommended automatic battery charger. (The minimum voltage threshold recognized by other battery chargers may be as high as 10.5 volts). Often times deeply discharged batteries can be restored by attaching another, fully-charged, battery to "jump start" the low battery. Follow the steps below to restore a deeply discharged battery.

1. Carefully connect the two batteries' positive terminals, then the negative terminals using jumper cables.
2. Connect the recommended battery charger to the low battery and initiate the charging sequence.

⚠ WARNING

Always check to ensure the positive cables are connected to the positive terminals before powering the charger on. Reversing polarity when charging can damage electrical components and risk personal injury. Be careful not to let battery cable clamps touch each other.

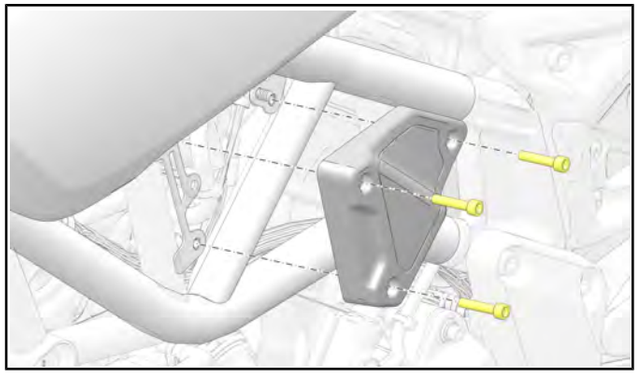
3. After the charging sequence has initiated, disconnect the fully-charged battery. Always disconnect the fully-charged battery positive first, followed by low battery positive, low battery negative, and finally fully-charged battery negative
4. Proceed with charging both batteries to full capacity. Listed in the table below are the approximate charging times for deeply discharged batteries. Always use the recommended automatic battery charger, and wait for the charger to complete the charge cycle before disconnecting it. The recommended automatic charger will indicate when the battery is fully charged on its display.

BATTERY PN	CHARGING TIME	BATTERY CAPACITY	CHARGING RATE
4017581	8 hours	12 AH	2 amps

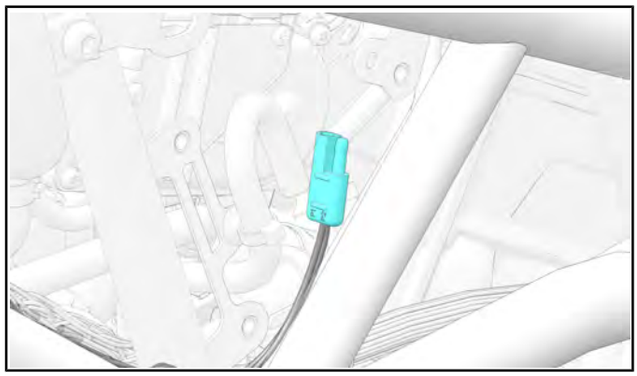
AGM BATTERY MAINTENANCE TIPS

1. If the motorcycle will not be driven for more than 2 weeks, maintaining the battery with the BatteryMINDer® 2012 AGM - 2 AMP charger (PN 2830438) is recommended.
2. To help prolong battery life, it is recommended to remove the battery from vehicles stored ONE month or longer. To maximize the life of stored batteries, they should be kept in a cool / dry location. Batteries will self discharge more rapidly when stored in extreme temperatures. Batteries should be maintained using the recommended battery charger while in storage.
3. Batteries will self-discharge more quickly when dirty. Periodic cleaning of the battery terminals using a terminal brush will help maximize battery life. Wash terminals with a solution of one tablespoon baking soda and one cup water. Rinse well with tap water and dry off with clean shop towels. Coat the terminals with dielectric grease or petroleum jelly.
4. Battery connections should be tightened to the correct torque during installation. This will reduce voltage drop and ensure a reliable connection between the regulator/rectifier and battery.

5. FTR motorcycles equipped with a SAE bullet style connector for quick access to charging the battery. The recommended BatteryMINDer® 2012 charger comes with the mating connector for easy plug and play maintenance. The connector is located behind the left-hand side V cover and taped to the chassis harness.



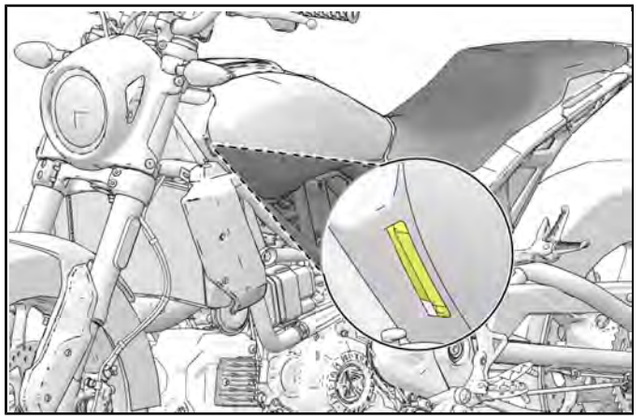
Carefully remove the tape to expose the connector and length of wire. Be sure to properly secure the wire and connector before operating the vehicle.



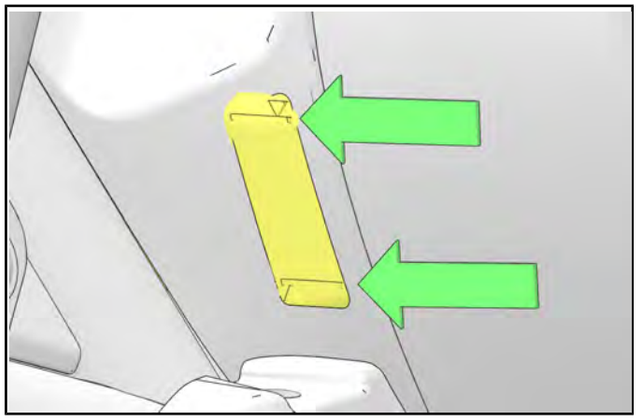
COOLANT LEVEL INSPECTION

The Coolant Overflow bottle is located under the airbox cover. The level can be viewed without the need to disassemble any components.

1. Locate the coolant bottle level window located on the left side of the unit.

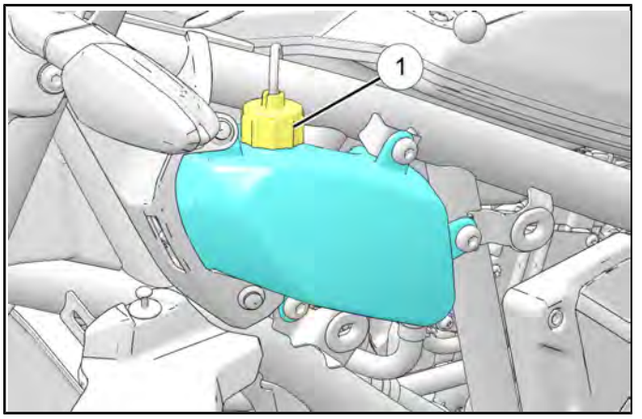


2. Ensure the coolant is in between the marked values.



3. If the coolant level is below the bottom line, coolant will need to be added to the system.
4. Remove the seat and airbox covers. See **Seat Removal / Installation page 7.19**
5. Remove airbox cover. Reference **Air Box Removal page 3.14**

6. Remove the overflow bottle cap ① to add coolant.



DRIVE CHAIN CLEANING / LUBRICATION

Clean the chain using a chain brush or clean rag to remove any dirt or grit. The chain must be lubricated using Indian Motorcycle chain lube (2884172). See **Maintenance Intervals page 2.4**

⚠ CAUTION

Always have the motorcycle off and the transmission in neutral when performing this procedure.

⚠ CAUTION

Do not use a de-greaser to clean the chain. De-greaser may damage the chain o-rings and cause premature wear.

SUSPENSION ADJUSTMENT GUIDE

IMPORTANT
Make sure rear shock preload is set correctly before changing compression and rebound settings below.

NOTICE
FTR Rally features a preload and rebound adjustments on the rear shock but no fork adjustments. ***FTR / FTR S*** features a fully adjustable fork and rear suspension components. ***FTR R Carbon*** features a fully adjustable fork and rear suspension components.

NOTICE
Turning adjusters fully clockwise (+) will result in a "full-in" position. While turning adjustments fully counter-clockwise (-) will result in a "full-out" position.

SETUP TIPS:

When adding preload, add rebound damping.

Always make sure front and rear damping settings are balanced (front to back).

For aggressive riding, add compression and rebound damping.

For low speed/urban riding, reduce compression and rebound damping.

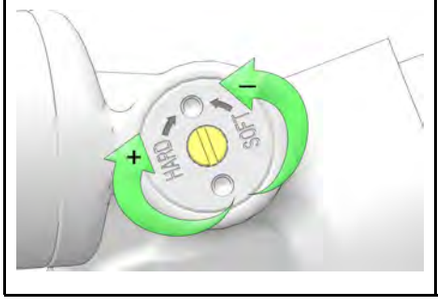
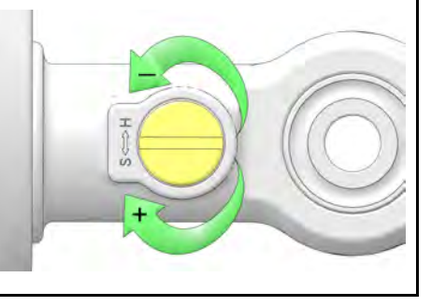
NOTE
Turing adjusters fully clockwise (+) will result in a "full-in" position. While turning adjustments fully counter-clockwise (-) will result in a "full-out" position.

Rear Shock Factory Setting

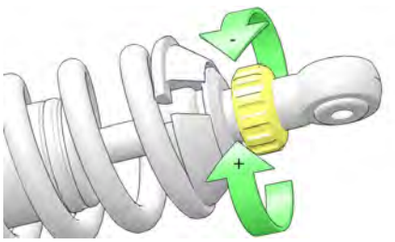
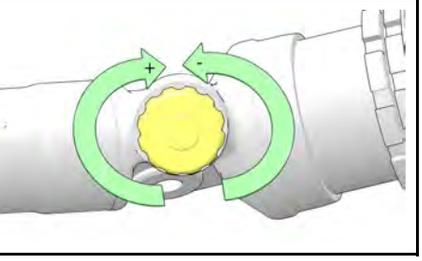
	FTR RALLY	FTR FTR S	FTR R CARBON
Shock Rebound, upper end of shock	15 clicks out *(from full-in, 24 clicks total)*	17 clicks out *(from full-in, 24 clicks total)*	14 clicks out *(from full-in, 40 clicks total)*
Shock Compression, reservoir end of shock	N/A	1.5 turns out *(from full-in, 3 turns total)*	15 clicks out *(from full-in, 22 clicks total)*
Shock Spring Ends Installed Length	180 mm (range 185 - 155 mm)	174 mm (range 179 - 149 mm)	168 mm (range 180 - 152 mm)

FTR / FTR S Recommended Damping Settings

RIDING TYPE:	SHOCK COMPRESSION (S MODEL ONLY)	SHOCK REBOUND
Low Speed Riding (Urban)	2.5 turns *(out from full in)*	19 clicks *(out from full in)*
General Riding (Town/Highway)	1.5 turns *(out from full in)*	15 clicks *(out from full in)*
General Riding (2-up)	1 turns *(out from full in)*	5 clicks *(out from full in)*

RIDING TYPE:	SHOCK COMPRESSION (S MODEL ONLY)	SHOCK REBOUND
Aggressive Riding (Track)	0.75 turns *(out from full in)*	5 clicks *(out from full in)*
		

FTR R Carbon Recommended Damping Settings

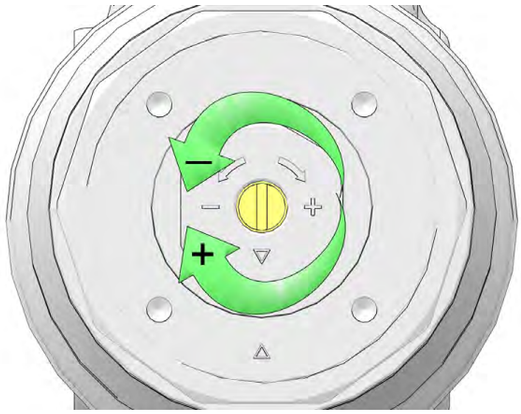
RIDING TYPE:	SHOCK COMPRESSION	SHOCK REBOUND
Low Speed Riding (Urban)	20 clicks *(out from full in)*	17 clicks *(out from full in)*
General Riding (Town/Highway)	15 clicks *(out from full in)*	14 clicks *(out from full in)*
General Riding (2-up)	13 clicks *(out from full in)*	12 clicks *(out from full in)*
Aggressive Riding (Track)	12 clicks *(out from full in)*	14 clicks *(out from full in)*
		

Front Fork Factory Setting

	FTR S	FTR
Fork Rebound, right side screw slot (20 click range)	7 clicks *(out from full in)*	N/A
Fork Compression, left side screw slot (20 click range)	10 clicks *(out from full in)*	N/A
Fork Preload, 19 mm hex (10 turn range)	5 turns *(in from full out)*	N/A

FTR S Recommended Damping Settings

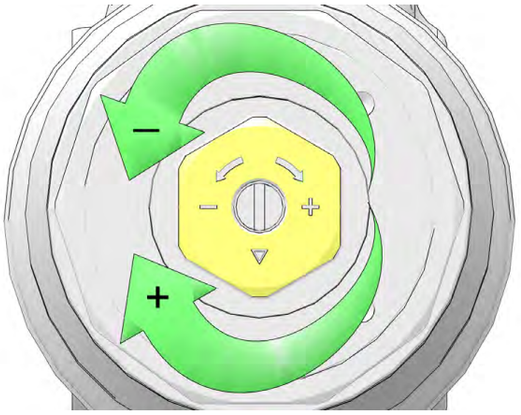
RIDING TYPE:	COMPRESSION (LEFT-HAND FORK)	REBOUND (RIGHT-HAND FORK)
Low Speed Riding (Urban)	17 clicks *(out from full in)*	14 clicks *(out from full in)*
General Riding (Town/Highway)	10 clicks *(out from full in)*	7 clicks *(out from full in)*
General Riding (2-up)	10 clicks *(out from full in)*	5 clicks *(out from full in)*
Aggressive Riding (Track)	5 clicks *(out from full in)*	4 clicks *(out from full in)*



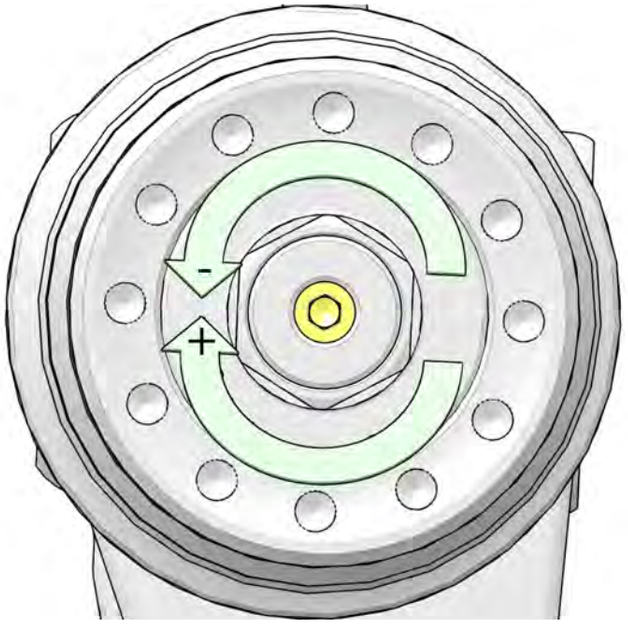
FTR S Recommended Pre-Load Settings

Adjustments can be make to the fork to increase or decrease pre-load for a personal rider preference.

IMPORTANT
Make sure both forks are adjusted evenly.

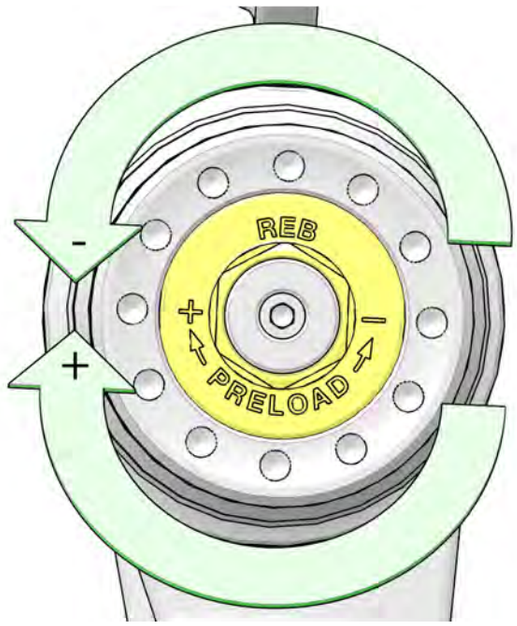


FTR R CARBON RECOMMENDED DAMPING SETTINGS



RIDING TYPE:	COMPRESSION (LEFT-HAND FORK)	REBOUND (RIGHT-HAND FORK)
Low Speed Riding (Urban)	22 clicks out	18 clicks out
General Riding (Town/Highway)	18 clicks out	16 clicks out
General Riding (2-up)	15 clicks out	14 clicks out
Aggressive Riding (Track)	14 clicks out	19 clicks out

FTR R CARBON RECOMMENDED PRE-LOAD SETTINGS

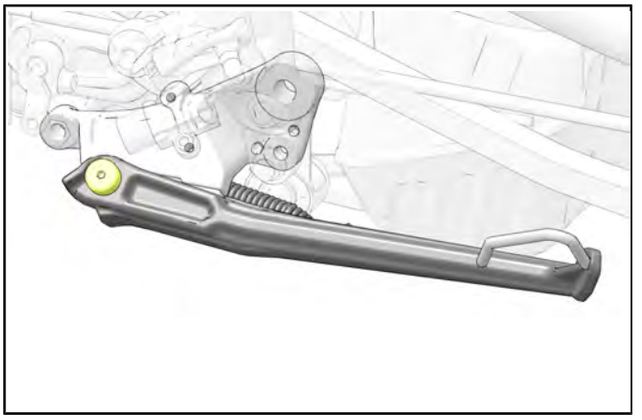


Adjustments can be make to the fork to increase or decrease pre-load for a personal rider preference.

IMPORTANT
Make sure both forks are adjusted evenly.

SIDE-STAND INSPECTION

1. Support the motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Inspect side-stand spring for damage or loss of tension. Verify the side-stand returns to fully retracted position.



3. Inspect side-stand for smooth movement.
4. Inspect side-stand pivot fastener nut for proper torque.

TORQUE
Side-stand Pivot Fastener: **35 ft-lbs (47 N·m)**

5. Replace side-stand if it is bent. Do not attempt to straighten side-stand.

BRAKE PEDAL INSPECTION

1. Press and release the brake pedal. It should move freely and smoothly and return to the rest position quickly when released.
2. Press brake pedal and check for firm resistance. If pedal feels spongy or travels too far without resistance, inspect system for leaks and bleed brakes. See Rear Brake Bleeding page 9.40

MAJOR MAINTENANCE PROCEDURES

IMPORTANT
Reference the **Maintenance Intervals page 2.4** for details on how often to perform each procedure.

MAINTENANCE PROCEDURE	LOCATION
Idle Speed / Fast Idle Speed	**Idle Speed / Fast Idle Speed page 3.8**
Spark Plug Removal	**Spark Plug Removal page 3.8**
Spark Plug Inspection / Gap	**Spark Plug Inspection / Gap page 3.9**
Spark Plug Installation	**Spark Plug Installation page 3.9**
Engine Compression Test	**Engine Compression Test page 3.9**
Engine Compression Test (WET)	**Engine Compression Test (Wet) page 3.10**
Crankcase Ventilation System	**Crankcase Ventilation System page 3.7**
Fuel Tank Vent Inspection	**Fuel Tank Vent Inspection page 4.27**
EVAP emission control system	**Evaporative Emission Control System page 4.14**
Fuel Line / Fuel Rail Inspection	**Fuel Line / Fuel Rail Inspection page 4.27**
Clutch Cable Inspection / Lubrication	**Clutch Cable Inspection / Lubrication page 5.5**
Clutch Lever Lubrication	**Clutch Lever Lubrication page 5.7**
Clutch Lever Freeplay	**Clutch Lever Free Play page 5.6**
Cooling System Inspection	**Cooling System Overview page 3.42**
Coolant Strength / Type	**Coolant Strength / Type page 3.42**
Cooling System Pressure Cap Test	**Cooling System Pressure Cap Test page 3.43**
Cooling System Pressure Test	**Cooling System Pressure Test page 3.43**
Coolant Drain / Fill	**Coolant Drain / Fill page 3.44**
Drive Chain Specifications	**Drive Chain Tension - Specifications page 8.9**
Drive Chain Tension	**Drive Chain Tension page 8.9**
Drive Chain Adjustment	**Drive Chain Adjustment page 8.75**
Shift Pedal Inspection / Lubrication	**Shift Pedal Inspection / Lubrication page 5.4**
Shift Pedal Adjustment	**Shift Pedal Adjustment page 5.4**
Sprocket Inspection	**Sprocket Inspection page 8.77**
Steering Head / Front Wheel Inspection	**Steering Head / Front Wheel Inspection page 8.9**
Swingarm Inspection	**Swingarm Inspection page 8.94**
Rear Shock Preload Inspection	**Rear Shock Preload Inspection page 8.59**
Rear Shock Preload Adjustment	**Rear Shock Preload Adjustment page 8.61**
Shock Analysis	**Shock Analysis page 8.62**
Front Brake Lever Inspection	**Front Brake Lever Inspection page 9.4**

MAINTENANCE PROCEDURE	LOCATION
Front Brake Lever Lubrication	**Front Brake Lever Lubrication page 9.4**
Brake Pedal Inspection	**Brake Pedal Inspection page 2.38**
Brake Pedal Lubrication	**Brake Pedal Lubrication page 9.6**
Rear Brake Pedal Adjustment	**Rear Brake Pedal Adjustment page 9.12**
Front Brake Pad Inspection	**Front Brake Pad Inspection page 9.43**
Rear Brake Pad Inspection	**Rear Brake Pad Inspection page 9.45**
Battery Disconnect	**Battery Disconnect page 10.12**
Battery Removal	**Battery Removal page 10.13**
Battery Installation	**Battery Installation page 10.14**
Valve Clearance Inspection	**Valve Clearance Inspection page 3.70**
Valve Clearance Adjustment	**Valve Clearance Adjustment page 3.71**

CHAPTER 3
ENGINE / COOLING / EXHAUST

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

GENERAL INFORMATION

SERVICE NOTES - ENGINE

A floor jack or commercially available motorcycle engine lift or hoist is required for engine removal. Arrange for assistance when removing and installing the engine.

Once the engine is removed from frame, an engine stand is recommended for engine disassembly and assembly.

Engine removal and installation methods may differ slightly depending on available equipment, but always be sure the engine and chassis are securely supported at all times.

REQUIRES ENGINE REMOVAL FOR SERVICE	CAN BE SERVICED WITH ENGINE IN FRAME
Crankshaft & Crankshaft Component Service	Airbox Removal
Transmission/All Internal Transmission Parts	Camshaft Chain / Guide / Tensioner Assembly
Cylinders	Fuel Injectors / Throttle Body / Fuel Rail
Oil Pump	Voltage Regulator, Stator, Rotor (Flywheel)
Balance Shaft	Clutch
Piston/Cylinder	Gearshift Linkage (External)
	Ignition System
	Oil Pump Drive
	Output Shaft Seal
	Torque Compensator Assembly
	Camshaft(s) / Bearings
	Valve Covers
	Starter, Starter One-Way Clutch, Starter Torque Limit Clutch
	Flywheel

SPECIAL TOOLS - ENGINE

TOOL DESCRIPTION	PART NUMBER
Engine Stand Adapter	PF-51240
Motorcycle Table Lift / Wheel Vise	Commercially Available
12"x12" Platform Jack	Commercially Available
Engine Hoist (Cherry Picker)	Commercially Available
Engine Stand	Commercially Available
Water Pump Seal Installation Tool	PF-51608
Oil Filter Wrench	PU-50105
Cup Adapter	PF-51665

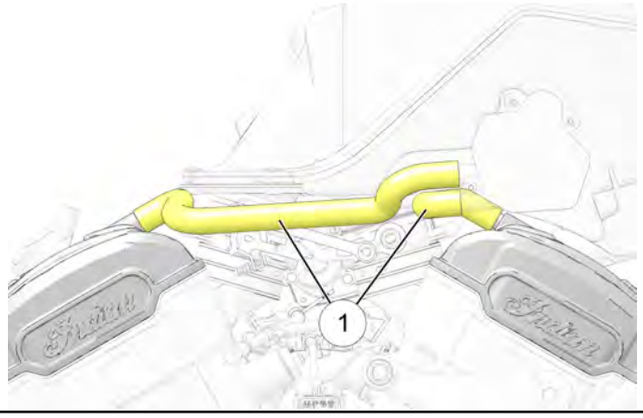
Bosch Automotive Service Solutions: 1–800–345–3322 or https://polaris.service-solutions.com/

SERVICE SPECIFICATIONS – ENGINE

ITEM	SPECIFICATIONS
Engine Dry Weight	Approximately 190 lbs (86 kg)
Oil Capacity (Dry Fill)	Approximately 5.0 Quarts (4.7 Liters)

CRANKCASE VENTILATION SYSTEM

1. To access the crankcase ventilation hoses first perform the following procedures:
2. Remove seat. See **Seat Removal / Installation page 7.19**
3. Remove fuel tank. See **Fuel Tank Removal page 4.24**
4. Remove airbox. See **Air Box Removal page 3.14**
5. Inspect condition of ventilation hoses ① along the entire length and at both ends.



6. Be sure hoses are not restricted, kinked, or cracked.
7. Replace worn or damaged hoses.
8. Install the Air Box, Fuel Tank & Seat. See
   - **Air Box Installation page 3.16**
   - **Fuel Tank Installation page 4.30**
   - **Seat Removal / Installation page 7.19**

MAINTENANCE - ENGINE

IDLE SPEED / FAST IDLE SPEED

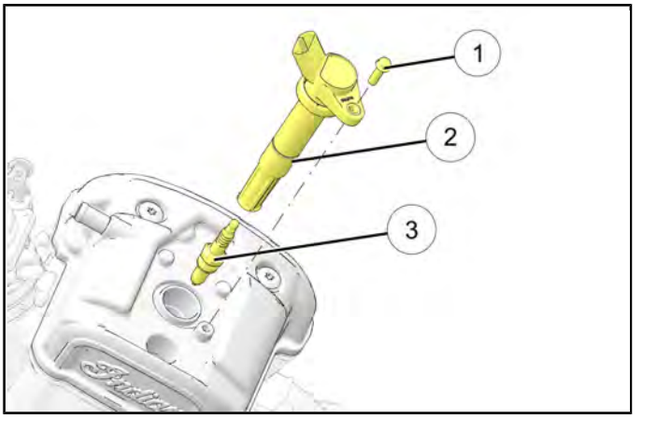
NOTICE
Idle speed is continuously monitored and adjusted by the ECM.

SPARK PLUG REMOVAL

⚠ CAUTION
HOT COMPONENTS **Wear insulated gloves and/or allow engine and exhaust to cool before handling these parts.**

IMPORTANT
The engine should be at room temperature to perform this procedure.

1. Place the motorcycle on the side-stand and allow engine to cool.
2. Remove the seat. See **Seat Removal / Installation page 7.19**.
3. Remove the fuel tank. See **Fuel Tank Removal page 4.24**.
4. Remove air box. See **Air Box Removal page 3.14**.
5. Disconnect the ignition coil electrical connector.
6. Remove the ignition coil fastener ①.



7. Remove the ignition coil assembly ②.
8. Using a 6" extension and a 5/8" spark plug socket, remove spark plug ③.

IMPORTANT
Check gap on replacement spark plug(s) before installation.

Spark Plug Gap: **0.030 in (0.80 mm)**

SPARK PLUG INSPECTION / GAP

⚠ CAUTION

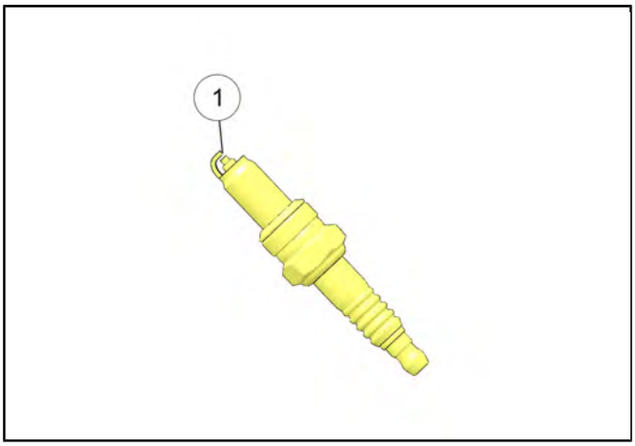
A hot engine can cause serious burns. Allow engine to cool or wear protective gloves when removing the spark plugs.

1. Remove spark plug(s). See **Spark Plug Removal page 3.8**.
2. Inspect electrodes for wear and carbon buildup. Look for a sharp outer edge with no rounding or erosion of the electrodes.
3. Clean with electrical contact cleaner or a glass bead spark plug cleaner only.

⚠ CAUTION

A wire brush or coated abrasive (sandpaper) should not be used to clean electrodes.

4. Measure electrode gap with a wire gauge ①. Adjust gap if necessary by carefully bending the grounding electrode until the specified gap is achieved.



Spark Plug Type: **NGK MR7F**

Spark Plug Gap: **0.030 in (0.80 mm)**

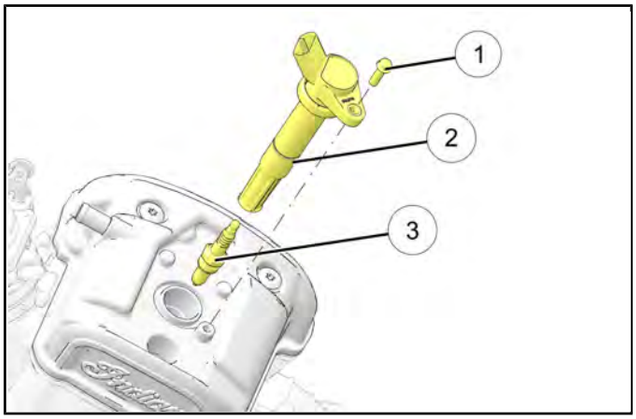
SPARK PLUG INSTALLATION

1. Inspect spark plug gap with a wire gauge. If gap adjustment is necessary, bend ground electrode carefully using a spark plug gap tool.

Spark Plug Type: **NGK MR7F**

Spark Plug Gap: **0.030 in (0.80 mm)**

2. Apply anti-seize compound sparingly to spark plug threads, avoiding the bottom 2 - 3 threads.
3. Torque spark plug ③ to specification.



TORQUE
Spark Plug: **106 in-lbs (12 N·m)**

⚠ CAUTION

Do not over tighten spark plugs. Damage to the cylinder head or spark plug may result.

4. Install ignition coil ② and fastener ①.

TORQUE
Ignition Coil Fastener: **88 in-lbs (10 N·m)**

5. Install air box assembly. See **Air Box Installation page 3.16**.
6. Install fuel tank assembly. See **Fuel Tank Installation page 4.30**.
7. Install seat assembly. See **Seat Removal / Installation page 7.19**.

ENGINE COMPRESSION TEST

1. Warm engine to operating temperature.
2. Shift transmission into neutral and stop engine.
3. Remove the seat. See **Seat Removal / Installation page 7.19**.
4. Remove the fuel tank. See **Fuel Tank Removal page 4.24**.
5. Remove the air box assembly. See **Air Box Removal page 3.14**.

6. Remove ignition coils. See **Ignition Coil Replacement page 10.42**.
7. Remove spark plug from cylinder to be tested. See **Spark Plug Removal page 3.8**.
8. Install compression tester in the spark plug hole following manufacturers instructions.
9. Crank engine until needle on compression gauge stops rising (about 5 seconds).
10. Repeat procedure for other cylinder.

Engine Compression Specifications	
Specification:	250–270 Psi (1724–1861 kPa)
Service Limit:	230 Psi (1586 kPa)

High engine compression may indicate:

- Carbon deposits in combustion chamber
- Engine modification
- Faulty Gauge

Low engine compression may indicate:

- Slow starter motor cranking speed
- Carbon or foreign material on valve seat
- Worn or damaged piston and/or piston rings
- Leaking exhaust or intake valves
- Leaking head gasket
- Valve timing incorrect
- Non-OEM camshafts or faulty gauge

If cylinder compression is below specification, perform a cylinder leakage test to determine where the leak is occurring. Follow the instructions provided with the leak-down tester.

ENGINE COMPRESSION TEST (WET)

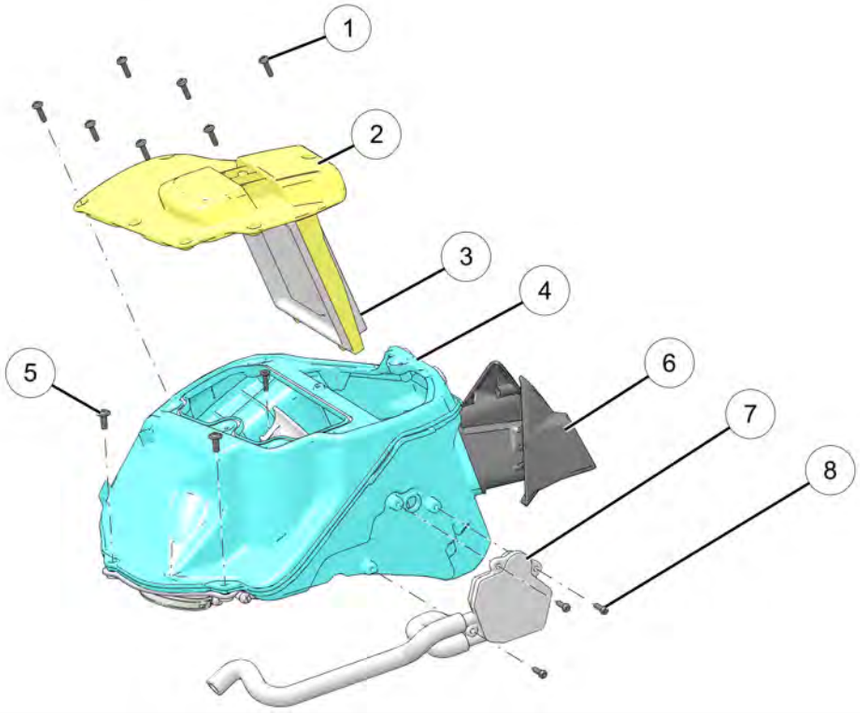
If a cylinder leakage tester is not available, perform a wet cylinder compression test.

1. Pour 3-5 cc of clean engine oil into each cylinder through spark plug hole. Repeat cylinder compression test. See **Engine Compression Test page 3.9**.
2. If compression increases substantially, inspect cylinder, piston, and rings.
3. If compression does not increase, inspect valves and valve seats.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

AIR CLEANER SERVICE

AIR BOX ASSEMBLY VIEW

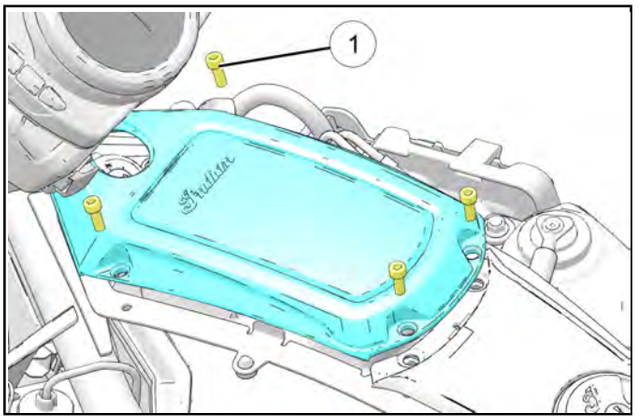


NUMBER	PART DESCRIPTION	TORQUE (IF APPLICABLE)
①	Air Filter Access Panel Fasteners	**14 in-lbs (2 N·m)**
②	Air Filter Access Panel	-
③	Air Filter	-
④	Air Box	-
⑤	Air box Adapter Fasteners	**36 in-lbs (4 N·m)**
⑥	Air Inlet	-
⑦	Oil Separator	
⑧	Oil Separator Fasteners	**14 in-lbs (2 N·m)**

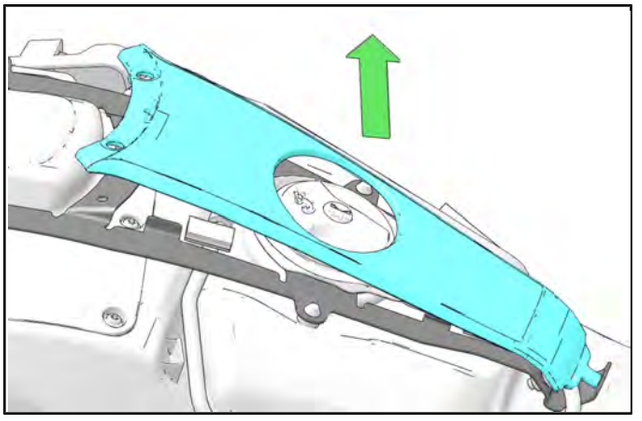
AIR FILTER REPLACEMENT

NOTICE
If the motorcycle is operated in wet or dusty conditions, more frequent servicing is required. The air filter element cannot be cleaned. Replace the filter when necessary.

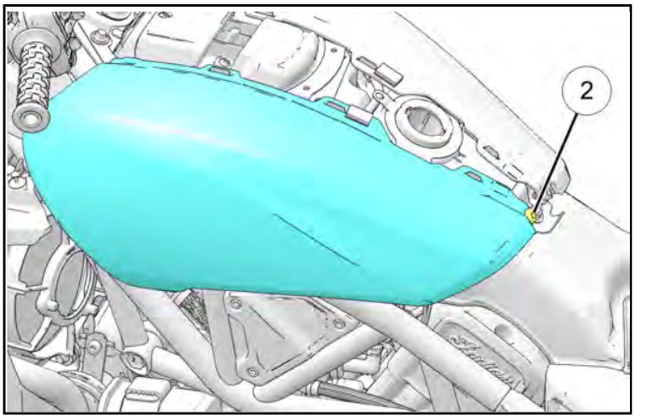
1. Remove the seat. See **Seat Removal / Installation page 7.19**.
2. Remove four fasteners ① securing air box bezel.



3. Remove the center console cover from the alignment bracket.

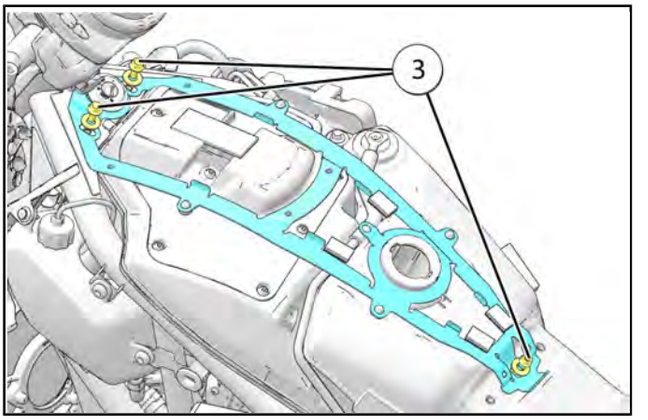


4. Remove the gas cap and relocate to clean, safe location.
5. Remove fastener securing the air box cover ②.

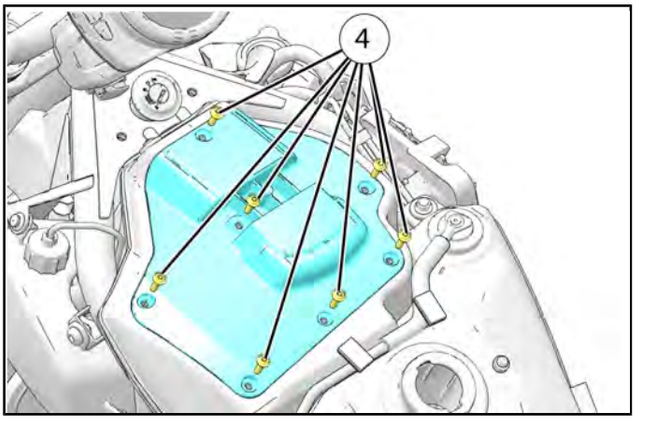


NOTICE
Pull air box cover up and out to remove.

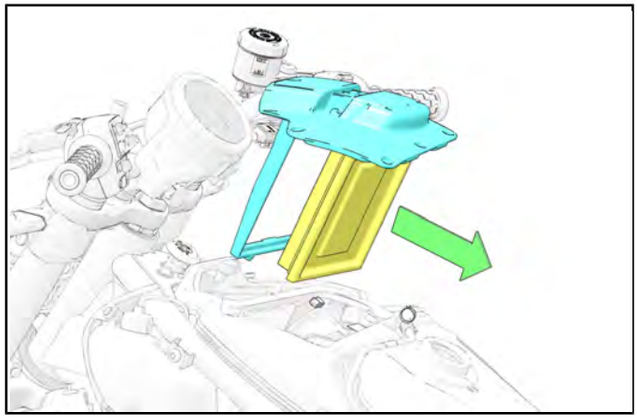
6. Remove three fasteners ③ to remove alignment bracket.



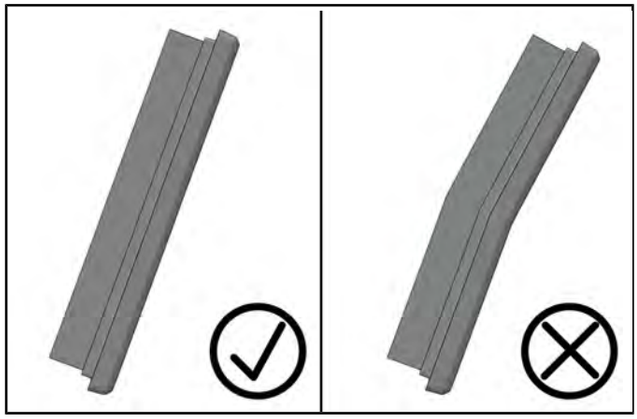
7. Remove seven fasteners ④ securing air filter access cover.



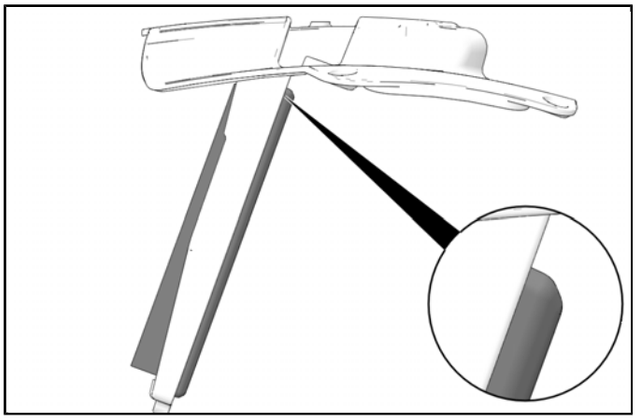
8. Remove the air filter from the airbox.



9. Inspect filter element and replace if dirty, wet, or oil fouled.
10. Install *New* filter with same orientation as old filter.
    - Make sure air filter is not bent prior to installation.



- Make sure air filter is fully seated in air filter cover during installation.



11. Install air filter access cover and secure with seven fasteners.

TORQUE
Air Filter Access Cover Fastener: **14 in-lbs (2 N·m)**

12. Install the alignment bracket and secure with fasteners.

TORQUE
Bodywork Alignment Bracket Fastener: **36 in-lbs (4 N·m)**

13. Install airbox cover.

TORQUE
Airbox Cover Fastener: **36 in-lbs (4 N·m)**

14. Install gas cap.
15. Install center console cover.
16. Install airbox bezel and secure with fasteners.

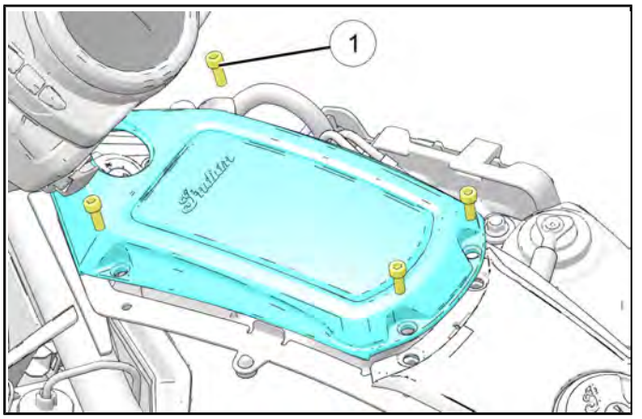
TORQUE
Airbox Bezel Fastener: **36 in-lbs (4 N·m)**

17. Reinstall seat. See **Seat Removal / Installation page 7.19**

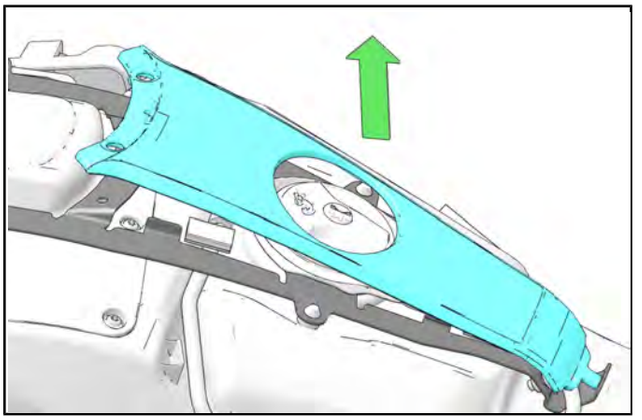
⚠ CAUTION
A loose fitting cover or improperly installed filter element may allow debris to enter the engine which may cause premature engine wear.

AIR BOX REMOVAL

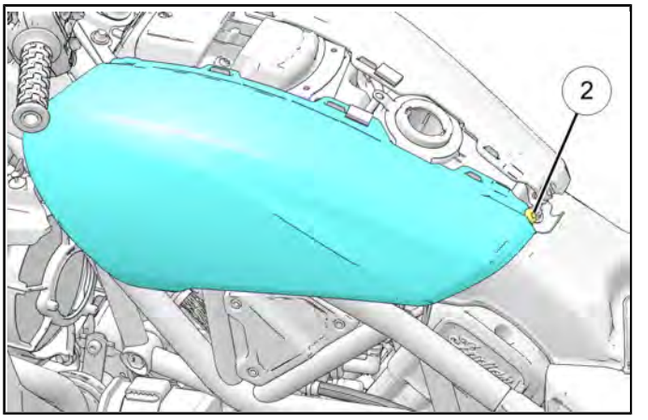
1. Remove the seat. See **Seat Removal / Installation page 7.19**.
2. Disconnect the battery. See **Battery Disconnect page 10.12**
3. Remove four fasteners ① securing air box bezel.



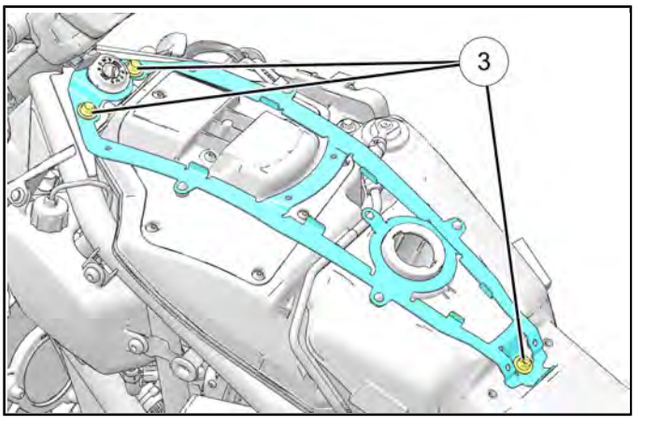
4. Remove the center console cover from the alignment bracket.



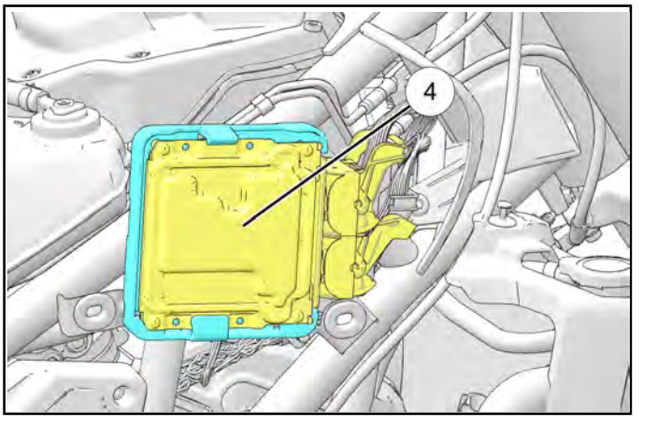
5. Remove the gas cap and relocate to safe location away.
6. Remove fastener securing the air box cover ②.



7. Remove three fasteners ③ to remove alignment bracket.

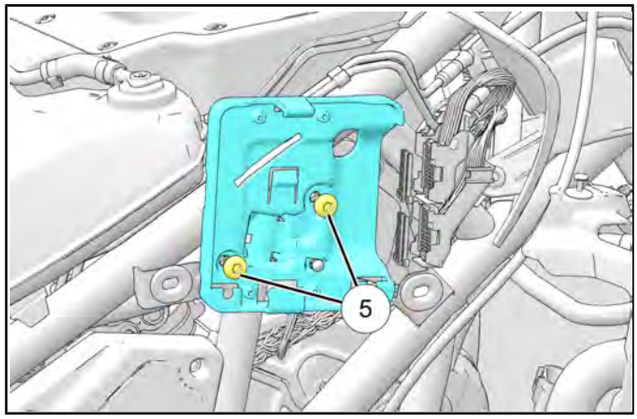


8. Remove and disconnect the ECM ④ by unclipping it from its mount.

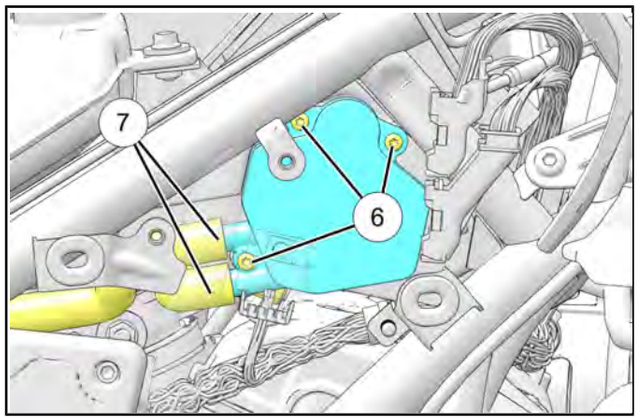


9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

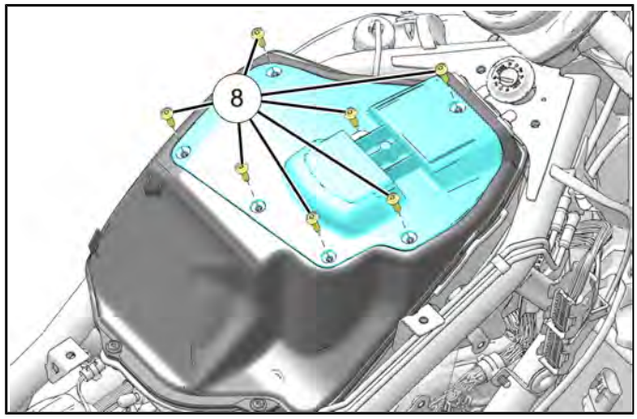
9. Remove two fasteners ⑤ securing ECM mount.



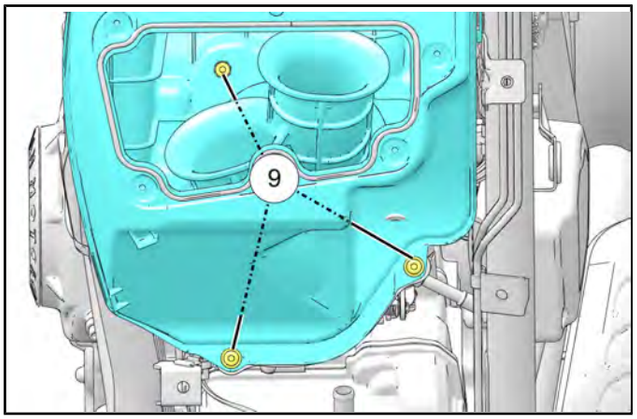
10. Remove three fasteners ⑥ securing oil separator to air box



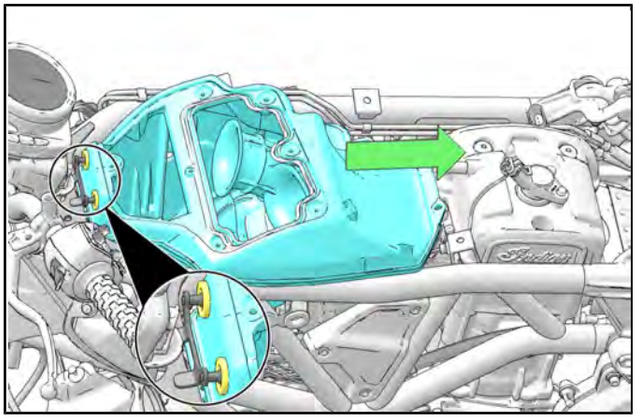
11. Disconnect two hoses ⑦ from oil separator.
12. Remove oil separator from air box.
13. Remove fuel tank. Reference **Fuel Tank Removal page 4.24**
14. Remove seven fasteners ⑧ securing Air filter access panel.



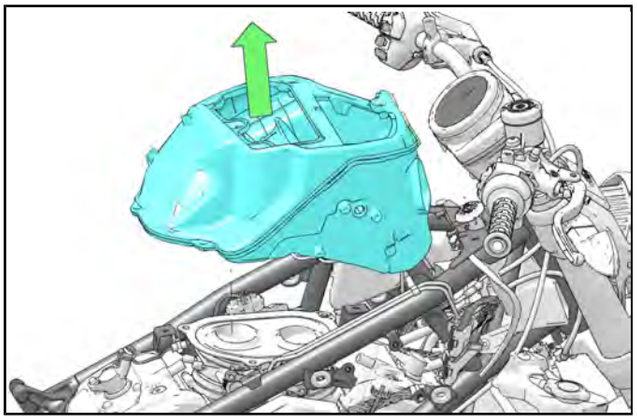
15. Remove air filter access panel and air filter.
16. Remove three fasteners ⑨ securing air box to the air box adapter.



17. Move the air box towards the rear of the unit to disengage the retaining features.



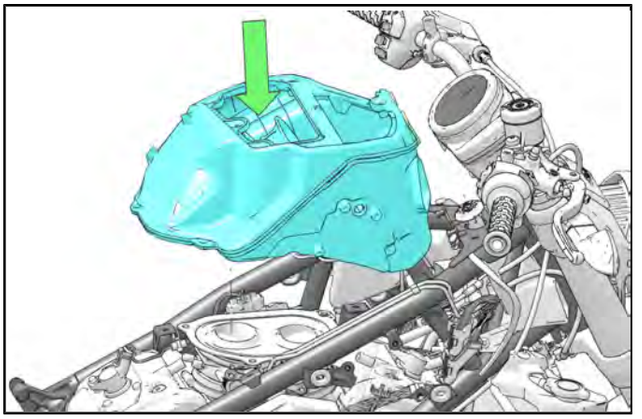
18. Lift the air box out from the unit.



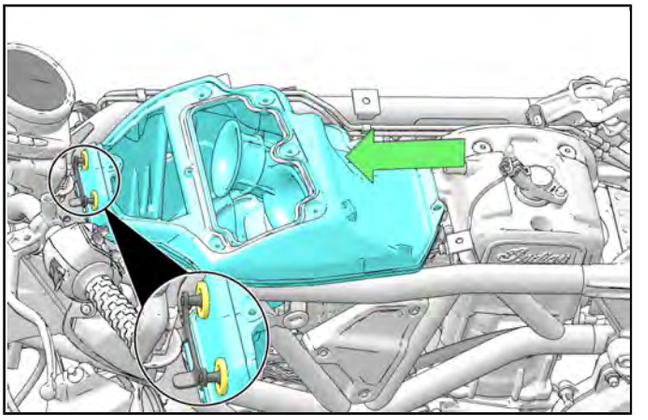
AIR BOX INSTALLATION

NOTICE
The fuel tank must be removed prior to air box installation.

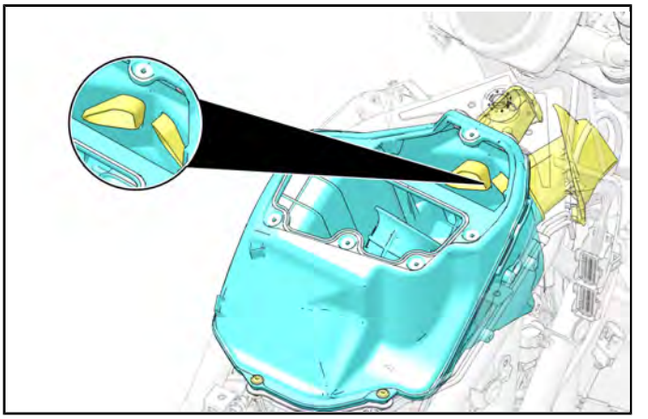
1. Install air box into frame.



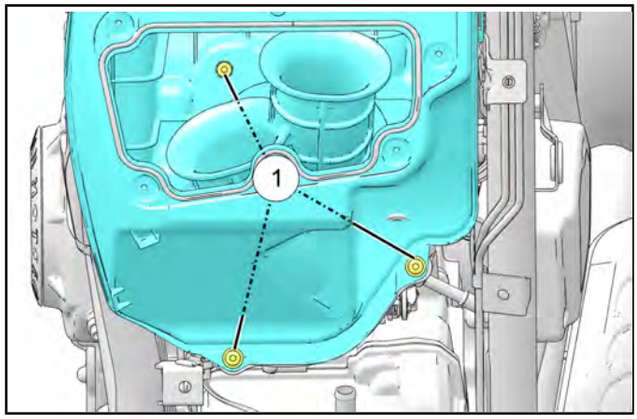
2. Move the air box forward to engage the retaining features.



IMPORTANT
When installing air box, ensure that the air inlets are secured to the air box.

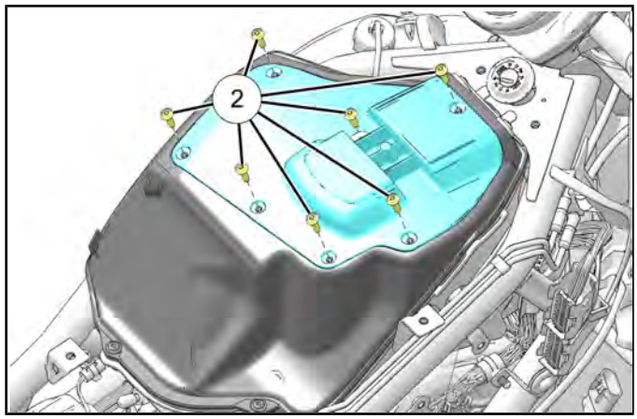


3. Install three fasteners ① securing air box to the air box adapter.



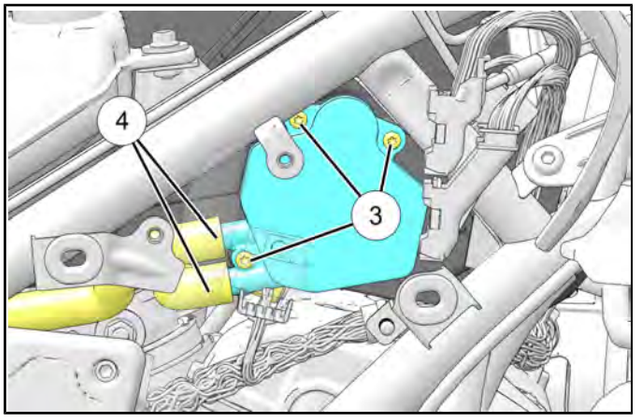
TORQUE
Air Box Adapter Fasteners: **36 in-lbs (4 N·m)**

4. Install air filter and air filter access panel.
5. Install seven fasteners ② securing air filter access panel



TORQUE
Air Filter Access Panel Fasteners: **14 in-lbs (2 N·m)**

6. Install oil separator and secure with three fasteners ③.

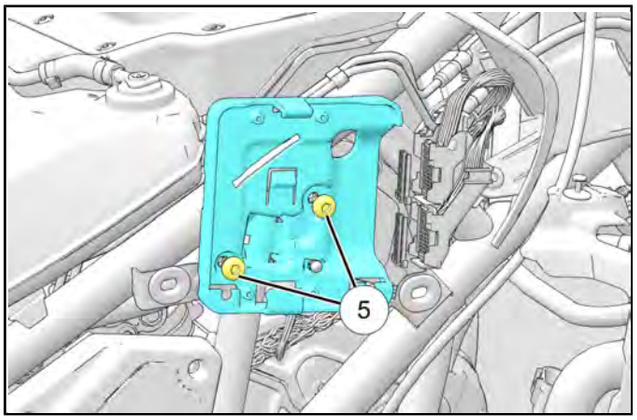


TORQUE
Oil Separator Fasteners: **14 in-lbs (2 N·m)**

7. Connect oil separator hoses ④

IMPORTANT
The longer hose goes on top and the shorter hose goes on bottom.

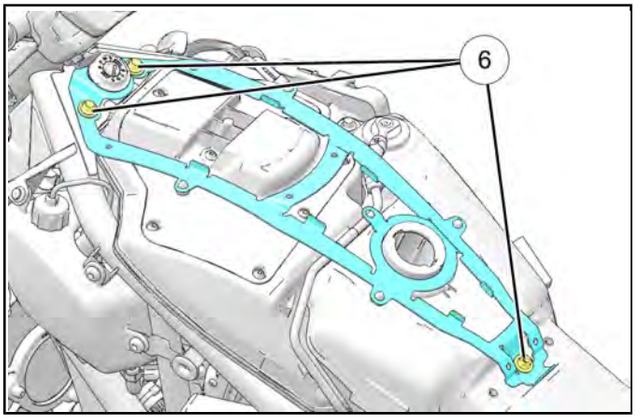
8. Install ECM mount and secure with two fasteners ⑤.



TORQUE
ECM Mount Fasteners: **36 in-lbs (4 N·m)**

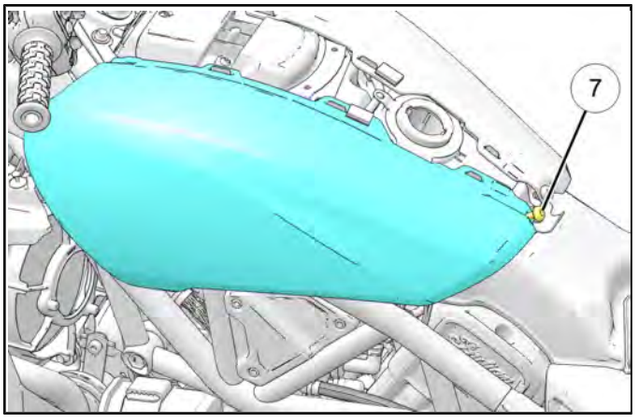
9. Install the ECM and reconnect electrical connections.
10. Install fuel tank. See **Fuel Tank Installation page 4.30**.

11. Install alignment bracket and secure with three fasteners ⑥.



TORQUE
Bodywork Alignment Bracket Fasteners: **36 in-lbs (4 N·m)**

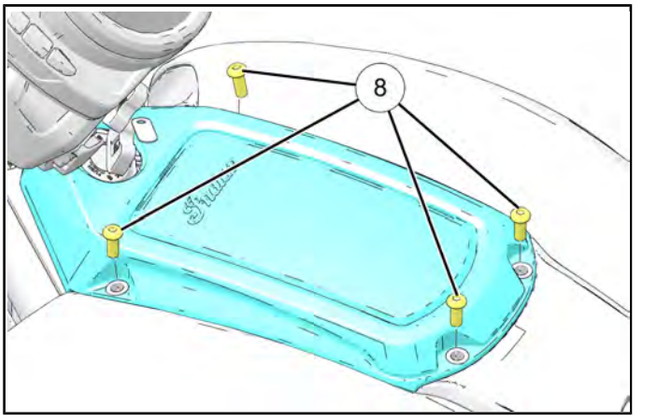
12. Install air box cover and secure with fastener ⑦.



TORQUE
Air Box Cover Fastener: **36 in-lbs (4 N·m)**

13. Install center council onto alignment bracket.

14. Install four fasteners ⑧ securing air box bezel.



TORQUE
Air Box Bezel Fastener **36 in-lbs (4 N·m)**

15. Reconnect battery connections and install battery cover.

TORQUE
Battery Terminal Fastener: **25 in-lbs (3 N·m)**

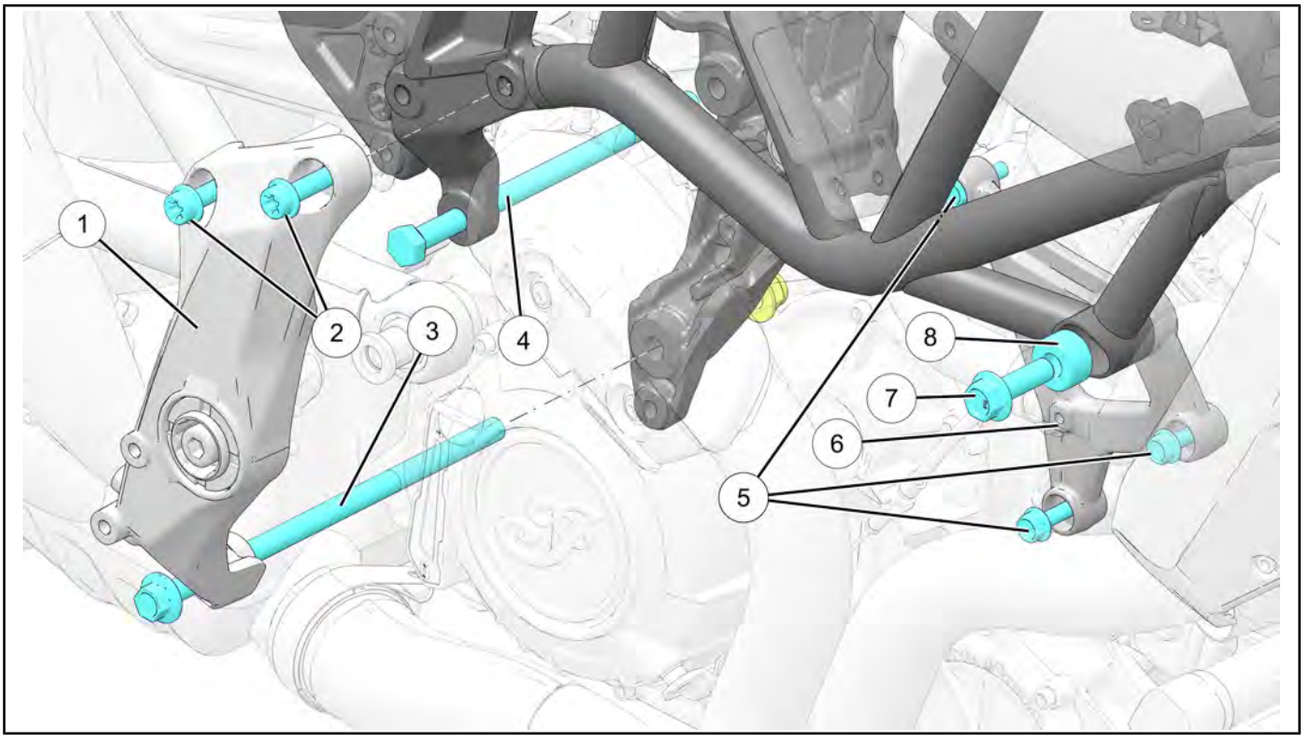
TORQUE
Battery Cover Fastener: **36 in-lbs (4 N·m)**

16. Install seat. See **Seat Removal / Installation page 7.19**.

ENGINE REMOVAL / INSTALL

ASSEMBLY VIEWS

ENGINE BRACKET / FASTENER COMPONENTS



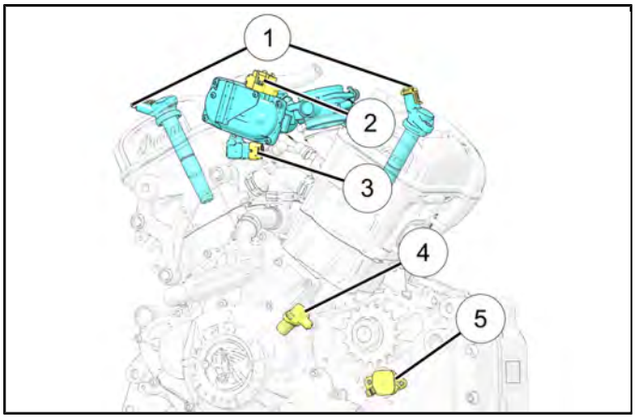
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Mid Frame Right Side	-
②	Mid Frame Fastener	**47 ft-lbs (64 N·m)**
③	Engine Mount Fastener (Rear Lower)	**51 ft-lbs (69 N·m)**
④	Engine Mount Fastener (Rear Upper)	**51 ft-lbs (69 N·m)**
⑤	Headmount Bracket To Cylinder Head Fastener	**26 ft-lbs (35 N·m)**
⑥	Headmount Bracket	-
⑦	Headmount To Main Frame Fastener	**74 ft-lbs (100 N·m)**
⑧	Headmount Spacer	-

ENGINE REMOVAL

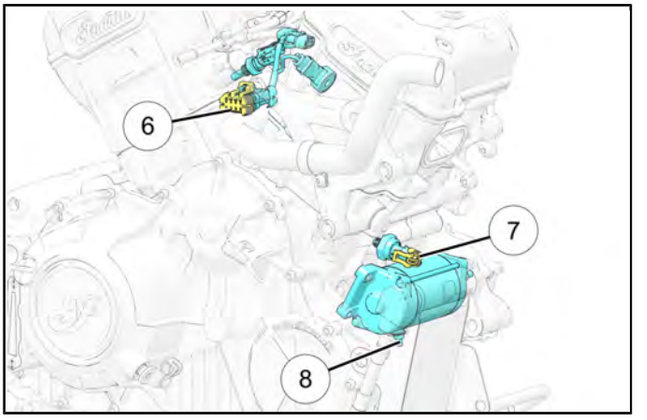
PREPARATION FOR ENGINE REMOVAL

NOTICE
Different methods can be used to remove the engine depending on the equipment available to the technician. All methods require the front wheel to be held securely in an upright position.

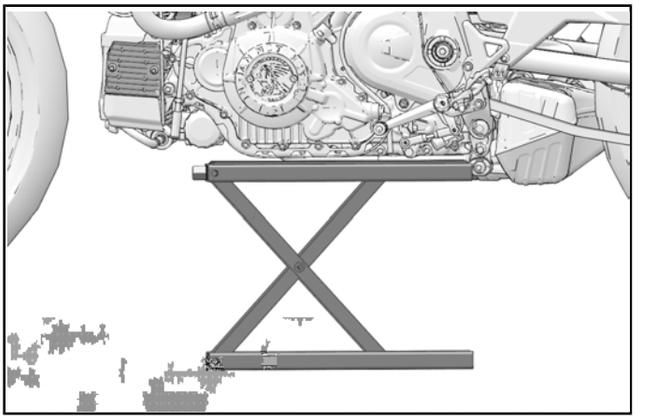
1. Support motorcycle securely in an upright position. Clamp front tire securely in a wheel vise.
2. Remove seat. See **Seat Removal / Installation page 7.19**.
3. Remove air box. See **Air Box Removal page 3.14**.
4. Remove the chin fairing (if applicable). See **Chin Fairing Replacement page 7.38**
5. Remove radiator. See **Radiator Removal / Installation page 3.57**.
6. Remove muffler. See **Muffler Removal / Installation page 3.126**.
7. Remove resonator. See **Resonator Removal / Installation page 3.127**.
8. Disconnect ignition coil connectors ①.



9. Disconnect throttle body connector ②.
10. Disconnect TMAP sensor connector ③.
11. Disconnect Crankshaft position sensor connector ④.
12. Disconnect gear position sensor connector ⑤.
13. Remove throttle body. See **Throttle Body Assembly Removal / Installation page 4.18**.
14. Disconnect jumper harness connector ⑥.



15. Disconnect oil pressure sensor connector ⑦.
16. Disconnect power cable going to starter motor ⑧.
17. Support the bottom of the engine with a scissor jack.



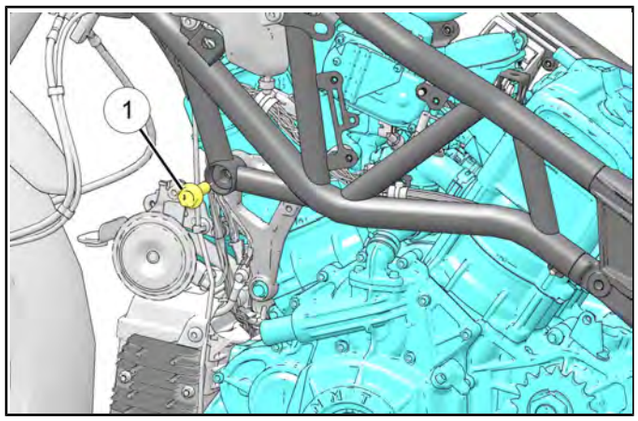
18. Remove battery tray to access electrical connections. See **Battery Tray Removal / Installation page 10.14**
19. Remove swingarm. See **Swingarm Removal page 8.94**.
20. Remove ABS module but do not disconnect brake lines. Reference **ABS Module Replacement page 9.37**.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

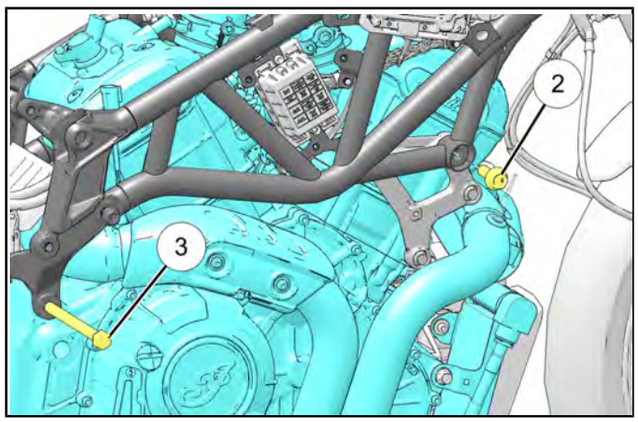
ENGINE TO FRAME, REMOVAL / INSTALLATION

REMOVAL

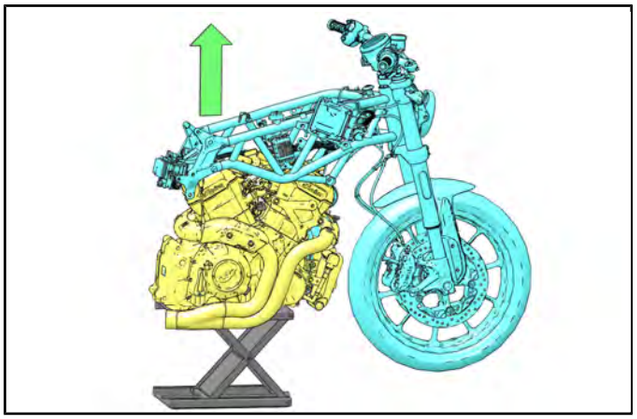
1. Perform the preliminary engine removal steps outlined in this chapter. See **Preparation For Engine Removal page 3.20**.
2. On the left side of the unit, remove headmount bracket fastener ①.



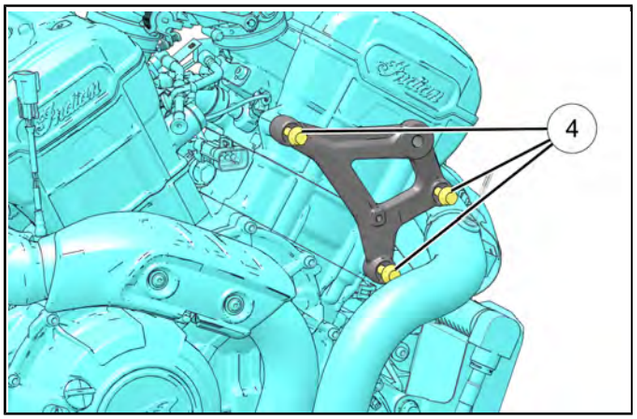
3. Remove electrical grounds from left side of engine.
4. On the right side of the unit, remove headmount bracket fastener ② and mid frame through bolt ③.



5. Remove hose from coolant overflow.
6. With the help of an assistant, lift the rear of the frame upward and remove the engine. Set the frame down on a jackstand or similar.



7. Remove headmount bracket from engine by removing its fasteners ④.



INSTALLATION

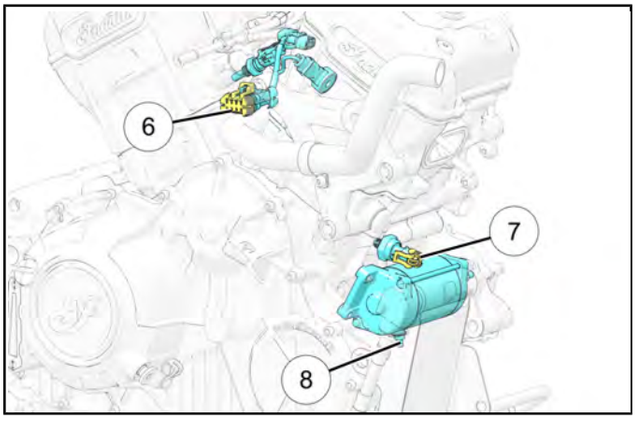
1. **Installation is performed by reversing the removal procedure.**

TORQUE
Headmount Bracket To Cylinder Head Fastener: **26 ft-lbs (35 N·m)**

TORQUE
Mid Frame Through Bolt: **51 ft-lbs (69 N·m)**

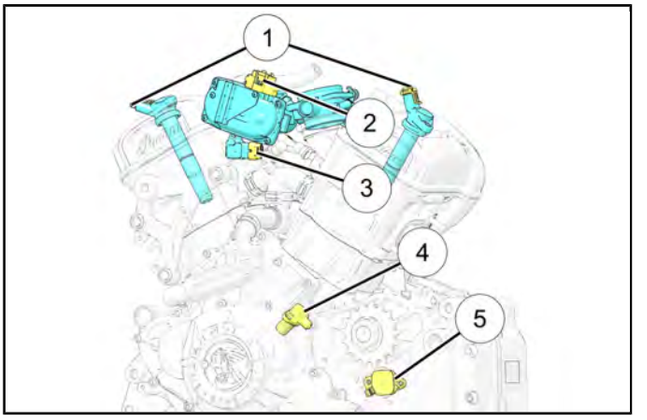
TORQUE
Headmount To Main Frame Fastener: **74 ft-lbs (100 N·m)**

2. Install swingarm. See **Swingarm Installation page 8.97**
3. Connect power cable to starter motor ⑧.



TORQUE
Battery Cable To Starter Motor Nut: **60 in-lbs (7 N·m)**

4. Connect oil pressure sensor connector ⑦.
5. Connect jumper harness connector ⑥.
6. Connect gear position sensor ⑤.



7. Connector crankshaft position sensor connector ④.
8. Connect TMAP sensor connector ③.
9. Connect throttle body connector ②.
10. Connect ignition coil connectors ①.
11. Install Resonator. See **Resonator Removal / Installation page 3.127.**
12. Install Muffler. See **Muffler Removal / Installation page 3.126**
13. Install Radiator. See **Radiator Removal / Installation page 3.57.**
14. Install Air box. See **Air Box Installation page 3.16**
15. Install Seat. See **Seat Removal / Installation page 7.19.**

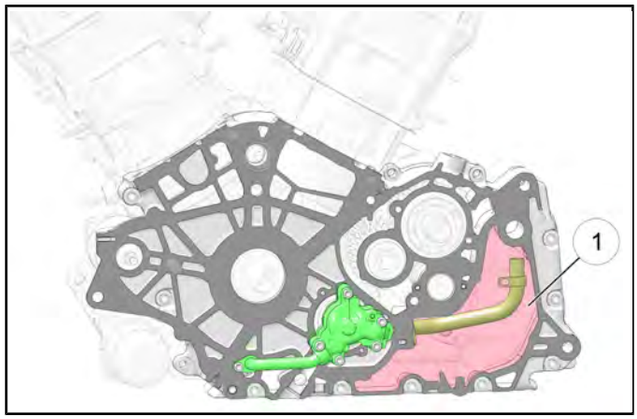
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

LUBRICATION / COOLING

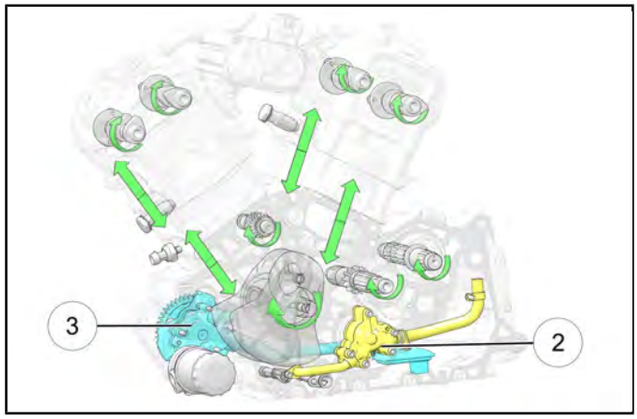
GENERAL INFORMATION

SERVICE NOTES - LUBRICATION SYSTEM

The FTR 1200 uses a semi-dry sump lubrication system. The engine oil is housed in a separate chamber within the engine cases ① as shown in the image below.



The engine has two separate oil pumps, a scavenge pump ② and pressure (lubrication) pump ③. The scavenge pump has two sets of internal gerotors. One set scavenges oil from the right side of the engine crankcase and the second set from the left side. The scavenge pump supplies oil to fill the oil tank area ① of the engine. The oiling system pressure relief valve is located inside the pressure oil pump.



To access the scavenge oil pump, the stator cover must be removed. To access the pressure pump, remove the right engine cover. Before disassembly, review the troubleshooting charts located in this chapter.

If the engine is making irregular noises that appear to be coming from rotating parts, check the lubrication side oil pressure. Check the oil pressure before engine disassembly, and recheck the oil pressure after a repair.

TROUBLESHOOTING - LUBRICATION SYSTEM

LOW OIL PRESSURE	HIGH OIL PRESSURE
Incorrect oil being used or low oil level	Incorrect oil being used
Engine temp above test temperature range	Additives added to oil to increase viscosity
Damaged O-rings or leaks at pipes or fittings	Engine temp below test temperature range
Damaged or worn oil pump or oil pump drive	Restricted oil passages
Pressure relief valve stuck open	Incorrect oil filter
Damaged engine bearings/excessive engine wear.	Pressure relief valve stuck closed
Restricted oil filter, oil filter screen or passages	

SERVICE SPECIFICATIONS – LUBRICATION SYSTEM

ITEM	STANDARD	SERVICE LIMIT
Engine Oil Fill Capacity (for DRY rebuilt engine)	4.5 qts. (4.25 L) Dry Engine	Not Applicable
Engine Oil Capacity (for Change with Filter) Follow the oil change procedure outlined in the Maintenance Chapter.	3.5 - 4.0 U.S. qts (3.3 – 3.8 Liters)	Not Applicable
Oil Pressure @ 3000 rpm (supply side) **Measurements must be taken with engine at operating temperature and specified Indian Motorcycle Engine Oil**	40 psi (275 kPa) Readings should be within 20% of the specification.	MINIMUM PRESSURE: 32 psi (220 kPa)

OIL PUMP CLEARANCES (SCAVENGE)		
Pump Gerotor OD to Oil Pump Body	.003"-.007" (0.100 mm - 0.200 mm)	.011" (.300 mm)
Oil Pump End Clearance	.0019"-.003" (.050 mm - 0.100 mm)	.007" (.200 mm)
Gerotor Tip Clearance	.0031"-.007" (.080 mm -.200 mm)	.0098" (.250 mm)
OIL PUMP CLEARANCES (FEED)		
Pump Gerotor OD to Oil Pump Body	.003"-.007" (0.100 mm - 0.200 mm)	.011" (.300 mm)
Oil Pump End Clearance	.0019"-.003" (.050 mm - 0.100 mm)	.007" (.200 mm)
Gerotor Tip Clearance	.0031"-.0059" (.080 mm - .150 mm)	.007" (.200 mm

COOLING SYSTEM SPECIFICATIONS		
ITEM	**DESCRIPTION**	**SPECIFICATION / CAPACITY**
Capacity Engine Coolant / Antifreeze	Extended Life Anti-Freeze 50/ 50 Premixed (Yellow)	System 2.2 Qts (2.064 Ltrs) / Recovery Bottle .152 Qt (.144 Ltrs)
Thermostat	Opening Temperature	180 Degrees F (82 Degrees C)
Cooling System Pressure Cap	Relief Pressure	16 PSI
COOLING FAN OPERATION		
CONDITION	**APPROXIMATE RESISTANCE OHMS Ω**	**TEMPERATURE**
Engine Protection Misfire	120Ω	240.8 Degrees F (116 Degrees C)
Coolant Hot Lamp (On Solid)	140Ω	231.8 Degrees F (111 Degrees C)
Cooling Fan On	209Ω	204.8 Degrees F (96 Degrees C)

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

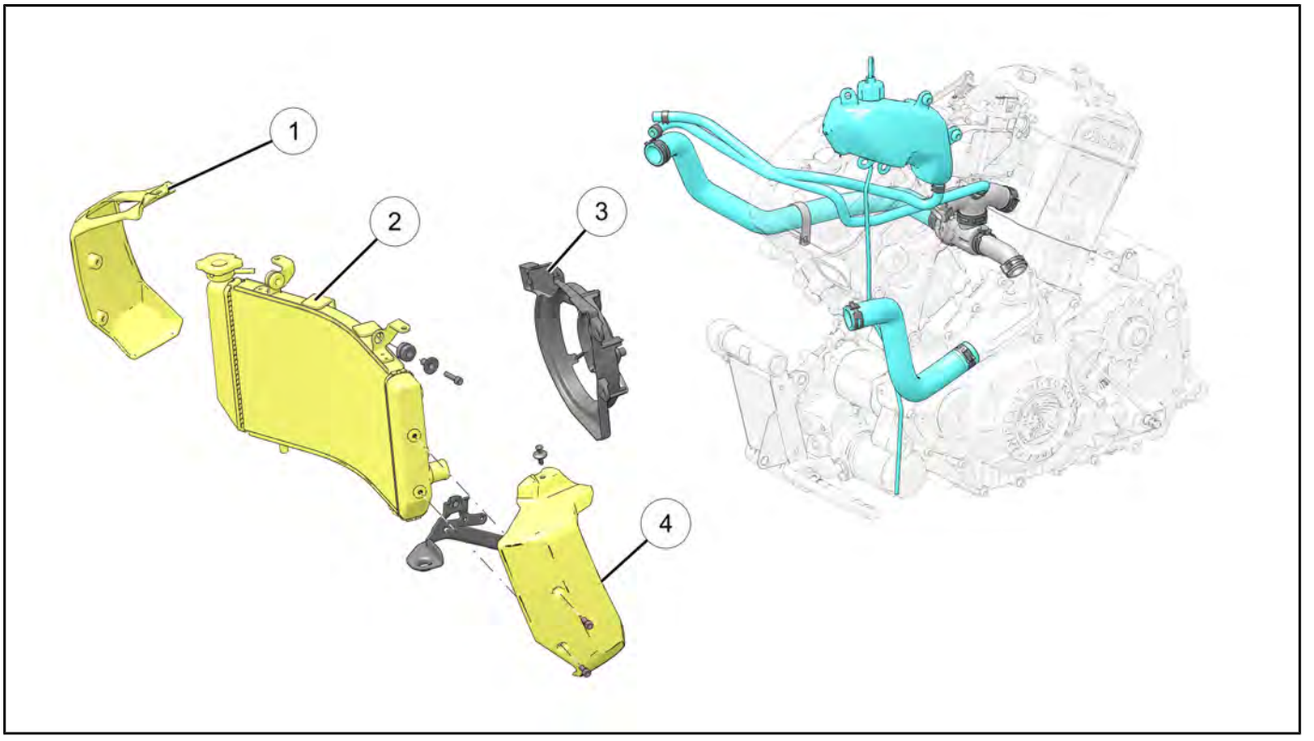
COOLING SYSTEM SPECIFICATIONS		
Cooling Fan Off	215Ω	203 Degrees F (95 Degrees C)
Room Temperature	2500Ω	68 Degrees F (20 Degrees C)

ASSEMBLY VIEWS

RADIATOR INSPECTION / CLEANING

⚠ CAUTION

Washing the vehicle with a high-pressure washer could damage the radiator fins and impair the radiators effectiveness. Use of a high-pressure washer is not recommended.

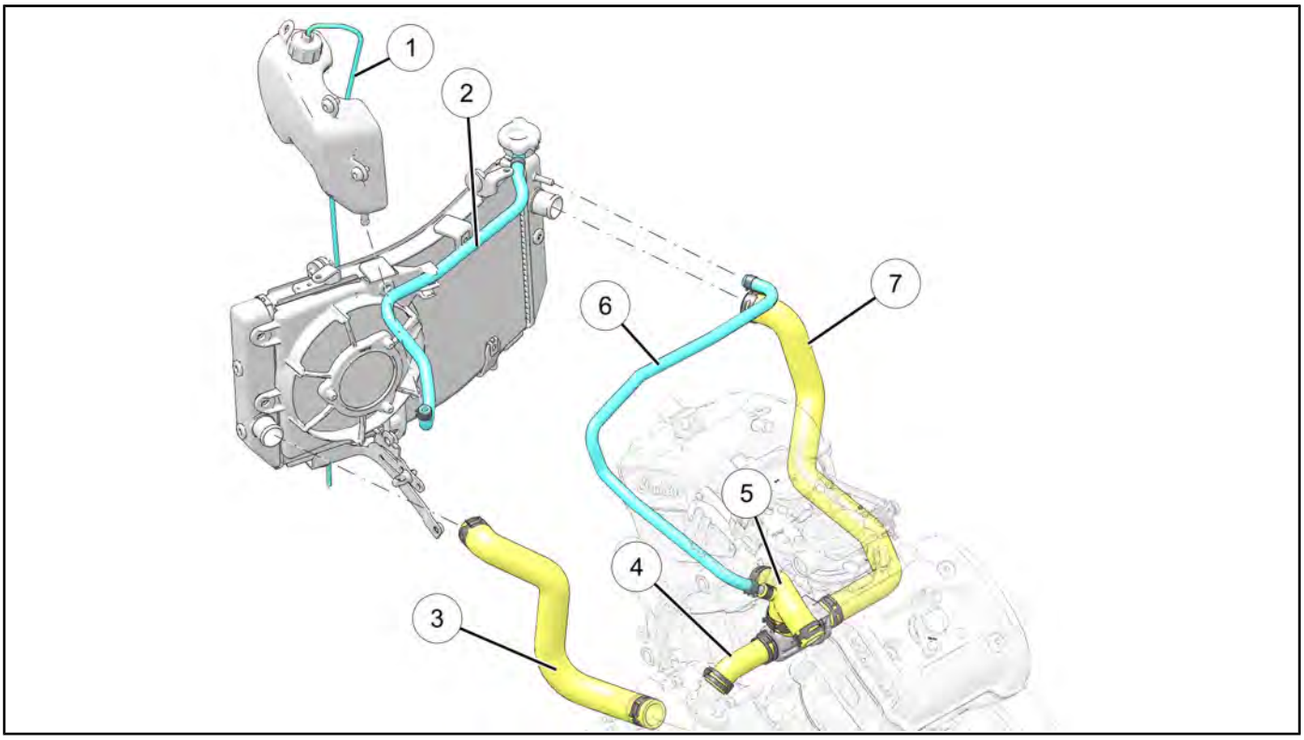


NUMBER	DESCRIPTION
①	Radiator Wing (Right)
②	Radiator Core
③	Radiator Fan Assembly
④	Radiator Wing (Left)

Radiator Inspection and Cleaning

1. Check radiator air passages for restrictions or damage.
2. Carefully straighten any bent radiator fins.
3. Remove any obstructions with low pressure compressed air or low pressure water.

COOLING SYSTEM HOSES



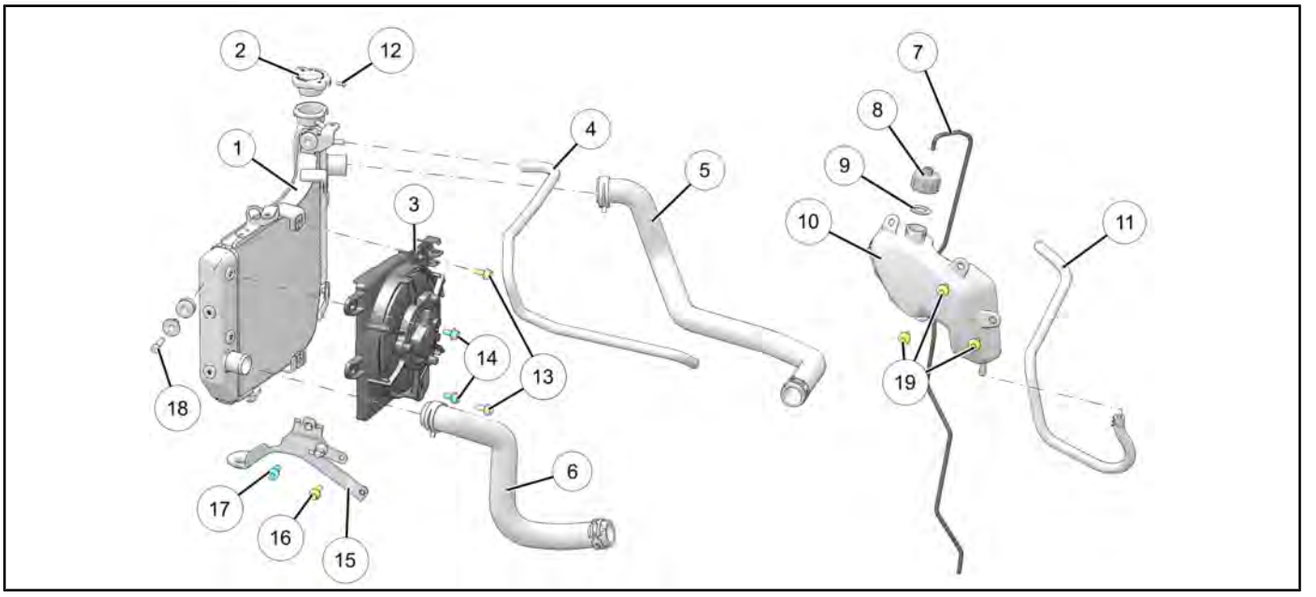
NUMBER	DESCRIPTION
①	Recovery Bottle Drain Hose
②	Head Outlet Hose
③	Radiator Outlet Hose
④	Bypass Hose
⑤	Coolant Junction
⑥	Coolant Bleed Hose (2023 routing is different than shown)
⑦	Radiator Inlet Hose

Cooling System Hoses Inspection

1. Inspect all vehicle coolant hoses for cracks, deterioration, abrasion or leaks. Replace if necessary.
2. Check tightness and condition of all hose spring clamps. Replace if necessary.

COOLING SYSTEM ASSEMBLY VIEW

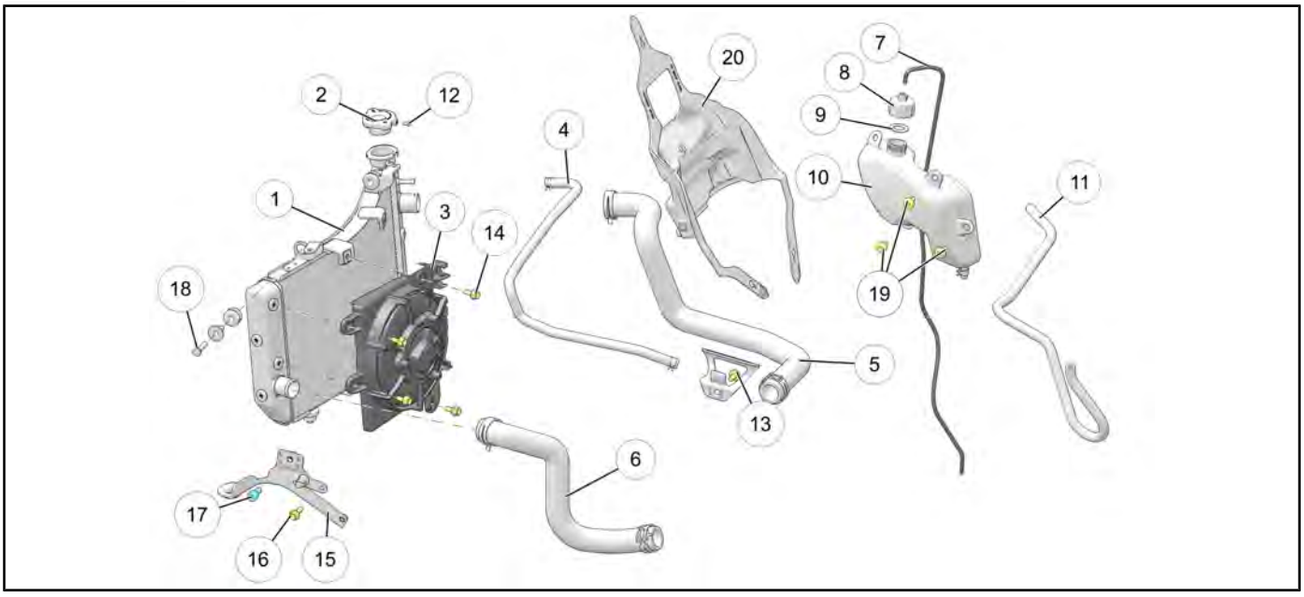
2019–2020 MODELS



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Radiator	-
②	Radiator Cap	-
③	Cooling Fan Assembly	-
④	Coolant Bleed Hose	-
⑤	Upper Radiator Hose	-
⑥	Lower Radiator Hose	-
⑦	Overflow Vent Hose	-
⑧	Overflow Cap	-
⑨	Overflow Cap Gasket	-
⑩	Coolant Recovery Bottle	-
⑪	Recovery Bottle Line	-
⑫	Radiator Cap Set Screw	**12 in-lbs (1 N·m)**
⑬	Cooling Fan Fastener (M6 1.0x14)	**36 in-lbs (4 N·m)**
⑭	Cooling Fan Fastener (M6 1.0x16)	**36 in-lbs (4 N·m)**
⑮	Radiator Bracket	-
⑯	Radiator Bracket Fastener (M6)	**96 in-lbs (11 N·m)**
⑰	Radiator Bracket Fastener (M8)	**96 in-lbs (11 N·m)**
⑱	Radiator Isolator Fasteners	**96 in-lbs (11 N·m)**
⑲	Coolant Recovery Bottle Fasteners	**36 in-lbs (4 N·m)**

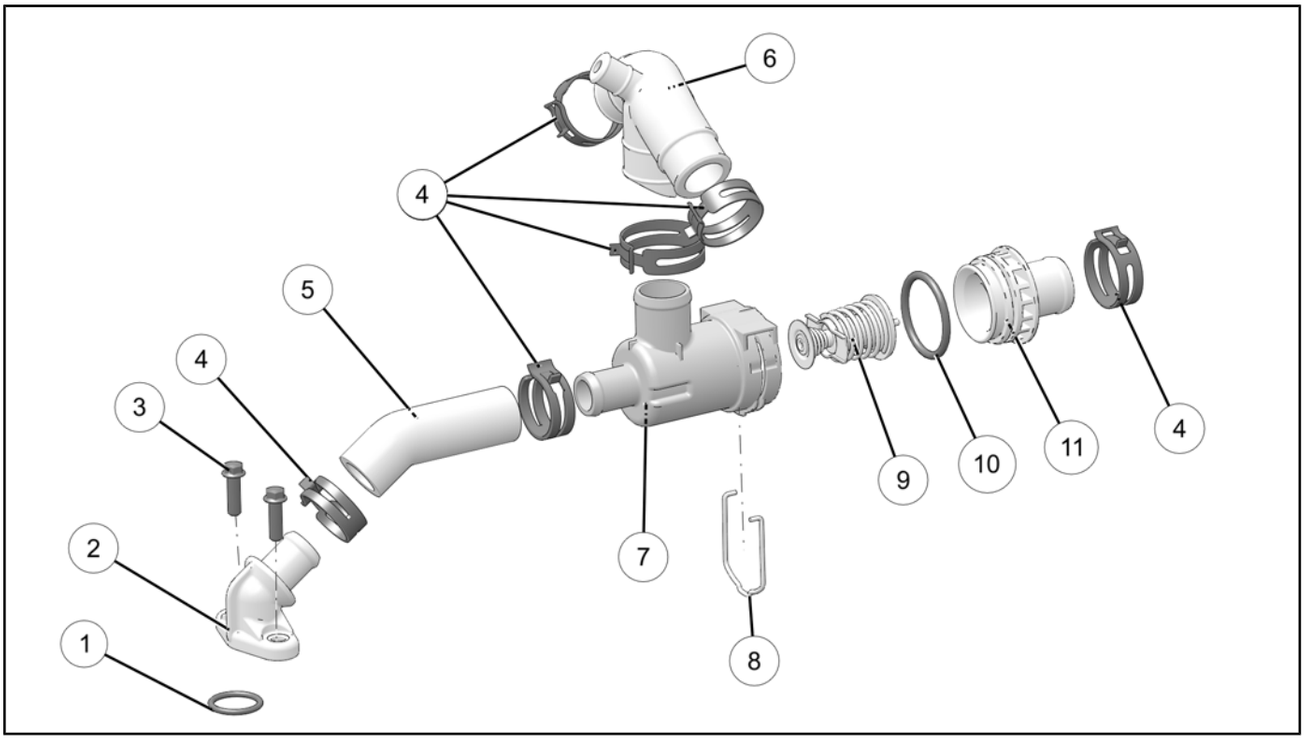
COOLING SYSTEM ASSEMBLY VIEW

2022+ MODELS



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Radiator	-
②	Radiator Cap	-
③	Cooling Fan Assembly	-
④	Coolant Bleed Hose	-
⑤	Upper Radiator Hose	-
⑥	Lower Radiator Hose	-
⑦	Overflow Vent Hose	-
⑧	Overflow Cap	-
⑨	Overflow Cap Gasket	-
⑩	Coolant Recovery Bottle	-
⑪	Recovery Bottle Line	-
⑫	Radiator Cap Set Screw	**12 in-lbs (1 N·m)**
⑬	Coolant Line Clip Fastener	**88 in-lbs (10)**
⑭	Cooling Fan Fastener	**36 in-lbs (4 N·m)**
⑮	Radiator Bracket	-
⑯	Radiator Bracket Fastener (M6)	**96 in-lbs (11 N·m)**
⑰	Radiator Bracket Fastener (M8)	**96 in-lbs (11 N·m)**
⑱	Radiator Isolator Fasteners	**96 in-lbs (11 N·m)**
⑲	Coolant Recovery Bottle Fasteners	**36 in-lbs (4 N·m)**
⑳	Heat Deflector	-

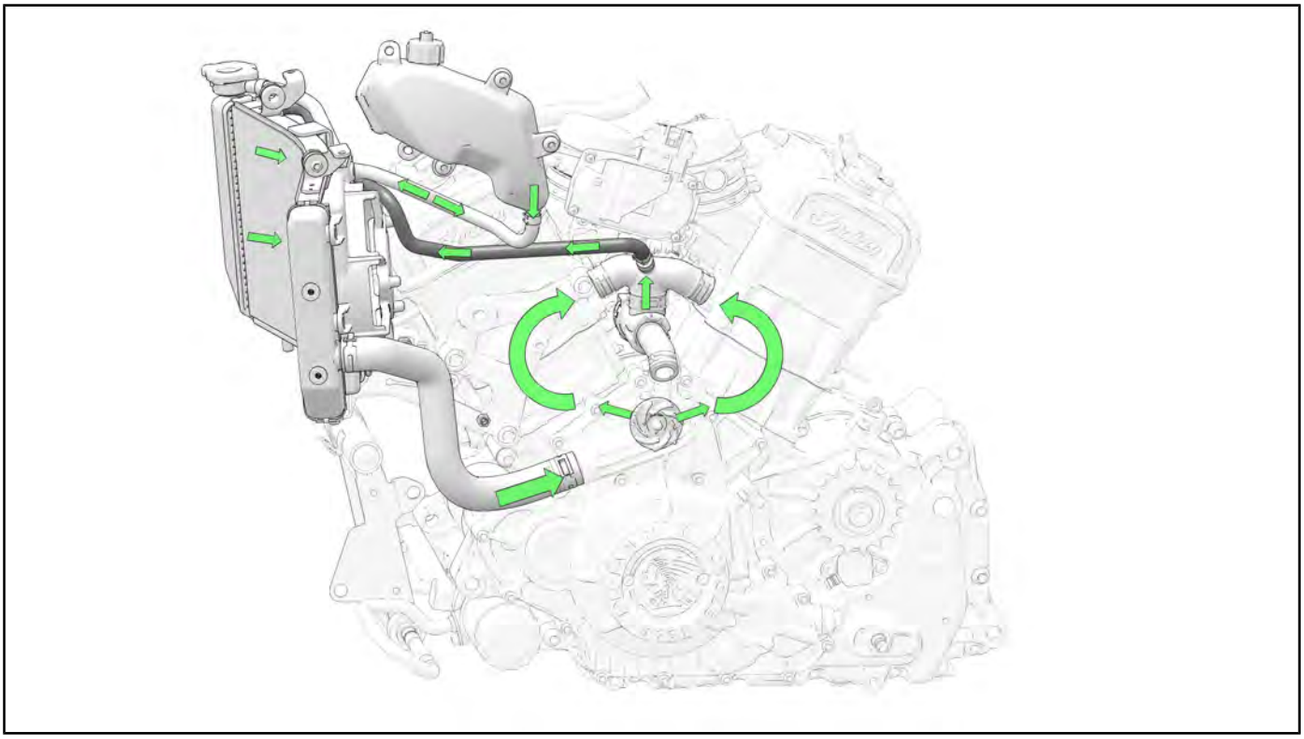
THERMOSTAT ASSEMBLY VIEW



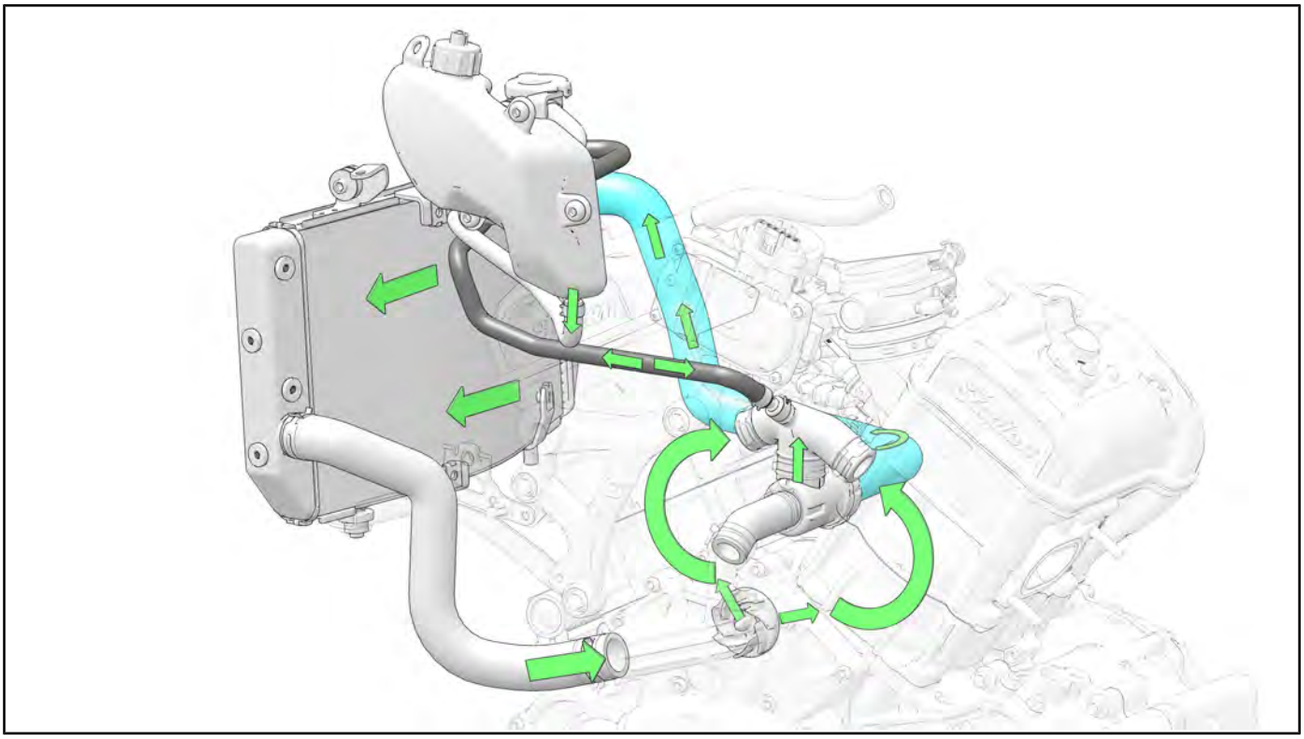
NUMBER	PART DESCRIPTION	TORQUE / NOTE
①	Coolant Bypass O-Ring	-
②	Coolant Bypass Fitting	-
③	Coolant Bypass Fitting Fasteners	**88 in-lbs (10 N·m)**
④	Springband Clamp	-
⑤	Coolant Bypass Hose	-
⑥	Coolant Junction	Single use item that must be replaced if removed from unit.
⑦	Thermostat Housing	-
⑧	Retainer	-
⑨	Thermostat	-
⑩	Thermostat O-Ring	-
⑪	Thermostat Port	-

COOLANT FLOW DIAGRAM

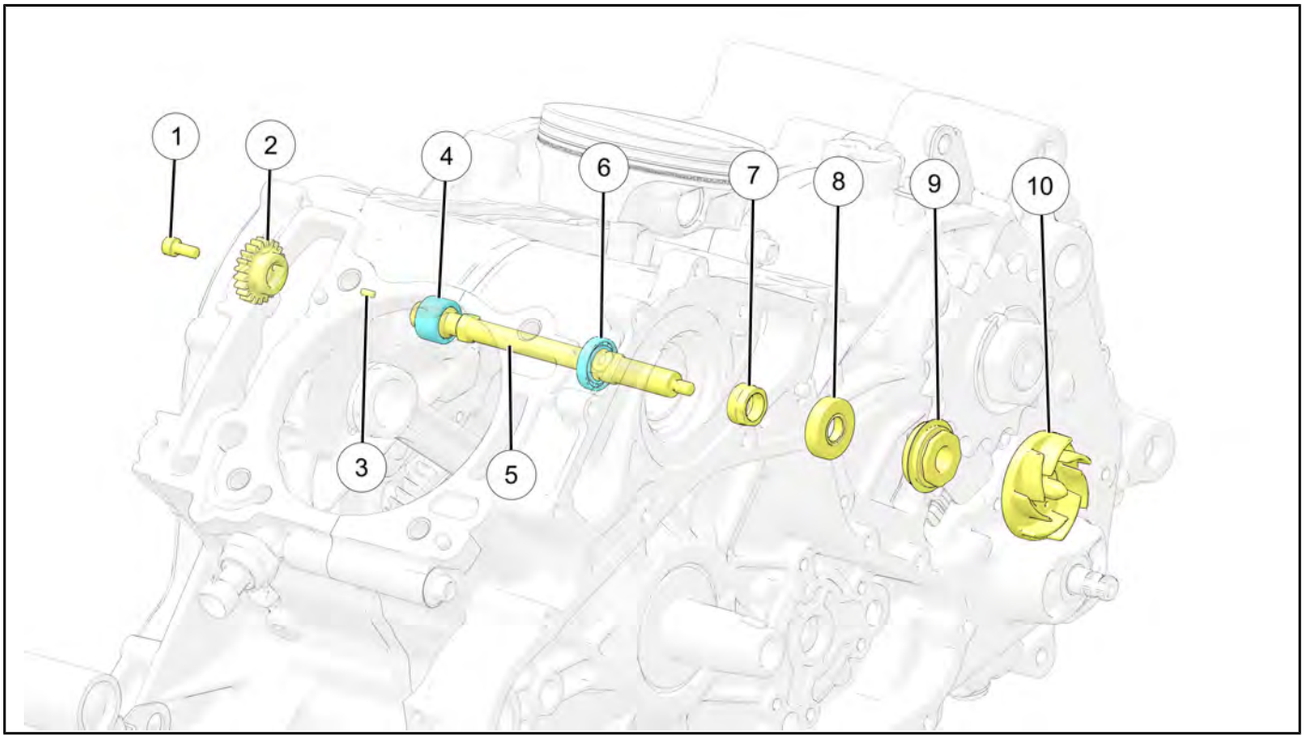
Cooling System Flow
Thermostat Closed (Bypass)



Cooling System Flow
Thermostat Open



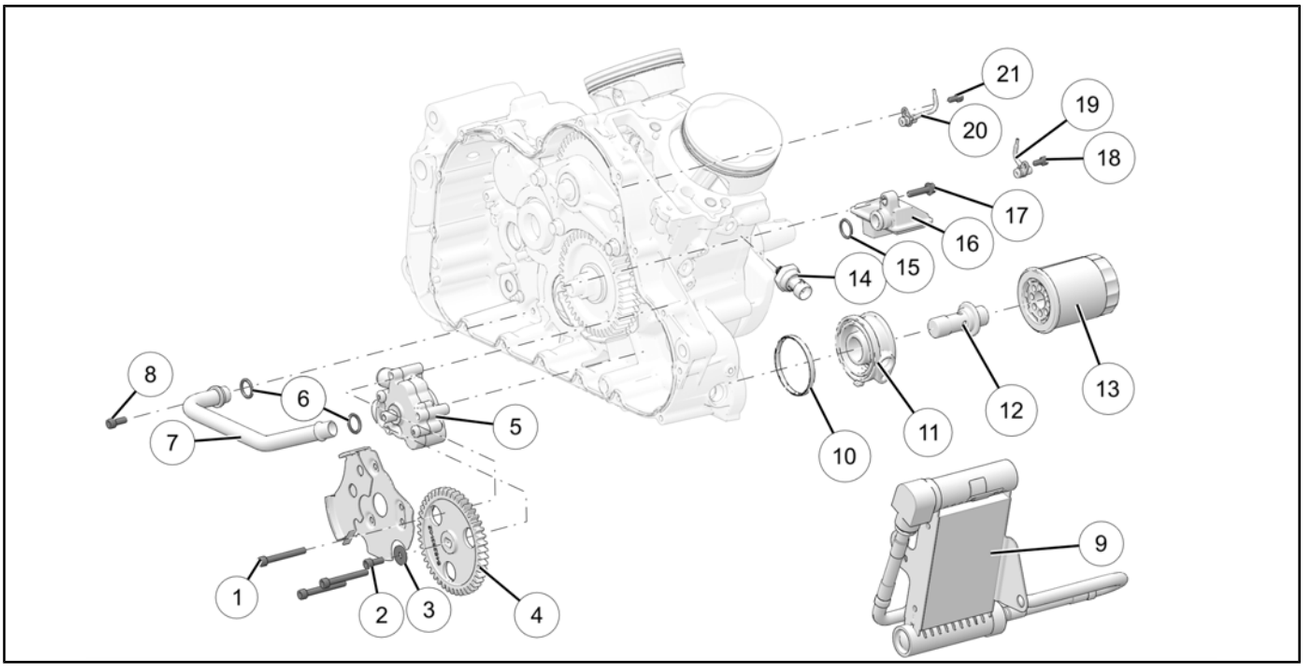
WATER PUMP ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Water Pump Driven Gear Fastener	**60 in-lbs (7 N·m)**
②	Water Pump Driven Gear	-
③	Water Pump Driven Gear Pin	-
④	Needle Bearing	-
⑤	Water Pump Shaft	-
⑥	Roller Bearing	-
⑦	Water Pump Shaft Nut	**13 ft-lbs (18 N·m)**
⑧	Shaft Seal	-
⑨	Shaft Water Seal	-
⑩	Water Pump Impeller	**17 in-lbs (2 N·m)**

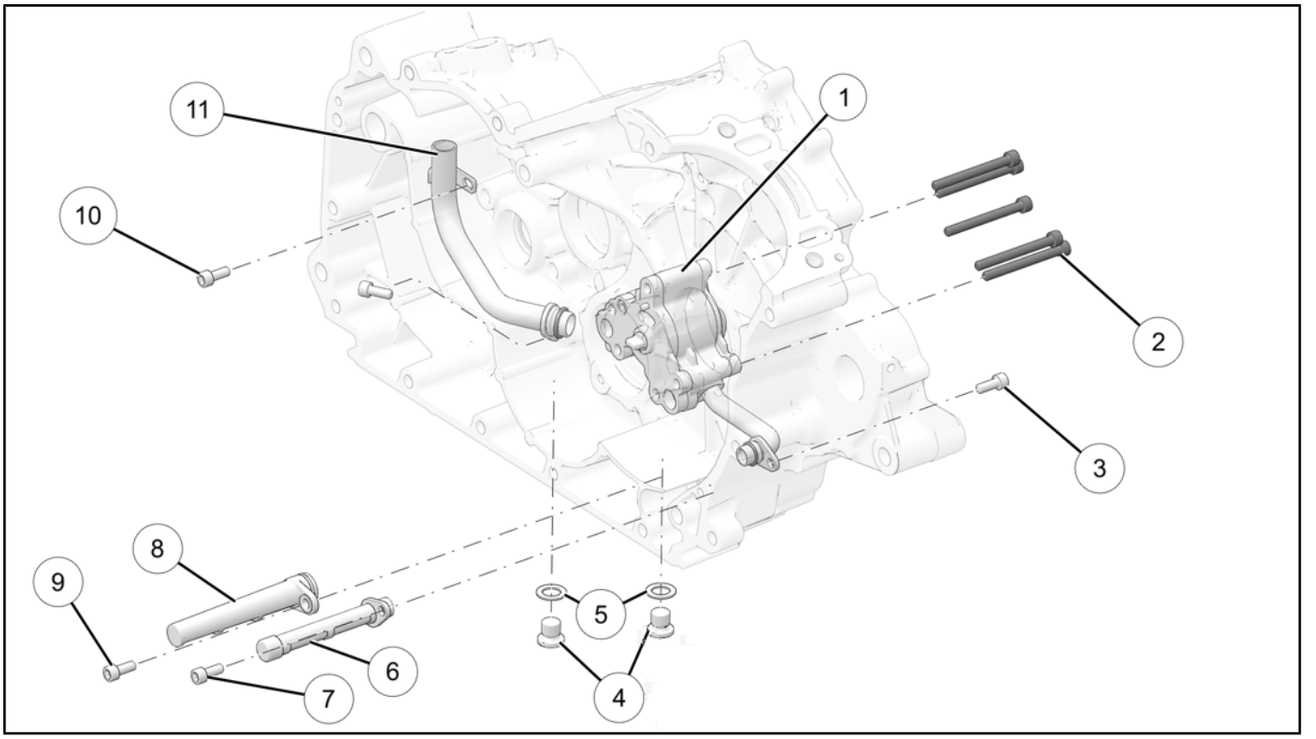
LUBRICATION SYSTEM ASSEMBLY VIEW

Pressure Lubrication System Assembly View



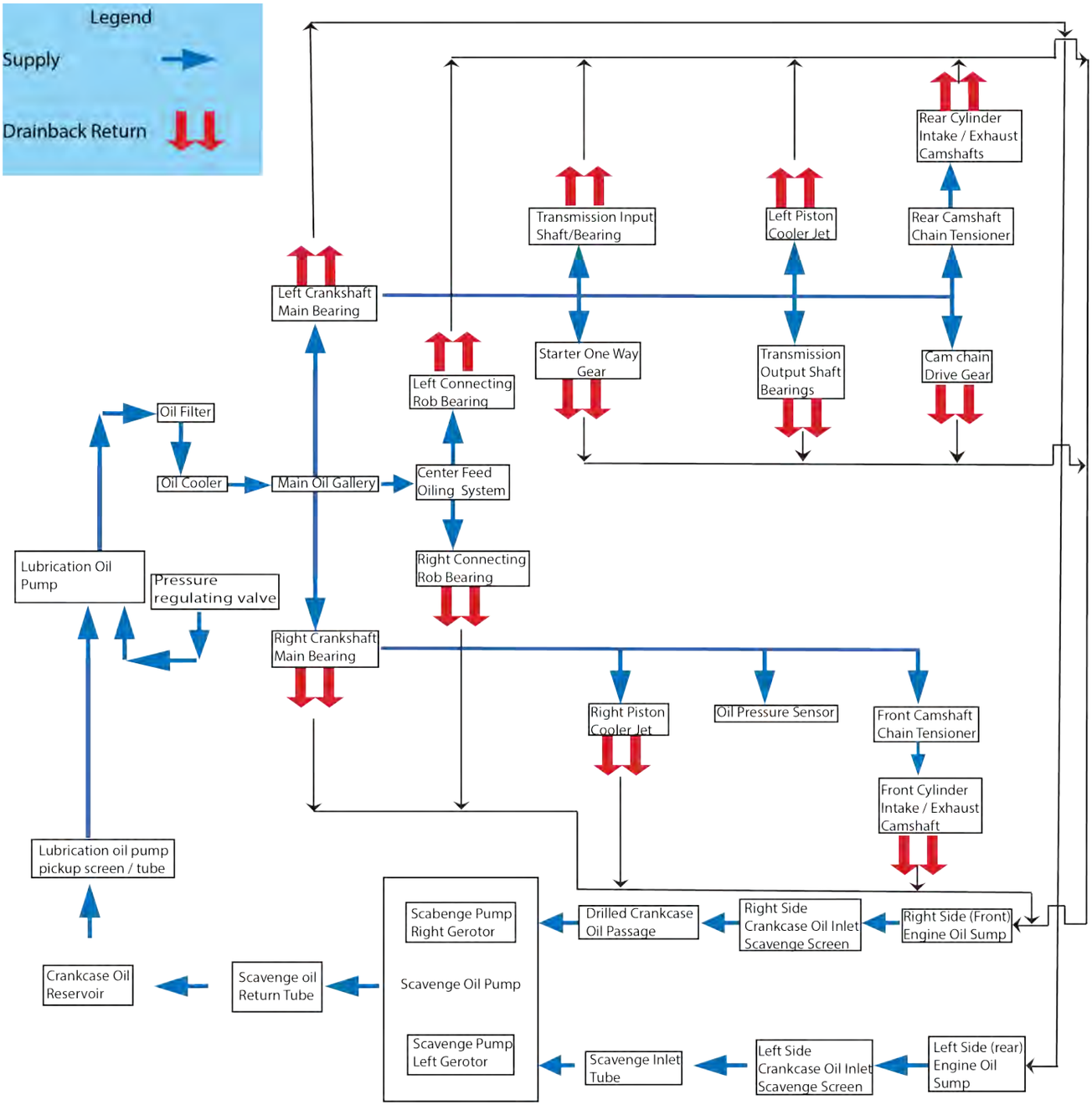
NUMBER	DESCRIPTION	NUMBER	DESCRIPTION
①	Oil Pump to Crankcase Fasteners (QTY: 3) **88 in-lbs (10 N·m)**	⑫	Oil Filter Spigot Adapter **22 ft-lbs (30 N·m)**
②	Oil Pump Gear Fastener **88 in-lbs (10 N·m)**	⑬	Oil Filter **115 in-lbs (13 N·m) or approximately 3/4 to 1 full turn after seal contacts the filter mount sealing surface.**
③	Oil Pump Gear Washer	⑭	Oil Pressure Sensor **10 ft-lbs (14 N·m)**
④	Oil Pump Gear	⑮	Oil Pickup O-Ring
⑤	Oil Pump Assembly (Pressure)	⑯	Oil Pickup Assembly
⑥	Oil Pressure Inlet Tube Seal (QTY: 2)	⑰	Oil Pickup Fastener **88 in-lbs (10 N·m)**
⑦	Oil Pressure Inlet Tube	⑱	Piston Cooling Jet Fastener **62 in-lbs (7)**
⑧	Inlet Tube to Oil Pump Fastener **88 in-lbs (10 N·m)**	⑲	Piston Cooling Jet, Front
⑨	Oil Cooler	⑳	Piston Cooling Jet, Rear
⑩	Oil Filter Seal Adapter	㉑	Piston Cooling Jet Fastener **62 in-lbs (7)**
⑪	Oil Filter Adapter	-	-

Scavenge Lubrication System Assembly View



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Engine Oil Scavenge Pump	-
②	Oil Scavenge Pump Fasteners (QTY: 5)	**88 in-lbs (10 N·m)**
③	Scavenge Inlet Tube Fastener	**88 in-lbs (10 N·m)**
④	Oil Drain Plug	**15 ft-lbs (20 N·m)**
⑤	Oil Drain Plug Sealing Washer	-
⑥	Scavenge Pickup	-
⑦	Scavenge Pickup Fastener	**88 in-lbs (10 N·m)**
⑧	Scavenge Oil Inlet	-
⑨	Scavenge Oil Inlet Fastener	**88 in-lbs (10 N·m)**
⑩	Scavenge Tube Fastener	**88 in-lbs (10 N·m)**
⑪	Oil Return Scavenge Tube	-

OIL FLOW DIAGRAM



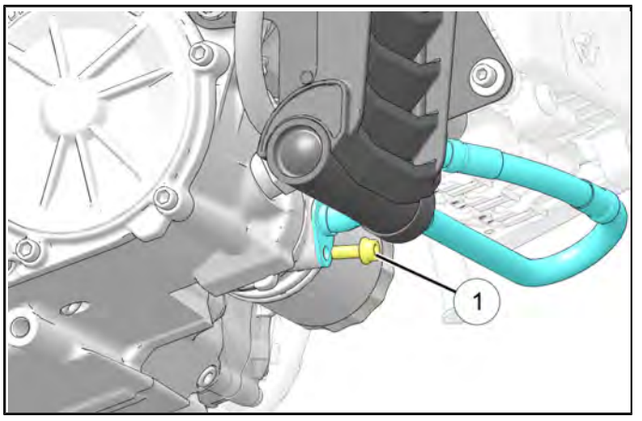
OIL COOLER

OIL COOLER REPLACEMENT

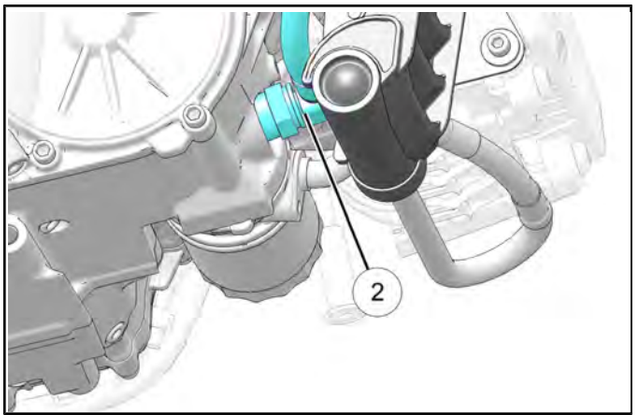
⚠ WARNING

Engine components get hot and remain hot for a period of time after the engine is stopped. Wear insulated protective clothing or wait for components to cool sufficiently before working on the machine.

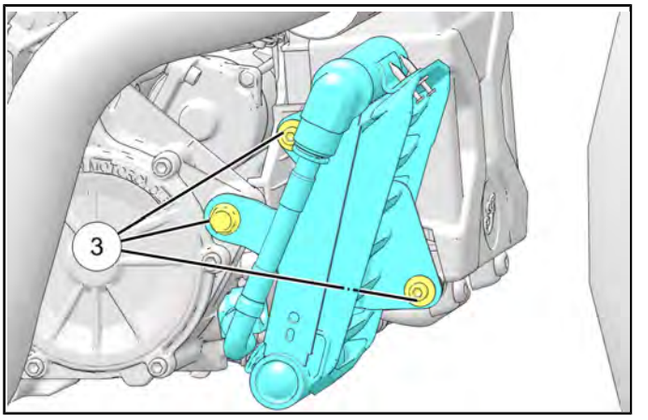
1. Drain engine oil. Reference **Engine Oil & Filter Change page 2.22**.
2. Remove chin fairing. See **Chin Fairing Replacement page 7.38**
3. Remove oil cooler line return fastener ①.



4. Remove oil cooler line clip ②.



5. Remove three fasteners ③ securing oil cooler



NOTICE

Replace o-ring prior to installation.

6. **Installation is performed by reversing the removal procedure.**
7. Lubricate o-ring with **PRO RUBBER LUBRICANT** prior to installation.

TORQUE
Battery Tray Through Bolt: **96 in-lbs (11 N·m)**

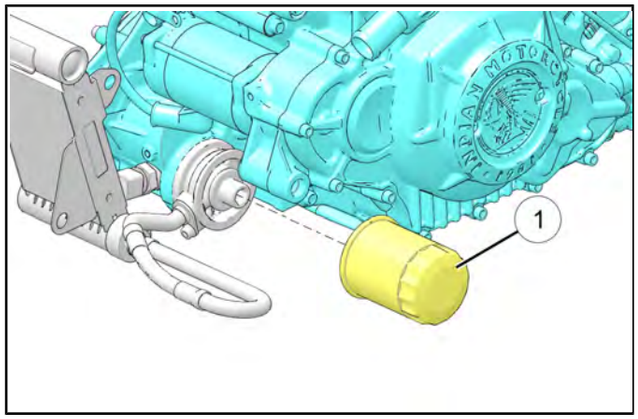
TORQUE
Oil Cooler Line Fastener: **88 in-lbs (10 N·m)**

8. Add the appropriate amount of engine oil. Reference **Engine Oil & Filter Change page 2.22**
9. Check the engine oil level. See **Engine Oil Level Check page 2.21**
10. Install chin fairing. See **Chin Fairing Replacement page 7.38**

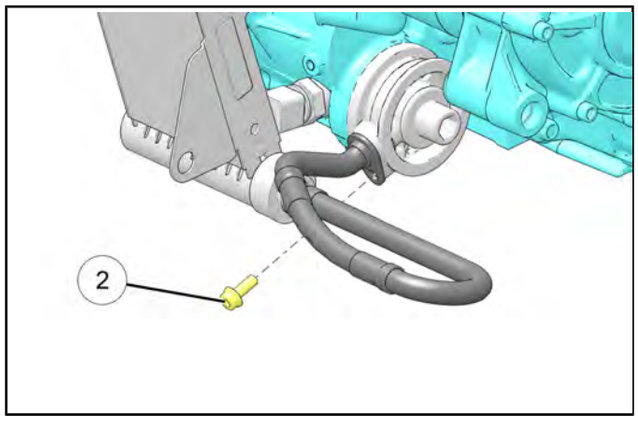
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

OIL COOLER ADAPTER REPLACEMENT

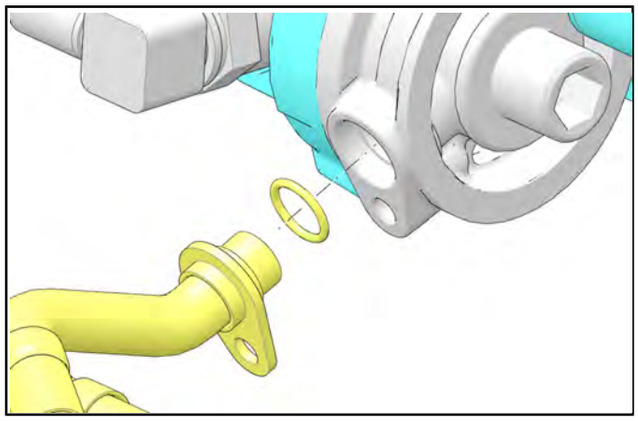
1. Drain Engine Oil. Reference **Engine Oil & Filter Change page 2.22**
2. Remove oil filter ①.



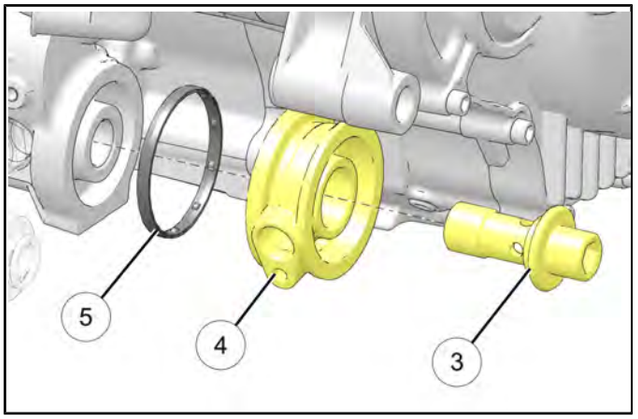
3. Remove oil cooler fastener ②.



4. Remove oil cooler line and O-ring.



5. Remove oil filter adapter spigot ③.



6. Remove oil filter adapter ④ and adapter seal ⑤.
7. **Installation is performed by reversing the removal procedure.**
8. Inspect O-ring and adapter seal for damage prior to reassembly.

TORQUE
Oil Filter Spigot Adapter: **22 ft-lbs (30 N·m)**

TORQUE
Oil Cooler Line Fastener: **88 in-lbs (10 N·m)**

TORQUE
Oil Filter: **115 in-lbs (13 N·m) or approximately 3/4 to 1 full turn after seal contacts the filter mount sealing surface.**

OIL COOLER INSPECTION

- Inspect cooler, lines, and all connections for leaks.
- Inspect lines for proper routing. Replace if there is any sign of abrasion or damage.
- Inspect cooler surface for obstructions, debris, or damaged fins.
- Rinse from back side to front with low pressure water.
- Inspect cooler mounting fastener for proper torque.
- Inspect mounting bracket and rubber grommets for cracks or damage.
- Replace any damaged components.

OIL PRESSURE TEST

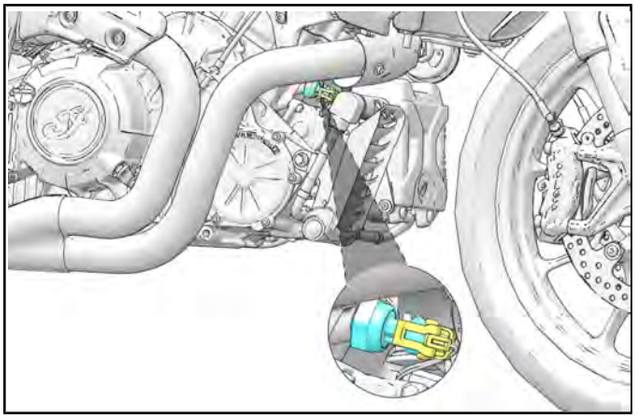
⚠ CAUTION

Use caution when working around hot engine oil.

NOTICE

Oil pressure switch activates at 3 psi ± 1 psi.

1. Start the engine and run until operating temperature is reached.
2. Turn the engine OFF.
3. Remove oil pressure sensor.



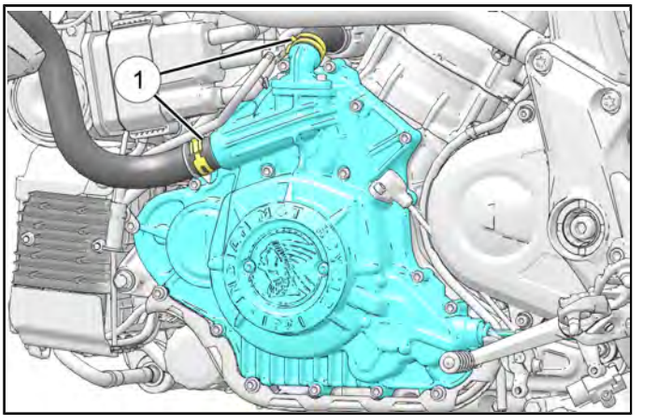
4. Install oil pressure gauge.
5. Use the dipstick to check the engine oil level and add recommended oil, if necessary.
6. Start engine and check oil pressure at 3000 rpm.
7. Compare reading to oil system specifications.
8. If oil pressure is outside of specification, refer to **Troubleshooting - Lubrication System page 3.23**
9. Once testing is completed, clean threads with Loctite Primer N, and apply thread sealant to the oil pressure switch threads and torque to specification.

TORQUE
Oil Pressure Switch: **10 ft-lbs (14 N·m)**

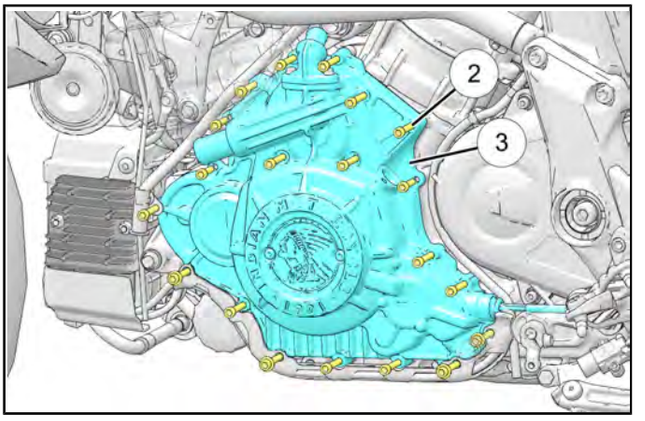
OIL PUMP SERVICE

SCAVENGE OIL PUMP REMOVAL

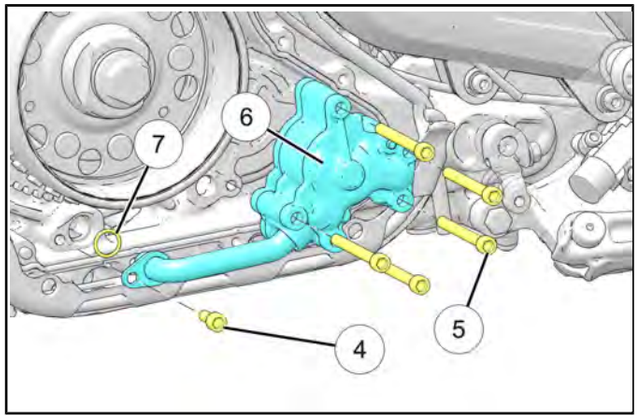
1. Drain cooling system. See **Coolant Drain / Fill page 3.44**.
2. Disconnect coolant bypass return hose ① from the stator cover.



3. Remove the crankshaft position sensor CPS. See **Crankshaft Position Sensor, Test / Replace page 4.53**.
4. Disconnect the stator electrical connector.
5. Remove the nineteen fasteners ② securing the stator cover ③.



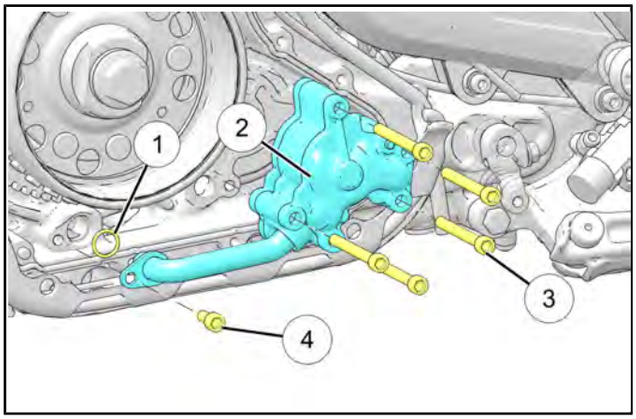
6. Remove the scavenge inlet tube fastener ④ and scavenge oil pump fasteners ⑤.



7. Remove scavenge oil pump assembly ⑥.
8. Remove and discard the O-ring on both sides ⑦.

SCAVENGE OIL PUMP INSTALLATION

1. Install a *New* o-rings ① on the inlet tube.



2. Install the oil pump ② into the crankcase and loosely install fastener ④ securing the inlet tube to the left-hand crankcase.
3. Align bolt holes and install oil pump fasteners ③ and torque to specification.

TORQUE
Scavenge Oil Pump Fasteners: **88 in-lbs (10 N·m)**

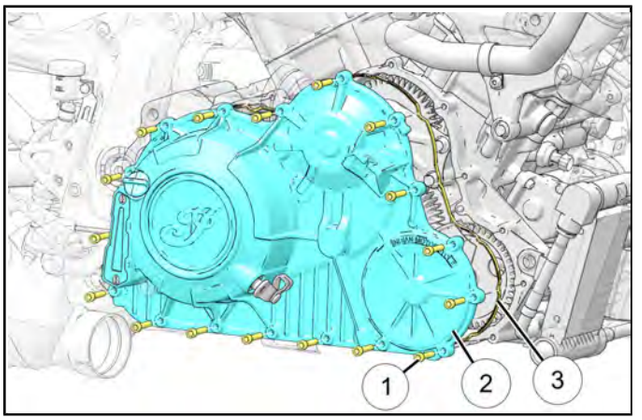
4. Torque inlet tube fastener to specification.

TORQUE
Scavenge Inlet Tube Fastener: **88 in-lbs (10 N·m)**

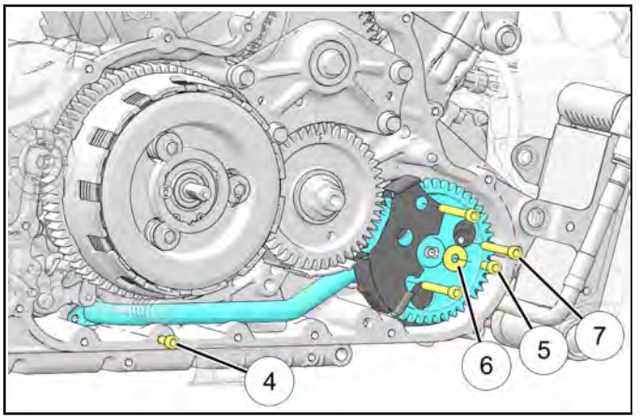
5. Install engine stator cover. See **Stator Cover Installation page 5.35**.
6. Verify engine oil pressure after assembly. See **Oil Pressure Test page 3.38**.

PRESSURE OIL PUMP REMOVAL

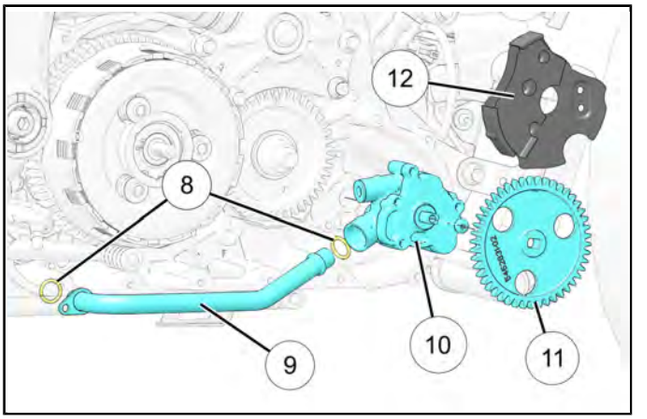
1. Remove exhaust head pipe. See **Front Head Pipe Removal / Installation, 2019–2020 models page 3.128**.
2. Disconnect clutch cable from engine clutch lever. See **Clutch Cable Removal / Installation page 8.28**.
3. Remove primary drive cover fasteners ①, cover assembly ② and the seal ③.



4. Remove pressure pump pickup tube fastener ④, gear fastener ⑤, washer ⑥ and three mounting bolts ⑦.



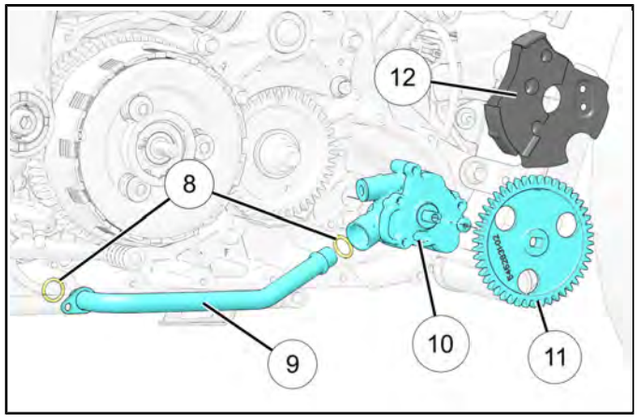
5. Remove pressure pump ⑩ and inlet tube ⑨ assembly from engine.



6. Separate inlet tube ⑨ from pressure pump ⑩ and discard inlet tube seals ⑧.
7. Separate gear shield ⑫ from oil pump gear ⑪.

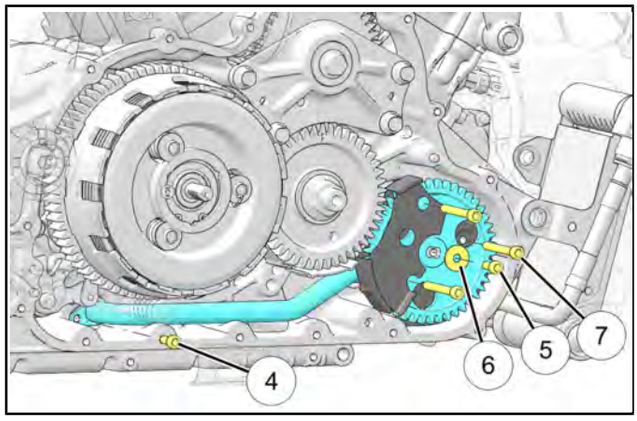
PRESSURE OIL PUMP INSTALLATION

1. Assemble gear shield ⑫ and gear ⑪ onto lubrication pump ⑩.



2. Lubricate new inlet tube o-rings ⑧ with engine oil and install the o-rings on the inlet tube ⑨.
3. Install the lubrication pressure pump assembly into the right crankcase with pump mounting fasteners ⑦ and pickup tube screw ④. Torque fasteners to specification.

TORQUE
Oil Pump to Crankcase Fasteners: **88 in-lbs (10 N·m)**



4. Assemble the inlet tube to the pump and torque fastener to specification.

TORQUE
Inlet tube to Oil Pump Fastener: **88 in-lbs (10 N·m)**

5. Install the oil pump gear fastener ⑤ and washer ⑥ onto pump shaft. Torque fastener to specification.

TORQUE
Oil Pump Gear Fastener: **88 in-lbs (10 N·m)**

6. Install the primary drive cover assembly. See **Primary Drive / Clutch Cover Installation page 5.16**.

⚠ CAUTION
Inspect the Crankshaft lip seal upon primary cover installation. If the seal is folded or damaged, it MUST be replaced. Upon replacement the crankshaft lip seal must have LUBRIPLATE 1242 applied. Failure to do so many cause sever engine damage and possible failure.

COOLING SYSTEM SERVICE

COOLING SYSTEM OVERVIEW

IMPORTANT
Use Indian Motorcycle 50/50 Extended Life Coolant only. Do not mix coolant types.

The engine coolant level is controlled or maintained by the recovery system. The recovery system components are the recovery bottle, filler neck, pressure cap and connecting hoses.

As coolant operating temperature increases, the expanding (heated) excess coolant is forced out of the system past the pressure cap and into the recovery bottle. As engine coolant temperature decreases the contracting (cooled) coolant is drawn back from the tank past the pressure cap and into the cooling system.

NOTICE
Some coolant level drop on new vehicles is normal as the system is purging itself of trapped air. Observe coolant levels often during the break-in period.

Overheating of engine could occur if air is not fully purged from the cooling system.

Indian Motorcycle 50/50 Extended Life Coolant is premixed and ready to use. Do not dilute with water.

COOLANT STRENGTH / TYPE

Test the strength of the coolant using an antifreeze hydrometer.

- A 50/50 mixture of extended life antifreeze and distilled water will provide the optimum cooling, corrosion protection, and antifreeze protection.
- Do not use tap water, straight antifreeze, or straight water in the system. Tap water contains minerals and impurities which build up in the system.
- Straight water or antifreeze may cause the system to freeze, corrode, or overheat.

FLUID CAPACITY
Recommended Coolant: Indian Motorcycle 50/50 Pre-Mixed Extended Life Antifreeze **System Capacity:** 2.32 qt (2.2 L) **Pressurized Circuit Capacity:** 2.16 qt (2.05 L) **Recovery Bottle Capacity:** .16 qt (.15 L) (PN 8560214) (Quart)

COOLING SYSTEM PRESSURE TEST

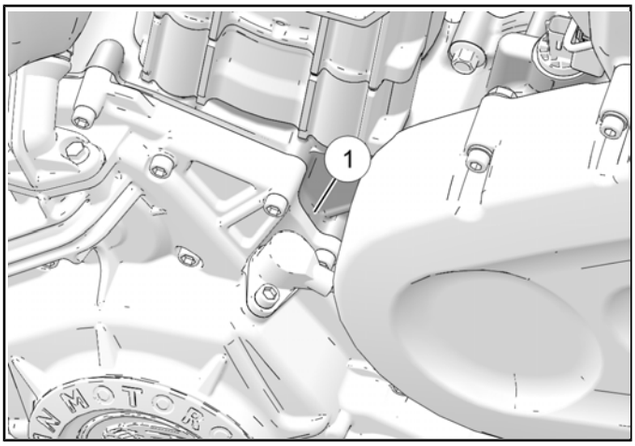
⚠ WARNING

Never remove pressure cap when engine is warm or hot. The cooling system is under pressure and serious burns may result. Allow the engine and cooling system to cool before servicing.

1. Remove safety set screw from pressure cap.
2. Remove the cooling system pressure cap and test using a cooling system pressure tester. (Commercially available).
3. The system must retain 11-14 psi (75-95 kPa) for five minutes or longer. If pressure loss is evident within five minutes, check the radiator, all cooling system hoses, hose clamps and water pump for leakage.

NOTICE

Coolant may be present at the water pump weep hole ① due to normal water pump function. Verify integrity of the water pump seal with a cooling system pressure test.

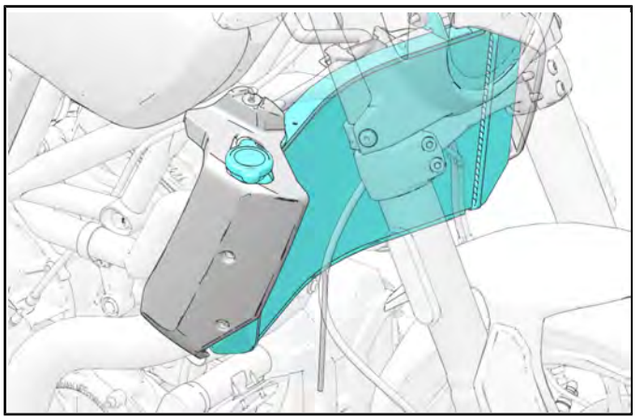


COOLING SYSTEM PRESSURE CAP TEST

⚠ WARNING

Never remove pressure cap when engine is warm or hot. The cooling system is under pressure and serious burns may result. Allow the engine and cooling system to cool before servicing.

1. Remove the safety set screw from the pressure cap.
2. Remove the cooling system pressure cap and test using a cooling system pressure tester. (Commercially available).



3. The cooling system pressure cap relief pressure is 16 psi (110 kPa). Replace cap if it does not hold the required specification pressure.

3

COOLANT DRAIN / FILL

WARNING

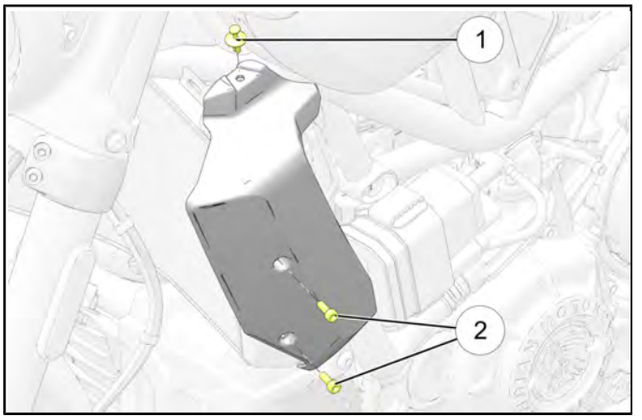
Never remove pressure cap when engine is warm or hot.
The cooling system is under pressure and serious burns may result.
Allow the engine and cooling system to cool before servicing.

Cooling System Drain

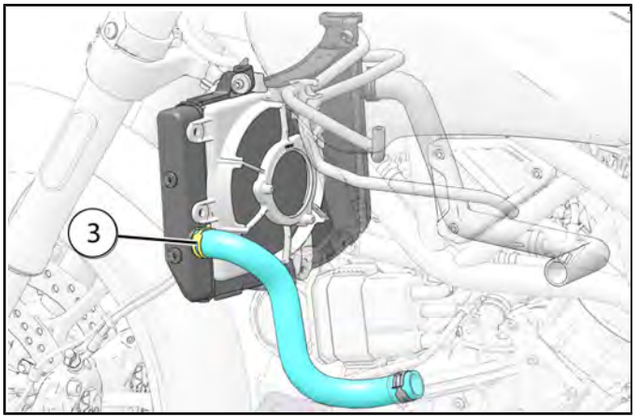
IMPORTANT

Pressure test the cooling system before and after cooling system service.

1. Remove the radiator cover push pin ① and two fasteners ②.



2. Remove the lower radiator hose ③ from the radiator.

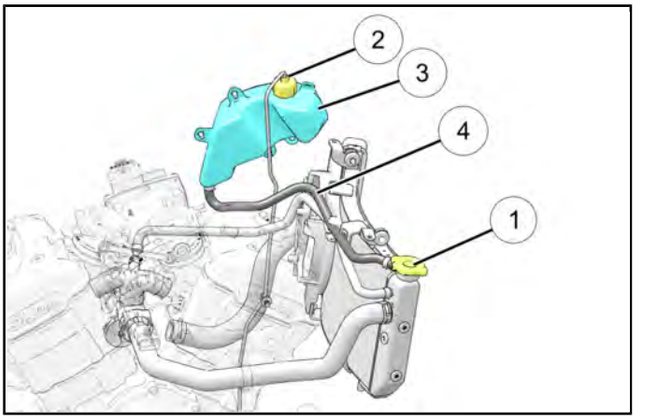


Cooling System Fill / Bleeding

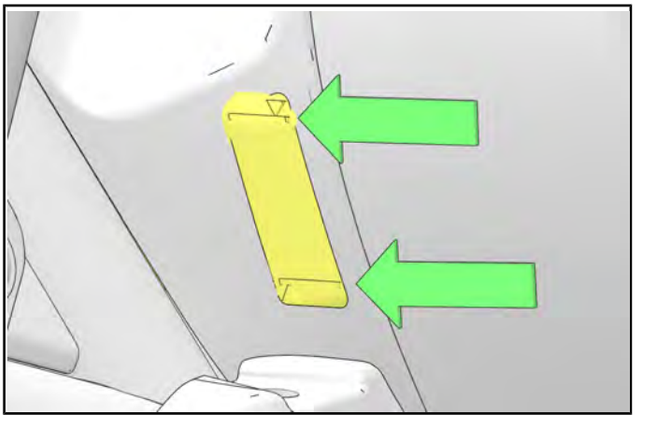
NOTICE

Pressure test before and after servicing the cooling system.

1. Remove the safety set screw from the pressure cap.
2. Remove cooling system pressure cap ① .
3. Use pinch pliers (commercially available) to pinch off the coolant line ④ between the coolant reservoir and pressure cap.



4. Install a cooling system vacuum fill tool (commercially available) on the pressure cap opening to create a vacuum in the cooling system.
5. Using the vacuum bleeder draw in Indian Motorcycle Extended Life 50/50 Engine Coolant to fill the cooling system.
6. Remove the vacuum bleeder and install the pressure cap and safety set screw.
7. Remove the pinch pliers from the coolant line between the reservoir and thermostat housing.
8. Add Indian Motorcycle Extended Life 50/50 Engine Coolant to the reservoir fill opening ② until the coolant reservoir ③ it is between markings.



9. Run the engine until the cooling fan cycles ON and OFF.
10. Recheck the coolant level in the reservoir and add until the level is between the markings.
11. Repeat the fill/bleed procedure until the coolant level in the reservoir no longer falls below the lower marking when cold.

COOLANT JUNCTION REPLACEMENT

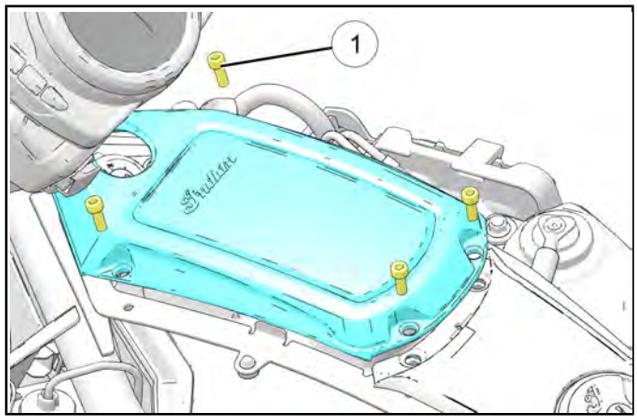
PREPARATION

1. Park the motorcycle on a lift table with the wheel clamped in a wheel vise.
2. Turn key to OFF position and remove key.

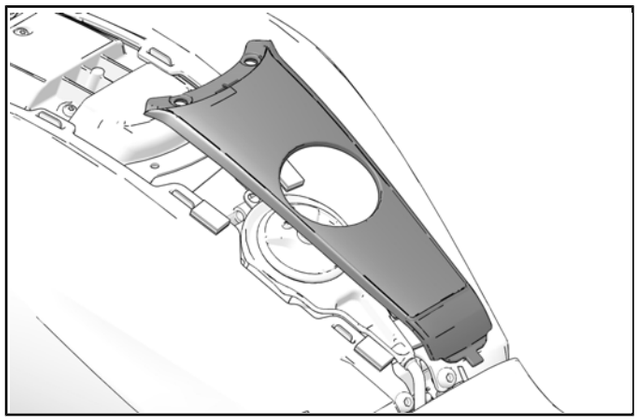
IMPORTANT
Allow the engine and cooling system to cool before servicing.

MOTORCYCLE DISASSEMBLY

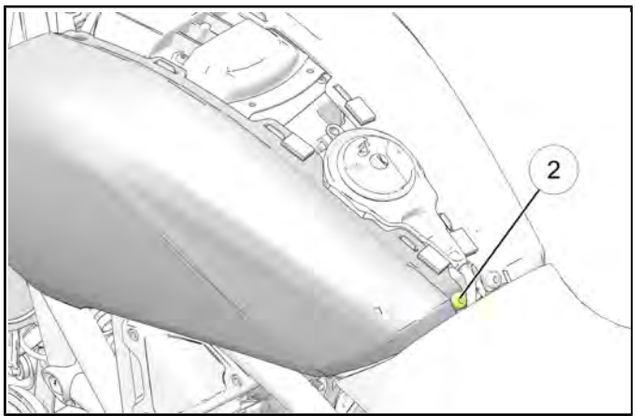
1. Remove four fasteners ① securing air box bezel.



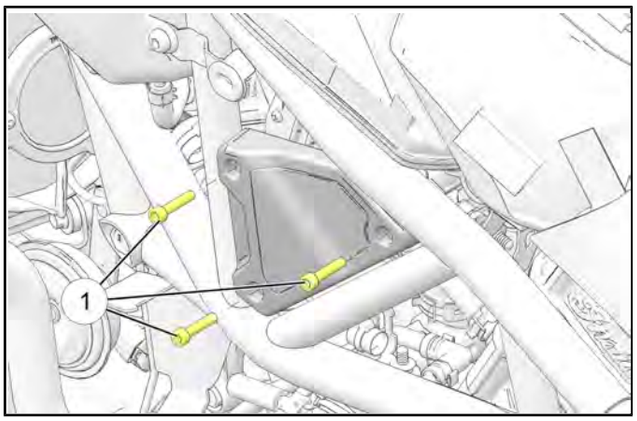
2. Remove the center console cover from the alignment bracket.



3. Remove fastener ② securing the left-side air box cover. Remove left-side air box cover.



4. Remove three fasteners ① securing left-side v-cover.

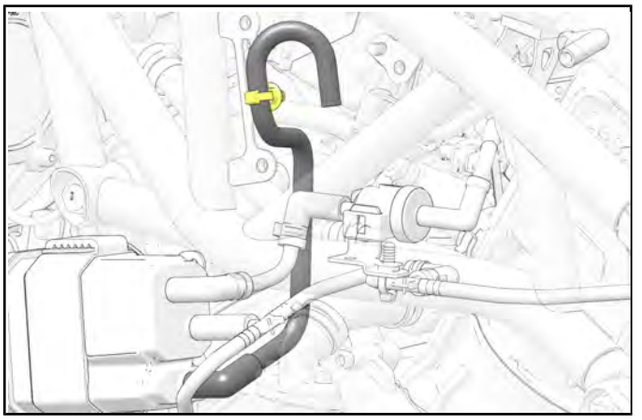


5. Wrap the left-hand side frame of the motorcycle using Gaffer tape as shown.

6. 49 state motorcycles proceed to step 7 (**step 7 page 3.47**).

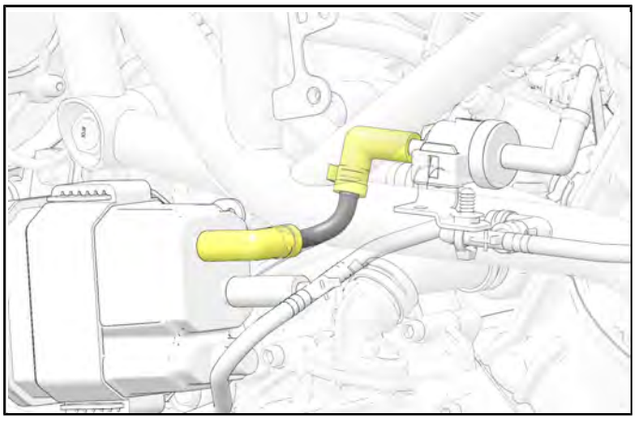
50 state and INTL models need to have the EVAP and purge valve lines removed:

a. Clip the cable tie securing the EVAP drain line.

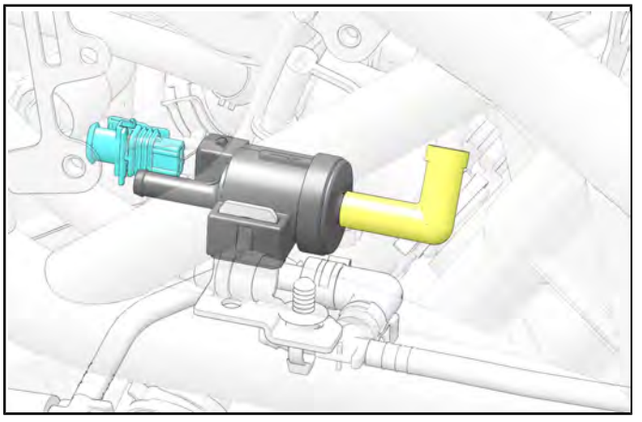


b. Disconnect from the EVAP cansiter and remove the line from the motorcycle.

c. Disconnect and remove the purge valve to EVAP canister line.

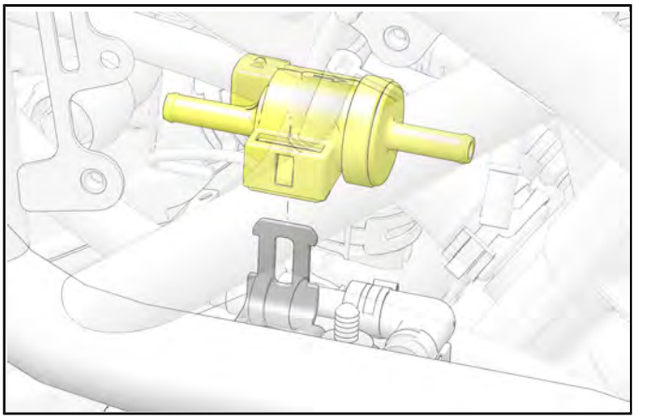


d. Disconnect the purge valve electrical connector.



e. Disconnect the purge valve input line.

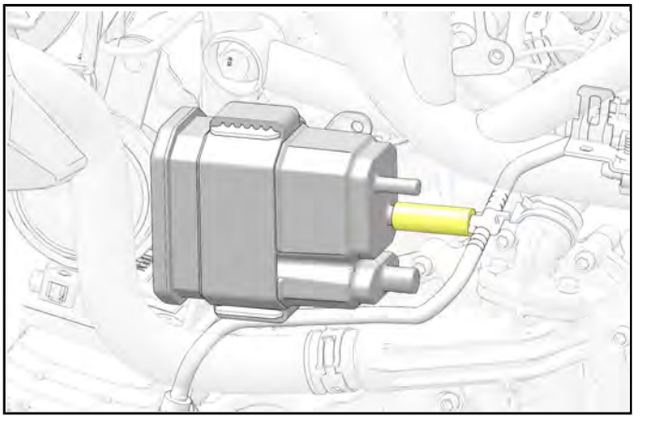
f. Remove the purge valve from its bracket.



NOTICE

Soapy water may be used to aid in removal of purge valve from bracket.

g. Disconnect the middle EVAP line and remove EVAP canister.



7. Drain Cooling System:

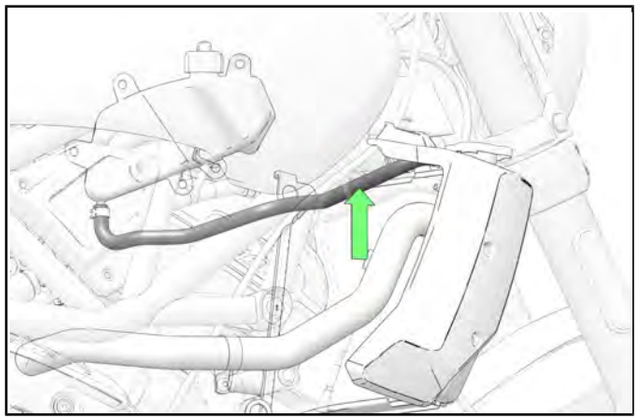
⚠ WARNING

Never remove pressure cap when engine is warm or hot.
The cooling system is under pressure and serious burns may result.

⚠ CAUTION

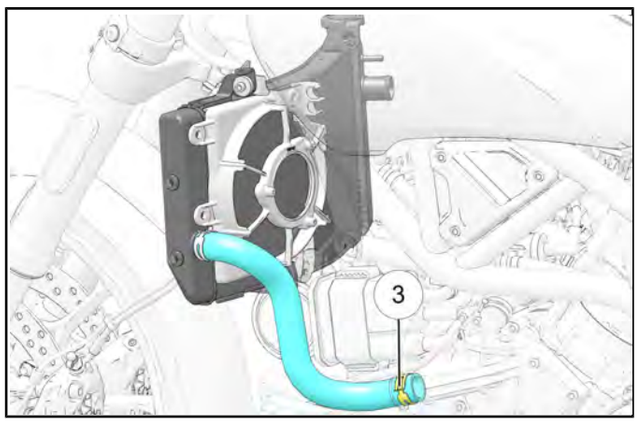
Make sure the motorcycle is completely cooled down before proceeding.

a. Use pinch pliers (commercially available) to pinch off the overflow bottle line.



b. Place a drain pan under the lower radiator hose.

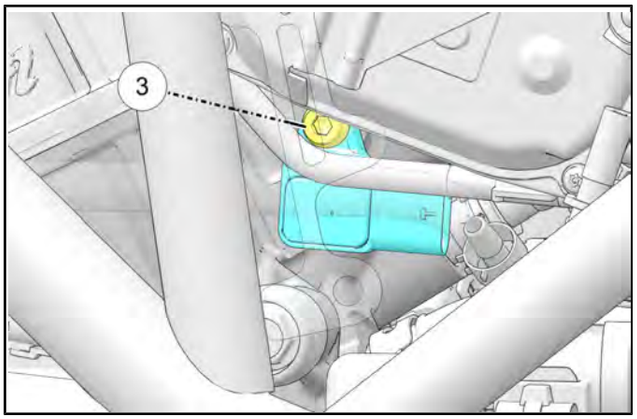
c. Slide the lower radiator hose clamp ③ down the hose. Gently pull the hose from the engine to drain the coolant.



⚠ CAUTION

Use care when removing the lower drain hose and avoid draining coolant onto the voltage regulator.

8. Pull the harness aside and remove TMAP sensor fastener ③. Pull the TMAP sensor straight out to remove.



⚠ CAUTION

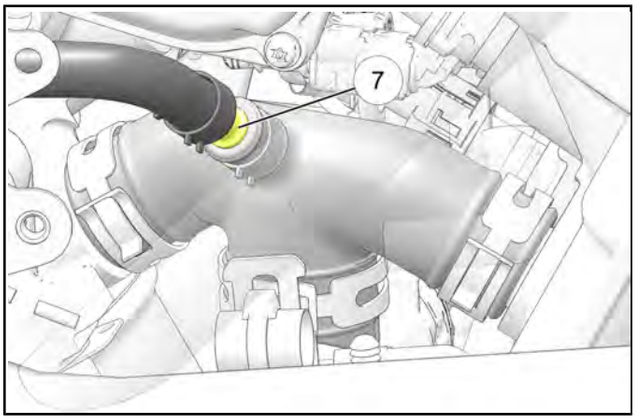
Do not pull up or down on the sensor during removal as damage to the sensor may occur.

IMPORTANT

Do not disconnect the electrical connection from the TMAP sensor.

COOLANT JUNCTION REMOVAL

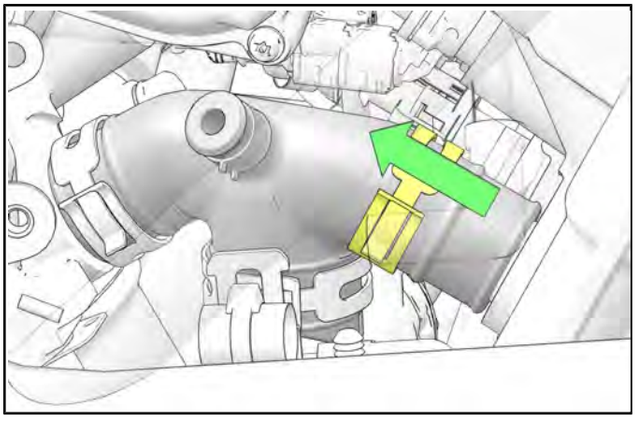
1. Release the clamp and then remove coolant bleed fitting ⑦ from the coolant junction.



2. Remove the coolant junction using the sequence of steps below for best removal procedure.

NOTICE
Using a Remote Action Hose Clamp Tool (commercially available) may help in clamp removal.

   a. Slide the **REAR** clamp up as far as possible.



   b. Install a remote clamp tool on the **FRONT** and leave it attached to the clamp.

   c. Using a 90 degree needle nose pliers, insert through the left-hand frame, squeeze the bottom clamp to release, and lift the coolant junction up and out.

3. Remove and retain the clamps for use with new coolant junction.

STOP!
DISCARD the coolant junction immediately.

COOLANT JUNCTION INSTALLATION

1. To keep the clamp in the open position, squeeze the front and bottom clamps and place the on a 22–25mm deep-well socket.

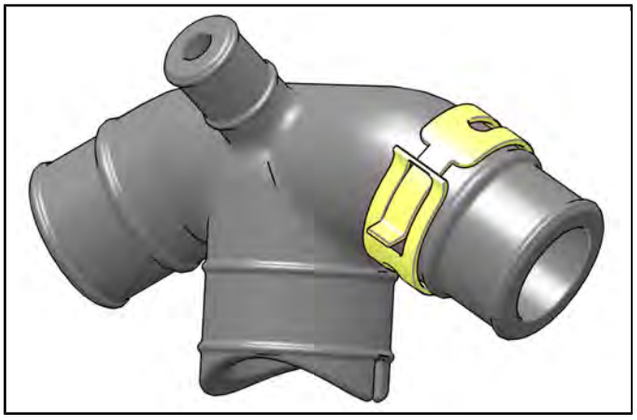
2. Install 13mm sockets over the FRONT and BOTTOM clamps to keep them in the open position.

3. Preset the FRONT and BOTTOM clamps open on the fittings as shown.

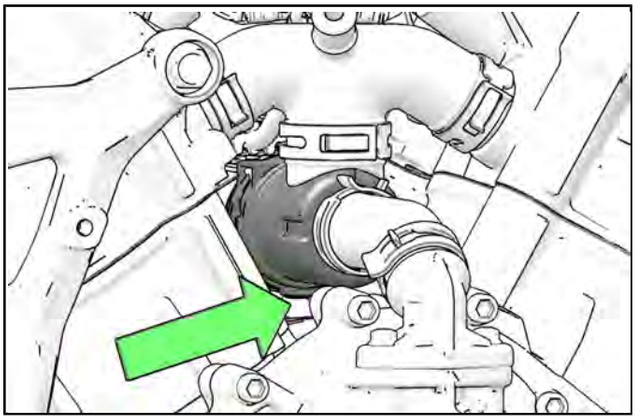
STOP!

Verify new 5418558 coolant junction is being installed by checking the part number molded into the coolant junction.

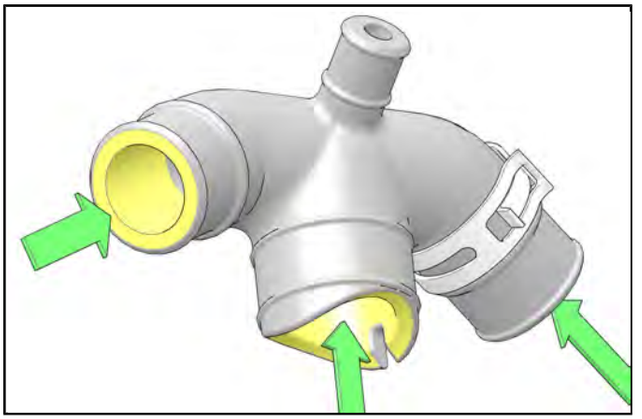
4. Preset the REAR clamp on the coolant junction. The springband clamp should be positioned above the rib on the coolant junction.



5. Place non-marring support between the engine block and the thermostat to support the coolant junction installation.



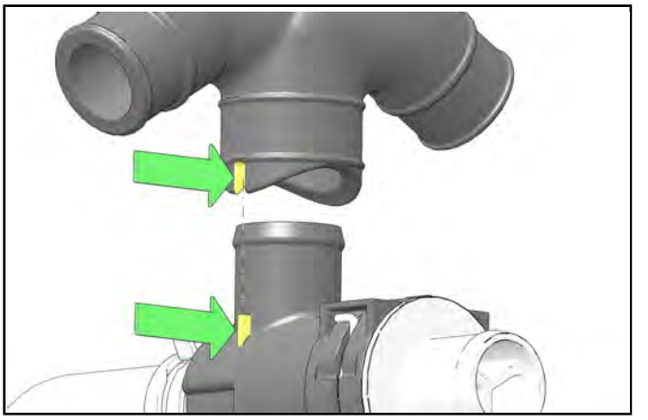
6. Using NEW coolant, thoroughly lubricate all the ports of the coolant junction AND fittings on the engine before installation.



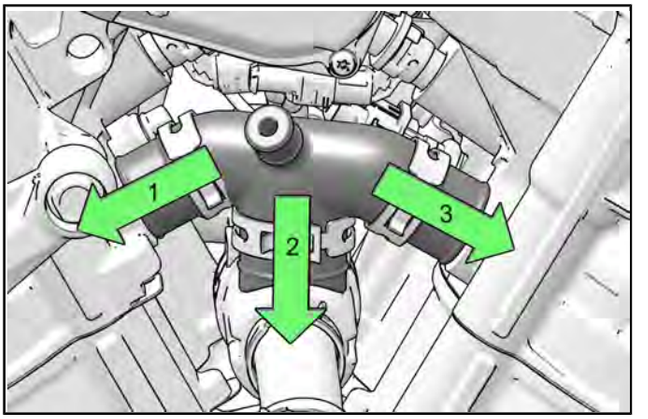
⚠ CAUTION

DO NOT USE BRAKE CLEANER OR OIL BASED LUBRICANTS

7. Make sure you align the NEW coolant junction notch with the thermostat alignment tab.



8. With the clamps positioned over the fittings, install the coolant junction following the order outline below.



IMPORTANT

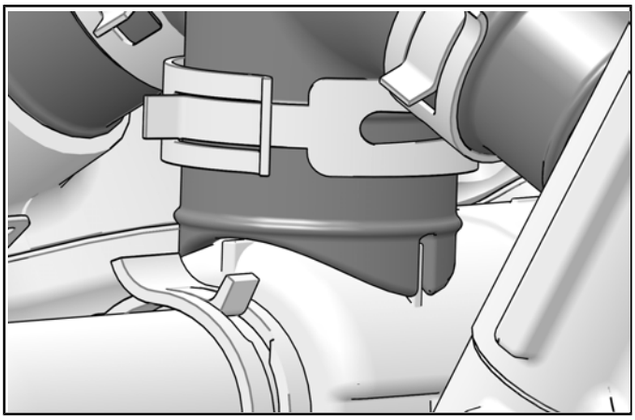
DO NOT slide clamp into position at this point.

9. Verify the coolant junction is fully seated by ensuring the ends of the coolant junction are in contact with the cylinder and thermostat and no part of the fitting is showing:

- Verify the FRONT of coolant junction is fully seated.

- Verify the REAR of coolant junction is fully seated.

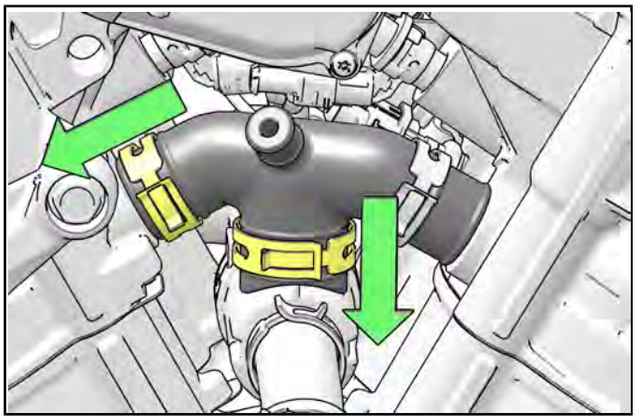
- Verify the BOTTOM of coolant junction is fully seated.



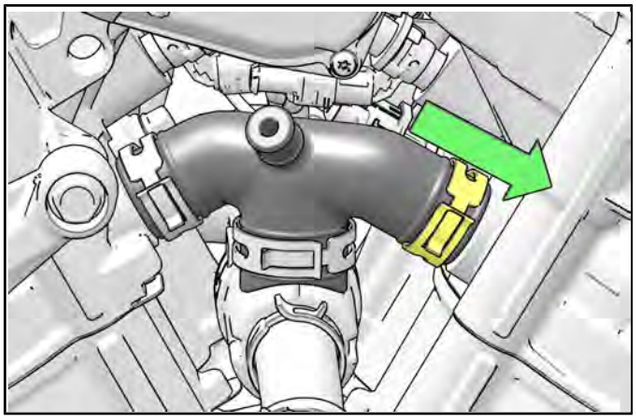
IMPORTANT

If not properly seated, the coolant junction may leak.

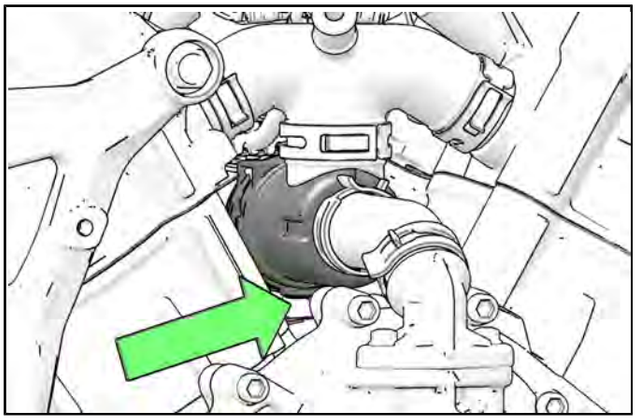
10. Install the front and bottom clamps into position over the ribbed area of the coolant junction arms. Remove the sockets once orientated in the correct position.



11. Using a long-nosed pliers, install the rear clamp into position.



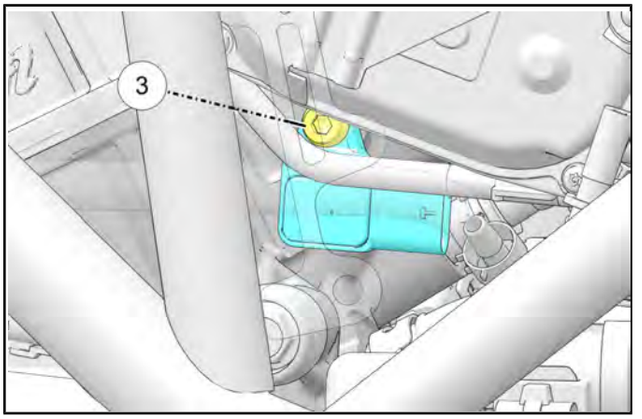
12. Remove the support placed between the engine block and the thermostat.



13.

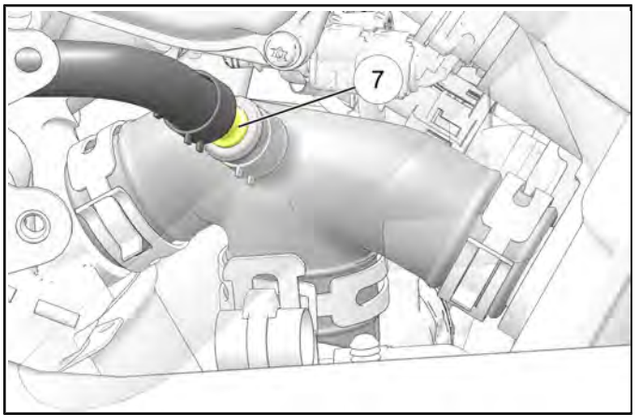
IMPORTANT
Inspect the TMAP sensor for damage before installation. If damage is found, submit an ASK Polaris case.

If no damage is found, Install TMAP sensor and install fastener ③. Torque fastener to specification.



TORQUE
T-Map Sensor Fastener: **53 in-lbs (6 N·m)**

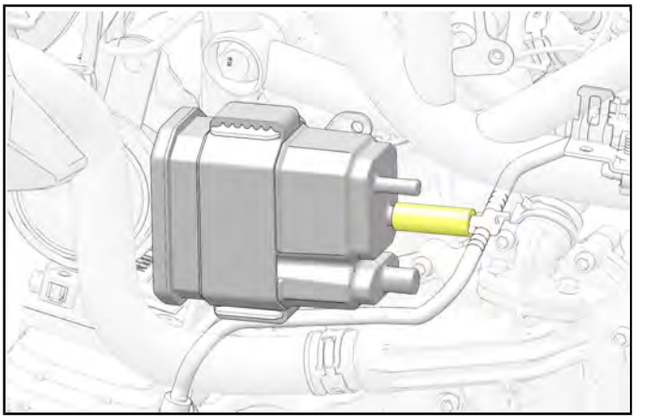
14. Install coolant bleed hose fitting to the coolant junction.



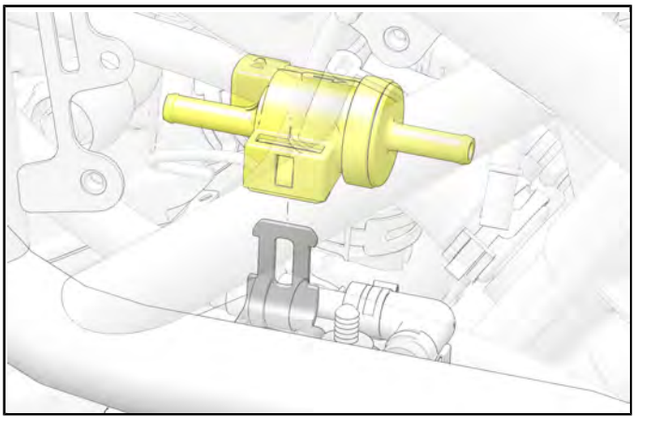
15. 49 state motorcycles proceed to step 16 (**step 16 page 3.54**).

    50 state and INTL models need to have the EVAP and purge valve lines installed:

    a. Install the EVAP canister. Connect the middle EVAP line to the canister.

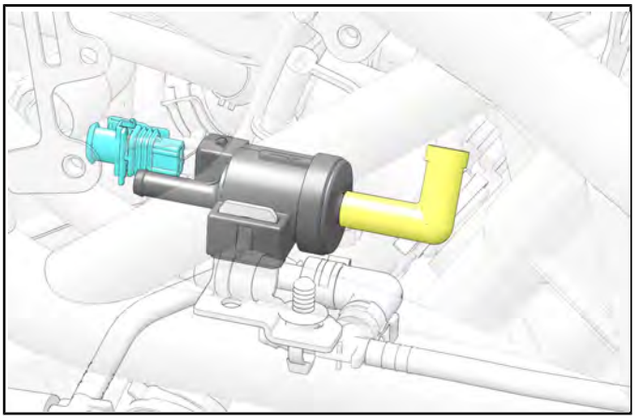


    b. Install the purge valve to the frame bracket.



NOTICE
Soapy water may be used to aid in installation of purge valve to bracket.

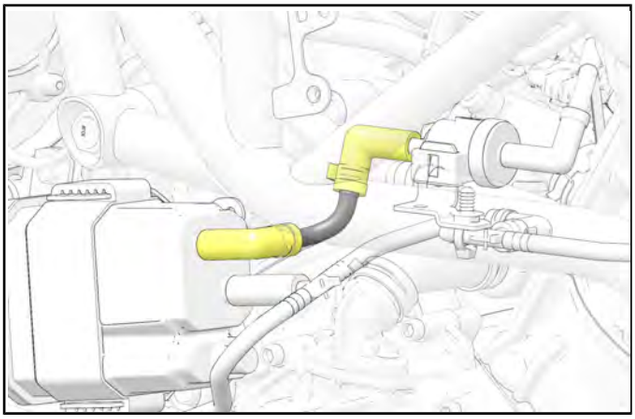
c. Conect the purge valve input line.



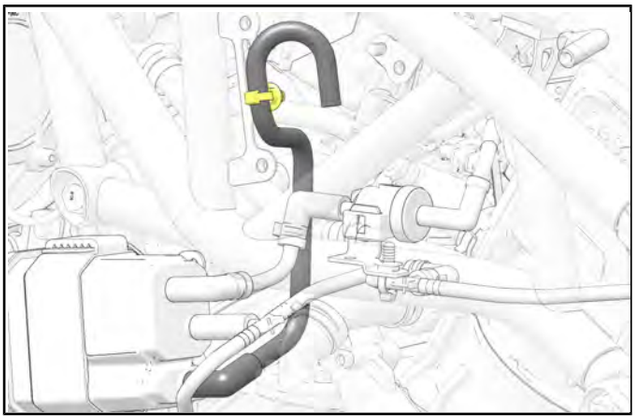
d. Connect the purge valve electrical connector.

IMPORTANT
Listen for audible “click” when pressing into place. Pull gently on connector once seated to ensure a proper connection has been made.

e. Install and Connect the purge valve to EVAP line.

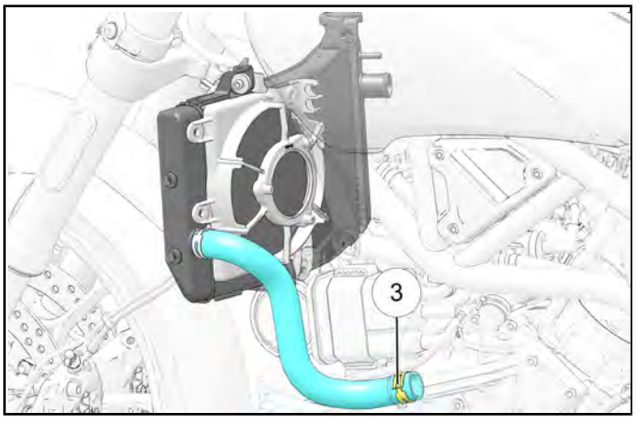


f. Connect the EVAP system drain line and route as shown.



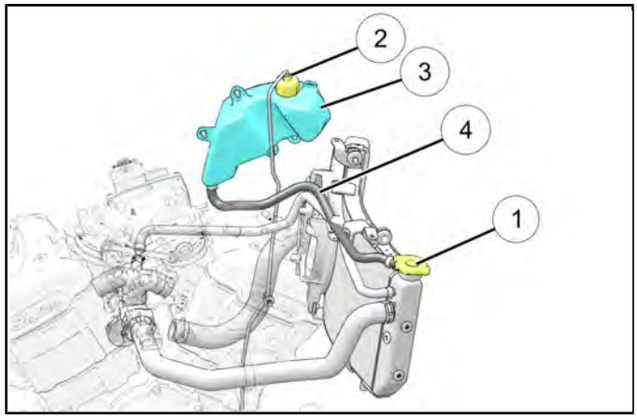
g. Install a NEW cable tie securing the EVAP drain line.

16. Unwrap the tape from the motorcycle frame and clean the frame to remove any residue.
17. Install lower radiator hose. Secure clamp over hose with clamp ③.



COOLANT FILL AND BLEEDING

1. Remove the safety set screw from the pressure cap ① and remove the pressure cap.

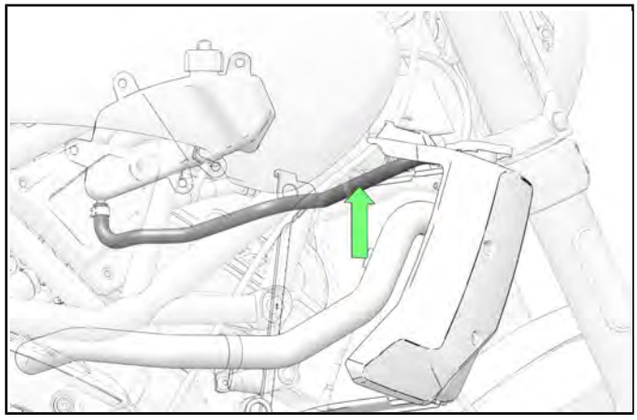


2. Install either Bosch 75260 OR Robinar 75260 cooling system vacuum fill tool on the pressure cap opening to create a vacuum in the cooling system.

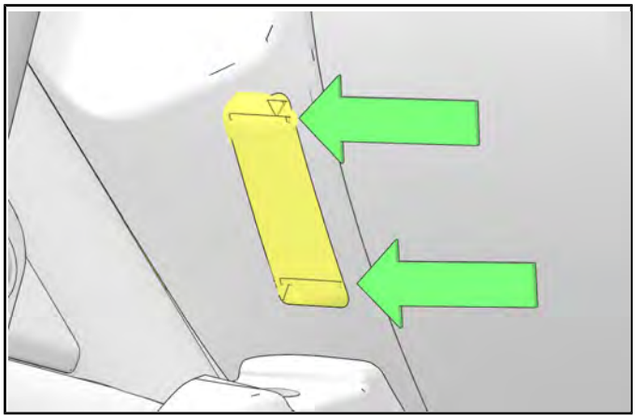
⚠ CAUTION

If the vacuum tool is not used, air may get trapped in the cooling system.

3. Using the vacuum bleeder draw in Indian Motorcycle Extended Life 50/50 Engine Coolant (2880966) to fill the cooling system.
4. Remove the vacuum bleeder and install the pressure cap and safety set screw.
5. Remove the pinch pliers from the coolant line between the reservoir and thermostat housing.



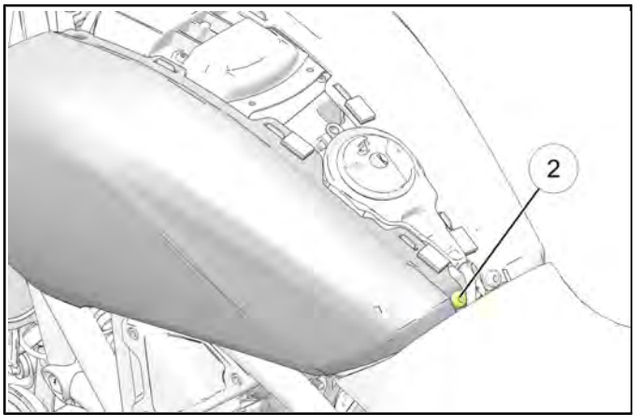
6. Add Indian Motorcycle Extended Life 50/50 Engine Coolant to the reservoir fill opening ② until the coolant ③ is between markings.



7. Verify the coolant level is full and no leaks are present. Verify engine temp drops as fan runs and shuts off.
8. Run the engine until the cooling fan cycles ON and OFF.
9. Recheck the coolant level in the reservoir and add until the level is between the markings.

MOTORCYCLE ASSEMBLY

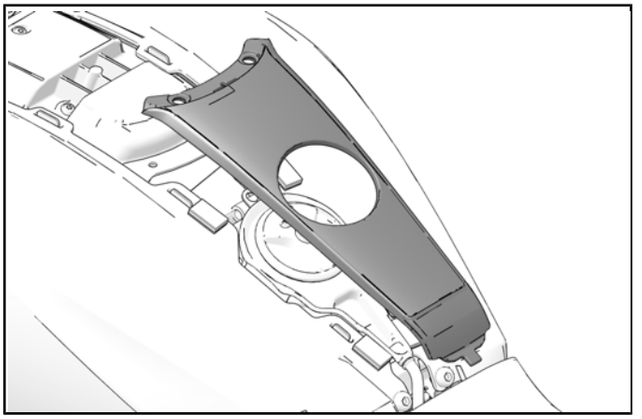
1. Lubricate air box cover grommets. Install air box cover and secure with fastener ②.



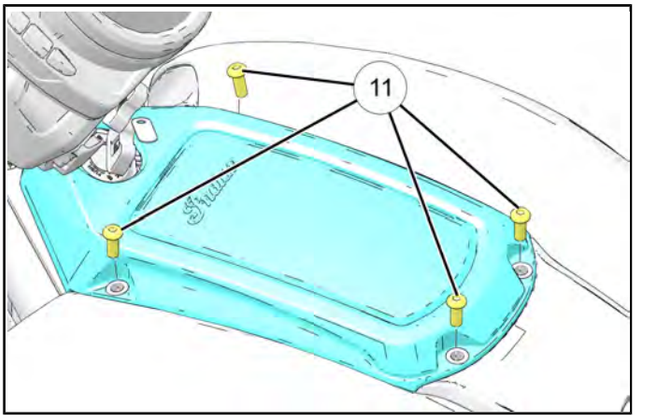
NOTICE
Use Soapy Water to help with installation. **DO NOT USE BRAKE CLEANER OR OIL BASED LUBRICANTS**

TORQUE
Air Box Cover Fastener: **36 in-lbs (4 N·m)**

2. Install fuel tank bezel onto alignment bracket.

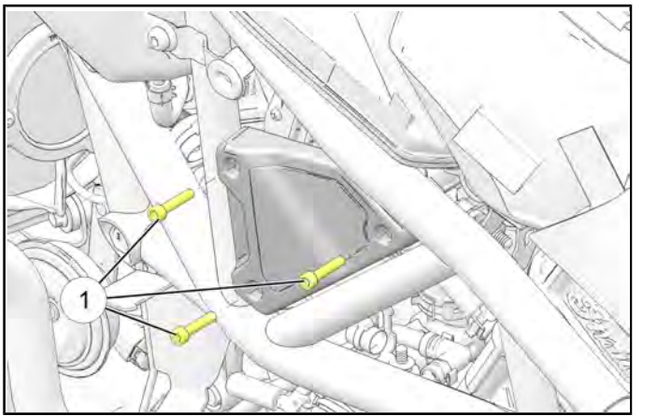


3. Install four fasteners ⑪ securing air box bezel.



TORQUE
Air Box Bezel Fastener: **36 in-lbs (4 N·m)**

4. Install left-hand V-Cover. Torque fasteners ① to specification.



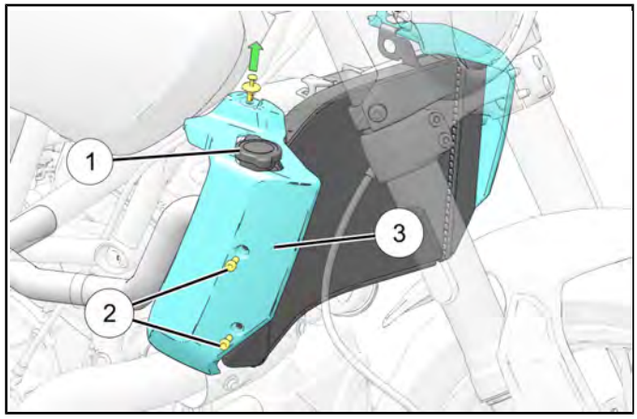
TORQUE
V-Cover Fasteners: **36 in-lbs (4 N·m)**

RADIATOR REMOVAL / INSTALLATION

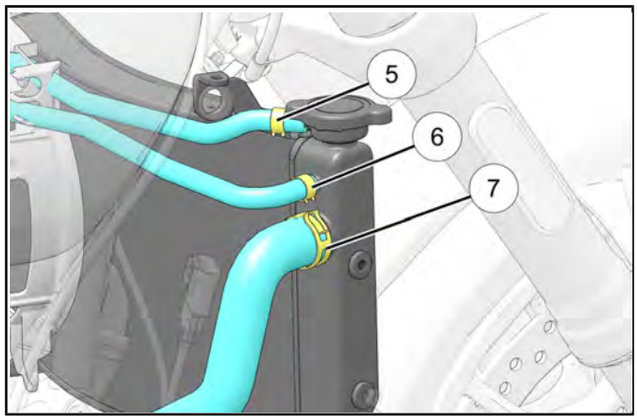
⚠ WARNING

Never remove pressure cap when engine is warm or hot. The cooling system is under pressure and serious burns may result.
Allow the engine and cooling system to cool before servicing.

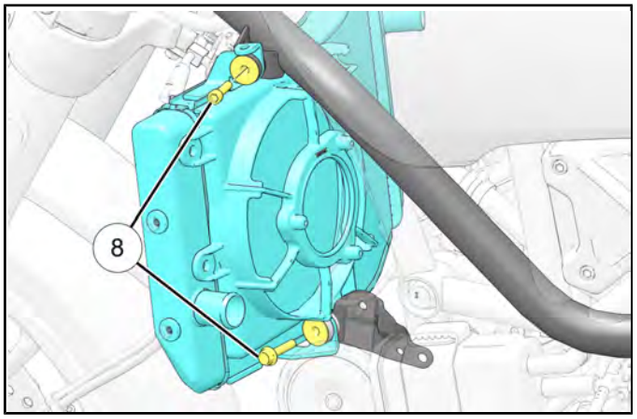
1. Drain the cooling system. See **Coolant Drain / Fill page 3.44**.
2. Remove the pressure cap ①.



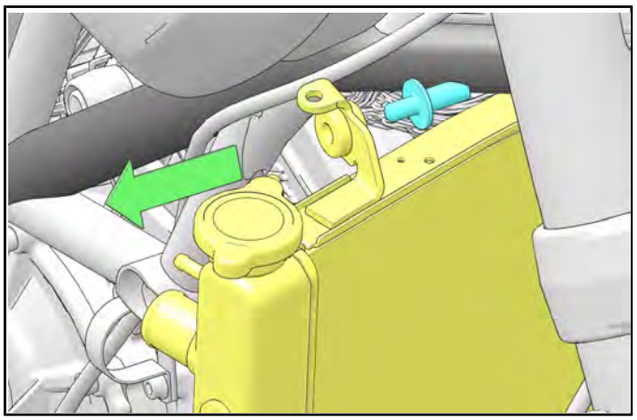
3. Remove the push pin and two fasteners ② retaining the radiator wings ③ to the radiator. Repeat step for opposite side.
4. On the right side of the unit, pinch off and remove the recovery bottle hose ⑤.



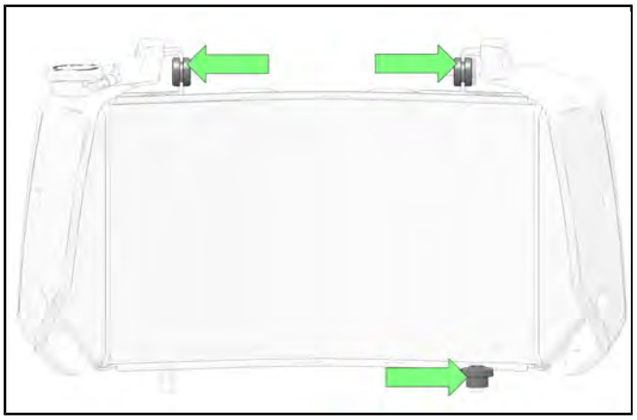
5. Remove the radiator bleed hose ⑥, and the upper radiator hose ⑦.
6. Disconnect the recovery bottle and radiator bleed hoses from the fan assembly.
7. On the left side of the unit, remove the lower radiator hose.
8. Remove the radiator fasteners ⑧.



9. Move the radiator away from the unit to disengage the retaining feature.



10. Inspect the rubber isolator for any cracks or signs of wear. Replace if worn.



3

11. **Installation is performed by reversing the removal procedure.**

TORQUE
Radiator Isolator Fasteners: **96 in-lbs (11 N·m)**

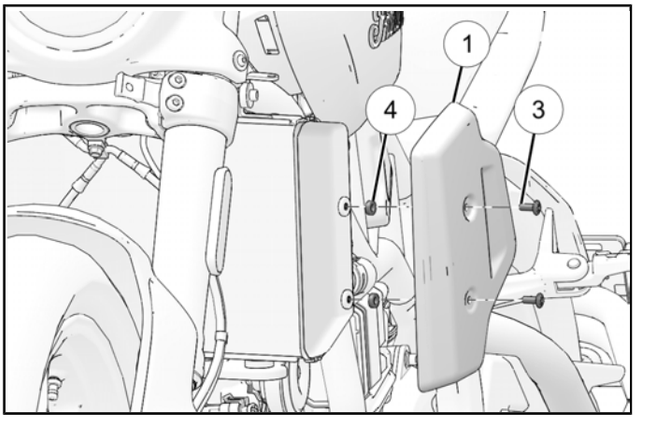
TORQUE
Radiator Wing Fasteners: **84 in-lbs (9 N·m)**

12. Fill and bleed cooling system. See **Coolant Drain / Fill page 3.44**.
13. Run the unit and inspect for leaks.

ALUMINUM RADIATOR COVER INSTALLATION

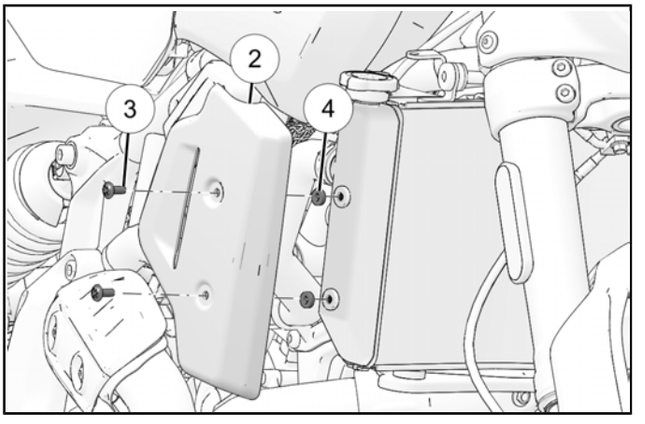
1. Install left-hand radiator guard ① with two radiator guard fasteners ③ and two spacers ④.

TORQUE
Radiator Wing Fasteners ③: **84 in-lbs (9 N·m)**



2. Install right-hand radiator guard ② with two radiator guard fasteners ③ and two spacers ④.

TORQUE
Radiator Wing Fasteners ③: **84 in-lbs (9 N·m)**

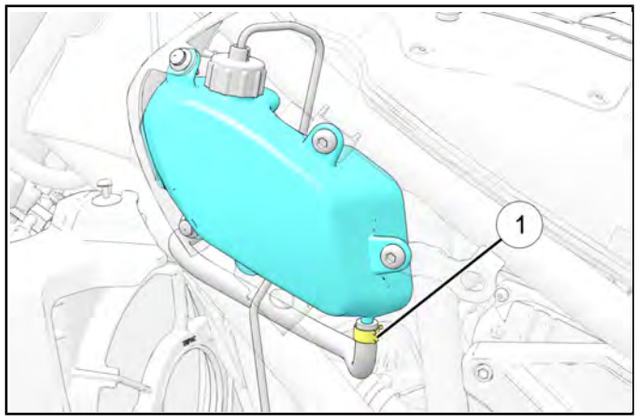


9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

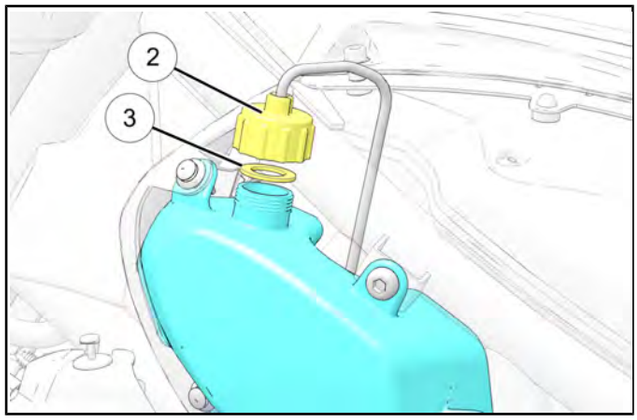
COOLANT RECOVERY BOTTLE REMOVAL / INSTALLATION

Removal

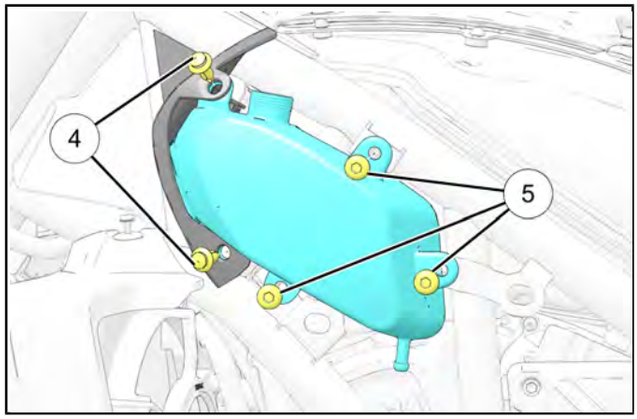
1. Remove the left side air box cover. Reference **Air Box Removal page 3.14**.
2. Remove the recovery bottle hose clamp ① and hose to drain coolant from the bottle.



3. Remove the recovery bottle cap ② and gasket ③.



4. Remove two push pins ④ and three fasteners ⑤ securing recovery bottle.



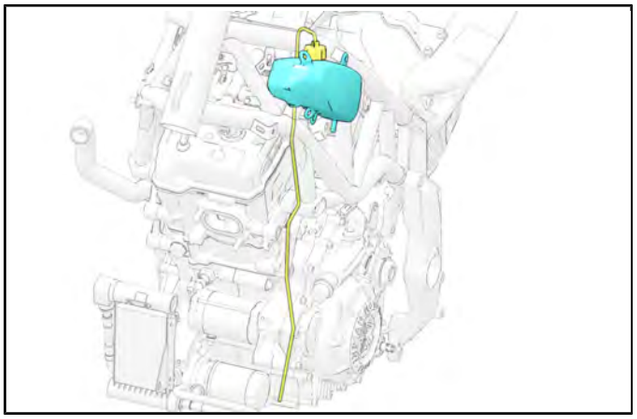
5. Remove recovery bottle.

Installation

1. Installation is performed by reversing the removal procedure.

TORQUE
Coolant Recovery Bottle Fasteners: **36 in-lbs (4 N·m)**

2. Fill the recovery bottle. See **Coolant Drain / Fill page 3.44**.
3. If the recovery bottle vent hose is being replaced, route the line as shown.



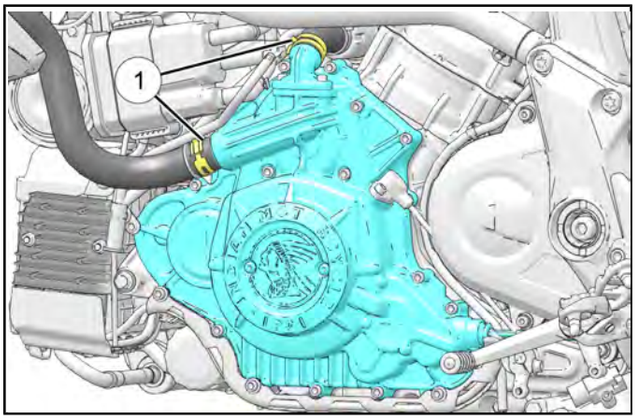
4. Install the left side air box cover. Reference **Air Box Installation page 3.16**.

WATER PUMP REPLACEMENT

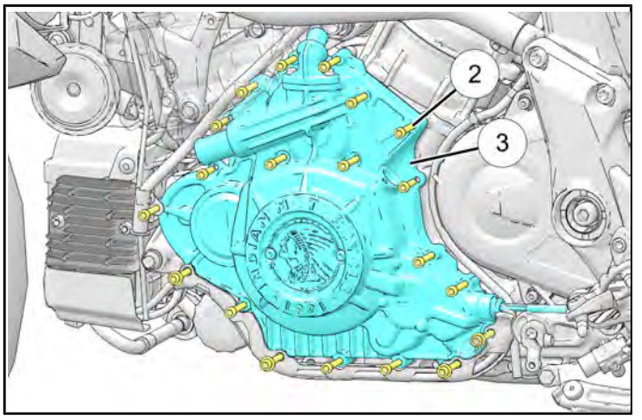
WATER PUMP SEAL REMOVAL AND INSTALLATION

NOTICE
Coolant may be present at the water pump weep hole due to normal water pump function. Verify integrity of the water pump seal with a cooling system pressure test.

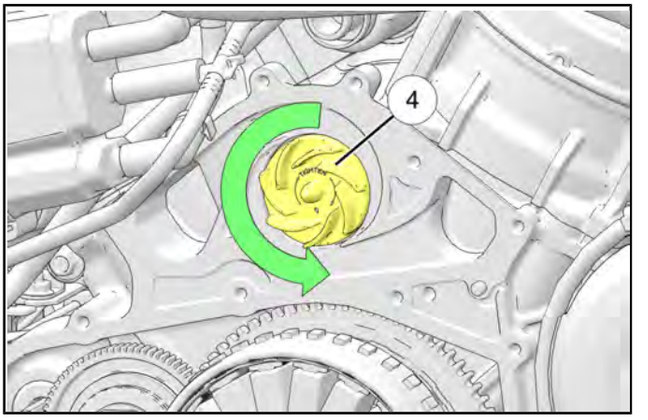
1. Drain cooling system. See **Coolant Drain / Fill page 3.44**.
2. Disconnect coolant bypass return hose ① from the stator cover.



3. Remove the crankshaft position sensor CPS. See **Crankshaft Position Sensor, Test / Replace page 4.53**.
4. Disconnect the stator electrical connector.
5. Remove the nineteen fasteners ② securing the stator cover ③.

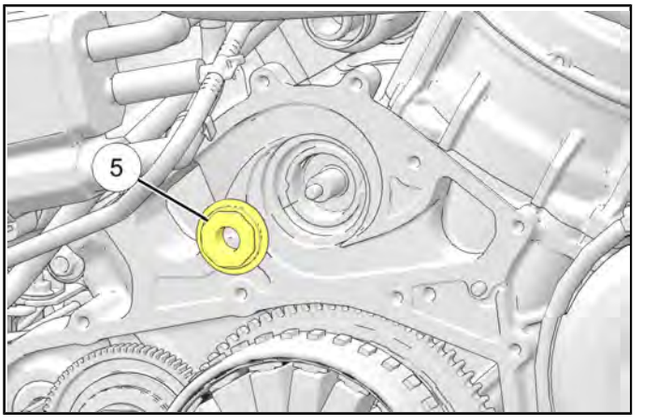


6. Remove water pump impeller ④.



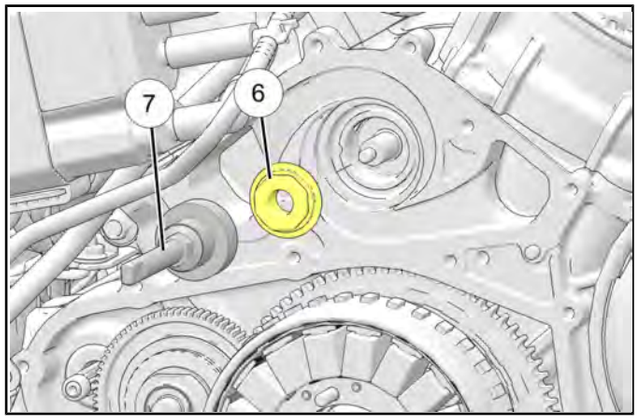
7. Remove the water pump seal assembly ⑤ with a hooked tool or equivalent taking care to not damage the water pump shaft or engine case.

⚠ CAUTION
Do not damage the engine case or sealing surfaces

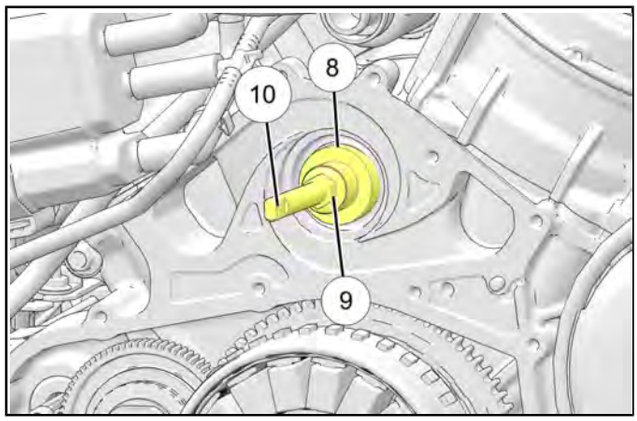


8. Clean the water pump seal bore and inspect the seal bore surfaces for scoring or damage.

9. Install new water pump seal ⑥ in engine case by hand. Thread water pump seal installation tool **PF-51608** ⑦ on the water pump shaft.



10. Use the wrench flats ⑩ to hold the water pump seal installation tool ⑨ from turning while turning the tool wrench hex ⑧ to seat the seal in the bore.



11. Reverse the removal procedure to reassemble. Torque fasteners to specification.

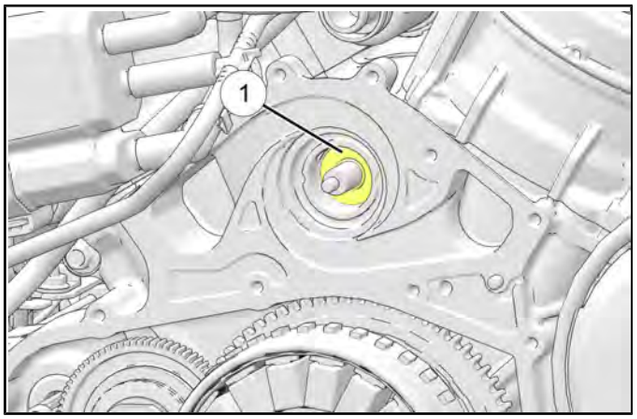
TORQUE
Water Pump Impeller: **17 in-lbs (2 N·m)**

TORQUE
Stator Cover Fasteners: **106 in-lbs (12 N·m)**

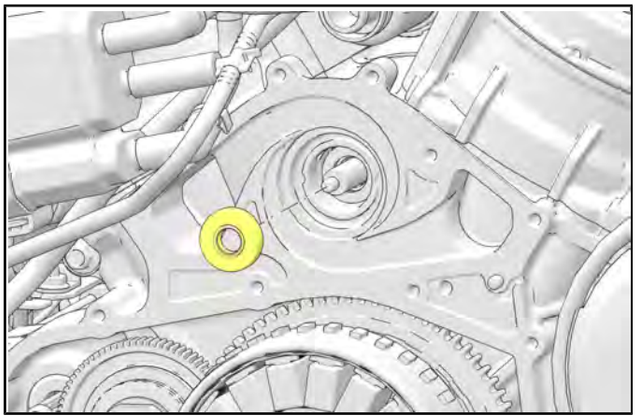
WATER PUMP SHAFT OIL SEAL REPLACEMENT

1. Remove water pump seal. Refer to **Water Pump Seal Removal and Installation**.
2. Remove water pump shaft oil seal ① with a hooked tool or equivalent taking care to not damage water pump shaft or engine case.

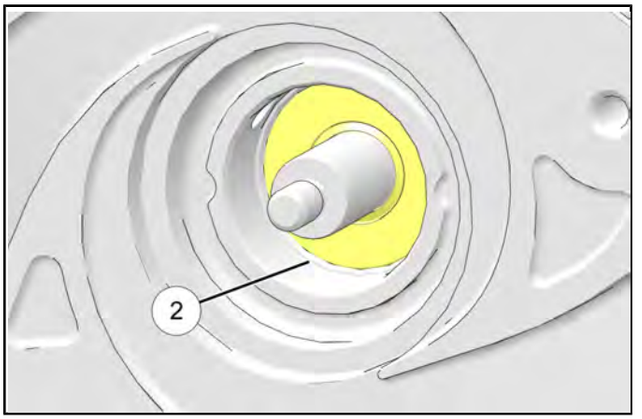
⚠ CAUTION
Do not damage the engine case or sealing surfaces



3. Clean the water pump oil seal bore and inspect the seal bore surfaces for scoring or damage.
4. Align the new water pump shaft oil seal in the engine case and insert with light pressure.



5. Use a suitable driver to install the seal so the outer face is flush with the step ② on the engine case.



6. Install new water pump seal. Refer to **Water Pump Seal Removal and Installation**.
7. Install Stator cover. See **Stator Cover Installation page 5.35**.

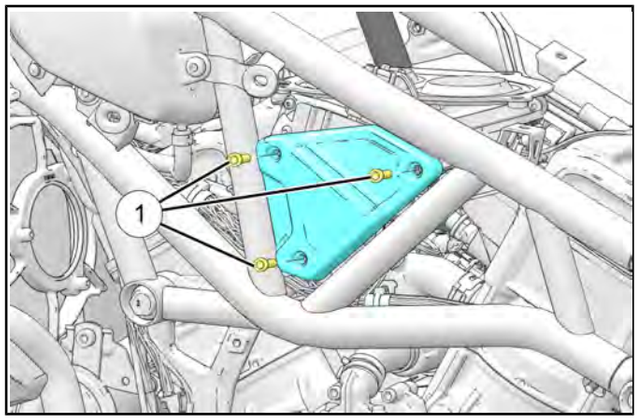
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

THERMOSTAT REPLACEMENT

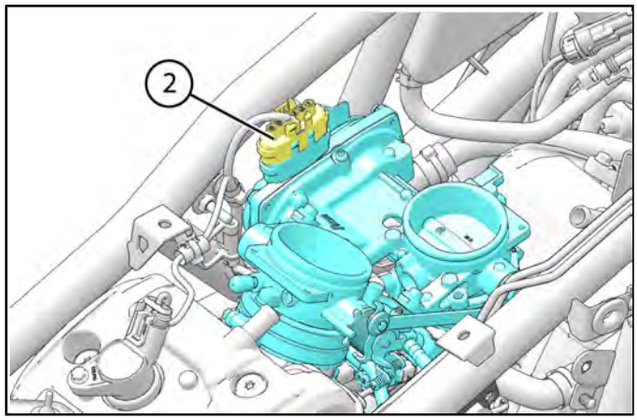
⚠ WARNING

Never remove pressure cap when engine is warm or hot. The cooling system is under pressure and serious burns may result. Allow the engine and cooling system to cool before servicing.

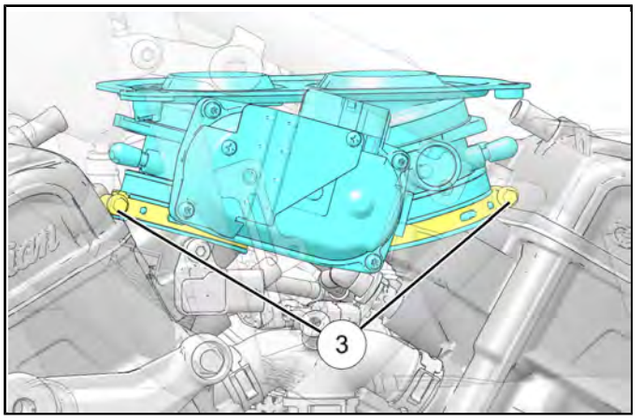
1. Drain Engine coolant see engine coolant. See **Coolant Drain / Fill page 3.44**.
2. Remove air box. See **Air Box Removal page 3.14**.
3. Remove three fasteners ① securing left side v-cover.



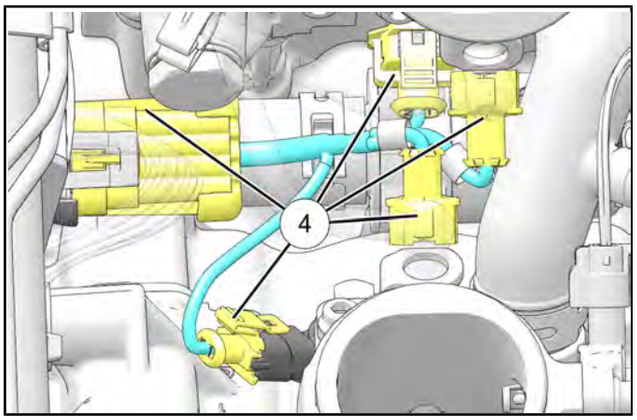
4. Disconnect throttle body electrical connector ②.



5. Disconnect two Evap hoses going into throttle bodies.
6. Remove two hose clamps ③ securing throttle bodies to the engine.

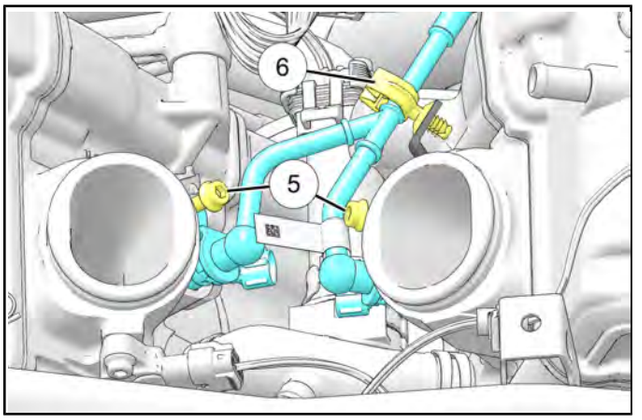


7. Remove the throttle body assembly. Insert a *Clean* shop rag into each cylinder head to prevent debris from entering.
8. Remove the jumper harness by disconnecting its electrical connections ④.

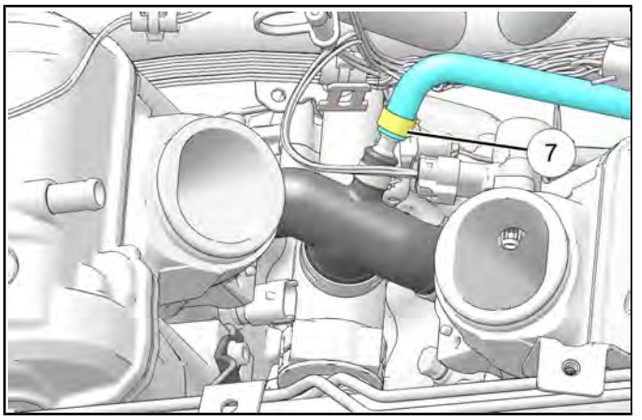


9. Depressurize fuel system. See **Fuel System Depressurization page 4.22**.

10. Remove two fasteners ⑤ securing fuel rail. Disconnect fuel rail from routing clip ⑥ and remove from unit. Cover the fuel injector holes to prevent debris from entering the engine.



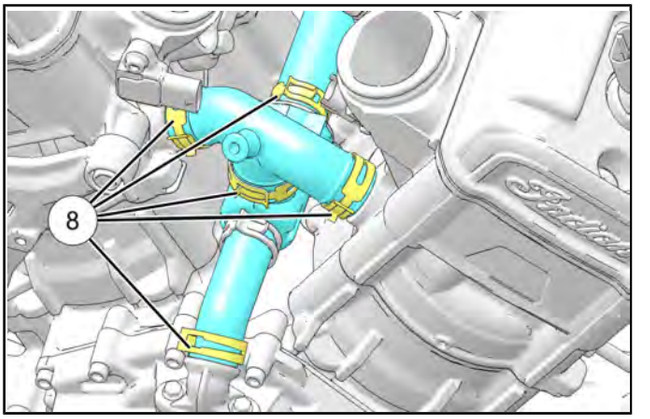
11. Disconnect springband clamp ⑦ securing coolant bleed hose to the coolant junction.



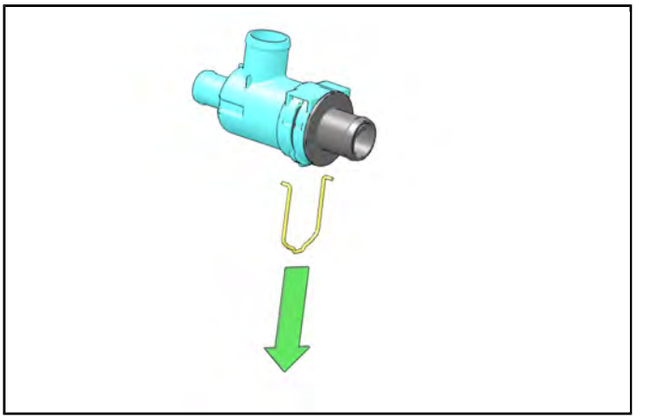
12. Remove the springband clamps ⑧ securing the coolant junction and thermostat housing.

IMPORTANT

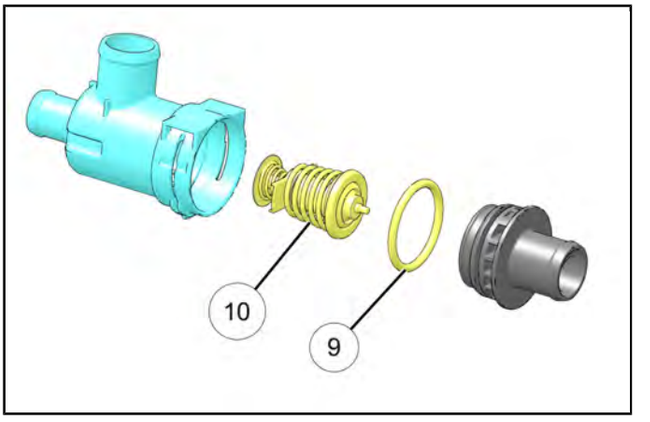
The coolant junction is a single use item that must be replaced if removed from unit.



13. Remove thermostat assembly from the unit.
14. Remove the retainer securing the thermostat assembly to the thermostat port.



15. Remove the thermostat o-ring ⑨ and thermostat ⑩.



16. **Installation is performed by reversing the removal procedure.**

TORQUE
Fuel Rail Fastener: **88 in-lbs (10 N·m)**

TORQUE
Throttle Body Hose Clamp: **17 in-lbs (2 N·m)**

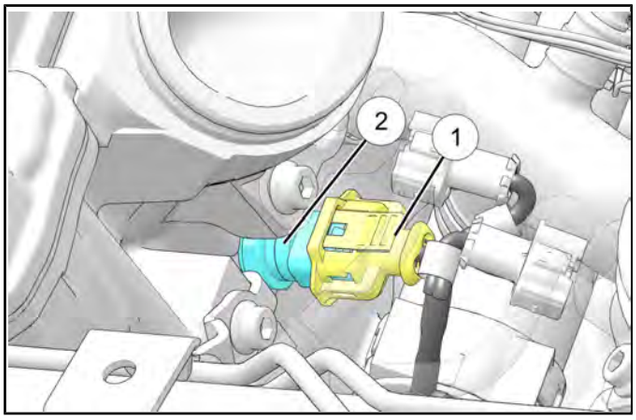
TORQUE
V-Cover Fasteners: **36 in-lbs (4 N·m)**

17. Reinstall air box. See **Air Box Installation page 3.16**.

COOLANT TEMPERATURE SENSOR REPLACEMENT

NOTICE
The coolant temperature sensor is located on the rear cylinder under the intake port. Some component disassembly is required to access the sensor.

1. Prior to removal drain engine coolant. See **Coolant Drain / Fill page 3.44**.
2. Remove air box. See **Air Box Removal page 3.14**.
3. To access the coolant temperature sensor, remove the throttle bodies. See **Throttle Body Assembly Removal / Installation page 4.18**.
4. Disconnect coolant temperature sensor electrical connector ①.



5. Removed the coolant temperature sensor ② from the cylinder head.
6. **Installation is performed by reversing the removal procedure.**

TORQUE
Coolant Temperature Sensor (CTS): **17 ft-lbs (23 N·m)**

7. Reinstall throttle bodies. See **Throttle Body Assembly Removal / Installation page 4.18**.
8. Reinstall air box. See **Air Box Installation page 3.16**.

TROUBLESHOOTING

Overheating

- Low coolant level
- Air in cooling system
- Wrong type/mix of coolant
- Faulty pressure cap or system leaks
- Restricted system (mud or debris in radiator fins causing restriction to air flow, passages blocked in radiator, lines, pump, or water jacket, accident damage)
- Engine running lean (fuel system restriction)
- Fuel pump output weak
- Water pump failure/ Loose impeller
- Engine Coolant Temperature Sensor failure
- Electrical malfunction
- Cooling fan inoperative or turning too slowly
- Low oil level
- Faulty hot lamp circuit
- Thermostat stuck closed or not opening completely

Temperature Too Low

- Thermostat stuck open

Leak at Water Pump Weep Hole

- Faulty water pump mechanical seal
- Worn pump shaft or pump shaft bearing

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

CYLINDER HEAD / VALVES

GENERAL INFORMATION

SERVICE NOTES

- This chapter covers service of the cylinder heads, camshafts, cam chains, tensioners and guides.
- Refer to Engine / Cooling / Exhaust Chapter for engine removal and installation.
- If cylinder heads are removed the cylinder base gasket must be replaced also.
- Mark and store all mating parts for correct engine assembly.
- Use Moly Assembly Paste - P/N: 2871460 or Indian Motorcycle Synthetic 15W60 Engine Oil to lubricate parts where indicated.
- Handle and store all parts in such a way that they will not be damaged or contaminated.
- Some fasteners have a pre-applied locking agent, and must be replaced if loosened or removed. Always replace fasteners that have a pre-applied locking agent or as directed in this service manual.
- There are some precision machining steps to be performed in this section. If you are not sure of your capabilities in these areas, have a competent machinist perform these operations.
- Valve guide and seat reconditioning should be performed by a technician proficient in cylinder head reconditioning techniques using high quality equipment with grinding stones. Do not attempt cylinder head repair without the proper equipment or experience in cylinder head reconditioning techniques.
- The intake and exhaust valves cannot be re-faced.
- Cleanliness of parts is critical to engine life and accurate parts inspection. Use clean solvent to clean all disassembled parts. Dry parts with compressed air and lubricate before engine inspection and engine assembly.

SERVICE NOTES - CAM CHAIN

Read the following tips to ease the removal, installation and timing procedures when servicing the cam chain and / or cylinder head assembly.

- Drain the engine oil prior to servicing the cam chain.
- If the cam chain(s) or cylinder head(s) will be removed, loosen all camshaft sprocket bolts prior to removing tensioners. Loosen exposed camshaft sprocket bolts 1/2 turn, rotate crankshaft to expose remaining bolts and loosen 1/2 turn.
- ALWAYS rotate the crankshaft CLOCKWISE by turning the primary drive Spud. Using a 15/16" wrench.
- Rotate the front piston to TDC on the compression stroke and lock the crankshaft prior to servicing the cam chain(s) / cylinder head(s). See **Locking the Crankshaft for Service page 6.6**.
- DO NOT rotate the crankshaft if one or both of the cam chain tensioners has been removed.

SPECIAL TOOLS - CYLINDER HEAD

TOOL DESCRIPTION	PART NUMBER
Valve Spring Compressor	**Commercially Available**
Crankshaft Locking Tool	PF-51235-A

Bosch Automotive Service Solutions: 1-800-345-2233 or https://polaris.service-solutions.com/

SERVICE SPECIFICATIONS - CYLINDER HEAD

CAMSHAFT DATA

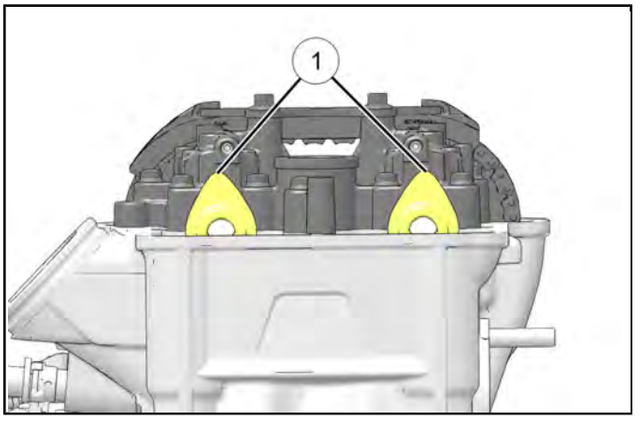
	DESCRIPTION	SPECIFICATION
CAMSHAFT DATA	Valve Train	Over Head Valve / 4 valves per cyl 2 Intake Valve / 2 Exhaust Valve
	Intake Valve Opens At 1 mm Lift	8.0° BTDC
	Intake Valve Closes At 1 mm Lift	222.0° ATDC
	Exhaust Valve Opens At 1 mm Lift	229° BTDC
	Exhaust Valve Closes At 1 mm Lift	1° ATDC
	Max Lobe Lift INTAKE EXHAUST	 .3976" (10.10 mm) .3897" (9.9 mm)
	Max Valve Lift INTAKE EXHAUST	 .3976" (10.10 mm) .3897" (9.9 mm)

CYLINDER HEAD & VALVE TRAIN DATA

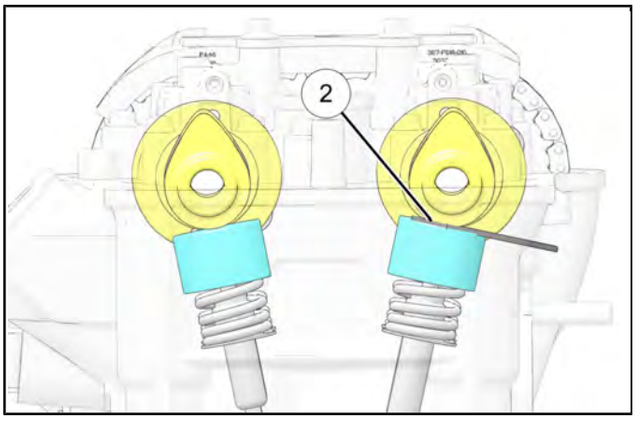
ITEM			STANDARD	SERVICE LIMIT
Cam Chain Tensioner (s)	Hydraulic / Self-Adjusting		-	-
Cam Shaft	Lobe Height	INTAKE	MIN: .9844" (25.003 mm) MAX: .9920" (25.197 mm)	.9745" (24.753 mm)
		EXHAUST	MIN: .9844" (25.003 mm) MAX: .9920" (25.197 mm)	.9745" (24.753 mm)
	Journal O.D. (Exhaust)		MIN: .9038"(22.957 mm) MAX: .9046" (22.978 mm)	.9025" (22.924 mm)
	Journal O.D. (Intake)		MIN: .9038"(22.957 mm) MAX: .9046" (22.978 mm)	.9025" (22.924 mm)
Cylinder Head	Warpage (Distortion)		-	.004" (.10 mm)
Valve, Valve Guide, Valve Seat	Valve Clearance	INTAKE	0.005" ± 0.002" (0.127 mm ± 0.05 mm)	-
		EXHAUST	0.10" ± 0.002" (0.254 mm ± 0.05 mm)	
	Guide Height from Valve Spring Seat (Installed)		11.4 –11.8 mm	-
	Valve Stem O.D.	INTAKE	.2155 — .2161" (5.475 – 5.490 mm)	-
		EXHAUST	.2147 — .2153" (5.455 – 5.470 mm)	
	Valve Stem Deflection (INTAKE & EXHAUST)		-	.005" (.13 mm)
	Valve Seat Width	INTAKE	.0354 - .0432" (.899 - 1.097 mm)	.0551" (1.399 mm)
		EXHAUST	.0551 - .0629" (1.399 - 1.598 mm)	.0748" (1.899 mm)
	Valve Stem Runout		-	.0005" (.013 mm)
	Valve Head Radial Runout		-	.002" (.05 mm)
Valve Spring	Free Length (INTAKE & EXHAUST)		1.9330" (49.1 mm) correct	1.9094" (48.5 mm)
	Intake Valve Maximum Lift		.3976" (10.1 mm)	-
	Exhaust Valve Maximum Lift		.3976" (10.1 mm)	-
	Spring Installed Height		1.3543" (34.4 mm) Correct	-

VALVE CLEARANCE INSPECTION

1. Remove the seat. See **Seat Removal / Installation page 7.19**.
2. Remove the fuel tank. See **Fuel Tank Removal page 4.24**.
3. Remove air box. See **Air Box Removal page 3.14**.
4. Remove valve covers. See **Valve Cover Removal page 3.88**.
5. Remove spark plugs. See **Spark Plug Removal page 3.8**
6. Remove stator cover. See **Stator Cover Removal page 5.35**.
7. Rotate the engine CCW (from flywheel side) until the cam lobes ① are facing away from valves being inspected.



8. Measure the valve clearance at location ② with a feeler gauge.



9. If the valve clearance is out of specification, proceed to "Valve Clearance Adjustment". See **Valve Clearance Adjustment page 3.71**.
10. Repeat steps 8 - 10 on each of the eight valves.
11. If previously removed, apply anti-seize compound to the spark plug threads and reinstall the spark plugs. Torque spark plugs to specification. See **Spark Plug Installation page 3.9**.
12. Inspect the valve cover seal and replace if necessary.
13. Install **NEW** isolators on the valve cover bolts. Install the valve cover and the three T40 bolts. Torque cover bolts to specification. See **Valve Cover Installation page 3.88**
14. Install the air box. See **Air Box Installation page 3.16**.
15. Install the fuel tank. See **Fuel Tank Installation page 4.30**.
16. Install the seat. See **Seat Removal / Installation page 7.19**.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

VALVE CLEARANCE ADJUSTMENT

NOTICE
Consult **Maintenance Intervals page 2.4** .

1. If any of the valve clearance measurements are out of specification, remove the camshaft carriers and camshafts. See steps 1–8 of **Cylinder Head Removal page 3.92** , then proceed with this procedure.

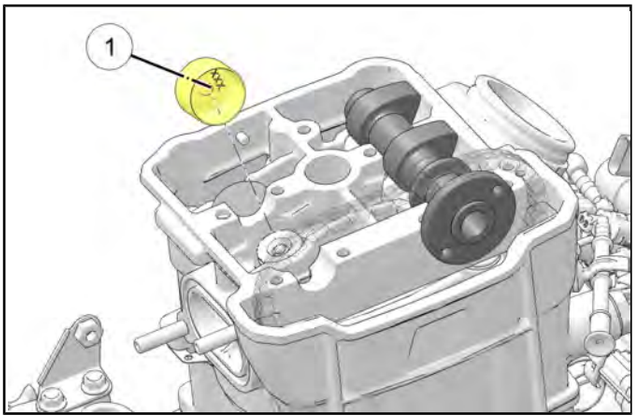
Intake Camshaft - PN 3023340 Exhaust Camshaft - PN 3023339

MEASUREMENT
Intake Valve Clearance (cold): **0.005 in (0.127 mm)** Exhaust Valve Clearance (cold): **0.010 in (0.254 mm)**

2. Remove the valve tappet from a valve that was out of specification.

IMPORTANT
Keep mated parts together and in order with respect to their location in the cylinder head for assembly purposes. Mark each component or place them in an organized rack as you remove them.

3. Record the 3 digit number on the bottom of the tappet ① .



4. Reference the valve clearance measurement recorded for that valve, along with the 3-digit tappet number.
5. Refer to the appropriate tappet selection matrix to select the proper tappet. See **Valve Lash - Tappet Selection page 3.102**.
6. Install the proper tappet.

IMPORTANT
Lubricate the outer portion of the valve tappet upon installation.

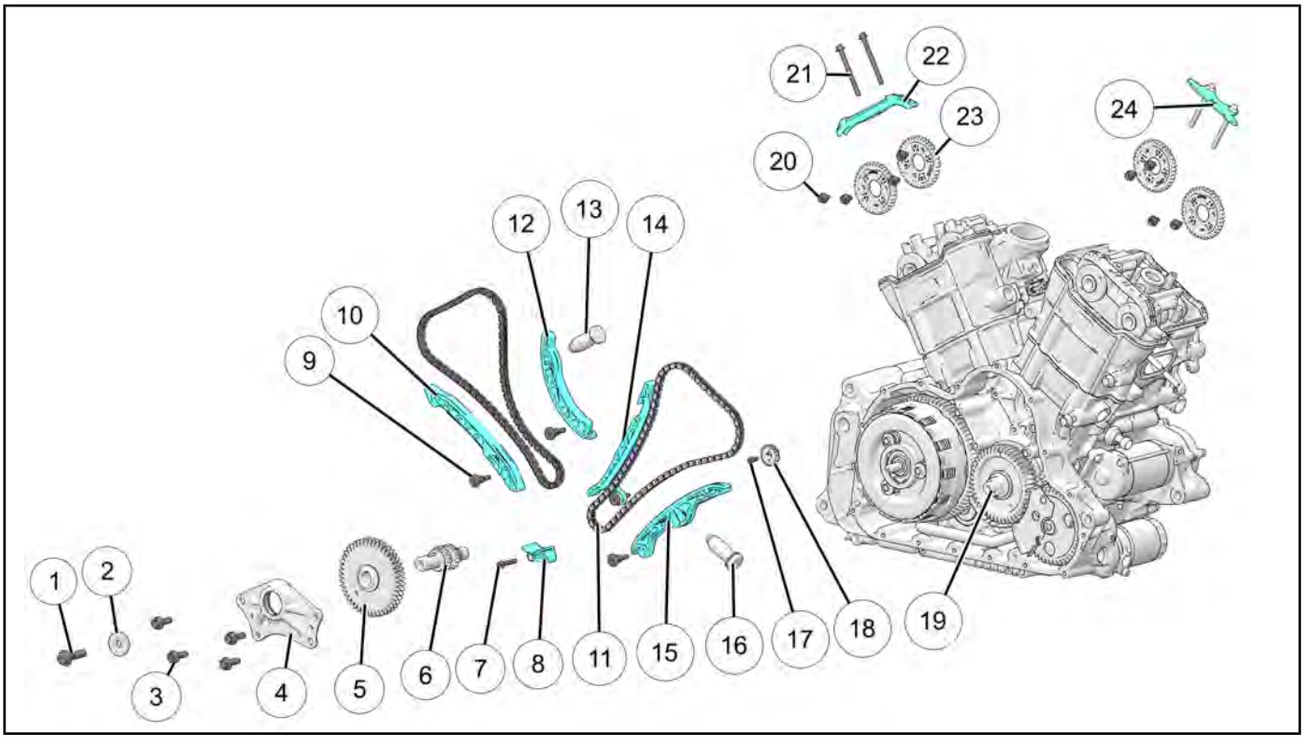
7. Repeat steps 2 - 6 until all necessary valves have been adjusted.
8. Reinstall the camshafts and camshaft carriers and tighten the bolts evenly to specification.

TORQUE
Camshaft Carrier Bolts: **88 in-lbs (10 N·m)**

9. Measure and confirm that valve clearance is now within specification for each valve.
10. If valve clearance is not within specification, repeat this procedure.

ASSEMBLY VIEWS

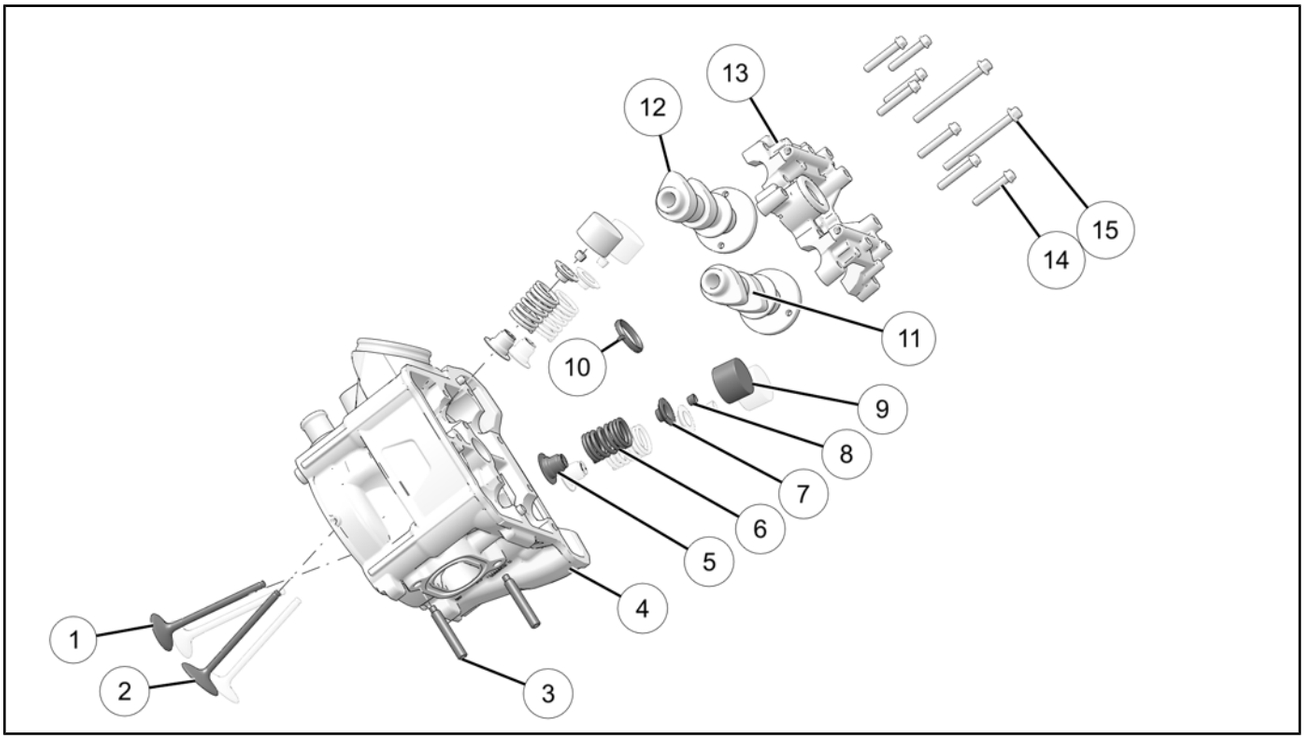
CAM CHAIN COMPONENTS ASSEMBLY VIEW



NUMBER	PART DESCRIPTION	TORQUE (IF APPLICABLE)
①	Cam Drive Fastener	**52 ft-lbs (70 N·m)**
②	Washer	-
③	Bearing Support Fasteners (QTY.4)	**14 ft-lbs (19 N·m)**
④	Bearing Support	-
⑤	Cam Idler Assembly Gear	-
⑥	Cam Drive Shaft Assembly	-
⑦	Cam Chain Lower Guide Fastener	**88 in-lbs (10 N·m)**
⑧	Cam Chain Lower Guide	-
⑨	Cam Chain Fixed Guide Shoulder Bolt	**88 in-lbs (10 N·m)**
⑩	Cam Chain Fixed Rear Guide	-
⑪	Cam Chain	-
⑫	Cam Chain Tensioner Rear Guide	-
⑬	Cam Chain Hydraulic Tensioner (Rear)	**30 ft-lbs (40 N·m)**
⑭	Cam Chain Fixed Front Guide	-
⑮	Cam Chain Tensioner Front Guide	-
⑯	Cam Chain Hydraulic Tensioner (Front)	**30 ft-lbs (40 N·m)**
⑰	Water Pump Driven Gear Fastener	**60 in-lbs (7 N·m)**

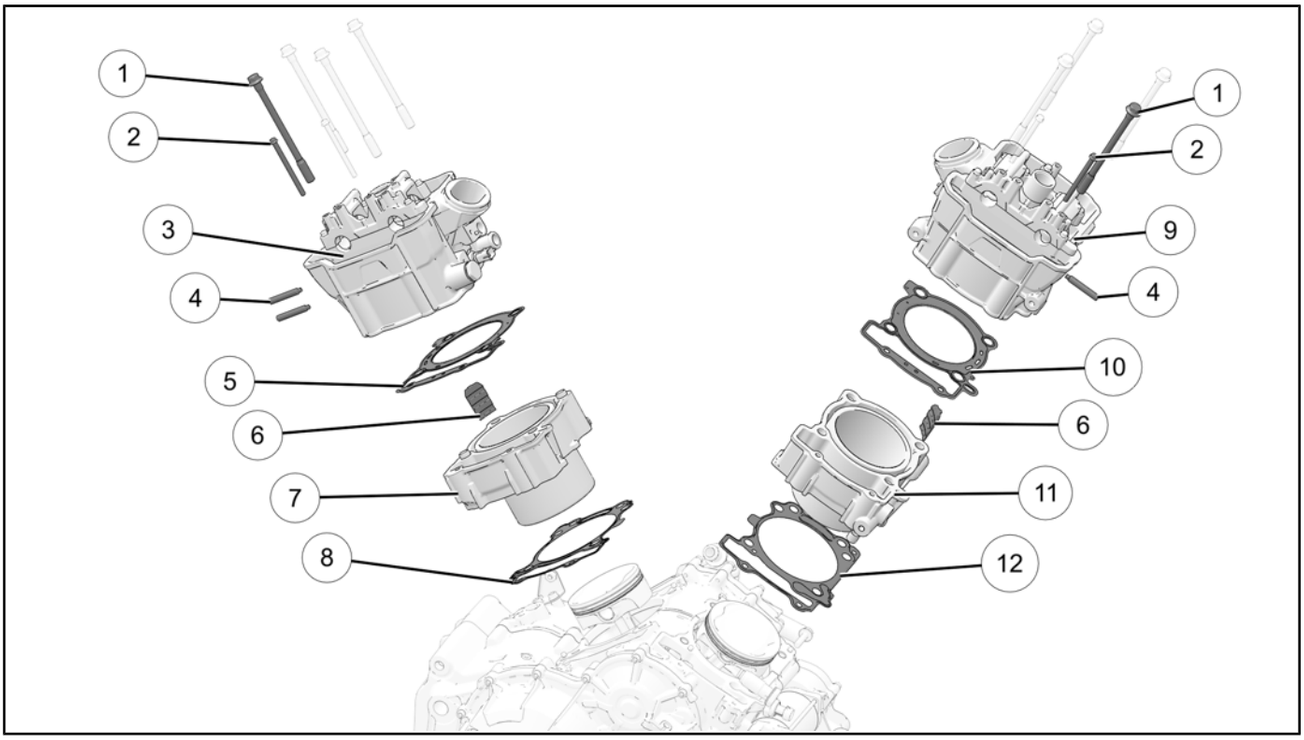
NUMBER	PART DESCRIPTION	TORQUE (IF APPLICABLE)
⑱	Water Pump Driven Gear	-
⑲	Shaft Assembly	-
⑳	Cam Driven Sprocket Fastener	**11 ft-lbs (15 N·m)**
㉑	Cam Chain Guide Fastener (QTY.2)	**88 in-lbs (10 N·m)**
㉒	Cam Chain Fixed Cover Guide (Rear)	-
㉓	Cam Driven Sprocket	-
㉔	Cam Chain Fixed Cover Guide (Front)	-

CYLINDER HEAD / CAMSHAFT ASSEMBLY VIEW



NUMBER	DESCRIPTION	QUANTITY	TORQUE
①	Exhaust Valve	2 per cylinder head	—
②	Intake Valve	2 per cylinder head	—
③	Exhaust Stud	2 per cylinder head	**88 in-lbs (10 N·m)**
④	Cylinder Head Assembly (Front shown)	—	—
⑤	Spring Seat with seal	4 per cylinder head	—
⑥	Valve Spring	4 per cylinder head	—
⑦	Valve Retainer	4 per cylinder head	—
⑧	Valve Keeper	8 per cylinder head	—
⑨	Valve Tappet	1 per valve	—
⑩	Cam Carrier Seal	1 per cylinder head	—
⑪	Intake Camshaft	1 per cylinder head	—
⑫	Exhaust Camshaft	1 per cylinder head	—
⑬	Camshaft Carrier	1 per cylinder head	—
⑭	Cam Carrier Bolt (Short)	7 per cylinder head	**88 in-lbs (10 N·m)**
⑮	Cam Carrier Bolt (Long)	2 per cylinder head	**88 in-lbs (10 N·m)**

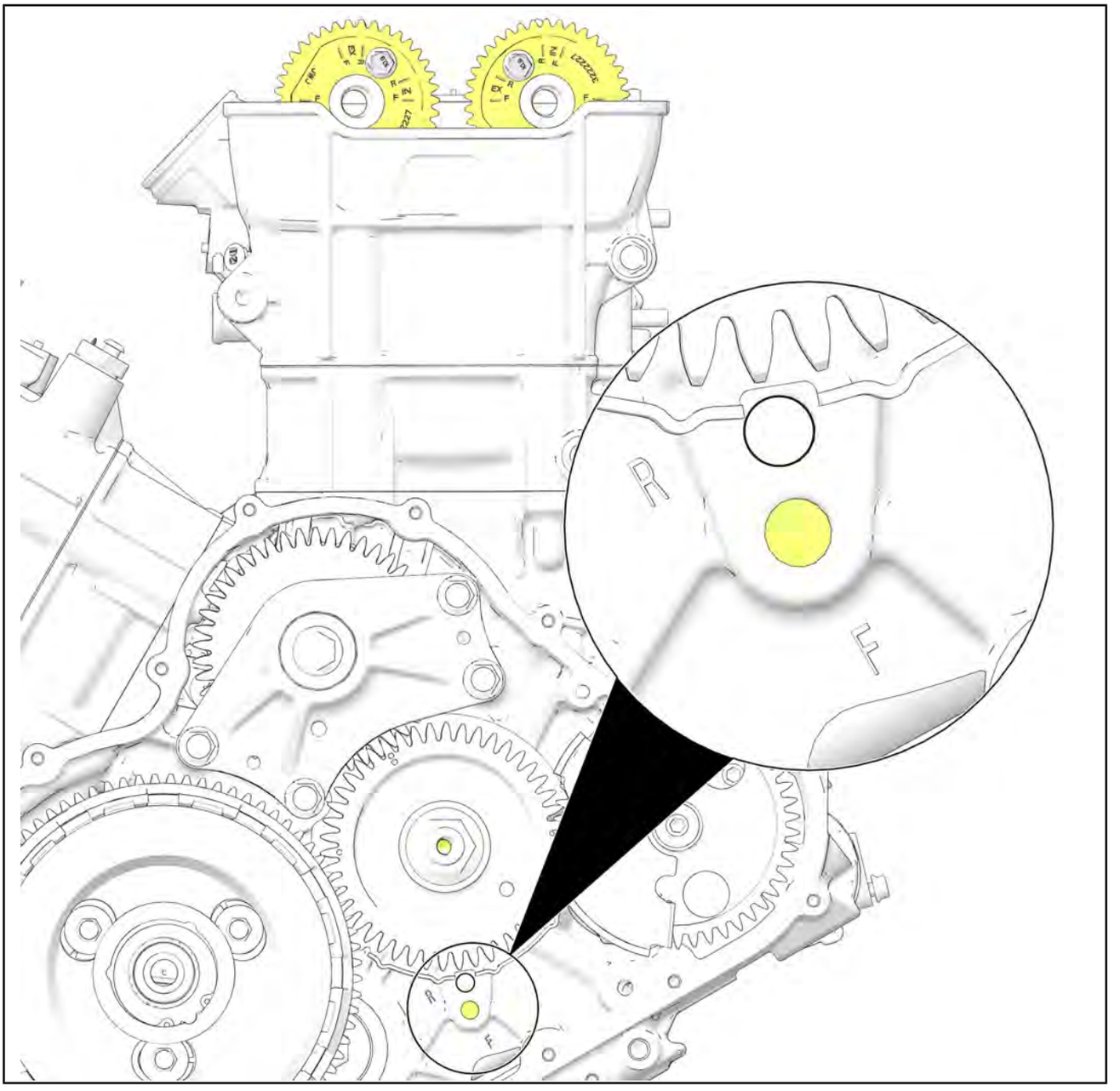
CYLINDER HEAD ASSEMBLY VIEW



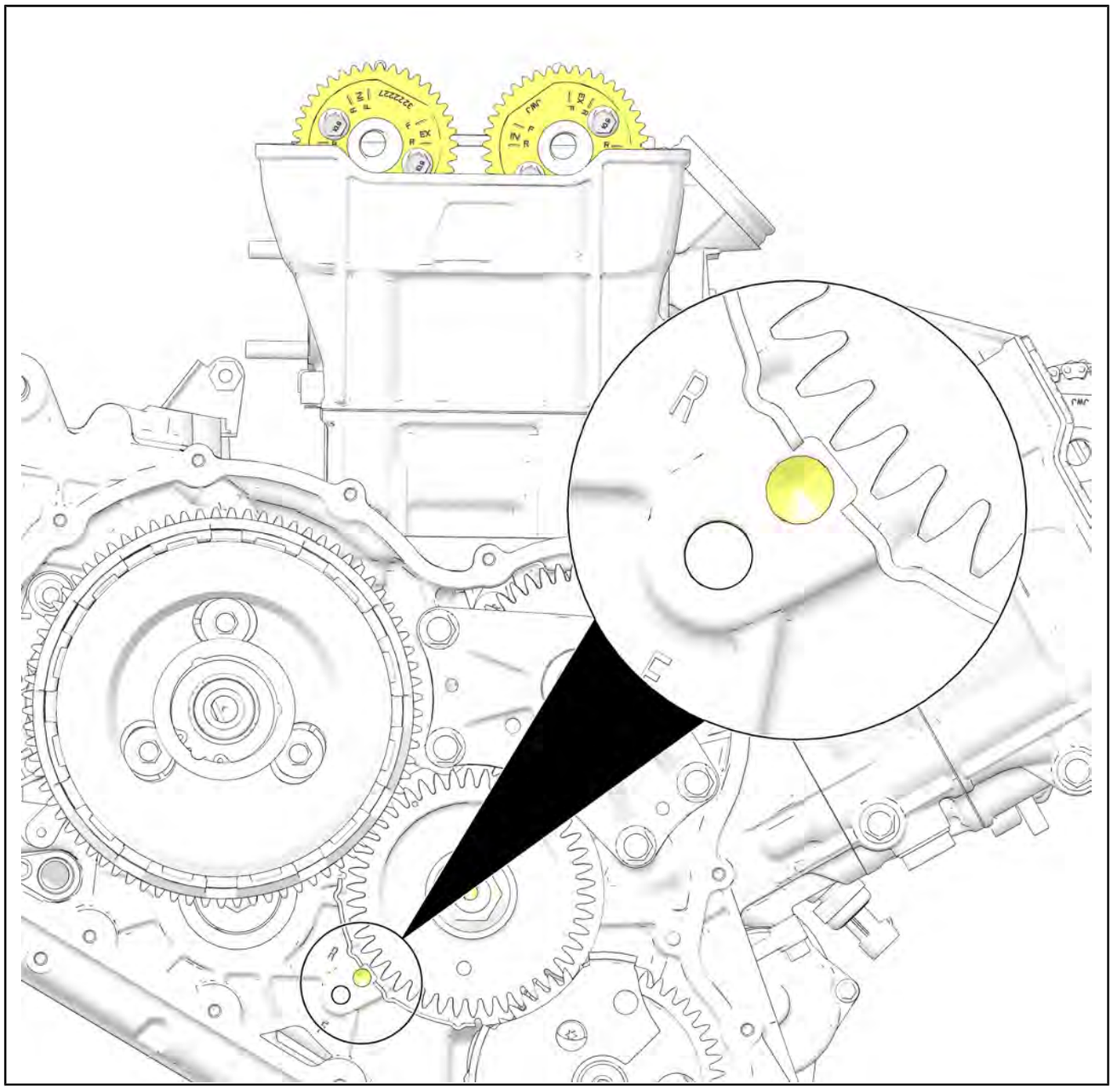
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Cylinder Head Fastener (M11)	**Step 1: Torque all fasteners to 18 ft-lbs (25 N·m) in sequence specified** **Step 2: Torque all fasteners to 30 ft-lbs (40 N·m) in sequence specified** **Step 3: Loosen all fasteners, until they are unseated, in sequence specified** **Step 4: Torque all fasteners to 15 ft-lbs (20 N·m) in sequence specified** **Step 5: Torque all fasteners to 26 ft-lbs (35 N·m) in sequence specified** **Step 6: Angle tighten all fasteners 180 degrees in sequence specified** **Step 7: Angle tighten all fasteners another 180 degrees in sequence specified.**
②	Cylinder Head Fastener (M6)	**88 in-lbs (10 N·m)**
③	Rear Cylinder Head ASM	–
④	Exhaust Stud	**88 in-lbs (10 N·m)**
⑤	Rear Cylinder Head Gasket	–
⑥	Coolant Diverter	–
⑦	Rear Cylinder	–
⑧	Rear Cylinder Base Gasket	–
⑨	Front Cylinder Head ASM	–
⑩	Front Cylinder Head Gasket	–
⑪	Front Cylinder	–
⑫	Front Cylinder Base Gasket	–

CAMSHAFT TIMING MARKS

Camshaft Timing Front Cylinder



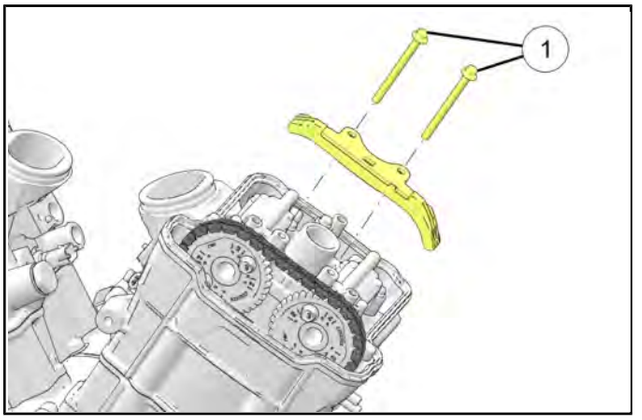
Camshaft Timing Rear Cylinder



CAM CHAIN SERVICE

CAM CHAIN GUIDE (UPPER), REMOVAL

1. Remove air box. See **Air Box Removal page 3.14**.
2. Remove valve cover(s). See **Valve Cover Removal page 3.88**.
3. Remove screws ① and lift guide off of cylinder head.



CAM CHAIN TENSIONER REMOVAL

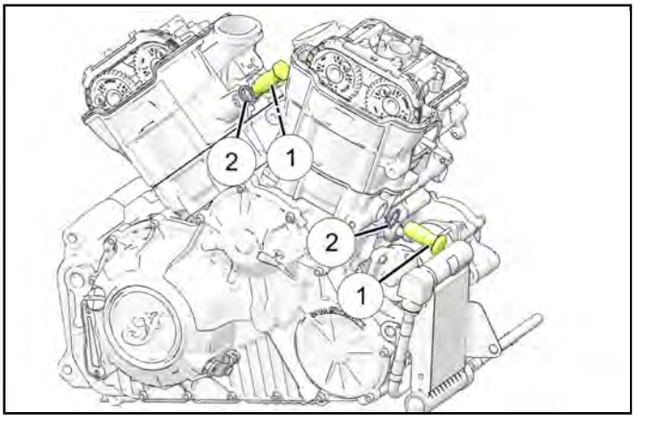
⚠ CAUTION

Do not rotate engine with tensioner(s) removed.

IMPORTANT

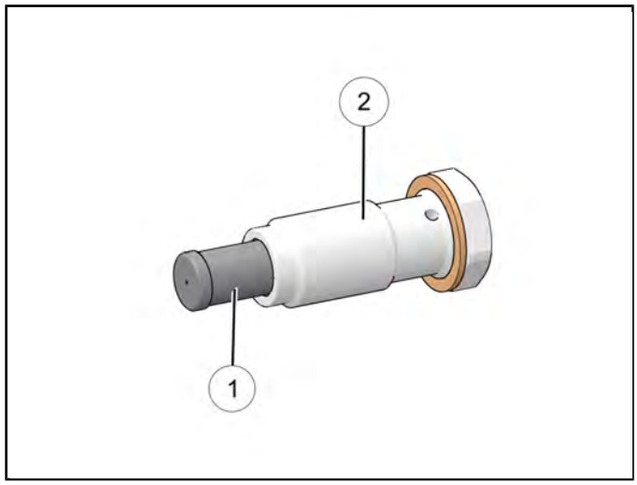
Protection has been built into the cam chain guide system to prevent the chain from jumping time with the tensioner(s) removed if the engine remains static. This does not guarantee the chain will not jump time with tensioner(s) removed. Do NOT rotate the crankshaft with tensioner(s) removed or the chain may jump time. This is the only way to guarantee the cam chain timing is correct upon reassembly.

1. Remove valve covers. See **Valve Cover Removal page 3.88**.
2. Lock the crankshaft for service with the front piston at TDC on the compression stroke. See **Locking the Crankshaft for Service page 6.6**.
3. Remove the cam chain tensioners ① and sealing washers ②.



CAM CHAIN TENSIONER INSPECTION

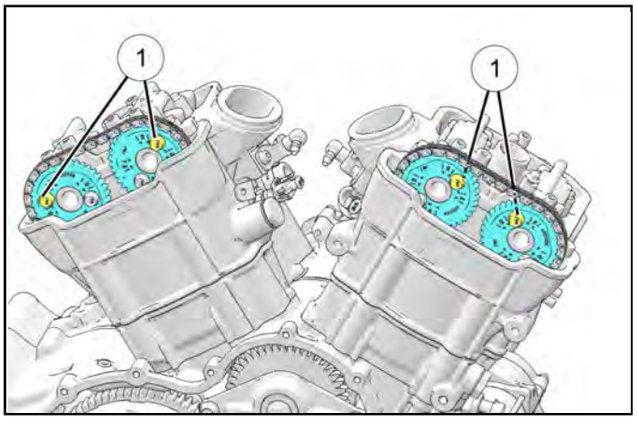
1. Visually inspect inner plunger ① for damage, scoring or burns.
2. Lubricate inner plunger with engine oil. Move plunger in and out of outer plunger ② to check for smooth movement without binding.
3. Verify the oil passage opening is free from debris.
4. Replace tensioner assembly if worn or damaged.



CAMSHAFT SPROCKET REMOVAL

1. Place motorcycle in an upright position with front wheel clamped in a wheel vise.
2. Drain engine oil and dispose of properly.
3. Remove valve cover(s). See **Valve Cover Removal page 3.88**.
4. Remove the primary cover. See **Primary Cover Removal page 5.16**.
5. Remove upper cam chain guide(s). See **Cam Chain Guide (upper), Removal page 3.78**.
6. Rotate the crankshaft to expose sprocket bolts ① and loosen 1/2 turn.

NOTICE
Use a piece of nylon webbing or rope to create an interference between the crank drive gear and clutch gear, thus locking the crankshaft while loosening sprocket bolts.



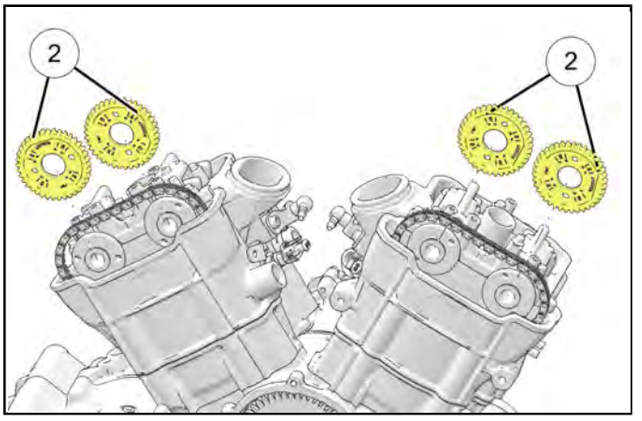
7. Repeat step 6 for remaining camshaft sprocket bolts.
8. Rotate crankshaft so the front piston is TDC on the compression stroke and lock in position. See **Locking the Crankshaft for Service page 6.6**.
9. Remove the cam chain tensioner(s). See **Cam Chain Tensioner Removal page 3.78**.

⚠ CAUTION
Do not rotate the crankshaft with tensioner(s) removed. Engine damage may occur.

10. Remove the camshaft sprocket bolts completely.

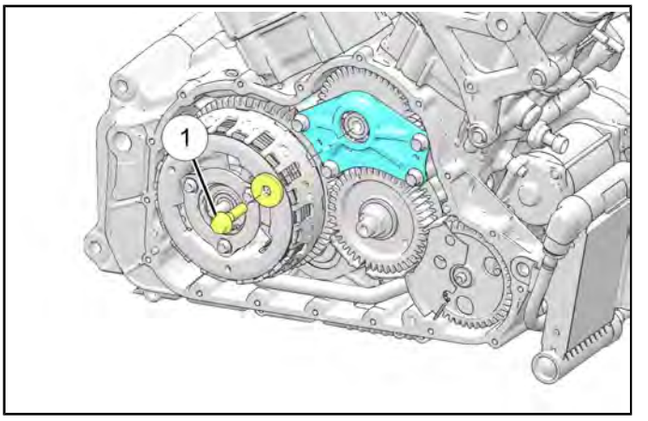
IMPORTANT
It will be necessary to use a thin 10mm spanner to remove the sprocket bolts that are not exposed. The bolts cannot be completely removed until the sprocket is out of the cylinder head.

11. Remove sprocket(s) ② from camshaft(s) using care not to drop the chain into the cam chain gallery.

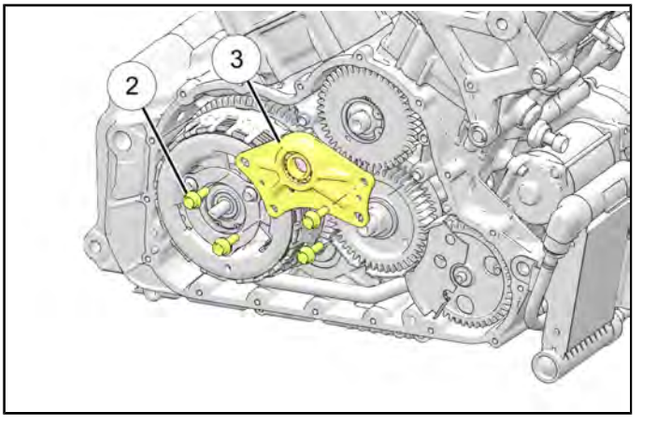


CAM DRIVE SPROCKET REMOVAL

1. Lock the crankshaft for service. See **Locking the Crankshaft for Service page 6.6**.
2. Remove bolt and washer ① securing cam drive gear to cam drive shaft.

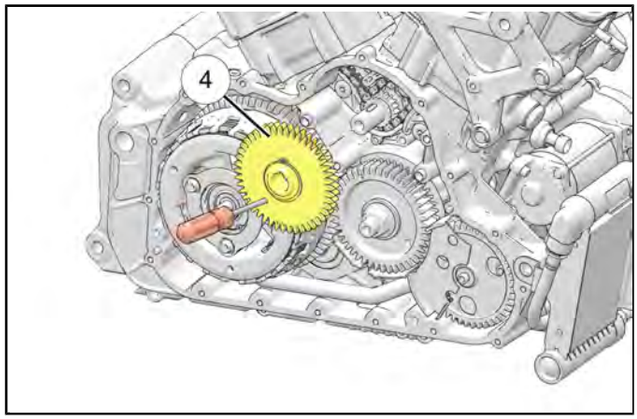


3. Remove four bolts ② securing the cam drive carrier to the crankcase.



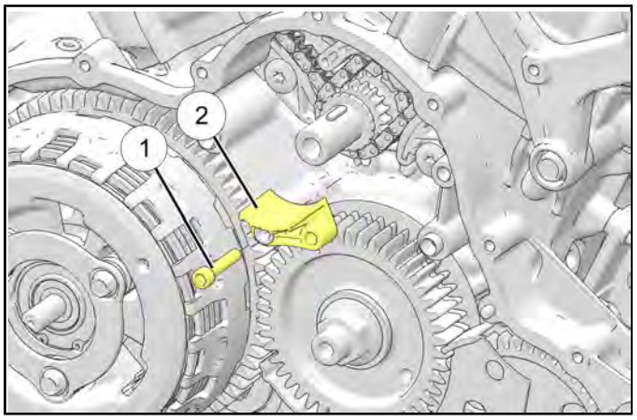
4. Remove the cam drive carrier ③ from the crankcase assembly.

5. Using a pin punch or similar tool, release the preload from the split gear teeth and slide the cam drive gear ④ off of the cam drive shaft.

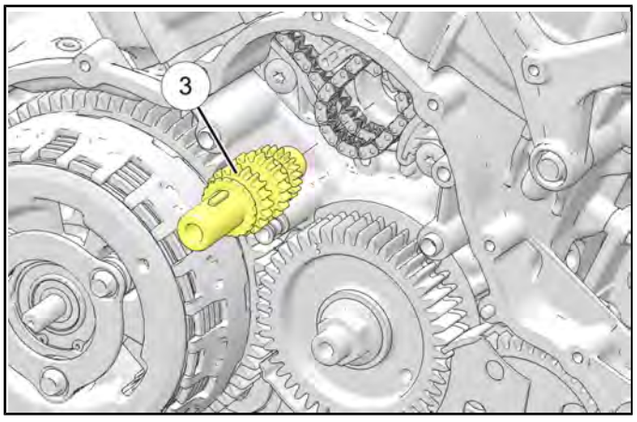


CAM DRIVE SHAFT REMOVAL

1. Remove the camshaft sprockets. See **Camshaft Sprocket Removal page 3.79**.
2. Remove the cam drive sprocket. See **Cam Drive Sprocket Removal page 3.80**.
3. Remove the screw ① securing the cam chain guide ② from the crankcase assembly.

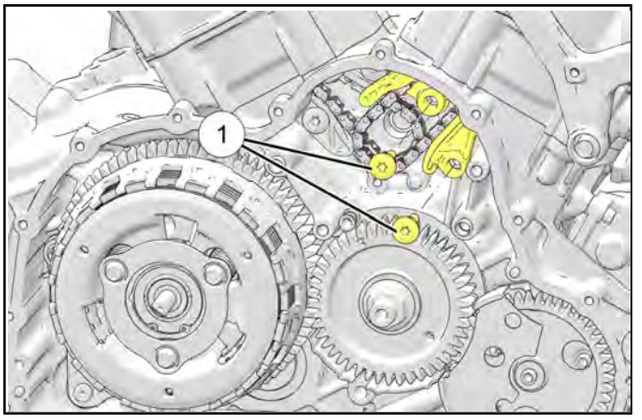


4. Slack the cam chains enough to remove the cam drive shaft ③ and slide out of bearing bore to remove.

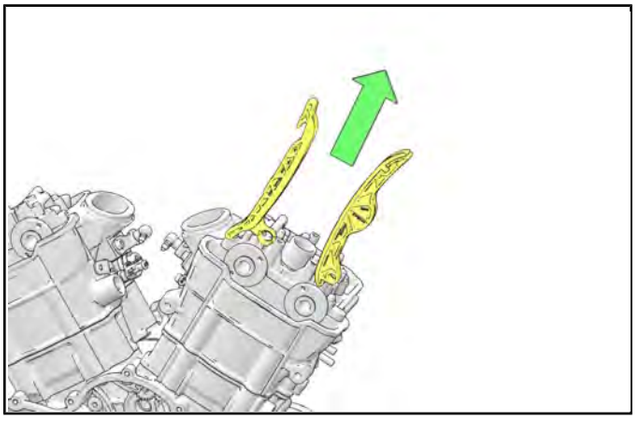


CAM CHAIN GUIDE (LOWER), REMOVAL

1. Remove camshaft sprockets. See **Camshaft Sprocket Removal page 3.79**.
2. Start with the front cylinder and remove bolts ① from the guides.



3. Remove the guide(s) through the top of the cylinder head.



4. Repeat steps 1 and 2 for the rear cam chain guides.

CAM CHAIN REMOVAL

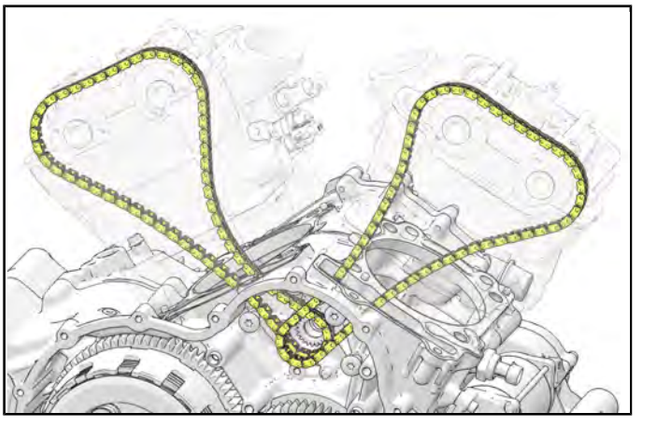
1. Remove the cam drive shaft. See **Cam Drive Shaft Removal page 3.81**.
2. Remove lower cam chain guides. See **Cam Chain Guide (lower), Removal page 3.82**.
3. Lift cam chain(s) out of engine.

CAM CHAIN INSTALLATION

⚠ CAUTION

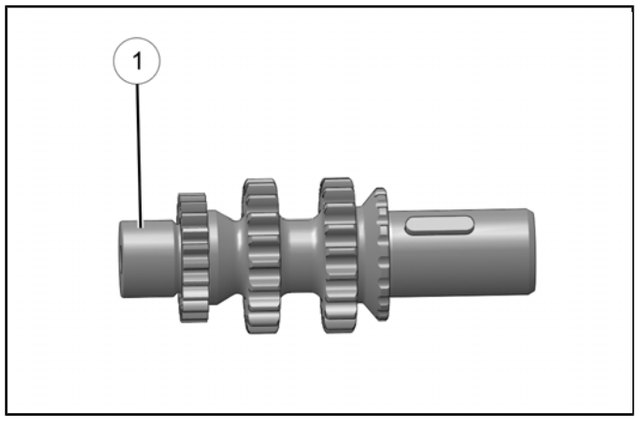
The engine used in this models is an INTERFERENCE ENGINE. If the camshafts and crankshaft must be turned independently of each other to set valve timing, the camshafts must be set to TDC prior to rotating the crankshaft. Failure to do this may cause the pistons to contact the valves resulting in engine damage.

1. Feed the cam chain(s) in through the top of the cylinder head(s) keeping the front chain on the outside (right side) of the rear chain.
2. Lay the chains over the camshaft hubs or hang them in position using string to keep them from falling into the crankcase.



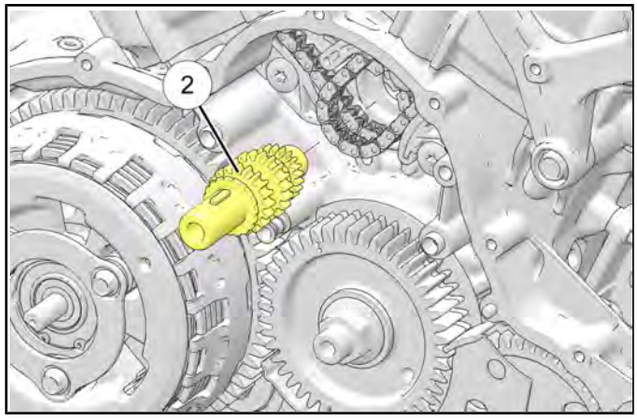
CAM DRIVE SHAFT INSTALLATION

1. Apply a thin coat of assembly lube to the bearing end of the cam drive shaft ①.

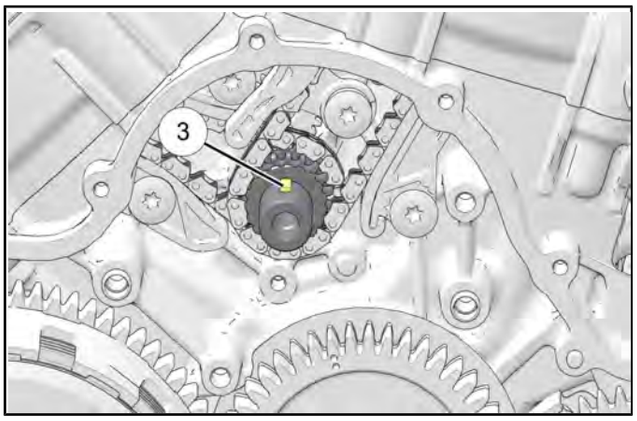


2. Install the cam drive shaft ②:

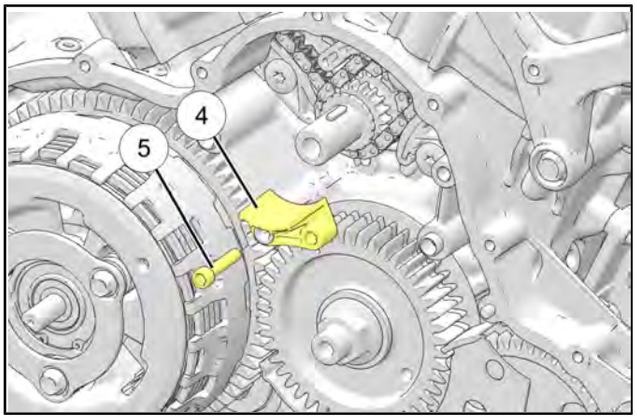
- Loop cam chains around respective sprockets
- Engage water pump gear teeth with cam drive shaft
- Slide cam drive shaft into bearing bore until fully seated



3. Turn the cam drive shaft so the key ③ is pointing at 12 o'clock.



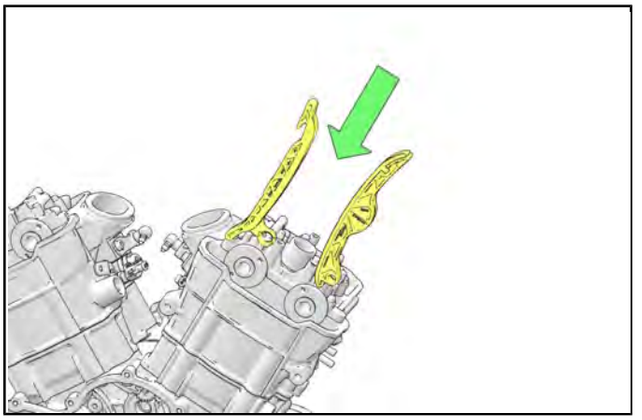
4. Install the cam chain guide ③ and torque screw ④ to specification.



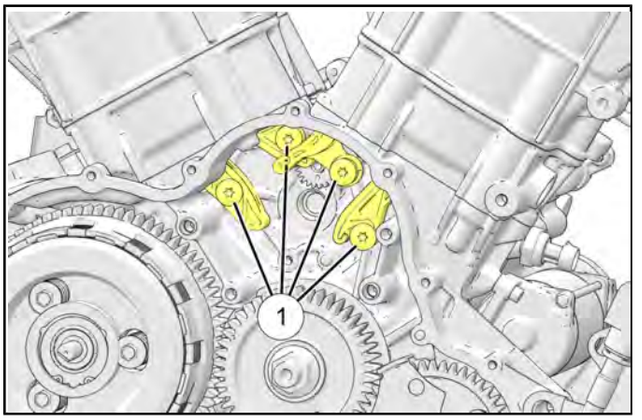
TORQUE
Cam Chain Fixed Guide Shoulder Bolt: **88 in-lbs (10 N·m)**

CAM CHAIN GUIDE (LOWER), INSTALLATION

1. Inspect the guides to verify the guide face isn't cracked or grooved from the chain. Replace guides if damaged.
2. Lower the guides into position through the top of the cylinder head(s).



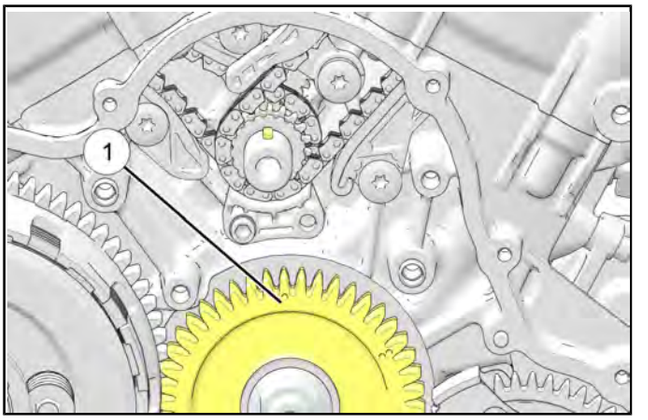
3. Starting with the rear cylinder, hand-tighten the screws ① until seated and torque to specification.



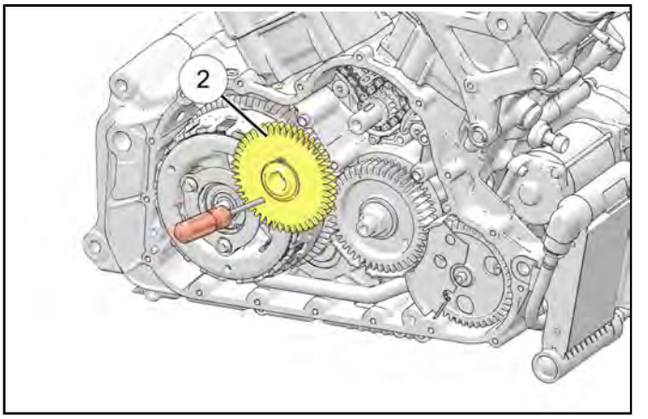
TORQUE
Cam Chain Fixed Guide Shoulder Bolt: **88 in-lbs (10 N·m)**

CAM DRIVE SPROCKET INSTALLATION

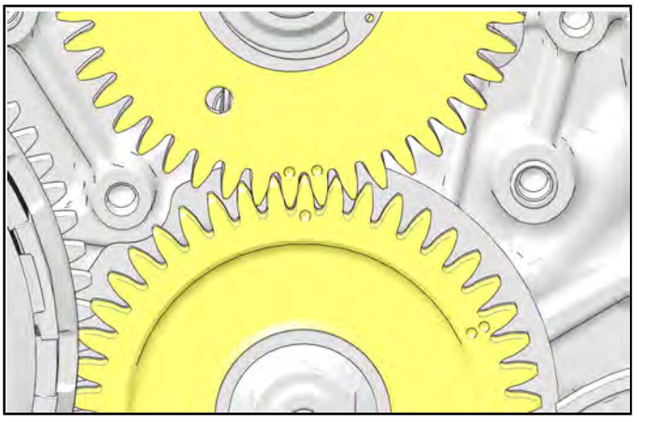
1. Rotate the primary drive gear so the timing mark① is pointing at 12 o'clock.



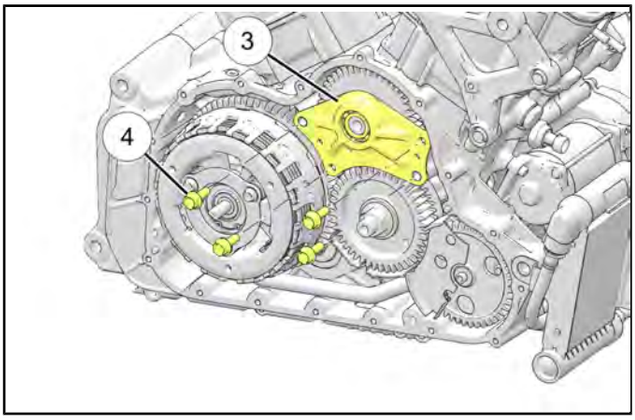
2. Lock the crankshaft in position for service. See **Locking the Crankshaft for Service page 6.6**.
3. Using a small screw driver ② or equivalent, preload the gear teeth of the cam drive sprocket.



4. Align the timing marks on the primary gear and cam drive sprocket as shown and slide the cam sprocket onto the cam drive shaft.

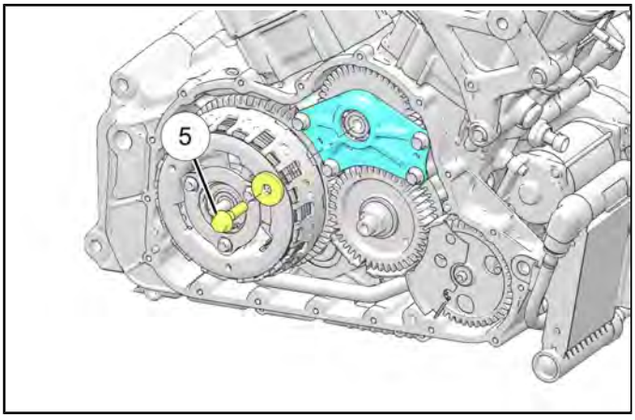


5. Slide the cam bearing support plate ③ into position and ensure it is aligned with the dowels. Hand tighten the four fasteners ④ until seated. Torque fasteners to specification.



TORQUE
Bearing Support Fasteners: **14 ft-lbs (19 N·m)**

6. Install the bearing support plate center fastener ⑤ and washer. Torque to specification.



TORQUE
Cam Drive Fastener: **52 ft-lbs (70 N·m)**

CAMSHAFT SPROCKET INSTALLATION / TIMING PROCEDURE

IMPORTANT
Camshaft sprockets are interchangeable (identical for all camshafts) and drilled offset so that they cannot be installed incorrectly. Letters / Timing Marks on sprockets will appear right-side up if timed correctly and the respective cylinder is at TDC. See **Camshaft Timing Marks page 3.76** for camshaft timing marks.

⚠ CAUTION
DO NOT rotate crankshaft / primary drive gear counterclockwise while timing the camshafts.

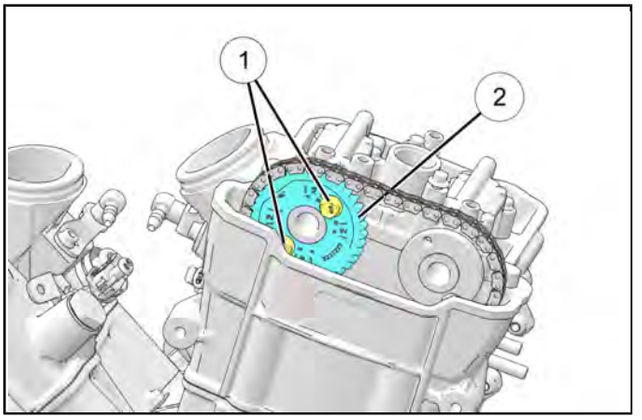
1. Lock the crankshaft so that the front piston is at TDC. See **Locking the Crankshaft for Service page 6.6**.
2. Install the cam sprockets on the camshafts, torque fasteners to spec.

IMPORTANT
Threaded holes in camshaft hubs must be free from oil and debris.

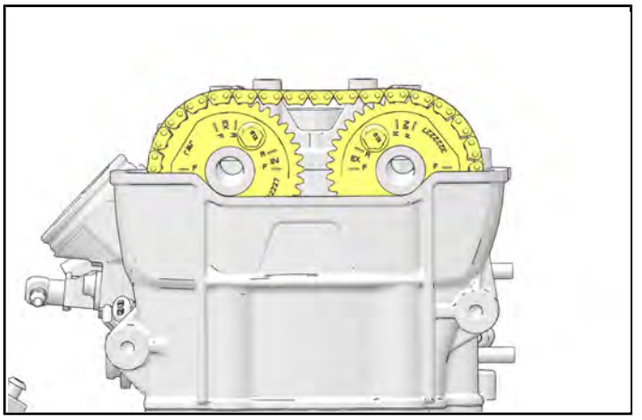
TORQUE
Cam Drive Sprocket Fasteners: **11 ft-lbs (15 N·m)**

3. Starting with the front cylinder, take up all chain slack on the INTAKE side.
4. Install the INTAKE camshaft, engaging the chain around the sprocket and taking the slack out between the sprockets.

5. Verify that the timing marks ② line up with the top of the head with the chain installed and drive gear to intake cam sprocket slack removed. The marks aligned should indicate INT and F, for INTAKE – FRONT.



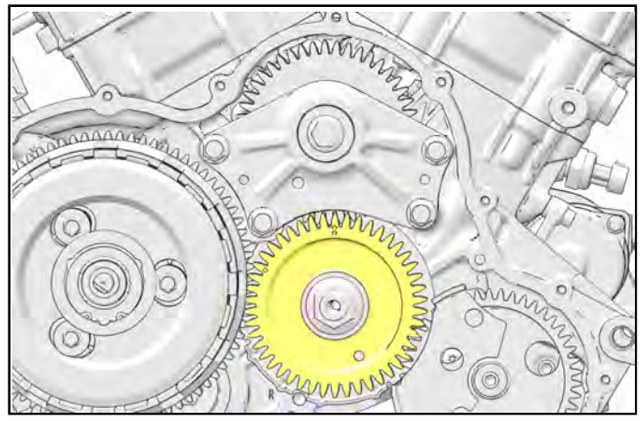
6. Install the EXHAUST cam. Verify the marks on the EXHAUST cam that are aligned with the flat top of the head are EXH and F, for EXHAUST – FRONT.
7. Verify the timing marks on both sprockets align with the machined valve cover gasket surface when slack is removed from the INTAKE side of the chain.



8. Install the front cylinder upper chain guide.

TORQUE
Cam Chain Guide Fastener (upper): **88 in-lbs (10 N·m)**

9. Install the front cam chain tensioner and torque to specification. See **Cam Chain Tensioner Installation page 3.87**.
10. Supporting the rear cam chain, remove the crankshaft locking pin, rotate the crankshaft 300° (CLOCKWISE) and re-lock the crankshaft with the rear piston in the TDC position. See **Locking the Crankshaft for Service page 6.6**.
11. The single dot timing mark on the primary drive gear will be at approximately 10 o'clock.



12. Take up the slack on the EXHAUST side of the cam chain. Lay it over the EXHAUST sprocket and install the cam in the head.
13. Verify that the timing marks line up with the top of the head with the chain installed and drive gear to intake cam sprocket slack removed. The marks aligned should indicate EXH and R, for EXHAUST – REAR.
14. Install the INTAKE camshaft, engaging the chain around the sprocket and taking the slack out between the sprockets.
15. Verify that the timing marks line up with the top of the head with the chain installed and drive gear to EXHAUST cam sprocket slack removed. The marks aligned should indicate INT and R, for INTAKE – REAR.
16. Install the rear cylinder cam carrier. Torque bolts to specification.

TORQUE
Camshaft Carrier Bolt: **88 in-lbs (10 N·m)**

17. Install the rear cylinder upper chain guide.

TORQUE
Camshaft Chain Guide Fastener (upper): **88 in-lbs (10 N·m)**

18. Install the rear cam chain tensioner and torque to specification. See **Cam Chain Tensioner Installation page 3.87**.
19. Rotate the crankshaft two times and stop on TDC of both cylinders to verify that the timing marks still match up and that the engine turns freely.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

CAM CHAIN TENSIONER INSTALLATION

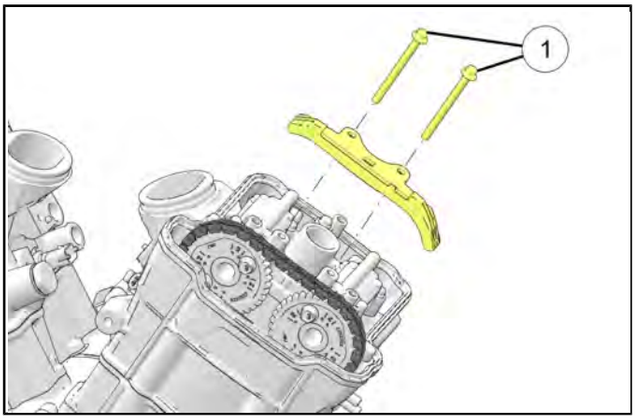
1. Verify that the engine is at TDC and the timing marks are properly aligned. See **Camshaft Timing Marks page 3.76**.
2. Install the tensioner(s) with new sealing washers and torque to specification.
3. Install tensioner bolt and torque to specification.

TORQUE
Cam Chain Hydraulic Tensioner: **30 ft-lbs (40 N·m)**

CAM CHAIN GUIDE (UPPER), INSTALLATION

1. Install guide(s) and torque screws ① to specification.

TORQUE
Cam Chain Guide Fasteners (upper): **88 in-lbs (10 N·m)**

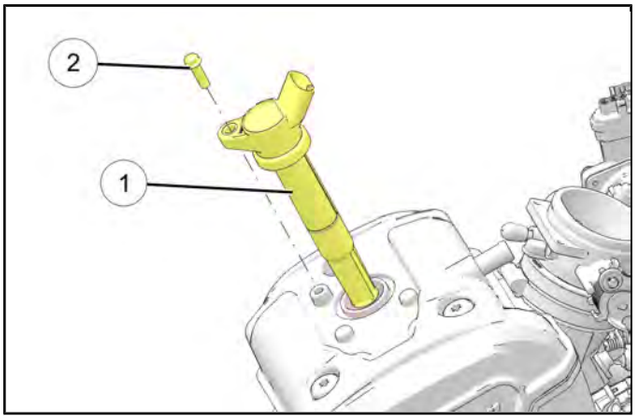


2. Install valve cover(s). See **Valve Cover Installation page 3.88**.

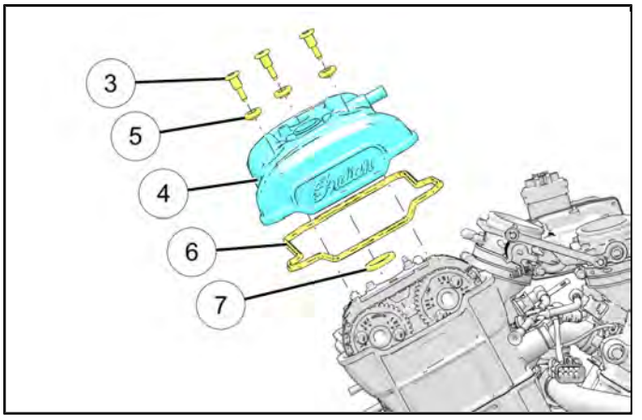
CYLINDER HEAD SERVICE

VALVE COVER REMOVAL

1. Remove seat. See **Seat Removal / Installation page 7.19**.
2. Remove fuel tank. See **Fuel Tank Removal page 4.24**.
3. Remove airbox. See **Air Box Removal page 3.14**.
4. Disconnect ignition coil electrical connector.
5. Remove ignition coil ① by removing its fastener ②.



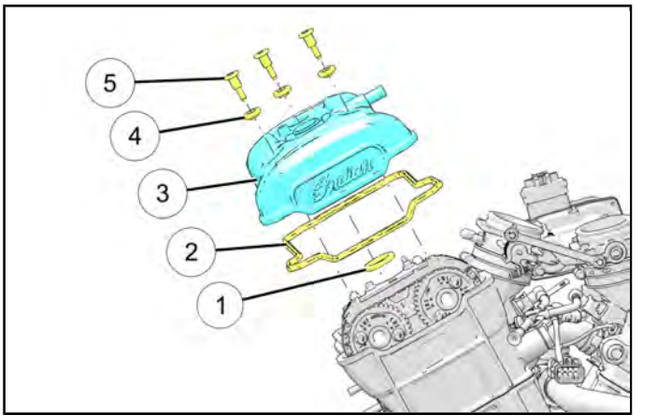
6. Remove three valve cover fasteners ③.



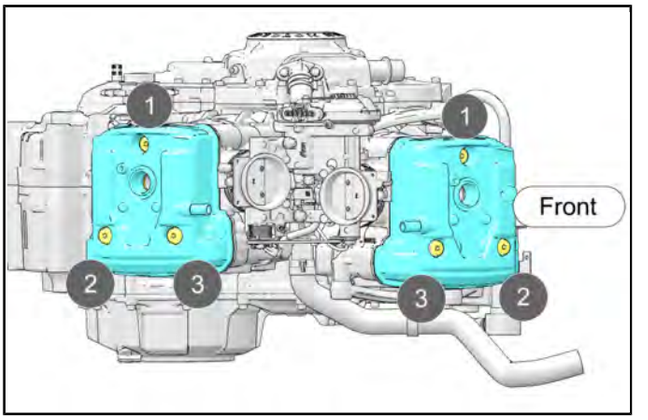
7. Remove the valve cover ④ .
8. Discard and replace the valve cover isolators ⑤, gasket seal ⑥, and spark plug tube seal ⑦.

VALVE COVER INSTALLATION

1. Install the new spark tube seal ① onto the cylinder head.



2. Install the valve cover ③ with new gasket ②.
3. Install *New* isolators ④ and lubricate with engine oil. Hand tighten three valve cover fasteners ⑤.
4. Reference torque sequence for valve cover fasteners.



TORQUE
Valve Cover Fasteners: **88 in-lbs (10 N·m)**

5. Reinstall ignition coil and fastener.

TORQUE
Ignition Coil Fastener: **88 in-lbs (10 N·m)**

6. Reinstall air box. See **Air Box Installation page 3.16**.

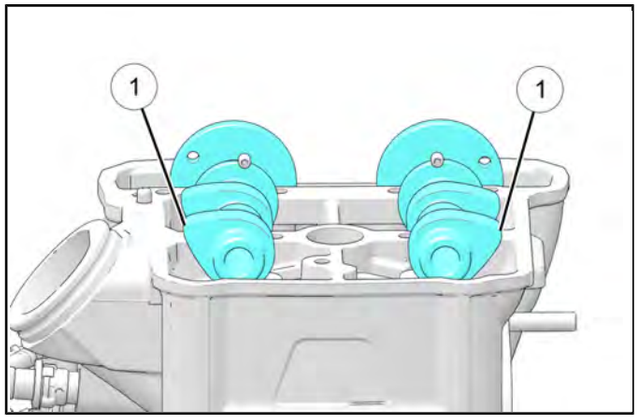
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

VALVE CLEARANCE ASSEMBLY

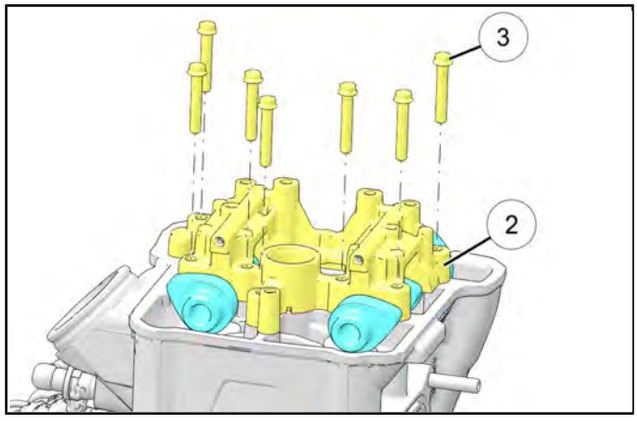
IMPORTANT

Always inspect valve clearance prior to camshaft installation or final engine assembly.

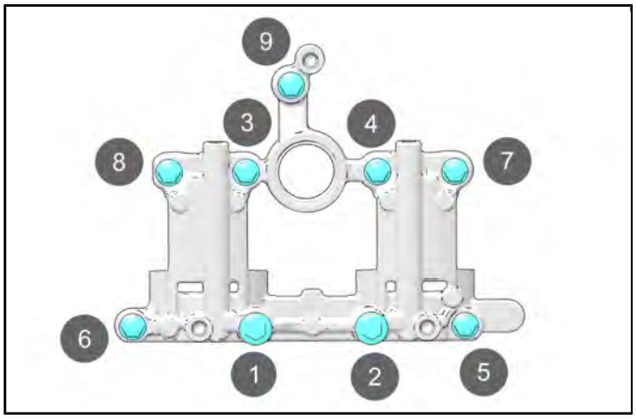
1. Reference the camshaft intake and exhaust markings made during disassembly.
2. Lubricate the camshaft bearing journal surfaces and lobe surfaces with assembly lube prior to installation.
3. Carefully install the camshafts into the cylinder head. The camshaft lobes ① should be positioned as shown.



4. Install *New* spark plug tube seal.
5. Carefully install the camshaft carrier ② onto the camshafts.



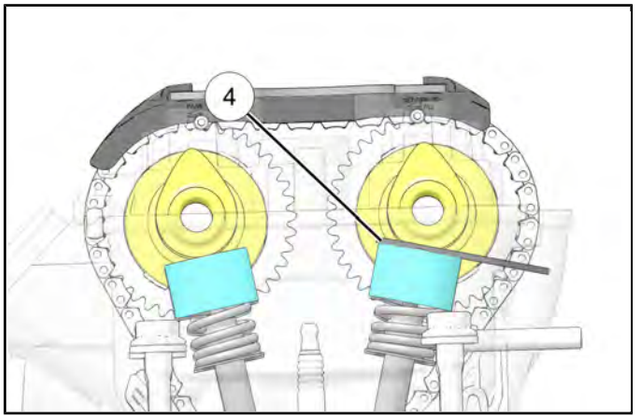
6. Install the camshaft carrier bolts ③. Torque fasteners in sequence as shown.



TORQUE

Camshaft Carrier Fasteners (short & long):
88 in-lbs (10 N·m)

7. Rotate the camshaft until the cam lobe above the valve being inspected is facing up.
8. Measure the valve clearance using a thickness (feeler) gauge ④. Record the measurement if clearance is out of specification.



9. Repeat steps 6 and 7 until all eight valves have been inspected.

MEASUREMENT

Intake Valve Clearance (cold): **0.005 in (0.127 mm) +/- 0.001 in (0.0254 mm)**
Exhaust Valve Clearance (cold): **0.010 in (0.254 mm) +/- 0.001 in (0.0254 mm)**

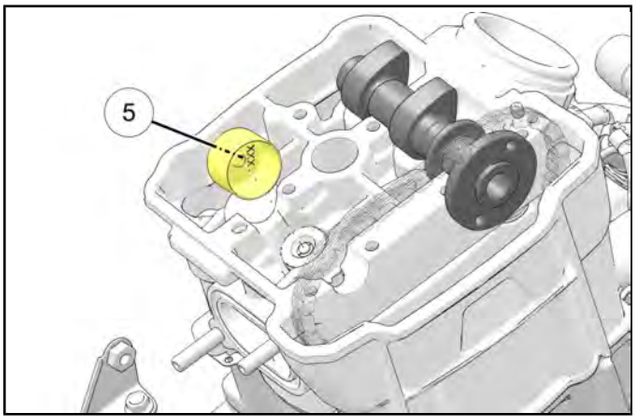
10. If any of the valve clearance measurements are out of specification, remove the camshaft carriers and camshafts and proceed with this procedure.

NOTICE
If all valve clearance measurements are within specification proceed to **Camshaft Sprocket Installation / Timing Procedure page 3.85**.

11. Remove the valve tappet from a valve that was out of specification.

IMPORTANT
Keep mated parts together and in order with respect to their location in the cylinder head for assembly purposes. Mark each component or place them in an organized rack as you remove them.

12. Record the 3 digit number ⑤ on the bottom of the tappet.



13. Reference the valve clearance measurement recorded for that valve, along with the 3-digit tappet number.
14. Refer to the appropriate tappet selection matrix (Intake or Exhaust) on the following pages and select the proper tappet.
15. Install the proper tappet.

IMPORTANT
Lubricate the outer portion of the valve tappet upon installation.

16. Repeat steps 10-14 until all necessary valves have been adjusted.
17. Reinstall the camshafts and camshaft carriers and tighten the bolts evenly to specification.

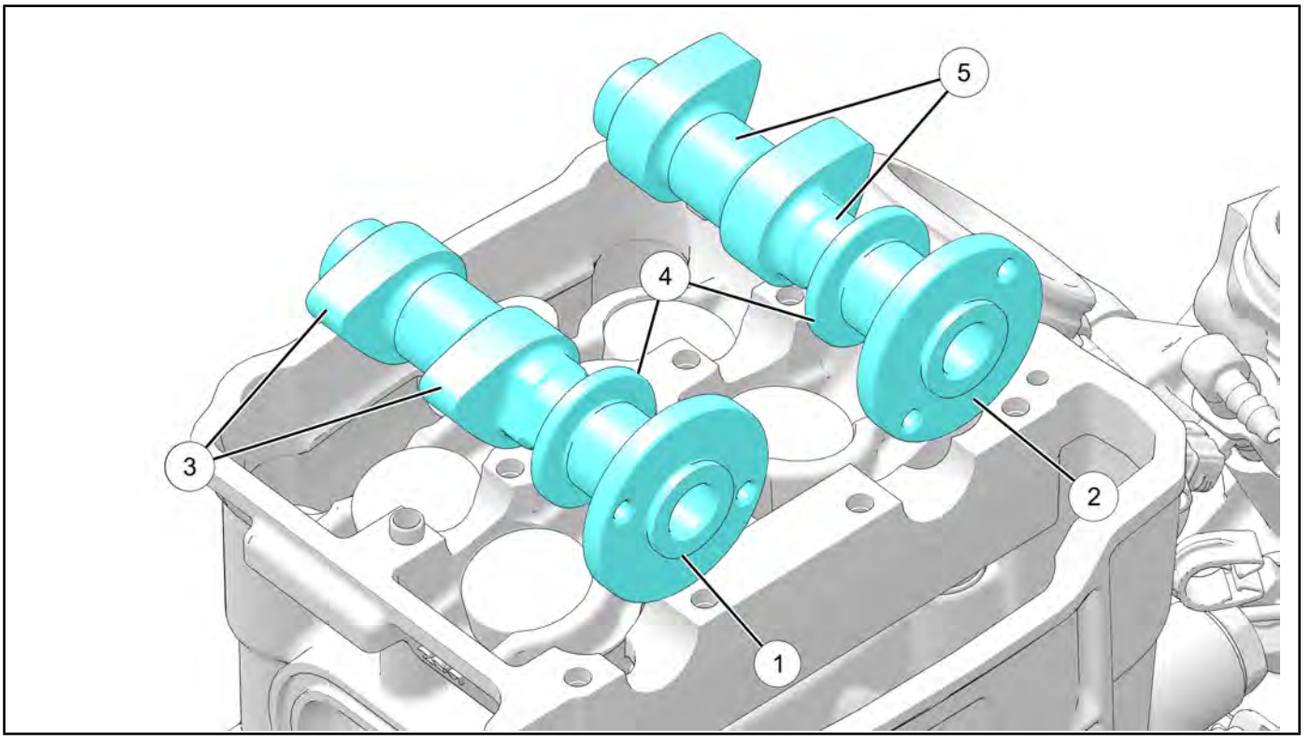
TORQUE
Camshaft Carrier Fasteners (short & long): **88 in-lbs (10 N·m)**

18. Measure and confirm that valve clearance is now within specification for each valve.
19. If valve clearance is not within specification, repeat this procedure.
20. If all valve clearance measurements are now within specification, proceed to **Camshaft Sprocket Installation / Timing Procedure page 3.85**.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

CAMSHAFT INSPECTION

For the following camshaft inspection procedure, refer to the camshaft service specifications section. See Service Specifications - Cylinder Head page 3.68.



NUMBER	DESCRIPTION
①	Exhaust Camshaft
②	Intake Camshaft
③	Cam Lobes
④	Thrust Face
⑤	Bearing Journals

1. Visually inspect camshaft journal surfaces for scoring or signs of insufficient lubrication. Replace camshaft if heavy scoring or damage is noted.
2. Inspect height of each cam lobe for INTAKE and EXHAUST camshafts.
3. Measure O.D. of each camshaft journal for INTAKE and EXHAUST camshafts.
4. Inspect the camshaft hub face for damage or surface roughness.
5. Inspect camshaft thrust face(s) for uneven wear and scoring.
6. Wash the camshaft in solvent.
7. Oil the camshaft.

CYLINDER HEAD REMOVAL

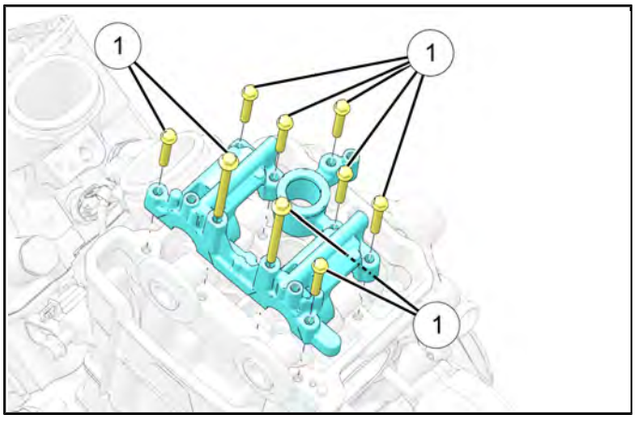
⚠ CAUTION

Cylinder and Cylinder Head assemblies may have extremely sharp machined surfaces. Gloves should be worn whenever handling these components to prevent personal injury.

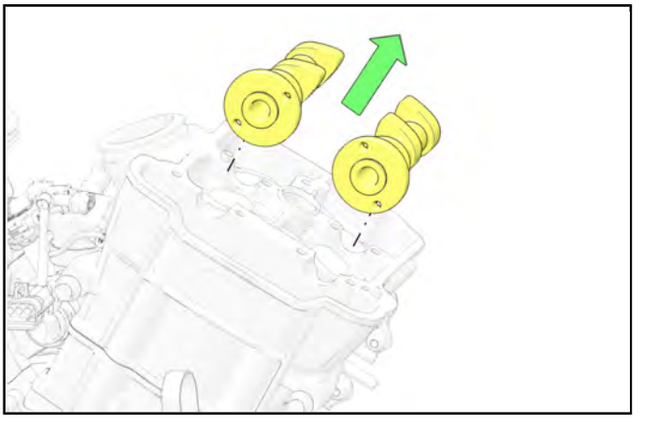
IMPORTANT

Removing the cylinder head(s) releases pressure on the cylinder base gasket(s). Cylinder base gasket(s) should always be replaced in conjunction with cylinder head removal / service.

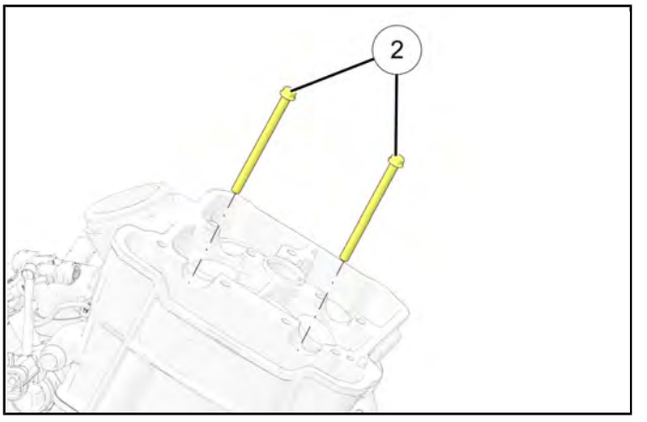
1. Remove engine from frame and place on an engine stand. See **Engine to Frame, Removal / Installation page 3.21**.
2. Remove the intake manifold assembly. See **Throttle Body Assembly Removal / Installation page 4.18**.
3. Remove the ignition coil from the cylinder(s) being serviced. See **Ignition Coil Replacement page 10.42**.
4. Remove the camshaft sprockets. See **Cam Drive Sprocket Removal page 3.80**.
5. Remove the lower cam chain guides. See **Cam Chain Guide (lower), Removal page 3.82**.
6. Carefully lower the cam chain into the cam chain gallery.
7. Remove the seven remaining screws ① and the camshaft carrier.



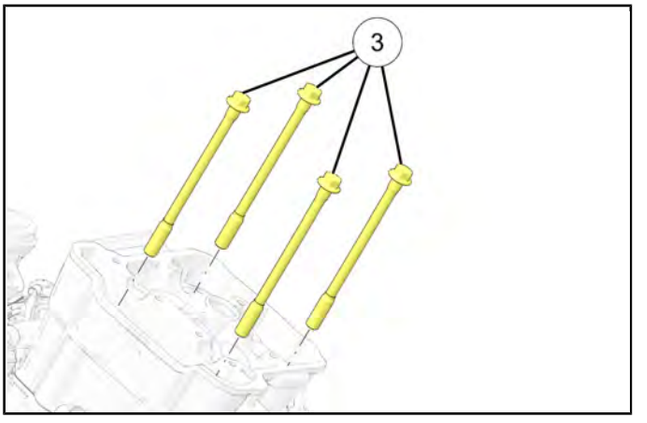
8. Paying attention to location / orientation, remove camshafts from cylinder head.



9. Using a long extension, remove the two screws ② from inside the cam chain gallery.

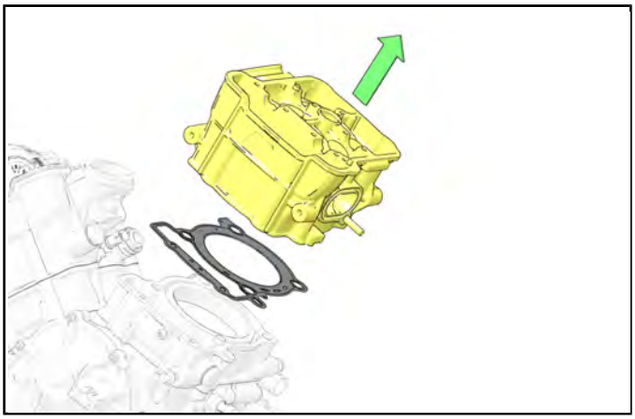


10. Alternately loosen and remove cylinder head bolts ③.



9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

11. Remove the cylinder head assembly and cylinder head gasket by carefully lifting off of cylinder.



CYLINDER HEAD DISASSEMBLY

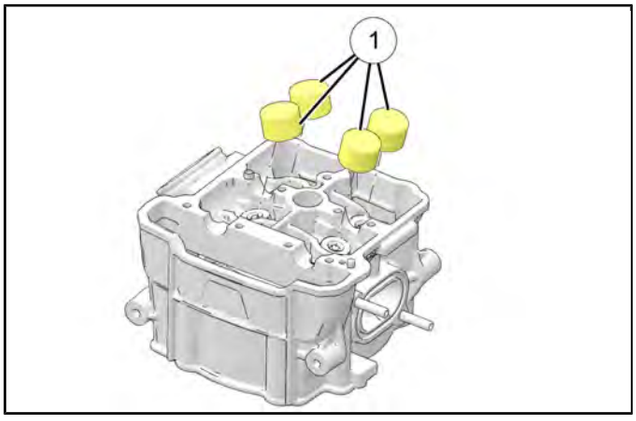
⚠ WARNING

Wear eye protection while removing valve springs.

IMPORTANT

Keep mated parts together for assembly.

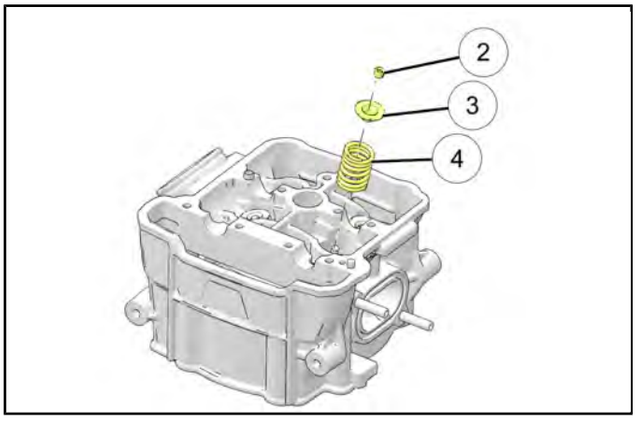
1. Remove the cylinder head(s) to be serviced. See **Cylinder Head Removal page 3.92**.
2. Remove the tappets ① by lifting out of the bore.



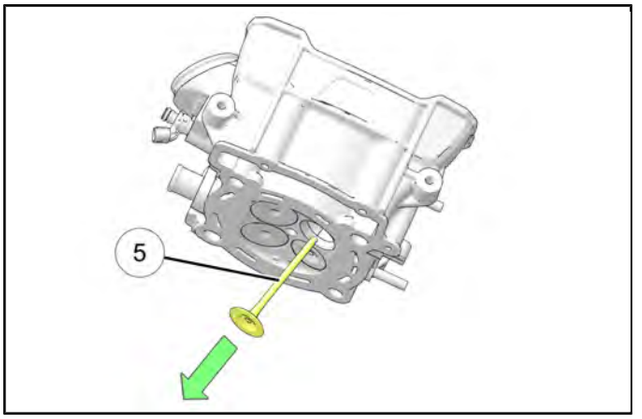
IMPORTANT

If tappets will be reused, wipe excess oil off using solvent and a clean towel. Mark each tappet with a marker so it can be matched to it's respective bore upon reassembly.

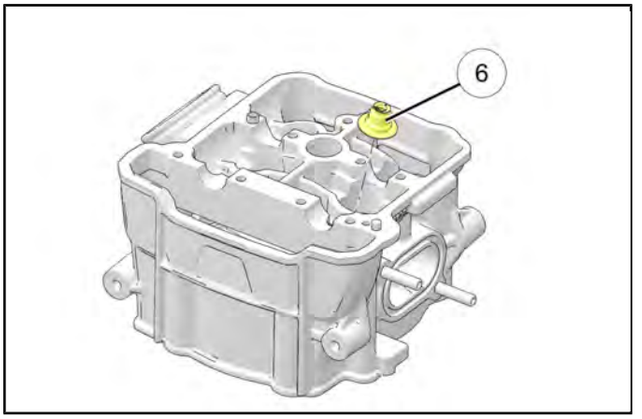
3. Using valve spring compressor **PV-1253** remove keepers ②, upper spring retainer ③ and valve spring ④ from valves.



4. Slide valve ⑤ out through the bottom of the cylinder head.



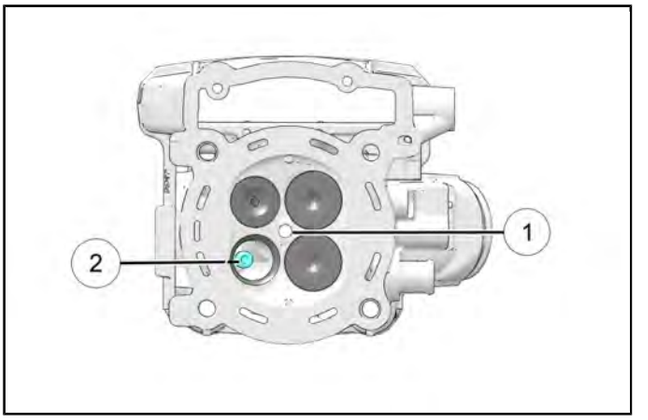
5. Remove and discard the spring seat / valve stem seal assembly ⑥.



6. Clean gasket surfaces.

CYLINDER HEAD INSPECTION

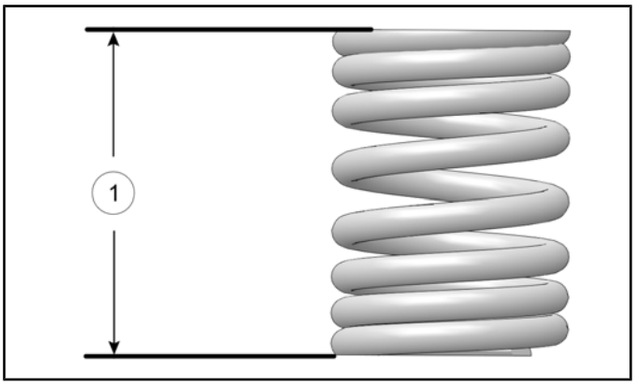
1. Visually inspect cylinder head for cracks or damage. Pay close attention to the areas around spark plug ① and valve seats ②.



2. Inspect cylinder head for distortion with a straight edge and feeler gauge. Check in different directions and locations on the cylinder head. For cylinder head service limits, see **Service Specifications - Cylinder Head page 3.68**.

VALVE SPRING FREE LENGTH INSPECTION

- Measure free length of valve springs. Replace springs that do not meet specification. See **Service Specifications - Cylinder Head page 3.68**.



ITEM	STANDARD LENGTH
①	1.93 in (49.1 mm)

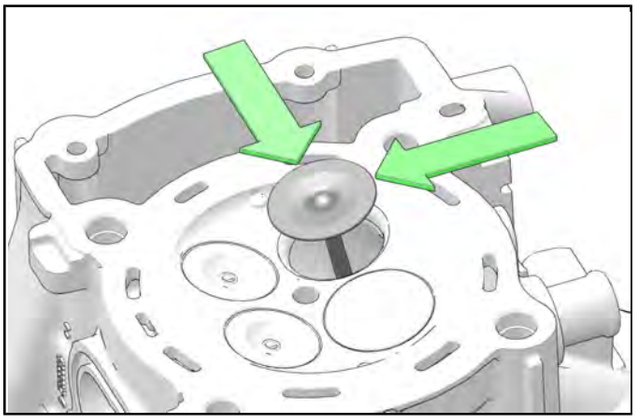
IMPORTANT
Intake and exhaust springs are identical.

VALVE INSPECTION

NOTICE
Valve service specifications can be found at the beginning of this chapter. See **Service Specifications - Cylinder Head page 3.68**.

IMPORTANT
Mark the valves for reassembly.

1. Place valves on V-blocks and measure valve stem runout ① using a runout gauge or similar tool.
2. Inspect the valve face for damage from burning, pitting or uneven contact.
3. Insert valves into their original locations in cylinder head.
4. Inspect that each valve moves up and down smoothly without binding in guide.
5. Measure valve stem deflection ③ for all valves to determine if valve or valve guide requires replacement.



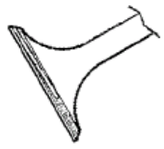
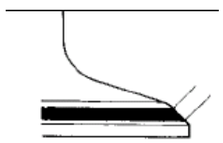
A. Raise valve 10mm (0.400") off of seat.

B. Position dial indicator as shown. Measure deflection in two directions perpendicular to each other (X & Y axis).

C. If valve deflection exceeds service limit measure valve stem diameter.

6. Replace valve and repeat step 6 if valve stem O.D. measures outside standard range. If valve stem deflection exceeds service limits with a new valve installed, valve guide must be replaced.
7. Installation of new valve guides and/or new valves requires valve seat reconditioning. This work should be performed by an experienced technician properly equipped to perform cylinder head reconditioning.

VALVE INSPECTION – QUICK REFERENCE

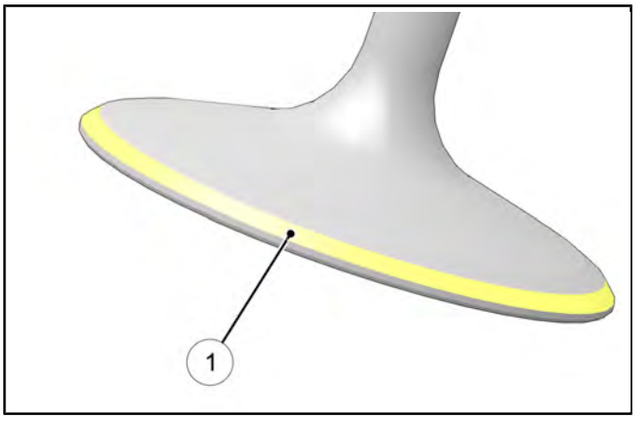
CONDITION	ILLUSTRATION	POSSIBLE CAUSE	CORRECTIVE ACTION
Uneven seat width		Bent valve stem, worn valve guide	Replace valve and reface seat
Damaged valve face		Burnt, pitted, foreign material damage	Replace valve and reface seat
Contact area too high		Wear, settling of valve seat	Lower with 30° stone
Contact area too low		Wear, settling of valve seat	Raise with 60° stone
Contact area too wide		Wear, settling of valve seat	Narrow with both 30° stone and 60° stone
Contact area too narrow			Use 45° stone
Contact area free of pitting and damage, centered in seat, proper width.		Correct	None

VALVE SEAT INSPECTION

IMPORTANT

Valves cannot be ground. If valve face is burned or badly worn, replace the valve.

1. Remove carbon deposits from valves and seats.
2. Inspect valve face for burning, pitting or uneven contact.
3. Apply a light coating of machinist's layout fluid or paste to valve face.
4. Install valve into valve guide.
5. Tap valve several times to make a clear impression on the valve face. Do not rotate valve.
6. Remove valve and measure contact area ①. See **Service Specifications - Cylinder Head page 3.68**.



7. If valve seat is incorrect, replace valve.

CYLINDER HEAD ASSEMBLY

⚠ CAUTION

Wear eye protection during assembly.

1. Lubricate valve stems with assembly lube.
2. Install valve in head *before* installing seal. Hold valve against seat wipe off the portion that extends above the guide.
3. Apply Indian Motorcycle engine oil to valve guide seal and install seal on valve, rotating the seal as you install it.
4. Install valve spring and upper retainer.

⚠ CAUTION

Do not compress valve springs more than necessary to install keepers.
Support cylinder head so valves will not be damaged.

5. Compress valve springs using a valve spring compressor and adapter.
6. Apply a small amount of grease to both sides of a valve keeper.
7. Insert both valve keepers in place on valve.
8. Remove spring compressor.
9. Repeat previous steps for remaining valves.
10. Be sure all keepers are fully seated in groove.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

CYLINDER HEAD INSTALLATION

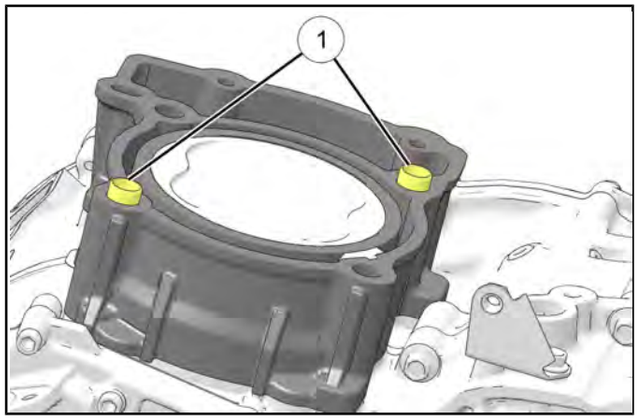
⚠ CAUTION

The cylinder head bolts are Torque-to-Yeild fasteners. They MUST be replaced after removal. Failure to do so can result in lower sealing pressure and engine damage.

IMPORTANT

The base gasket seal is broken when the cylinder head is removed and must be replaced. See **Cylinder Installation page 3.115**.

1. Verify that locating dowels ① are in position on the cylinder deck.



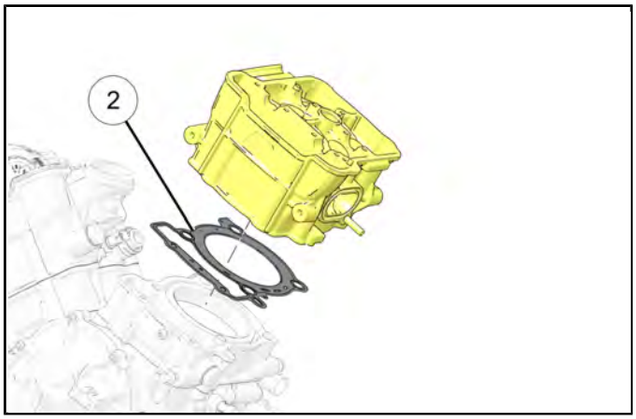
2. Thoroughly clean cylinder and cylinder head mating surfaces.

IMPORTANT

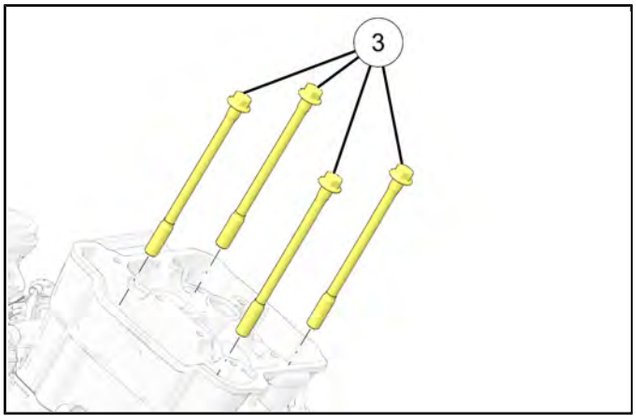
Gaskets and gasket sealing surfaces must be free of oil and grease during assembly.

3. Install a new head gasket ②.

4. Set cylinder head in place on cylinder and press down over the locating dowels until fully seated.

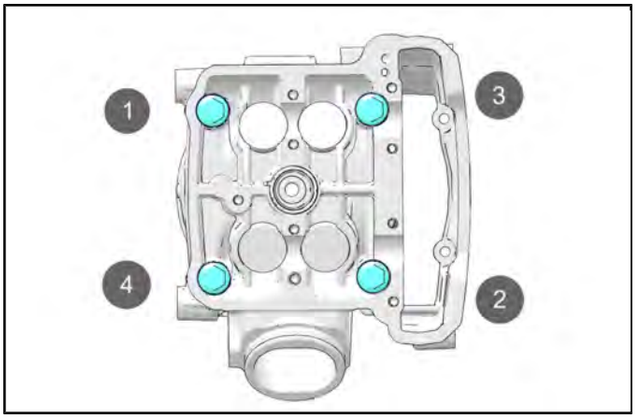


5. Apply a thin coat of Indian Motorcycle engine oil to the cylinder head bolt threads and underneath bolt heads and install fasteners ③ finger-tight.

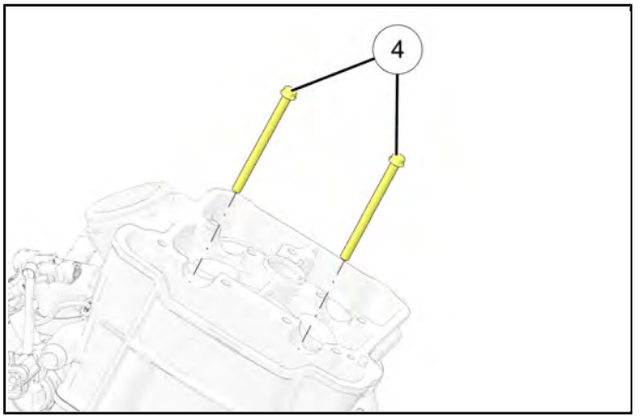


6. Torque cylinder head fasteners in an "X" pattern following the specified sequence:

TORQUE
Cylinder Head Fasteners: **Step 1: Torque all fasteners to 18 ft-lbs (25 N·m) in sequence specifiedStep 2: Torque all fasteners to 30 ft-lbs (40 N·m) in sequence specifiedStep 3: Loosen all fasteners, until they are unseated, in sequence specifiedStep 4: Torque all fasteners to 15 ft-lbs (20 N·m) in sequence specifiedStep 5: Torque all fasteners to 26 ft-lbs (35 N·m) in sequence specifiedStep 6: Angle tighten all fasteners 180 degrees in sequence specifiedStep 7: Angle tighten all fasteners another 180 degrees in sequence specified.**

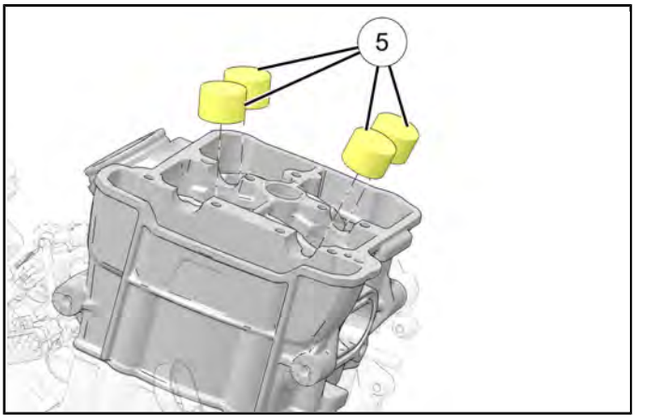


7. Install fasteners ④ into cam chain gallery and torque to specification.

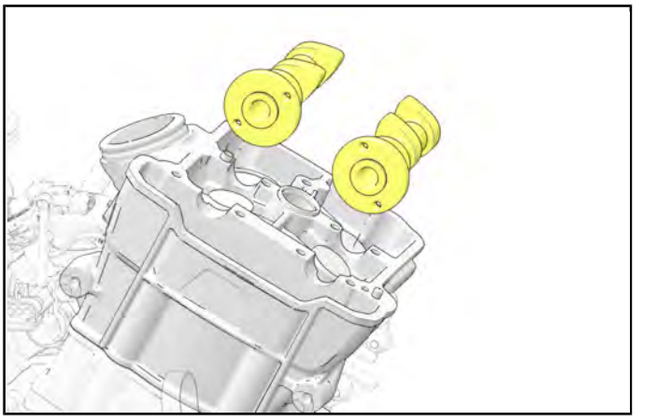


TORQUE
Cam Chain Gallery Fasteners: **88 in-lbs (10 N·m)**

8. Apply a thin coat of Indian Motorcycle engine oil to each of the tappets ⑤ and install them in the same position from which they were removed.

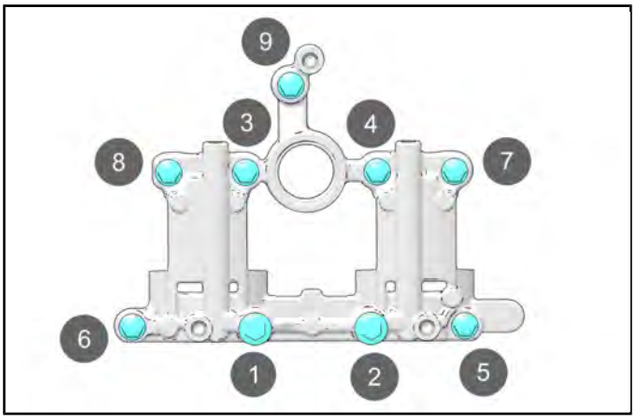


9. Lubricate camshaft lobes and bearing journals with Indian Motorcycle engine oil and install into cylinder head.



10. Insert *New* spark plug seal into the cam carrier and install carrier onto cylinder head.

11. Temporarily install the upper cam chain guide and torque the carrier fasteners per the specified sequence.



TORQUE
Camshaft Carrier Fasteners (short & long): **88 in-lbs (10 N·m)**

12. Check valve lash and adjust if necessary. See **Valve Clearance Assembly page 3.89**.
13. Remove upper cam chain guide.
14. Install cam chain. See **Camshaft Sprocket Installation / Timing Procedure page 3.85**.
15. Install upper cam chain guide and re-torque per STEP 11.
16. Install valve cover(s). See **Valve Cover Installation page 3.88**.
17. Install intake manifold. See **Throttle Body Assembly Removal / Installation page 4.18**.
18. Install engine in frame. See **Engine to Frame, Removal / Installation page 3.21**.

VALVE LASH - TAPPET SELECTION

A 440 tappet means the thickness of the tappet is 4.40 mm. Part Number: 5138477-XXX (X's represent 3 digit tappet size)

An Engine Valve Lash Adjustment calculator has been created and is located under Service and Warranty – News, Forms and Links. Click or go to
https://www.polarisdealers.com/files/ServWarr/English/Engine%20Valve%20Adjustment%20Calculator.pdf

The proper valve tappet may also be obtained by completing these steps:

IMPORTANT
The Valve Lash Specification and Measured Valve lash must be calculated in millimeters (mm)

1. Subtract the valve lash specification from the actual valve lash on the engine (i.e. 0.29 mm – 0.20 mm) = 0.09 mm.
2. Divide the 3 digit tappet number by 100 (i.e. 450 / 100) = 4.5 mm.
3. Add the results of step 1 and step 2 (i.e. 0.09 mm + 4.5 mm) = 4.59 mm.
4. Multiply that answer by 100 to obtain the correct new tappet (i.e. 4.59 mm x 100 = 459).
5. Refer to the table below to find the closest available tappet size to the result from step 4 (i.e. 459 should be rounded to 460 since there is a 460 tappet).

AVAILABLE TAPPETS

440	450	460	470	480	490	500	510	520	530	540
442	452	462	472	482	492	502	512	522	532	542
445	455	465	475	485	495	505	515	525	535	545
448	458	468	478	488	498	508	518	528	538	

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

TROUBLESHOOTING CYLINDER HEAD AND VALVE TRAIN

NOTICE

Cylinder head, valve train and piston/cylinder problems are usually detected by an engine compression test. Other problems associated with this area of the engine are external fluid leaks, excessive oil consumption or abnormal noises.

The troubleshooting tables that follow list *possible* causes of engine mechanical problems. Always thoroughly investigate before disassembling an engine.

PROBLEM	POSSIBLE CAUSE	PART(S) AFFECTED	REPAIR RECOMMENDED
Hard Starting / Won't Start	Low Compression	Worn Valve Guide(s)	Replace Valve Guide(s)
		Poor Seating of Valve(s)	Repair or Replace
		Broken Valve Spring(s)	Replace
		Spark Plug Not Seated	Torque to Specification
		Incorrect Valve Timing	Repair / Retest
		Valve Stuck Open	Repair / Retest
		Cylinder Head Gasket Leak	Repair / Retest
		Slow Starter Motor	Refer to Electrical Chapter
		Worn Rings, Piston, or Cylinder	Refer to Engine / Cooling / Exhaust Chapter
		Valve Clearance out of Specification	Adjust Valve(s)
		Ignition Problem	Refer to Electrical Chapter
		Fuel Problem	Refer to Fuel Delivery / EFI Chapter
Electric Starter Straining to Turn Engine Over	High Compression	Excessive carbon build-up in combustion chamber	De-carbon Combustion Chamber
	Excessive Starter Load	Internal Engine / Drive Components Seized or Binding	Determine Cause of Seizure or Binding
Poor idle Quality (Engine Related)	Low Compression	Valve Clearance out of Specification	Adjust Valve(s)
		Poor Seating of Valve(s)	Repair or Replace
	Excessive Oil in Combustion Chamber	Valve Guides	Replace
		Worn Rings, Piston, or Cylinder	Refer to Engine / Cooling / Exhaust Chapter
		Engine Oil Overfilled	Correct Engine Oil Level
Engine Noise	Valve Train Area	Loose or Tight Valve(s)	Adjust Valve(s)
		Broken or Weak Valve Spring(s)	Replace
		Worn Camshaft or Tappet	Replace
		Chain Tensioner and / or Guide Worn	Replace
		Cam Bearings Worn or Damaged	Replace
	Piston / Cylinder Area	Worn Pistons and / or Cylinders	Replace
		Worn Wrist Pin, Wrist Pin Bore and / or Connecting Rod	Replace

PROBLEM	POSSIBLE CAUSE	PART(S) AFFECTED	REPAIR RECOMMENDED
		Worn Piston Rings or Piston Ring Lands	Replace
	General	Exhaust Leak	Reseal Exhaust
	Timing Chain Area	Chain / Sprocket Worn	Replace
		Chain Tensioner and / or Guide Worn	Replace
	Bottom End Area	Main Bearings	Refer to Transmission / Crankshaft Chapter
		Rod Bearings	Refer to Transmission / Crankshaft Chapter
		Loose Side Clearance	Refer to Transmission / Crankshaft Chapter
	Transmission Area	Bearings	Refer to Transmission / Crankshaft Chapter
Poor High-Speed Running	Air Intake Problem	-	Refer to Fuel Delivery / EFI Chapter
	Fuel Injection Problem	-	Refer to Fuel Delivery / EFI Chapter
	Ignition Problem	-	Refer to Electrical Chapter
	Valve Float	Weak Valve Springs	Replace
	Insufficient Valve Travel	Worn Camshaft / Tappet	Replace
	Valves Opening and Closing at Wrong Time	Incorrect Valve Timing	Correct
Lack of Power in all RPM Ranges	Low Compression	Worn Piston, Rings, Cylinder, Poor Valve Seating	Repair / Replace
	Valve Timing Incorrect	Cam Chain and Sprockets	Correct
	Valve Float	Weak Valve Springs	Replace
	Insufficient Valve Lift	Worn Camshaft / Tappets	Replace
	Ignition / Fuel Injection System	-	Refer to Fuel Delivery / EFI Chapter (EFI) or Electrical Chapter (Ignition)
	Oiling Problem	Oil Overfilled	Correct Engine Oil Level

CYLINDER / PISTON

GENERAL INFORMATION

SERVICE NOTES

NOTE
Clean the machine thoroughly before removing engine from frame.

- This section covers service of the cylinder, piston and rings. The engine must be removed from the frame to perform the procedures in this section. Refer to Engine / Cooling / Exhaust Chapter for engine removal and installation.
- Mark and store all mated parts for assembly. Assemble engine by putting used parts that pass inspection back in the same location.
- Machined mating surfaces are very delicate. Handle and store all parts in such a way that the mating surfaces will not be damaged.
- Many parts require assembly lubrication. Follow the assembly lubrication procedures carefully.
- There are many precision measuring steps in this section. If you are not sure of your capabilities in these areas, have a competent machinist perform the precision part inspection operations.
- Cleanliness of parts is critical to engine life and proper parts inspection. Use clean solvent and hot, soapy water to clean parts. Dry with compressed air before inspection and engine assembly. Coat parts with fresh lubricant to prevent oxidation after cleaning.

SPECIAL TOOLS - CYLINDER / PISTON

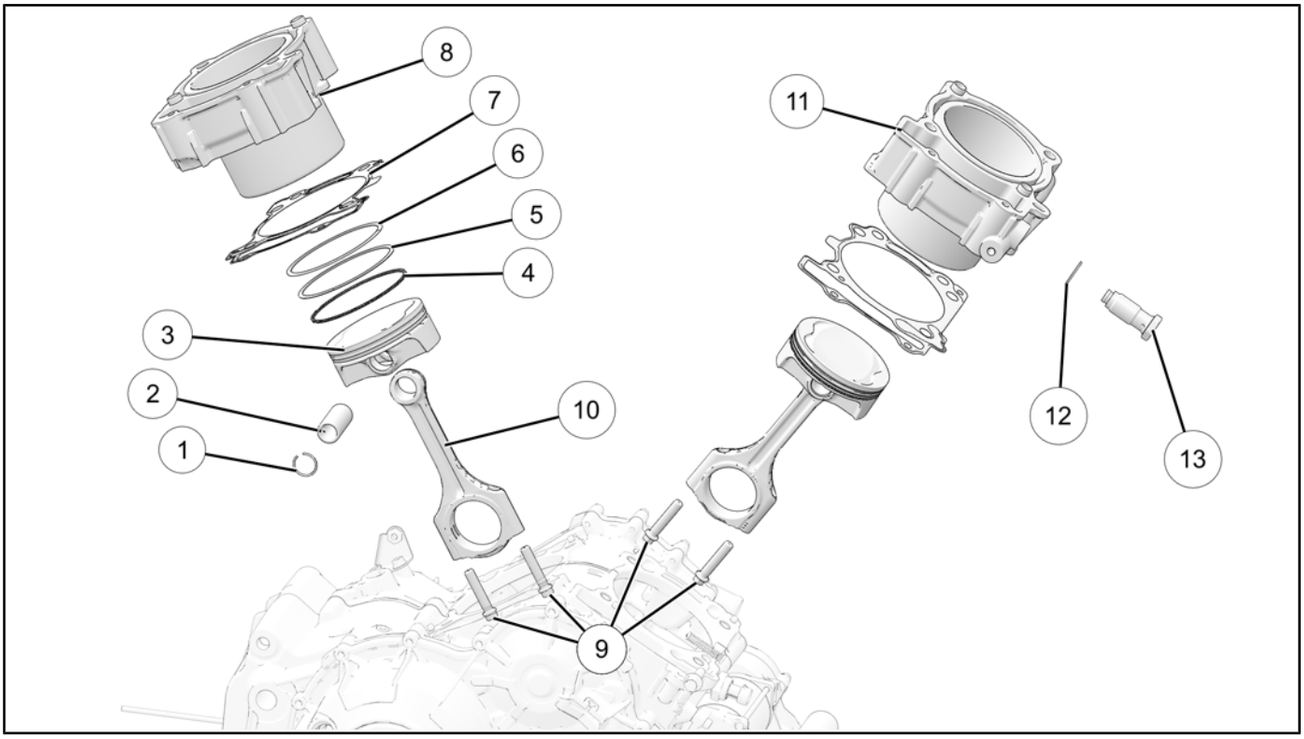
TOOL DESCRIPTION	PART NUMBER
Piston Ring Compressor	PV-43570-A
Engine Lock Tool - Transmission	PF-51612
Engine Lock Tool - Crankshaft	PF-51235-A
Cylinder Bore Gauge	PV-3017
Engine Case Splitting Tool	PF-51234-A
Straightedge, Feeler Gauge	Commercially Available

Bosch Automotive Service Solutions: 1-800-345-3322 or https://polaris.service-solutions.com/

SERVICE SPECIFICATIONS - CYLINDER / PISTON

ITEM		STANDARD	SERVICE LIMIT
Cylinder	I.D.	102.000 - 102.008 (4.0157 - 4.016")	Check taper and out-of-round
	Out of Round	Measure 50 mm down from head surface	0.05 mm (.002")
	Taper		0.05 mm (.002")
	Gasket Surface Warpage	-	0.1 mm max. (.0039")
Piston	Piston Mark Direction	Piston orientation is determined by arrow on piston crown. Position BOTH pistons so arrows point to front of engine.	
	Piston O.D. (Nominal) (Measured 12 mm up from bottom of skirt, 90 degrees to pin)	98.933 - 98.947 mm (3.8949 - 3.8955")	Replace if piston-to-cylinder clearance is excessive with good cylinder
	Piston Pin Hole I.D.	23.930 - 23.750 mm (.9421 - .9350")	22.047 mm (.8679")
	Piston Pin O.D.	22.000 - 22.005 mm (.866 - .868")	21.96 mm (.864")
	Piston to Cylinder	.045 - .075 mm (.0017 - .0029")	.15 mm (.006")
	Piston to Piston Pin	.004 - .015 mm	.030 mm
Piston Ring Clearances	Ring End Gap - Top (Installed) Ring End Gap - 2nd (Installed)Ring End Gap - 3rd (Oil Control Rails) (Installed)	.15 - .31 mm (.006 - .012") .25 - .50 mm (.009 - .019") .25 - 1.02 mm (.009 - .040")	.80 mm (.031") 1.11 mm (.043") .80 mm (.031")
	Piston Ring Marks	-	DOT mark must face UP on all rings.
Piston Ring to Ring Land	Top Ring (1.2 mm ring thickness)	.03 - .095 mm (.0001 - .0037")	.15 mm (.0059")
	2nd Ring (1.2 mm ring thickness)	.02 - .066 mm (.0007 - .0025")	.10 mm (.0039")
	Oil Control Ring	.03 - .13 mm (.001 - .0051")	.25 mm (.0098")

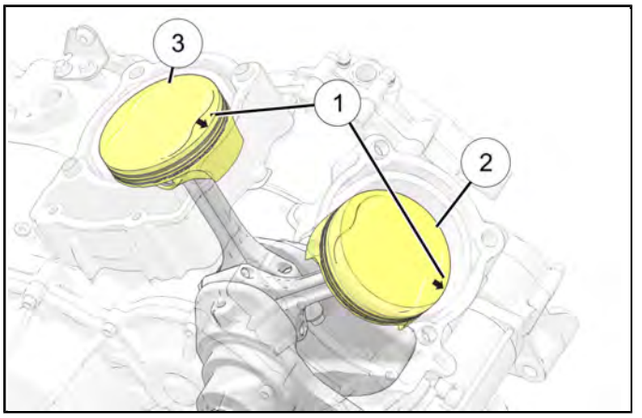
CYLINDER / PISTON ASSEMBLY VIEW

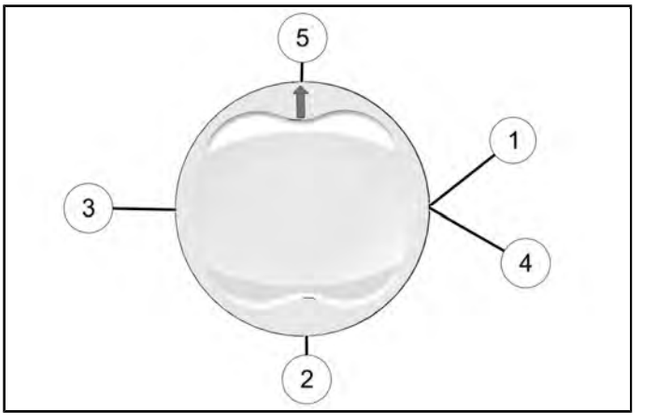


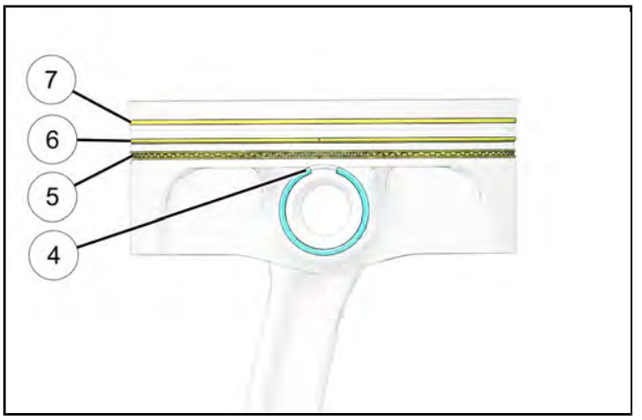
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Piston Circlip	
②	Piston Wrist Pin	
③	Piston	
④	Oil Control Wring / Expander	
⑤	Compression Ring #2	
⑥	Compression Ring #3	
⑦	Cylinder Base Gasket	
⑧	Rear Cylinder	
⑨	Connecting Rod Fastener (Single Use Fastener)	**Step 1: Torque both fasteners to 22 ft-lbs (30 N·m)** **Step 2: Tighten both fasteners an additional 90°**
⑩	Connecting Rod	
⑪	Front Cylinder	
⑫	Sealing Washer	
⑬	Cam Chain Tensioner	

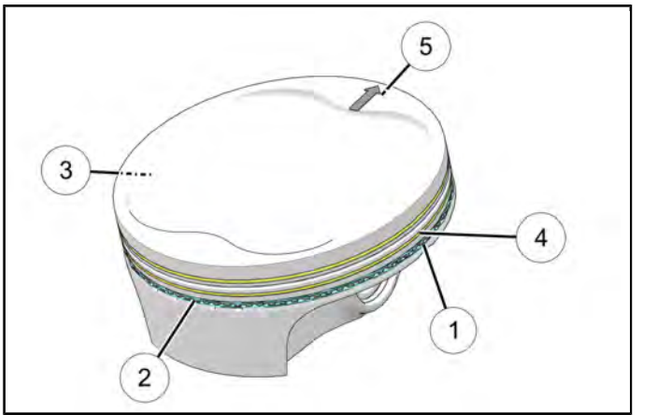
CYLINDER / PISTON SERVICE

PISTON RING PROFILE AND ORIENTATION







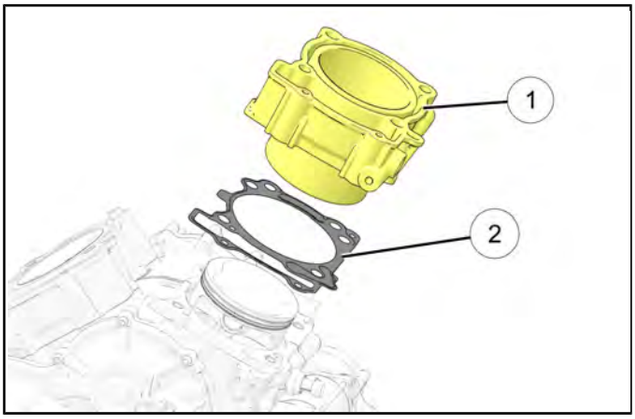


① Arrows on piston crown indicate installation direction. Both arrows point toward the front of the engine.
② Front piston is installed closest to the primary drive side of the engine.
③ Rear piston is installed closest to the mag side of the engine.
④ Wrist pin circlip. Install the circlip with the gap positioned at 12 o'clock.
⑤ Oil Control Ring
⑥ Compression Ring No. 2
⑦ Compression Ring No. 1

① Lower Oil Ring Rail End Gap
② Oil Ring Spring Expander End Gap
③ Upper Oil Ring Rail End Gap
④ Second Compression Ring End Gap
⑤ Top Compression Ring End Gap

CYLINDER REMOVAL

1. Remove cylinder head(s). See **Cylinder Head Removal page 3.92**.
2. Remove cylinder(s) ①. Support pistons to prevent damage. Place shop towels around piston/rings to prevent damage.



3. Remove cylinder base gasket ②.
4. Clean gasket surfaces of cylinders thoroughly.

⚠ CAUTION

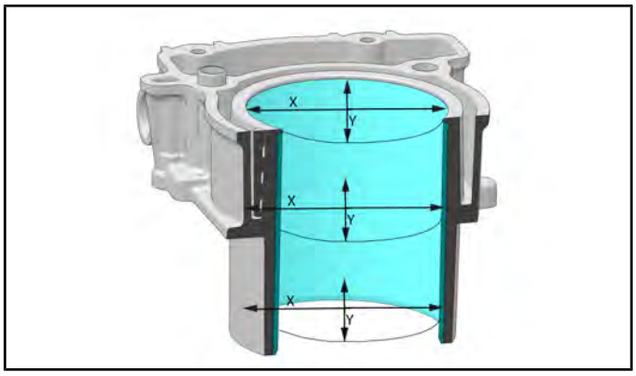
Careless handling of cylinder, pistons or rings may cause irreparable damage. Do not damage gasket surfaces during cleaning.

CYLINDER INSPECTION

1. Visually inspect cylinder bores for scratches and wear.
2. Inspect gasket surfaces for scratches or other damage that may cause an oil leak.

CYLINDER BORE MEASUREMENT

1. Measure each cylinder bore in 6 places to determine:



IMPORTANT

Bottom measurement should be taken 2.6 in (66 mm) up from base.

- Cylinder Bore Inside Diameter
- Cylinder Taper
- Out of Round

2. Use maximum measurement to determine wear.
3. Use the worksheet provided to record measurements and calculate the clearance.

PISTON TO CYLINDER CLEARANCE WORKSHEET

FRONT CYLINDER	RECORDED MEASUREMENT	SPECIFICATION
Top "X"		Taper Service Limit: .05mm (.002")
Middle "X"		
Bottom "X"		
Top "Y"		
Middle "Y"		
Bottom "Y"		
Difference between largest "Y" measurement and smallest "Y" measurement	Taper for "Y" axis:	
Difference between largest "X" measurement and smallest "X" measurement	Taper for "X" axis:	
Largest difference between any "X" axis measurement and "Y" axis measurement	Cylinder Out-of-Round:	Out-of-Round Service Limit: .05mm (.002")
Piston Skirt Measurement		
Difference between largest "X" axis measurement and piston measurement	Piston-to-Cylinder Clearance*	Piston-to-Cylinder Clearance Service Limit: .15 mm (.006")

REAR CYLINDER	RECORDED MEASUREMENT	SPECIFICATION
Top "X"		Taper Service Limit: .05mm (.002")
Middle "X"		
Bottom "X"		
Top "Y"		
Middle "Y"		
Bottom "Y"		
Difference between largest "Y" measurement and smallest "Y" measurement	Taper for "Y" axis:	
Difference between largest "X" measurement and smallest "X" measurement	Taper for "X" axis:	
Largest difference between any "X" axis measurement and "Y" axis measurement	Cylinder Out-of-Round:	Out-of-Round Service Limit: .05mm (.002")
Piston Skirt Measurement		
Difference between largest "X" axis measurement and piston measurement	Piston-to-Cylinder Clearance*	Piston-to-Cylinder Clearance Service Limit: .15 mm (.006")

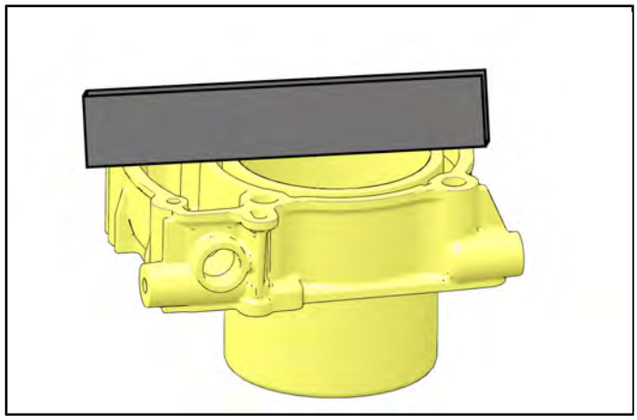
Compare recorded measurement to specifications. If measured value exceeds service limit replace the appropriate part.

IMPORTANT
If the piston-to-cylinder clearance exceeds the service limit, *measure a new piston and re-calculate the clearance.* If the piston-to-cylinder clearance exceeds the service limits with a new piston, the cylinder can be replaced or serviced to accommodate oversize piston/rings by a qualified machine shop.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

CYLINDER WARPAGE MEASUREMENT

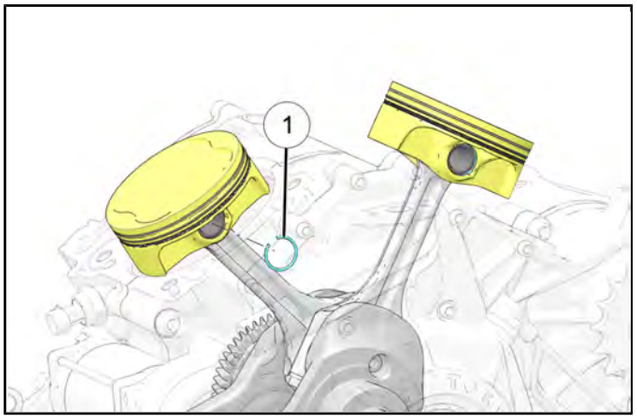
1. Inspect cylinder for warpage at cylinder head surface and base gasket surface.



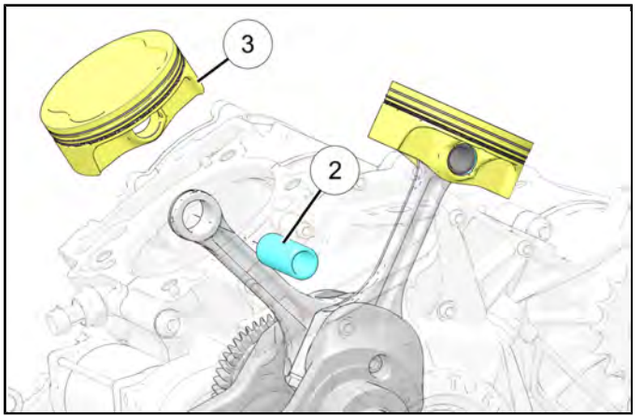
2. Place a straight edge diagonally across cylinder mating surfaces in several positions. Attempt to slide a .05mm (.002") feeler gauge under the straight edge in each position.
3. Replace cylinder if warped beyond the service limit.

PISTON & PISTON RING REMOVAL

1. Cover crankcase with a clean shop towel to prevent piston circlip from falling into the crankcase.
2. Remove the left piston pin circlip ①.



3. Push piston pin ② out to left side of engine and remove the piston ③.

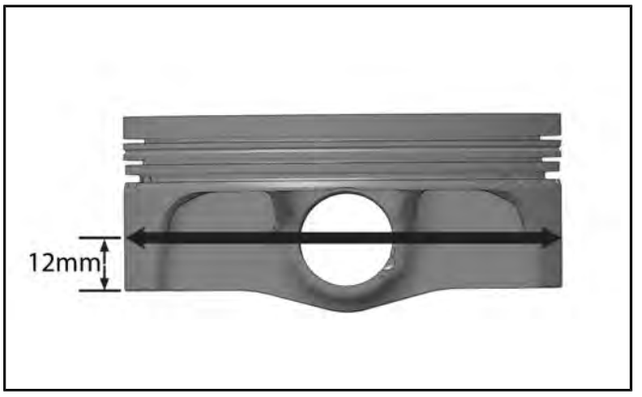


4. Rotate rings in piston grooves. Rings should rotate freely in grooves.
5. Clean carbon deposits from piston.
6. Spread rings only wide enough to remove them from piston. Spreading rings too wide will damage them.
7. Clean piston ring grooves. Break or cut a piston ring in half. File or grind one edge square and remove all burrs. Use this piston ring to carefully clean piston ring grooves.

IMPORTANT
A soft wire brush may be used to only clean the top of the piston. Do not use a wire brush to clean the sides of piston or the piston ring grooves.

PISTON & PISTON RING INSPECTION

1. Visually inspect piston for cracks, excessive wear, scoring, etc.
2. Measure piston skirt O.D. (90° to pin and 12 mm from bottom of piston skirt). Replace piston if worn beyond the service limit. See **Service Specifications - Cylinder / Piston page 3.106**.



3. Calculate Piston to Cylinder Clearance. Subtract piston O.D. from cylinder bore I.D. and compare to specifications. See **Service Specifications - Cylinder / Piston page 3.106**.
4. Replace parts that do not meet specification.

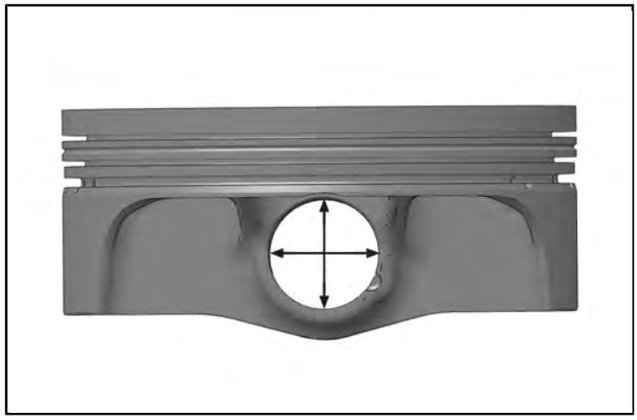
IMPORTANT
If piston-to-cylinder clearance exceeds service limit, *measure a new piston and re-calculate clearance*. If piston-to-cylinder clearance exceeds service limits with a new piston, cylinder must be replaced.

5. Use a piston to push each ring squarely into cylinder bore from bottom (push rings 25-50 mm into cylinder).

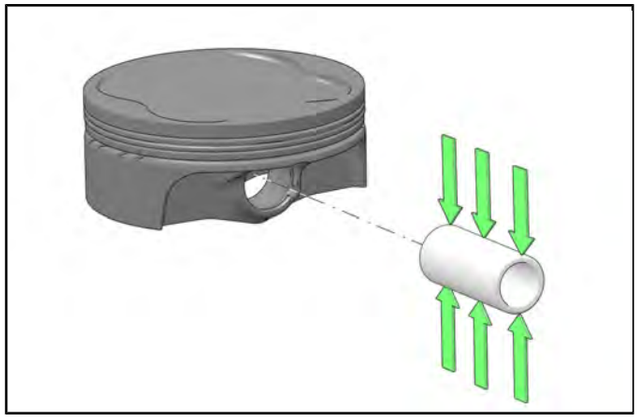
6. Measure installed ring end gap with a feeler gauge and compare to specifications. See **Service Specifications - Cylinder / Piston page 3.106**.
7. Replace parts that exceed service limit.

PISTON PIN / PIN BORE INSPECTION

1. Measure piston pin bore I.D. (as shown) as close to the circlip groove as possible with a telescoping gauge. Record the smallest measurement.



2. Measure piston pin O.D. at three locations. Record largest measurement.



3. Calculate piston pin-to-piston clearance. Subtract pin O.D. from pin hole I.D.

4. Measure connecting rod small end I.D. at the center of the bore.

5. Calculate connecting rod-to-piston pin clearance by subtracting pin O.D from rod hole I.D.

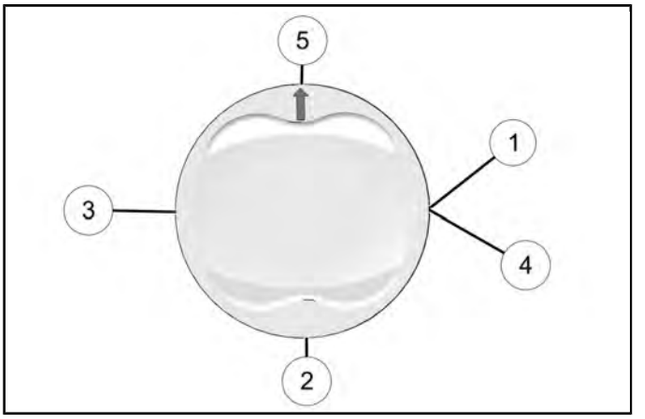
6. Compare measurements to specifications and replace any worn parts. See **Service Specifications - Cylinder / Piston page 3.106**.

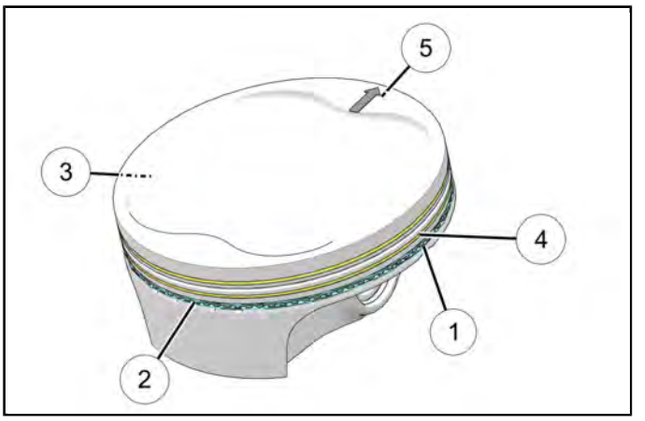
PISTON RING INSTALLATION

⚠ CAUTION

The rings may be damaged if they are over expanded during installation.

1. Lubricate all rings with engine oil.
2. Carefully install oil control ring expander.
3. Install top and bottom rails.
4. Install top ring and second ring with pip markings facing UP.
5. Compress each ring by hand and rotate to be sure they rotate freely in grooves.
6. Locate ring end gaps as shown below in relation to arrow on piston crown.

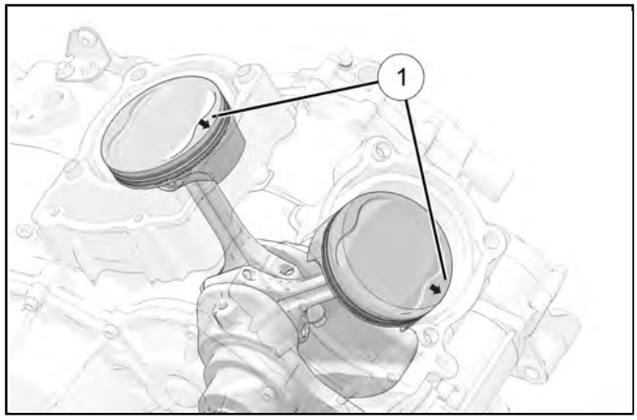




NUMBER	DESCRIPTION
①	Lower oil Ring Rail End Gap
②	Oil Ring Spring Expander End Gap
③	Upper Oil Ring Rail End Gap
④	Second Compression Ring End Gap
⑤	Top Compression Ring End Gap

PISTON INSTALLATION

The pistons are marked with an arrow on the crown ①. Install pistons on connecting rods with arrow as shown, facing the FRONT of the engine.

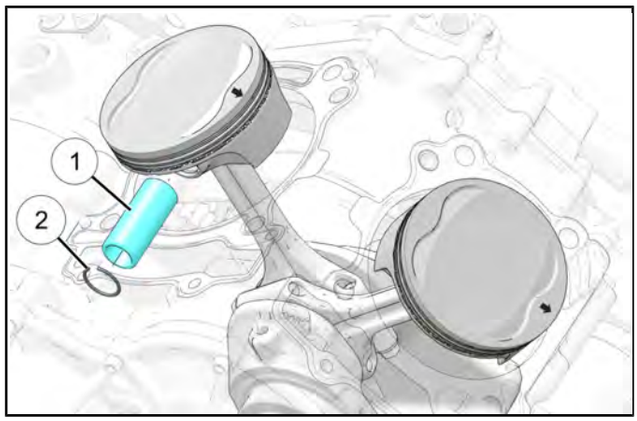


1. Place a clean shop towel over crankcase to prevent foreign material from entering crankcase.
2. Install a new circlip on one side of the piston with end gap facing UP (12:00 position).

⚠ CAUTION

Never reuse piston pin circlips.

3. Lubricate piston pin and I.D. of connecting rod small end with engine oil or moly lube.
4. Install piston over connecting rod with arrow on piston crown facing FRONT of engine.
5. Push piston pin ① through rod and piston pin bore until it is stopped by circlip.
6. Install remaining circlip ② with end gap facing up (12:00 position.)



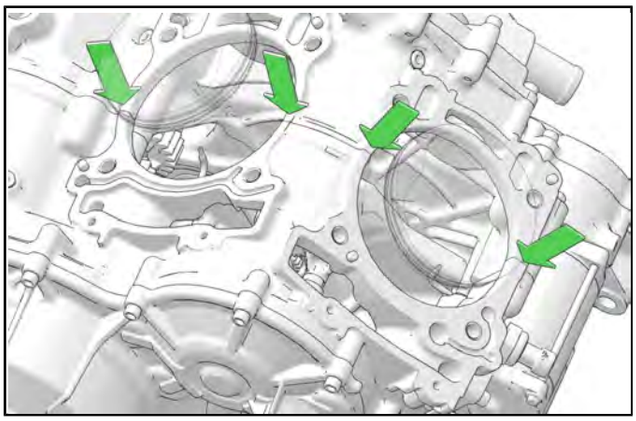
7. Make sure both piston circlips are seated properly in the groove.

CYLINDER INSTALLATION

IMPORTANT

Be sure all top end parts are ready for assembly. Sealant on crankcase parting line must not be allowed to dry before top end is assembled and torqued.

1. Rinse the cylinders with clear water and immediately dry with compressed air. Cylinder bore should be wiped with a clean white shop towel and engine oil.
2. Apply a light coat of engine oil to piston and rings.
3. Ensure cylinder alignment dowel pins are in place and gasket surfaces are clean and oil-free.
4. It is permissible to apply a small amount of **Loctite 598** flange sealant to the cylinder base gasket surface at the crankcase split line. Clean the split line with alcohol prior to applying sealant.



5. Install new cylinder base gaskets onto crankcase.

IMPORTANT

Inspect all sealing surfaces carefully for scratches or imperfections. DO NOT allow oil or grease to contact gaskets or sealing surfaces during the assembly process.

6. Apply a small amount of engine oil to inside surfaces of a piston ring compressor band.

7. Install piston ring compressor over rings and compress rings into ring grooves.

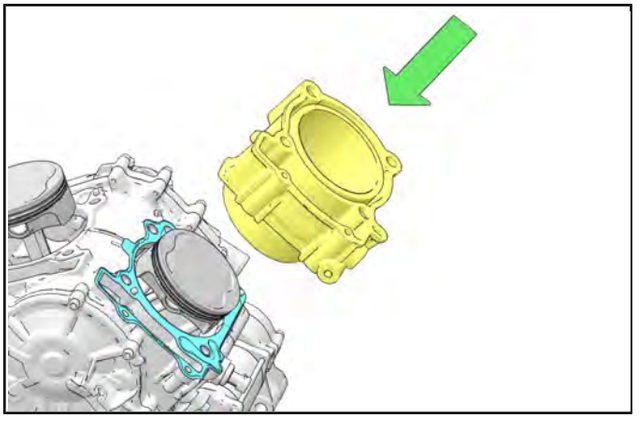
⚠ CAUTION

Be sure compressor band end gap does not align with any ring end gap when compressing the rings.

IMPORTANT

Install cylinders in their original locations. **Cylinder with cam chain tensioner is the front cylinder.**

8. Remove protective covering from crankcase.
9. Carefully install cylinder(s) over piston/ring assembly. Do not force cylinder over piston. Monitor rings carefully. If a piston ring becomes dislodged from the ring compressor; remove cylinder, inspect ring carefully for damage.



10. Remove piston ring compressor when rings are fully captive in cylinder.
11. Slide cylinder down over piston until seated to base gasket and crankcase surface.
12. Repeat for remaining cylinder.
13. Install cylinder head(s). See **Cylinder Head Installation page 3.99**.

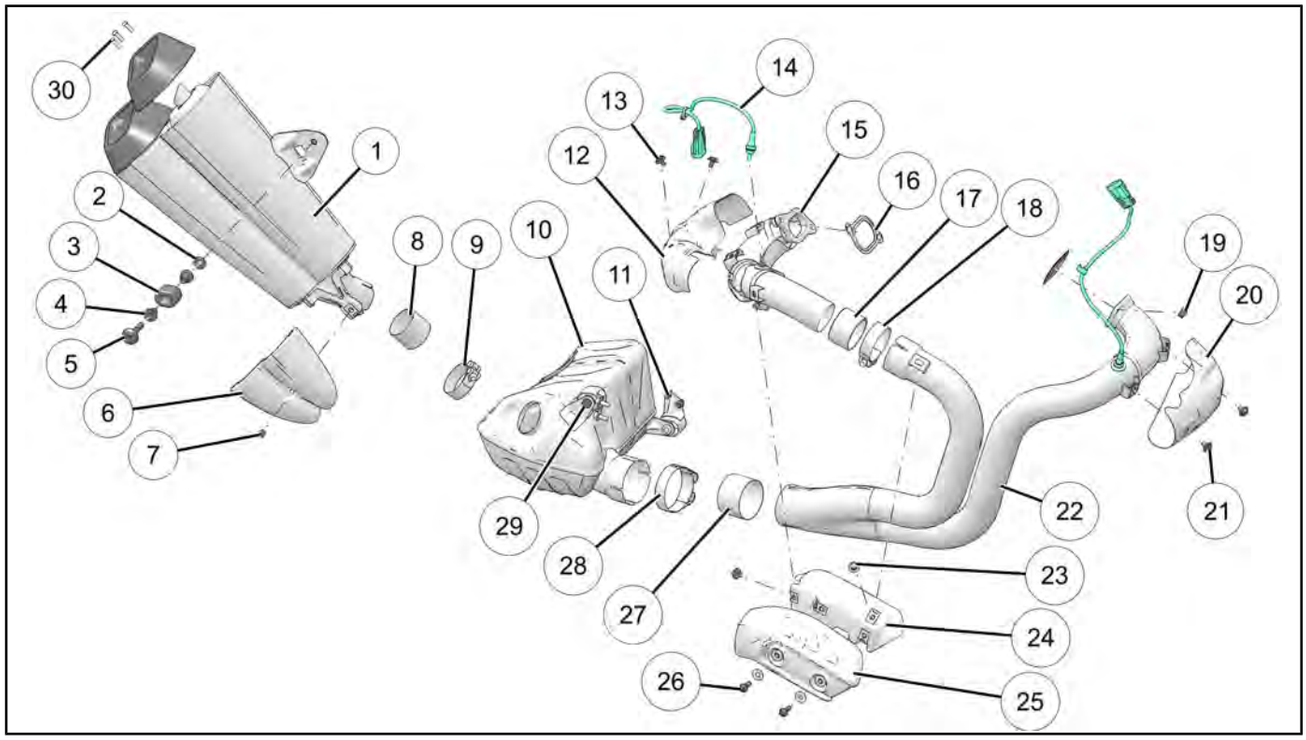
CYLINDER / PISTON TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	PART(S) AFFECTED	REPAIR RECOMMENDED
Hard Starting / Won't Start	Low Compression	Worn Valve Guide(s)	Replace Valve Guide(s)
		Poor Seating of Valve(s)	Repair or Replace
		Broken Valve Spring(s)	Replace
		Spark Plug Not Seated	Torque to Specification
		Incorrect Valve Timing	Repair / Retest
		Valve Stuck Open	Repair / Retest
		Cylinder Head Gasket Leak	Repair / Retest
		Slow Starter Motor	Refer to Electrical Chapter
		Worn Rings, Piston, or Cylinder	Refer to Engine / Cooling / Exhaust Chapter
		Valve Clearance out of adjustment	Inspect / Adjust as necessary
		Ignition Problem	Refer to Electrical Chapter
		Fuel Problem	Refer to Fuel Delivery / EFI Chapter
Electric Starter Straining to Turn Engine Over	High Compression	Excessive carbon build-up in combustion chamber	De-carbon Combustion Chamber
	Excessive Starter Load	Internal Engine / Drive Components Seized or Binding	Determine Cause of Seizure or Binding
Poor idle Quality (Engine Related)	Low Compression	Valve Clearance out of adjustment	Inspect / Adjust as necessary
		Poor Seating of Valve(s)	Repair or Replace
	Excessive Oil in Combustion Chamber	Valve Guides or worn valve stem seals	Replace
		Worn Rings, Piston, or Cylinder	Refer to Engine / Cooling / Exhaust Chapter
		Engine Oil Overfilled	Correct Engine Oil Level
Engine Noise	Valve Train Area	Valve Clearance out of adjustment	Inspect / Adjust as necessary
		Broken or Weak Valve Spring(s)	Replace
		Worn Camshaft or Rocker Arm	Replace
		Camshaft Bearing Damage / Wear	Inspect / Repair
		Cam Sprockets Worn	Replace
	Piston / Cylinder Area	Worn Pistons and / or Cylinders	Replace

PROBLEM	POSSIBLE CAUSE	PART(S) AFFECTED	REPAIR RECOMMENDED
		Worn Wrist Pin, Wrist Pin Bore and / or Connecting Rod	Replace
		Worn Piston Rings or Piston Ring Lands	Replace
	General	Exhaust Leak	Reseal Exhaust
	Timing Chain Area	Chain / Sprocket Worn	Replace
		Chain Tensioner and / or Guide Worn	Replace
	Bottom End Area	Main Bearings	Refer to Transmission / Crankshaft Chapter
		Rod Bearings	Refer to Transmission / Crankshaft Chapter
		Loose Side Clearance	Refer to Transmission / Crankshaft Chapter
	Transmission Area	Bearings	Refer to Transmission / Crankshaft Chapter
Poor High-Speed Running	Air Intake Problem	-	Refer to Fuel Delivery / EFI Chapter
	Fuel Injection Problem	-	Refer to Fuel Delivery / EFI Chapter
	Ignition Problem	-	Refer to Electrical Chapter
	Valve Float	Weak Valve Springs	Replace
	Insufficient Valve Travel	Worn Camshaft / Tappets	Replace
	Valves Opening and Closing at Wrong Time	Incorrect Valve Timing	Correct
Lack of Power in all RPM Ranges	Low Compression	Worn Piston, Rings, Cylinder, Poor Valve Seating	Repair / Replace
	Valve Timing Incorrect	Cam Chain and Sprockets	Correct
		Damaged Cam Gears	Replace
	Valve Float	Weak Valve Springs	Replace
	Insufficient Valve Lift	Worn Camshaft / Tappets	Replace
	Ignition / Fuel Injection System	—	Refer to Fuel Delivery / EFI Chapter (EFI) or Electrical Chapter (Ignition)
	Oiling Problem	Oil Overfilled	Correct Engine Oil Level

EXHAUST

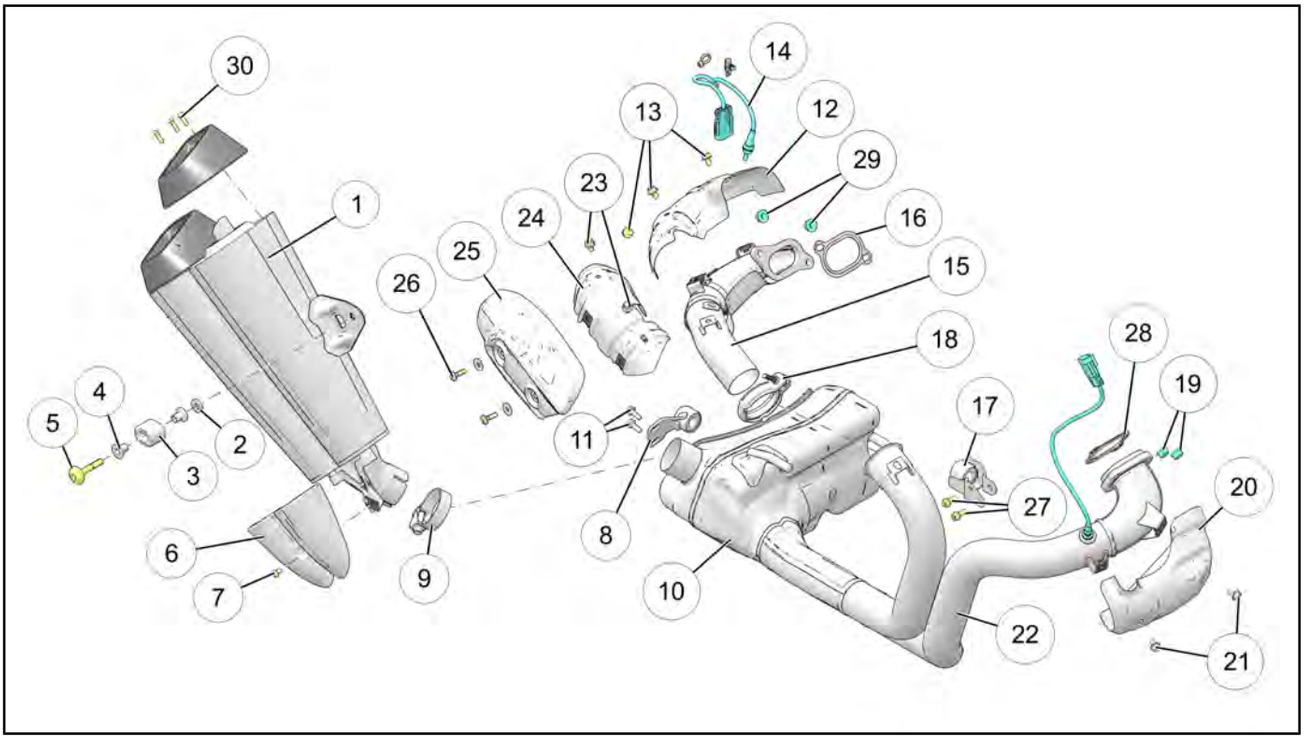
EXHAUST SYSTEM ASSEMBLY VIEW (2019-2020)



NUMBER	PART DESCRIPTION	TORQUE (IF APPLICABLE)
①	Muffler	-
②	Muffler Spacer	-
③	Muffler Isolator Grommet	-
④	Exhaust Isolator Insert	-
⑤	Muffler Isolator Fastener	**16 ft-lbs (22 N·m)**
⑥	Muffler Heat Shield	-
⑦	Muffler Heat Shield Fastener	**70 in-lbs (8 N·m)**
⑧	Exhaust Gasket	-
⑨	Exhaust Clamp (Muffler to Resonator)	**144 in-lbs (16 N·m)**
⑩	Resonator	-
⑪	Resonator Bracket Fastener	**88 in-lbs (10 N·m)**
⑫	Rear Heat Shield	-
⑬	Heat Shield Fastener, Rear	**88 in-lbs (10 N·m)**
⑭	Oxygen Sensor	**14 ft-lbs (19 N·m)**
⑮	Rear Headpipe	-
⑯	Exhaust Sealing Gasket	-
⑰	Exhaust Gasket	-
⑱	Exhaust Clamp (Front Headpipe to Rear Headpipe)	**144 in-lbs (16 N·m)**
⑲	Headpipe Fasteners	**16 ft-lbs (22 N·m)**
⑳	Front Heat Shield	-

NUMBER	PART DESCRIPTION	TORQUE (IF APPLICABLE)
㉑	Heat Shield Fastener, Front	**88 in-lbs (10 N·m)**
㉒	Front Headpipe Assembly	-
㉓	Heat Shield Base Fastener, Central	**88 in-lbs (10 N·m)**
㉔	Central Heat Shield Base	-
㉕	Central Heat Shield	-
㉖	Heat Shield Fastener, Central	**88 in-lbs (10 N·m)**
㉗	Exhaust Gasket	-
㉘	Exhaust Clamp (Front Headpipe to Resonator)	**144 in-lbs (16 N·m)**
㉙	Resonator Fastener	**16 ft-lbs (21 N·m)**
㉚	Muffler Cap Fasteners	**45 in-lbs (5 N·m)**

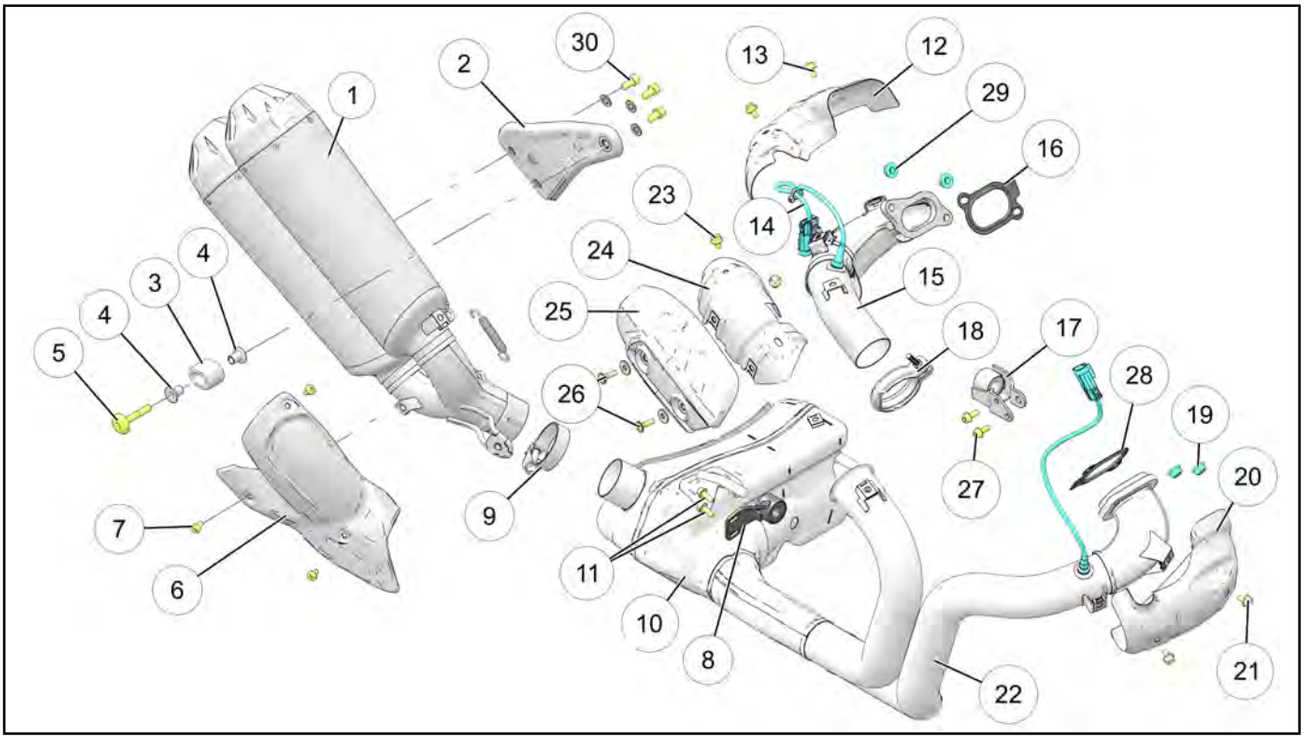
EXHAUST SYSTEM ASSEMBLY VIEW (2022)



NUMBER	PART DESCRIPTION	TORQUE (IF APPLICABLE)
①	Muffler	-
②	Muffler Spacer	-
③	Muffler Isolator Grommet	-
④	Exhaust Isolator Insert	-
⑤	Muffler Isolator Fastener	**16 ft-lbs (22 N·m)**
⑥	Muffler Heat Shield	-
⑦	Muffler Heat Shield Fastener	**70 in-lbs (8 N·m)**
⑧	Resonator Mount (right-hand)	-
⑨	Exhaust Clamp (Front Headpipe to Resonator) 2022	**15 ft-lbs (20 N·m)**
⑩	Resonator	-
⑪	Resonator Mount Fasteners	**84 in-lbs (9 N·m)**
⑫	Heat Shield , Rear	-
⑬	Heat Shield Fastener, Rear	**88 in-lbs (10 N·m)**
⑭	Oxygen Sensor	**14 ft-lbs (19 N·m)**
⑮	Head Pipe, Rear	-
⑯	Exhaust Sealing Gasket	-
⑰	Resonator Mount (left-hand)	-
⑱	Exhaust Clamp (Front Headpipe to Rear Headpipe)	**88 in-lbs (10 N·m)**
⑲	Head Pipe Fasteners	**16 ft-lbs (22 N·m)**
⑳	Heat Shield, Front	-

NUMBER	PART DESCRIPTION	TORQUE (IF APPLICABLE)
㉑	Heat Shield Fastener, Front	**88 in-lbs (10 N·m)**
㉒	Headpipe Assembly, Front	-
㉓	Heat Shield Base Fastener, Central	**88 in-lbs (10 N·m)**
㉔	Central Heat Shield Base	-
㉕	Central Heat Shield	-
㉖	Heat Shield Fastener, Central	**88 in-lbs (10 N·m)**
㉗	Resonator Mount Fasteners	**84 in-lbs (9 N·m)**
㉘	Exhaust Sealing Gasket	-
㉙	Head Pipe Fasteners	-
㉚	Muffler Cap Fasteners	**45 in-lbs (5 N·m)**

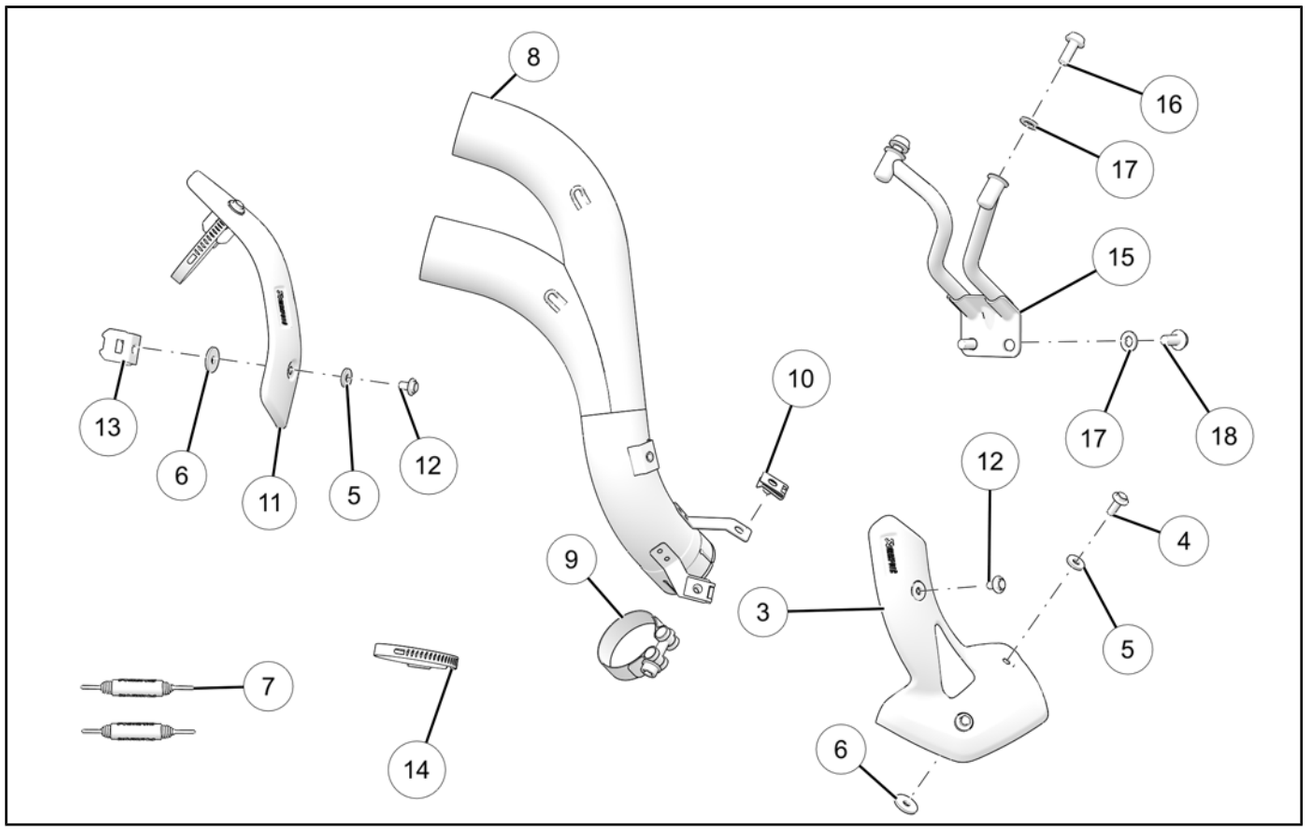
EXHAUST SYSTEM ASSEMBLY VIEW (2023)



NUMBER	PART DESCRIPTION	TORQUE (IF APPLICABLE)
①	Muffler	-
②	Muffler Bracket	-
③	Muffler Isolator Grommet	-
④	Exhaust Isolator Insert	-
⑤	Muffler Isolator Fastener	**16 ft-lbs (22 N·m)**
⑥	Muffler Heat Shield	-
⑦	Muffler Heat Shield Fastener	**70 in-lbs (8 N·m)**
⑧	Resonator Mount (right-hand)	-
⑨	Exhaust Clamp (Front Headpipe to Resonator) 2023	**22 ft-lbs (30 N·m)**
⑩	Resonator	-
⑪	Resonator Mount Fasteners	**84 in-lbs (9 N·m)**
⑫	Heat Shield , Rear	-
⑬	Heat Shield Fastener, Rear	**88 in-lbs (10 N·m)**
⑭	Oxygen Sensor	**14 ft-lbs (19 N·m)**
⑮	Head Pipe, Rear	-
⑯	Exhaust Sealing Gasket	-
⑰	Resonator Mount (left-hand)	-
⑱	Exhaust Clamp (Front Headpipe to Rear Headpipe)	**88 in-lbs (10 N·m)**
⑲	Head Pipe Fasteners	**16 ft-lbs (22 N·m)**
⑳	Heat Shield, Front	-

NUMBER	PART DESCRIPTION	TORQUE (IF APPLICABLE)
㉑	Heat Shield Fastener, Front	**88 in-lbs (10 N·m)**
㉒	Headpipe Assembly, Front	-
㉓	Heat Shield Base Fastener, Central	**88 in-lbs (10 N·m)**
㉔	Central Heat Shield Base	-
㉕	Central Heat Shield	-
㉖	Heat Shield Fastener, Central	**88 in-lbs (10 N·m)**
㉗	Resonator Mount Fasteners	**84 in-lbs (9 N·m)**
㉘	Exhaust Sealing Gasket	-
㉙	Head Pipe Fasteners	-
㉚	Muffler Bracket Fasteners	**18 ft-lbs (25 N·m)**

HIGH MOUNT EXHAUST ASSEMBLY VIEW



ITEM	DESCRIPTION	TORQUE
③	Heat Shield–Lower, Akrapovič	—
④	Lower Heat Shield Fasteners	**88 in-lbs (10 N·m)**
	Washer, M6 15 x 2	—
	Spacer, M6 20 x 2	—
⑦	Spring–Fixation, Akrapovič	—
⑧	Tube–Exhaust Pipe, High Mount	—
⑨	Exhaust Clamp (Muffler to Resonator)	**144 in-lbs (16 N·m)**
⑩	Nut–Clip, M6	—
⑪	Heat Shield–Upper, Akrapovič	—
⑫	Upper Heat Shield Fasteners	**88 in-lbs (10 N·m)**
	Gusset–Upper Heat Shield, 1.0 x 25 x 62	—
⑭	Upper Heat Shield Clamps	**18 in-lbs (2 N·m)**
⑮	Bracket–High Mount	—
⑯	Exhaust Mount Fasteners (mount to chassis)	**19 ft-lbs (26 N·m)**
⑰	Washer, M8, 16 x 1.6	—
⑱	Exhaust Mount Fasteners (mount to muffler)	**19 ft-lbs (26 N·m)**

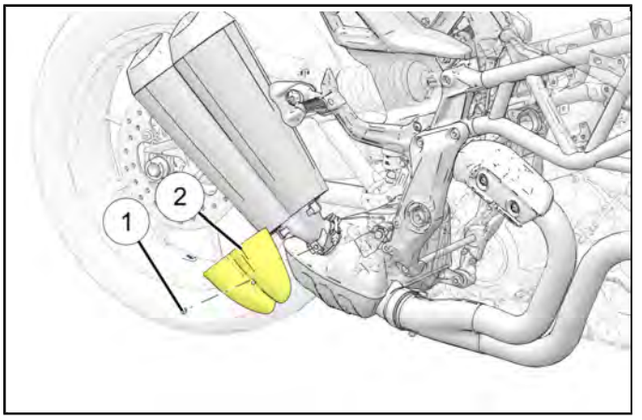
EXHAUST SERVICE

MUFFLER REMOVAL / INSTALLATION

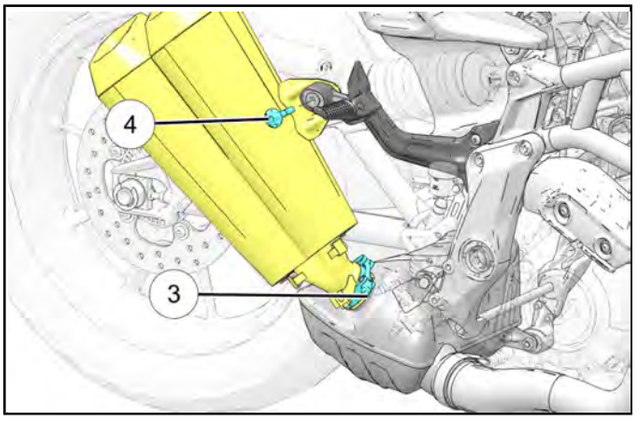
⚠ WARNING

Engine and exhaust components get hot and remain hot for a period of time after the engine is stopped. Wear insulated protective clothing or wait for components to cool sufficiently before working on the machine.

1. Remove the muffler heat shield fastener ① and the muffler heat shield ②.



2. Remove the exhaust clamp ③ retaining the muffler to the exhaust resonator.



IMPORTANT

Note orientation of exhaust clamp for reinstallation.

3. Remove the muffler isolator fastener ④.
4. Remove the muffler from the resonator.
5. **Installation is performed by reversing the removal procedure.**

IMPORTANT

New exhaust gaskets are required for reinstallation.

TORQUE

Muffler Isolator Fastener:
16 ft-lbs (22 N·m)

TORQUE

Exhaust Clamp (Muffler to Resonator):
144 in-lbs (16 N·m)

TORQUE

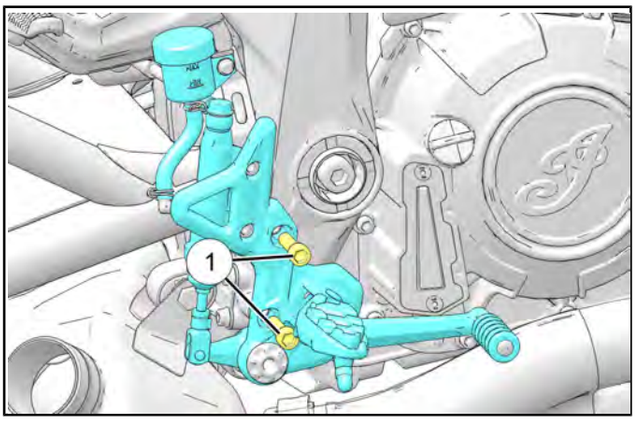
Muffler Heat Shield Fastener:
70 in-lbs (8 N·m)

RESONATOR REMOVAL / INSTALLATION

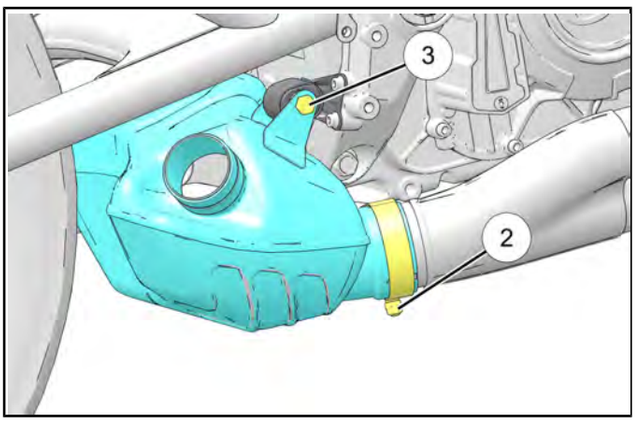
⚠ WARNING

Engine and exhaust components get hot and remain hot for a period of time after the engine is stopped. Wear insulated protective clothing or wait for components to cool sufficiently before working on the machine.

1. Prior to Resonator Removal, Remove muffler. See **Muffler Removal / Installation page 3.126**.
2. Remove two fasteners ① retaining the right foot control.



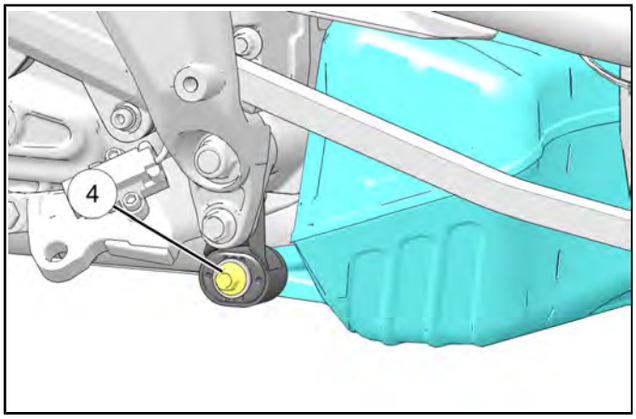
3. Remove exhaust clamp ② connecting resonator to front headpipe.



IMPORTANT

Note orientation of exhaust clamp for reinstallation.

4. Remove the right hand side resonator mount fastener ③.
5. Remove the left side resonator mount fastener ④.



6. Remove resonator from the unit.
7. **Installation is performed by reversing the removal procedure.**

IMPORTANT

New exhaust gaskets are required for reinstallation.

TORQUE

Resonator Fastener:
16 ft-lbs (21 N·m)

TORQUE

Exhaust Clamp (Front Headpipe to Resonator):
144 in-lbs (16 N·m)

TORQUE

Footpeg Fasteners (driver):
17 ft-lbs (23 N·m)

3

FRONT HEAD PIPE REMOVAL / INSTALLATION, 2019–2020 MODELS

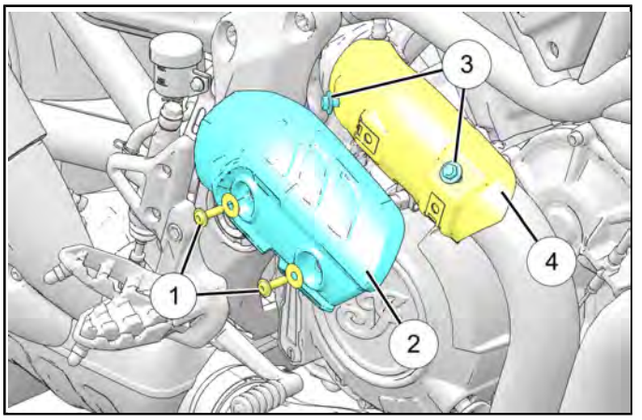
⚠ WARNING

Engine and exhaust components get hot and remain hot for a period of time after the engine is stopped. Wear insulated protective clothing or wait for components to cool sufficiently before working on the machine.

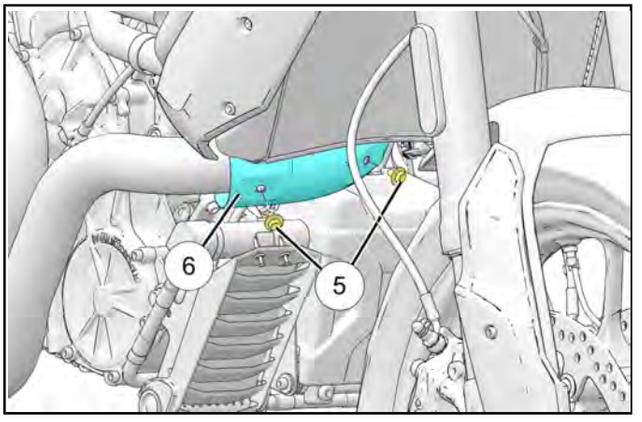
NOTICE

The front head pipe can be removed with the resonator and muffler still installed.

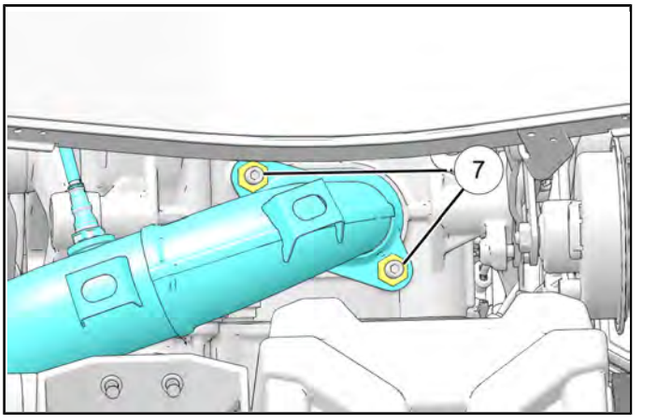
1. Remove the right side air box cover by following steps 3–7 in **Air Box Removal page 3.14**.
2. Unplug oxygen sensor electrical connector.
3. On the right side of the unit, remove two fasteners ① securing the central exhaust heat shield ②.



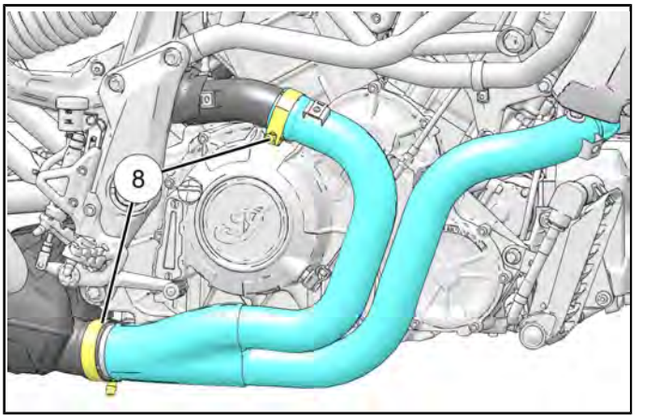
4. Remove the two fasteners ③ that secure the central heat shield base ④.
5. Remove two fasteners ⑤ securing front exhaust heat shield ⑥.



6. Remove head pipe fasteners ⑦ securing head pipe to cylinder head.



7. Loosen two exhaust clamps ⑧.



8. Remove front head pipe assembly from unit.

9. **Installation is performed by reversing the removal procedure.**

IMPORTANT
New exhaust gaskets are required for reinstallation.

TORQUE
Headpipe Fasteners: **16 ft-lbs (22 N·m)**

TORQUE
Exhaust Clamp (Front Headpipe to Rear Headpipe): **144 in-lbs (16 N·m)**

TORQUE
Exhaust Clamp (Front Headpipe to Resonator): **144 in-lbs (16 N·m)**

TORQUE
Heat Shield Fastener, Front: **88 in-lbs (10 N·m)**

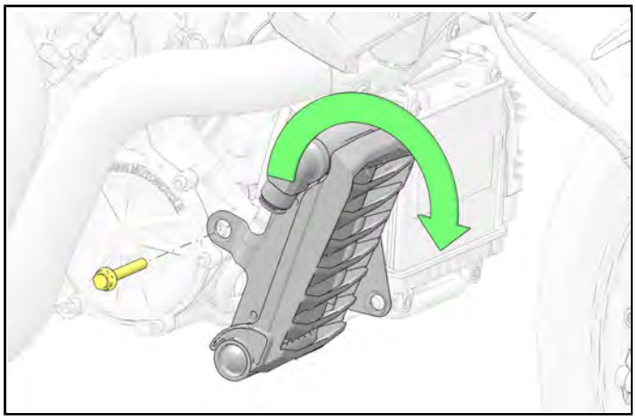
TORQUE
Heat Shield Base Fastener, Central: **88 in-lbs (10 N·m)**

FRONT HEAD PIPE REMOVAL / INSTALLATION, 2022+ MODELS

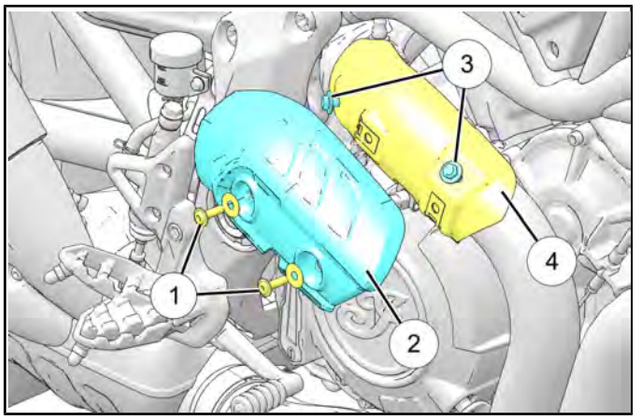
⚠ WARNING
Engine and exhaust components get hot and remain hot for a period of time after the engine is stopped. Wear insulated protective clothing or wait for components to cool sufficiently before working on the machine.

FRONT HEAD PIPE REMOVAL

1. Remove the right side air box cover by following steps 3–7 in **Air Box Removal page 3.14**.
2. Remove chin fairing. See **Chin Fairing Replacement page 7.38**
3. Unplug oxygen sensor electrical connector.
4. Remove the oil cooler mount fastener and pivot the oil cooler forward.

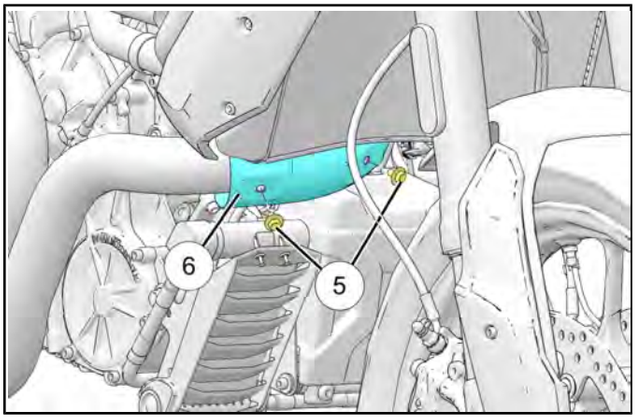


5. On the right side of the unit, remove two fasteners ① securing the central exhaust heat shield ②.

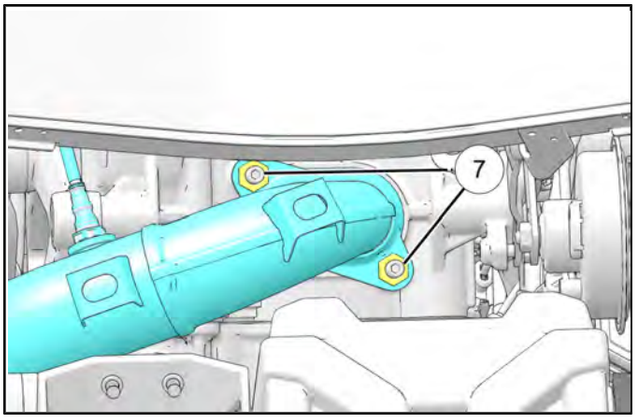


6. Remove the two fasteners ③ that secure the central heat shield base ④.

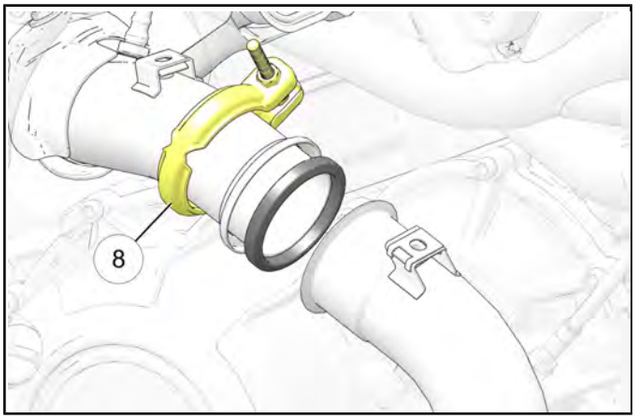
7. Remove two fasteners ⑤ securing front exhaust heat shield ⑥.



8. Remove head pipe fasteners ⑦ securing head pipe to cylinder head.

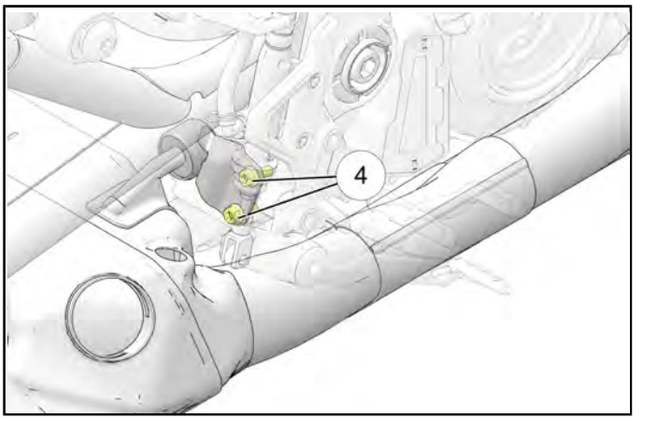


9. Remove clamp ⑧ and gasket.

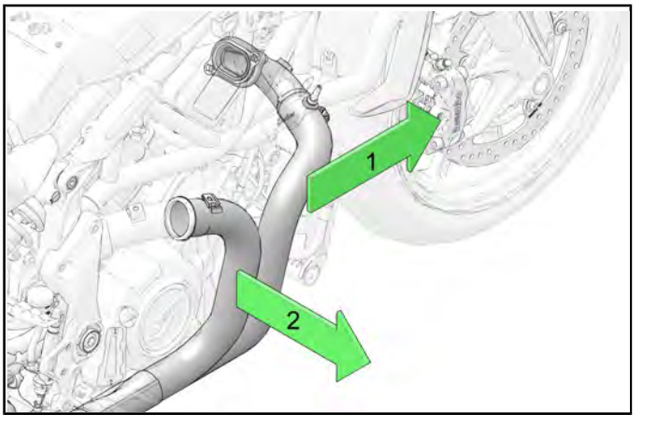


IMPORTANT
New exhaust clamp and gasket are required for reinstallation.

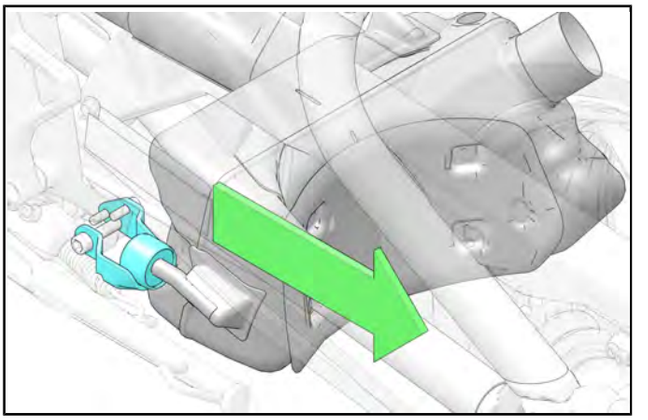
10. Remove two right-hand resonator mount fasteners ④ and remove hanger from frame.



11. Slide the exhaust assembly forward to disengage from rear header and pivot assembly outwards.



12. Slide the exhaust assembly rearward and disengage with the left-hand hanger.



FRONT HEAD PIPE INSTALLATION

1. **Installation is performed by reversing the removal procedure.**

TORQUE
Headpipe Fasteners: **16 ft-lbs (22 N·m)**

TORQUE
Exhaust Clamp (Front Headpipe to Rear Headpipe): **88 in-lbs (10 N·m)**

TORQUE
Heat Shield Fastener, Front: **88 in-lbs (10 N·m)**

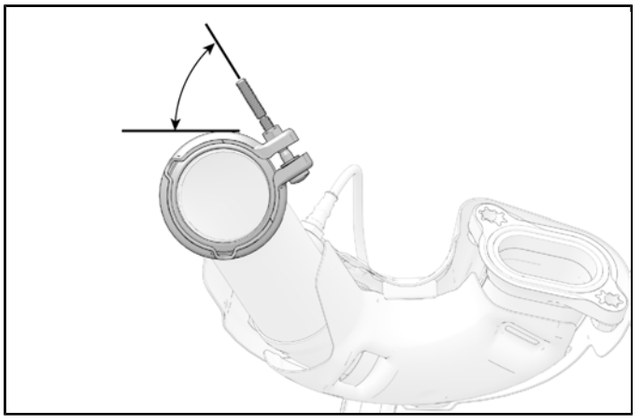
TORQUE
Heat Shield Base Fastener, Central: **88 in-lbs (10 N·m)**

TORQUE
Central Heat Shield Fastener: **88 in-lbs (10 N·m)**

TORQUE
Resonator Mount Fasteners: **84 in-lbs (9 N·m)**

TORQUE
Oil Cooler Mount Fastener: **72 in-lbs (8 N·m)**

2. Clock the Exhaust Clamp (Front Headpipe to Rear Headpipe) to the correct angle for 2022 models. Break off end of stud at break point.



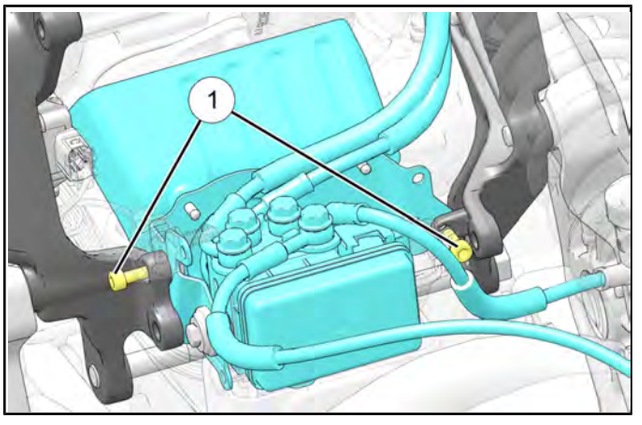
3. Install chin fairing. See **Chin Fairing Replacement page 7.38**

REAR HEAD PIPE REMOVAL / INSTALLATION, ALL MODELS

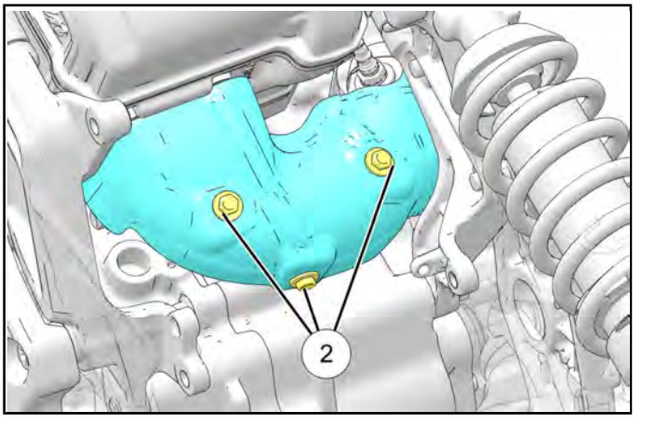
⚠ WARNING

Engine and exhaust components get hot and remain hot for a period of time after the engine is stopped. Wear insulated protective clothing or wait for components to cool sufficiently before working on the machine.

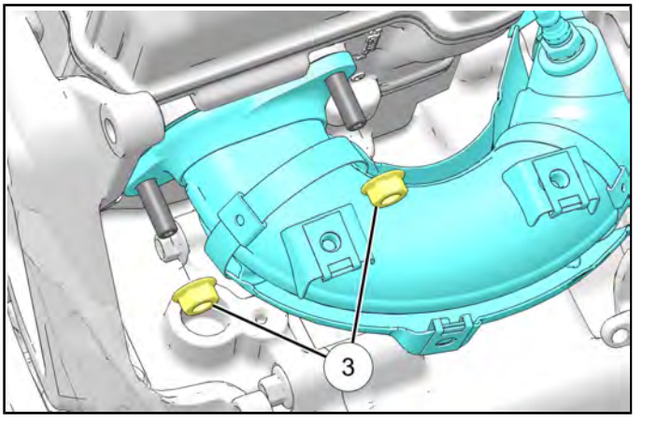
1. Remove seat. See **Seat Removal / Installation page 7.19**.
2. Remove fuel tank. See **Fuel Tank Removal page 4.24**.
3. Remove front head pipe. See .
   - 2019–2020 models: **Front Head Pipe Removal / Installation, 2019–2020 models page 3.128**
   - 2022+ models: **Front Head Pipe Removal / Installation, 2022+ models page 3.129**
4. Remove two fasteners ① securing the ABS module bracket. The rear head pipe fasteners are easily accessible with the ABS module bracket loose.



5. Disconnect rear head pipe oxygen sensor electrical connection
6. Remove the rear heat shield by removing two fasteners ②.



7. Remove head pipe fasteners ③.



8. Remove rear head pipe.
9. **Installation is performed by reversing the removal procedure.**

TORQUE
Exhaust Studs: **88 in-lbs (10 N·m)**

TORQUE
Headpipe Fasteners: **16 ft-lbs (22 N·m)**

TORQUE
Rear Heat Shield Fasteners: **88 in-lbs (10 N·m)**

TORQUE
ABS Mount Bracket Fasteners: **97 in-lbs (11 N·m)**

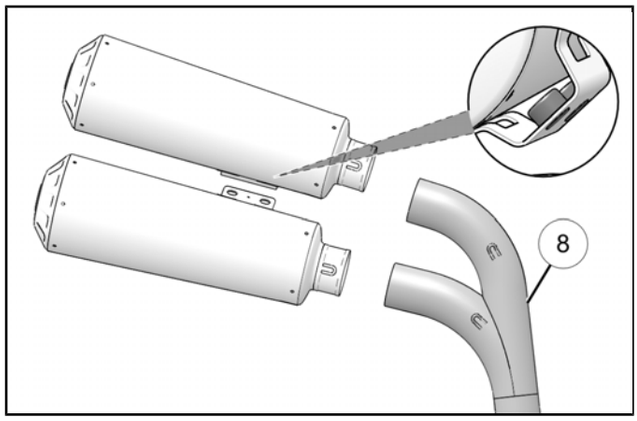
10. Install Front head pipe. See **Front Head Pipe Removal / Installation, 2019–2020 models page 3.128**.
11. Install Fuel Tank. See **Fuel Tank Installation page 4.30**.
12. Install Seat. See **Seat Removal / Installation page 7.19**.

HIGH MOUNT EXHAUST INSTALLATION

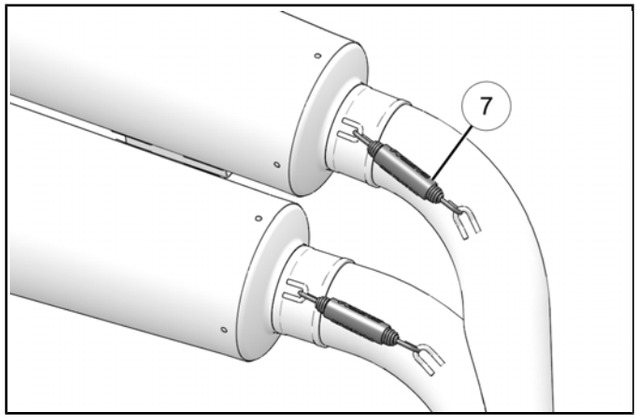
EXHAUST ASSEMBLY

1. Slide retained upper muffler and lower muffler onto exhaust pipe ⑧.

NOTICE
Upper muffler can be identified by weld nuts on rear-side bracket.

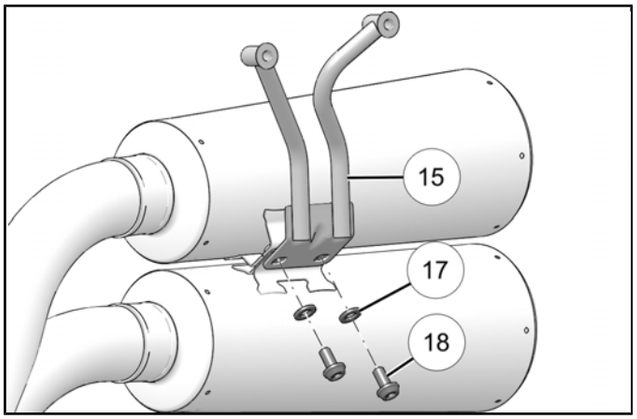


2. Secure mufflers to exhaust pipe with two springs ⑦.



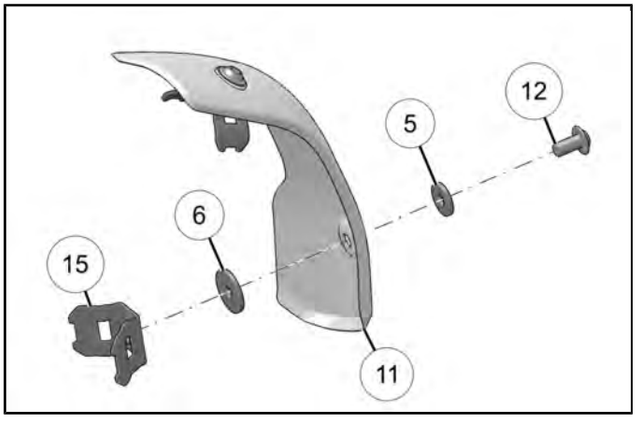
3. Install exhaust mount ⑮ to mufflers with two exhaust mount fasteners ⑱ and two washers ⑰, as shown.

Do not torque exhaust mount fasteners at this time.

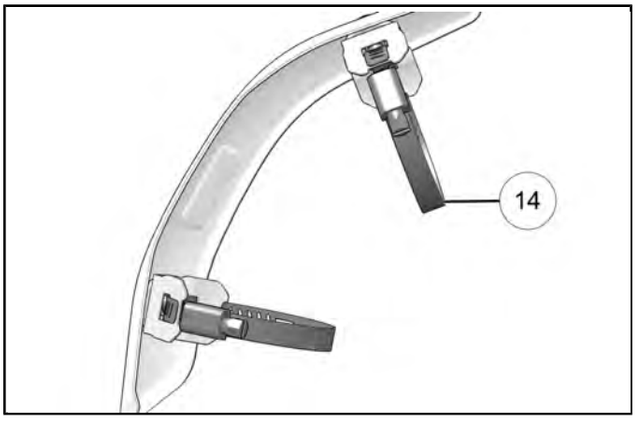


4. Install two gussets ⑮ onto upper heat shield ⑪ with two heat shield fasteners ⑫, two washers ⑤, and two spacers ⑥, as shown. Ensure spacers ⑥ are installed between gusset ⑮ and under-side of heat shield ⑪.

Do not torque upper heat shield fasteners at this time.

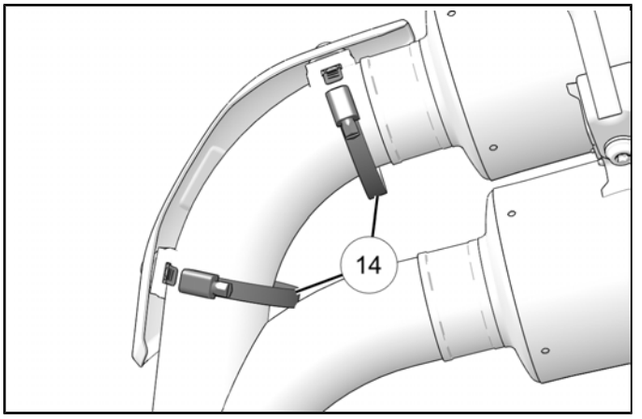


5. Pass two heat shield clamps through slots of installed gussets.



6. Place upper heat shield over upper exhaust pipe tube. Ensure heat shield overlaps connection between upper muffler and exhaust pipe. Tighten clamps to secure heat shield.

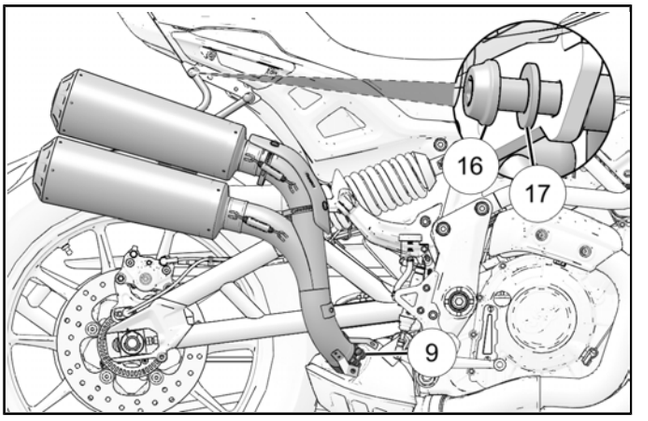
Do not torque heat shield clamps at this time.



EXHAUST INSTALLATION

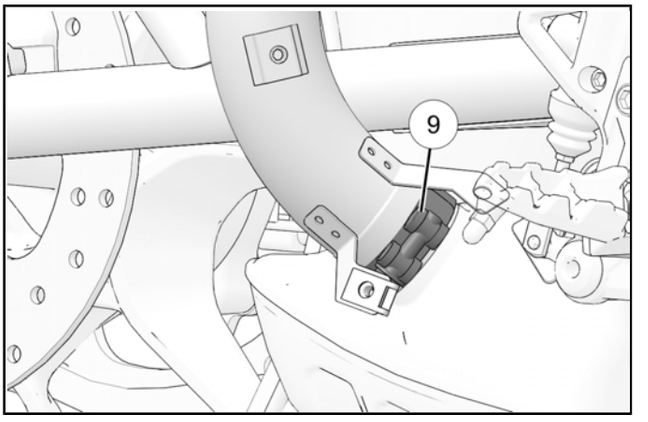
1. Slide exhaust pipe clamp ⑨ onto base of exhaust pipe and place exhaust pipe onto exhaust resonator. Align exhaust mount with accessory mounts and install with two mounting fasteners ⑯ and two washers ⑰.

Do not torque two mounting fasteners ⑯ at this time.



2. Tighten clamp ⑨ around base of exhaust pipe.

TORQUE
Exhaust Clamp ⑨ (Muffler to Resonator): **144 in-lbs (16 N·m)**



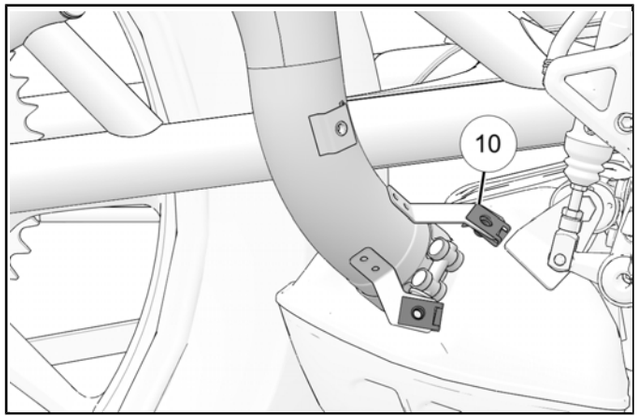
3. Torque mounting fasteners ⑯, installed in step 1 of this section.

TORQUE
Exhaust Mount Fasteners (mount to chassis)⑯: **19 ft-lbs (26 N·m)**

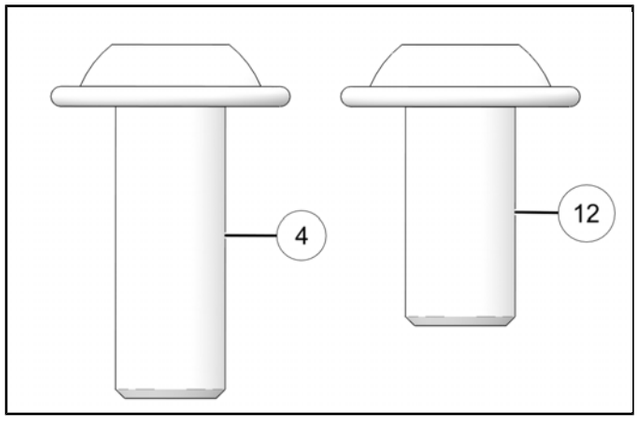
4. Torque exhaust mount fasteners ⑱, installed in step 3 of *Exhaust Assembly* section.

TORQUE
Exhaust Mount Fasteners (mount to muffler) ⑱: **19 ft-lbs (26 N·m)**

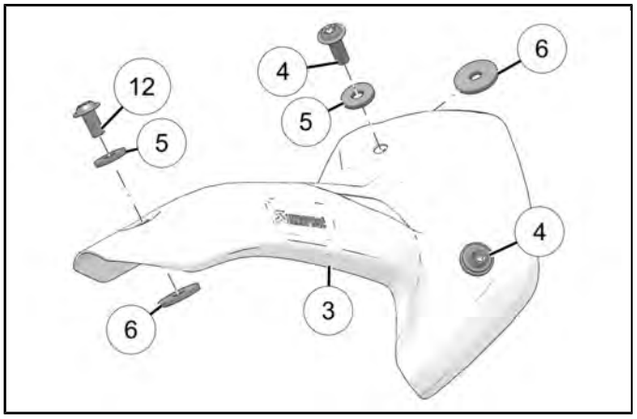
5. Slide two clip-nuts ⑩ onto lower heat shield mounts.



6. Ensure two heat shield fasteners ④ (long) are used at lower mounting locations. Using fasteners ④ (long) instead of fastener ⑫ (short) at upper mounting location may result in fastener being installed into exhaust pipe and causing damage.



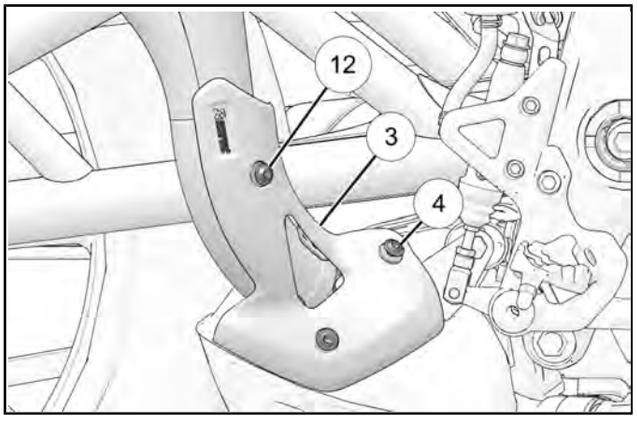
7. Pass heat shield fasteners ④ and ⑫ through three washers ⑤, heat shield ③, and three spacers ⑥.



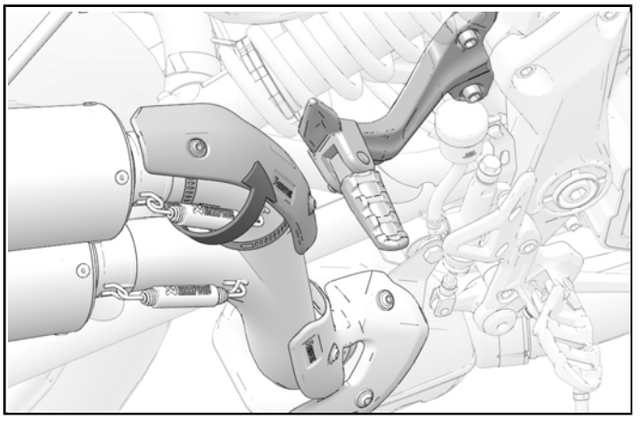
8. Install lower heat shield ③ onto exhaust pipe mounts. Ensure spacers are aligned with clip-nuts underneath heat shield.

TORQUE
Upper Heat Shield Fastener ⑫: **88 in-lbs (10 N·m)**

TORQUE
Lower Heat Shield Fasteners ④: **88 in-lbs (10 N·m)**

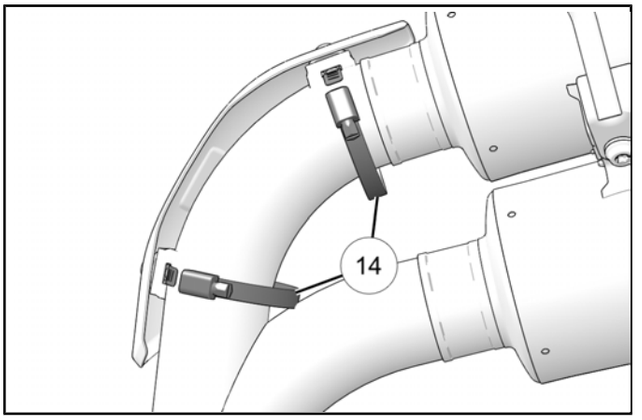


9. Adjust heat shield so that it does not contact passenger foot peg when opened or closed.



10. Tighten heat shield clamps ⑭ to specification.

TORQUE
Upper Heat Shield Clamps ⑭: **18 in-lbs (2 N·m)**



CHAPTER 4
FUEL DELIVERY / EFI

GENERAL INFORMATION

SERVICE NOTES

Many hazards are present when working on or around the fuel injection system. Read and pay close attention to the following warnings and cautions when working on any component in this section.

⚠ WARNING

Gasoline is extremely flammable and is explosive under certain conditions. Work in a well ventilated area. Open flames, sparks and cigarettes must be kept away from gasoline.

⚠ WARNING

Careless handing of the control cables can result in twisting or bending of the cables. This can cause the cables to stick or bind, resulting in loss of vehicle control.

⚠ WARNING

The engine exhaust from this product contains chemicals known to cause cancer, birth defects or other reproductive harm.

⚠ WARNING

The engine and exhaust system become very hot during operation and remains hot for a period of time after the engine is shut off. Wear insulated protection for hands and arms or wait until the engine and exhaust system have cooled before performing service work.

⚠ WARNING

Always stop the engine and refuel outdoors or in a well ventilated area.

⚠ WARNING

If you get gasoline in your eyes or if you swallow gasoline, see your doctor immediately. Never try to syphon gasoline using mouth suction.

⚠ WARNING

Never start the engine or let it run in an enclosed area. Engine exhaust fumes are poisonous and can cause loss of consciousness and death in a short time.

⚠ WARNING

The battery should always be disconnected before working on the fuel system.

When replacing fuel lines, always use genuine Indian Motorcycle replacement parts. This will ensure top performance, function and durability.

Fuel lines remain under pressure at all times. Use caution when disconnecting lines for service.

Pull the fuel pump fuse to disable fuel pump and crank engine to release pressure. Always depressurize the fuel system prior to service.

Cover the fuel line connections with a clean, absorbent towel to minimize spillage while disconnecting.

Don't overlook the basics while troubleshooting the fuel system:

- Except where noted, views of connectors are from WIRE side of the connector.
- A battery in a low state of charge can cause problems. Be sure battery is in good condition and fully charged.
- Air leaks in intake tract / air box - check for air leaks and repair to avoid misdiagnosing the EFI system.
- Contaminated or improper fuel.
- Restricted fuel flow / filters (low fuel pressure).
- Fuel tank vent line or evaporative emissions lines pinched or obstructed.
- Faulty spark plug(s).
- Corroded, disconnected, or incorrectly connected wiring.
- Poor ground connections - be sure all grounds are clean and tight.
- Exhaust system restriction or improper exhaust.
- Engine mechanical condition.

SPECIAL TOOLS - FUEL SYSTEM / EFI

TOOL DESCRIPTION	PART NUMBER
Fuel Pressure Adapter	PV-48656
Fuel Pressure Gauge	PU-43506–A
Fuel Tank Fitting Plug 12mm	PV-50567
Relay Bypass	PU-49466
MultiLink XP	PU-52792
USB to Serial Adapter	PU-50621

Bosch Automotive Service Solutions: 1-800-345-2233 or https://polaris.service-solutions.com/

SERVICE SPECIFICATIONS - FUEL SYSTEM / EFI

ITEM	SPECIFICATIONS
Fuel Pump Pressure	4.0 BAR (400 kPa) (58 psi)
Idle Speed	1100 rpm ± 50 rpm
Fuel Pump Amp Draw (Normal Operation)	3 - 5 Amps
Recommended Octane	91 Octane Minimum
Injector Resistance	11.4 - 12.6 Ohms

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

EFI SYSTEM PRECAUTIONS

⚠ CAUTION

While electronic fuel injection is durable and reliable, the components can be damaged or problems may occur if the following precautions are not taken.

It is not advisable to "jump start" the machine with another battery. Although problems are unlikely to occur if everything is done carefully, the electrical component could be damaged.

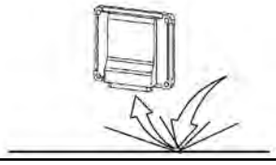
Never disconnect the battery while the engine is running.

When connecting and disconnecting the battery cables refer to Electrical Chapter for complete battery connection and charging information. See **Battery Installation page 10.14**.

Make sure that the ignition is powered down before connecting and disconnecting connections. Best practice is to disconnect the battery before connecting or disconnecting the electrical connections.

Fuses and circuit breakers protect critical electrical components and circuits. Never replace the fuse with a larger value fuse or "jumper" the fuse with wire, aluminum foil or any other means. Always investigate the cause of the problem and repair before replacing the fuse.

The ECM and sensors are sensitive pieces of electronic equipment. Dropping or hitting them may cause irreparable damage.



Static electricity can damage the electronic controllers beyond repair. The human body can easily store enough static electricity to damage sensitive electronic components. Before working with any components of the Fuel Injection system, ground yourself to dissipate any static charge. Also take care not to touch any of terminal pins on the ECM.

Do not touch ECM connector pins

Anti-static wrist strap PV-43541

⚠ CAUTION

Some tests require probing of the ECM wiring harness connector. Do not touch or probe the exposed pins on the ECM. Static electricity from your body or the meter can easily damage the ECM.

Always use the proper adapter from the Connector Test Adapter Kit when probing the terminals. Most of the connectors are sealed and cannot be back probed. Be extremely careful not damage the connectors by forcing meter probes into the connectors.

Connector test adapter kit PV-43526

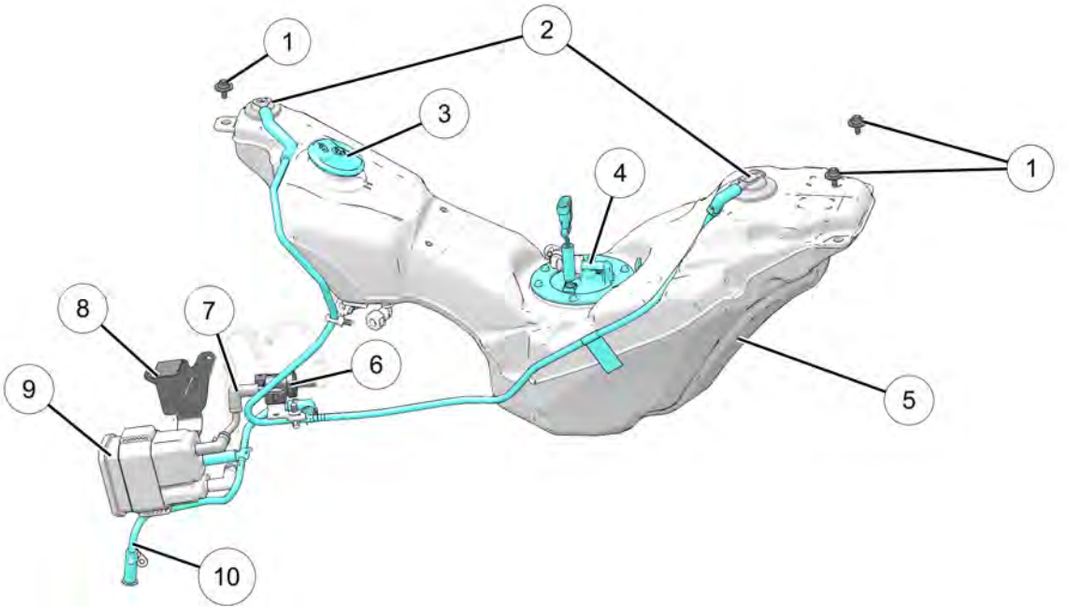
Poor connections are the most common cause of Electronic Fuel Injection malfunctions. Inspect connector and wiring connections carefully during troubleshooting.

Carefully inspect the connections of the failed circuit before doing any other troubleshooting steps. Wire terminals should be corrosion free and fully seated into the connectors. Connector should snap together and lock.

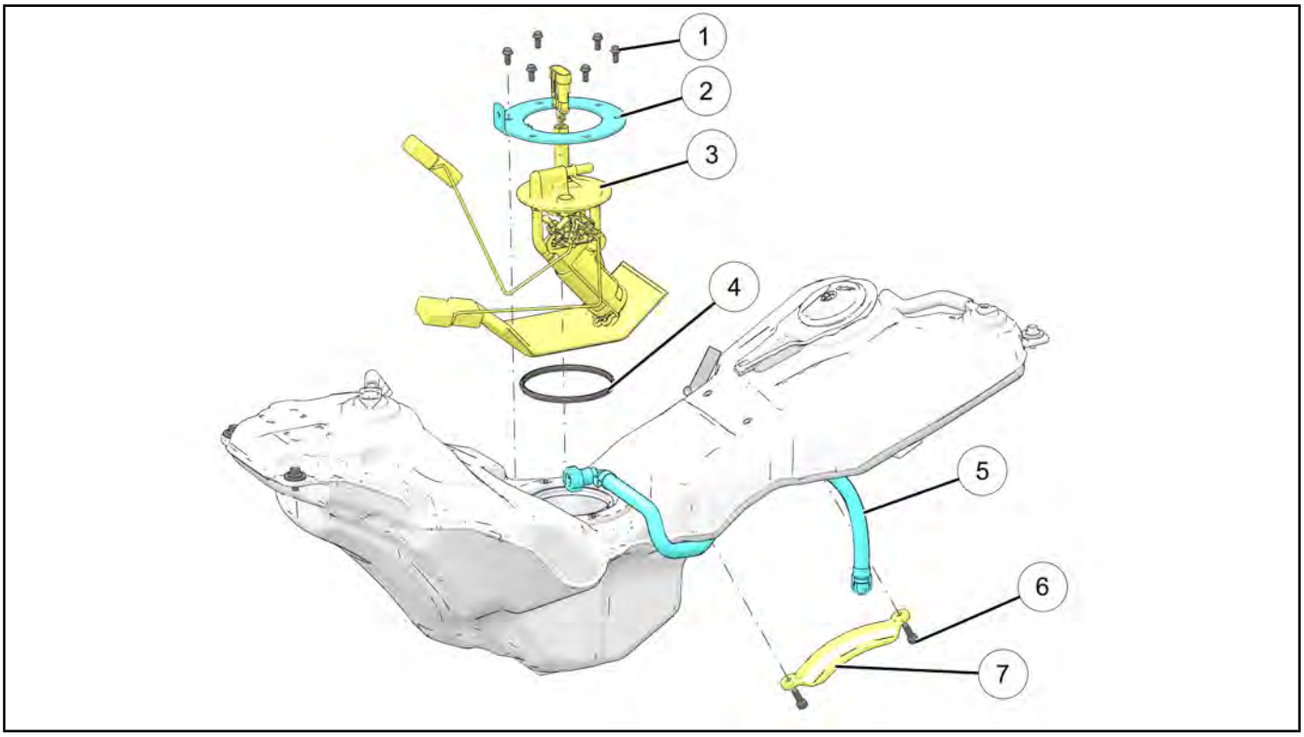
4

ASSEMBLY VIEWS

FUEL SYSTEM ASSEMBLY VIEW



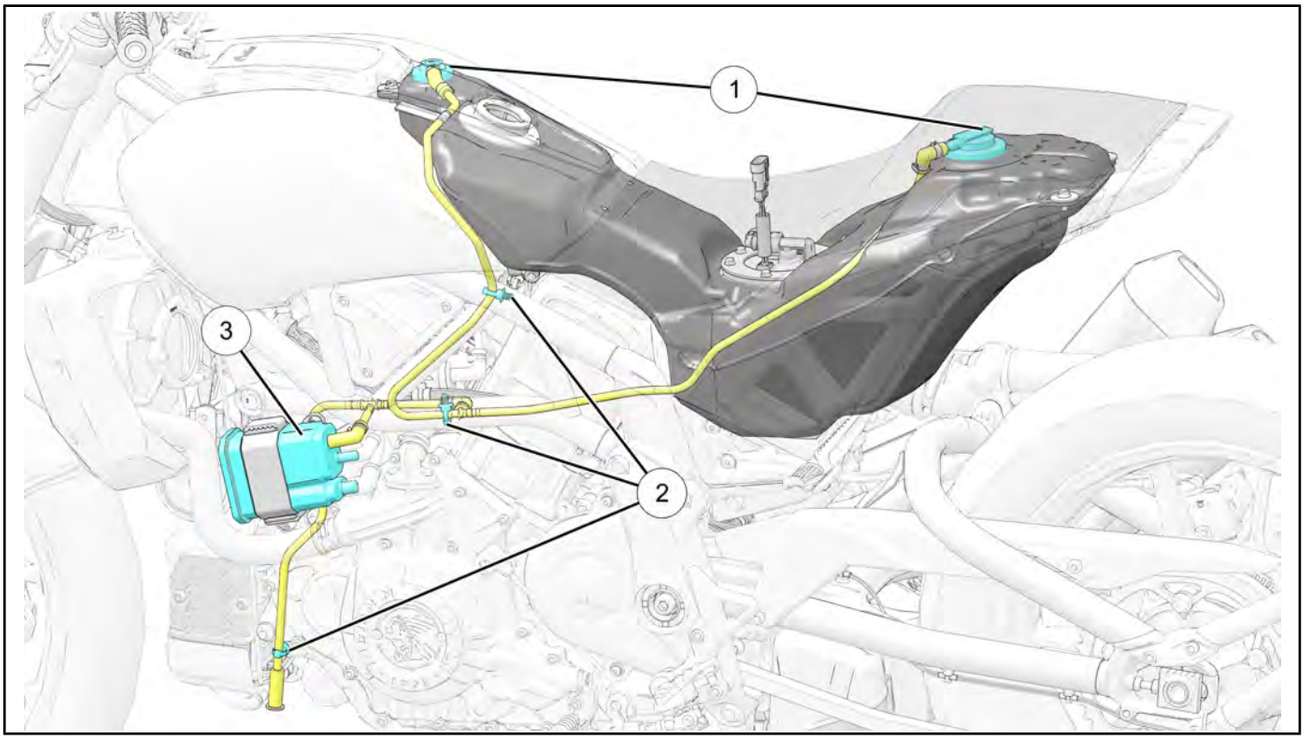
NUMBER	DESCRIPTION
①	Fuel Tank Mounting Fastener
②	Fuel Vent Valve
③	Fuel Fill Cap
④	Fuel Pump Assembly
⑤	Fuel Tank
⑥	Purge Valve
⑦	Carbon Canister To Purge Valve Line
⑧	Carbon Canister Bracket
⑨	Carbon Canister
⑩	Fuel Vent Line



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Fuel Pump Fasteners	**80 in-lbs (9 N·m)**
②	Fuel Pump Lock Ring	-
③	Fuel Pump Assembly	-
④	Fuel Pump Seal	-
⑤	Fuel Line	-
⑥	Fuel Line Retainer Fastener	**43 in-lbs (5 N·m)**
⑦	Fuel Line Retainer	-

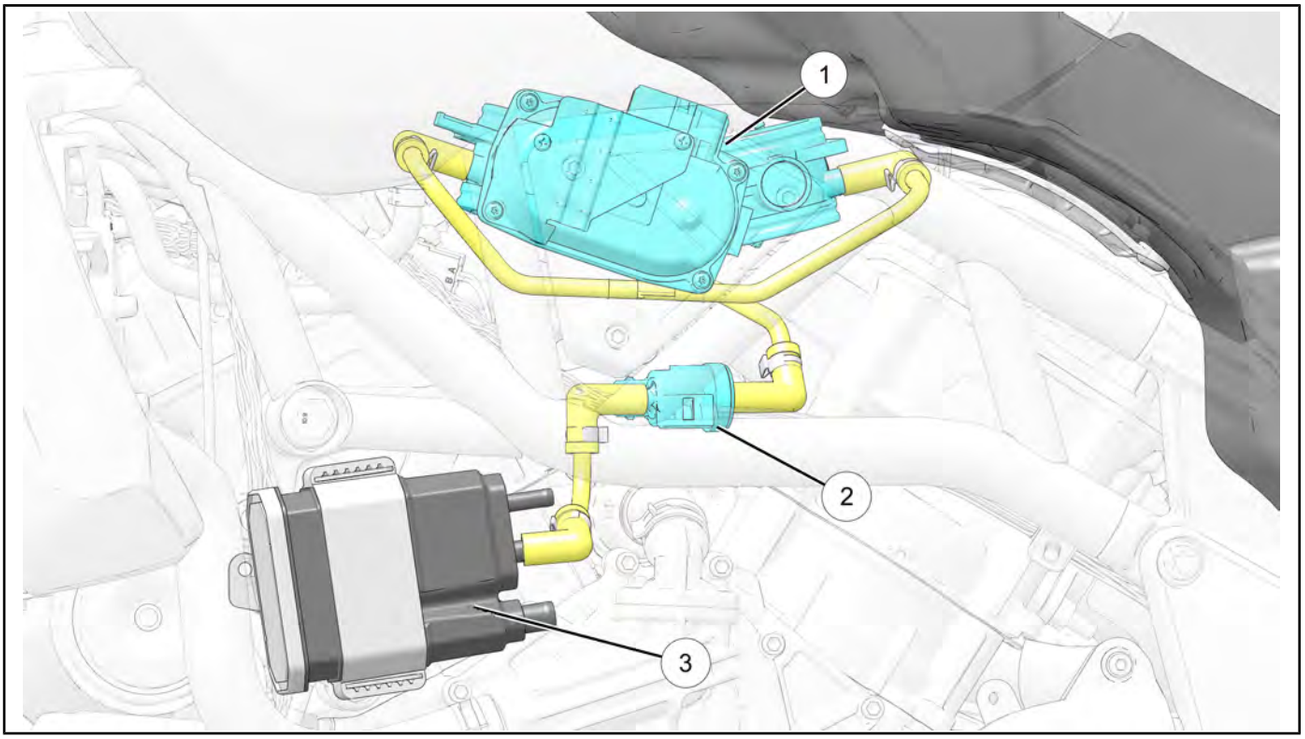
FUEL LINE ROUTING / RETENTION

Fuel Vent Line Routing / Retention



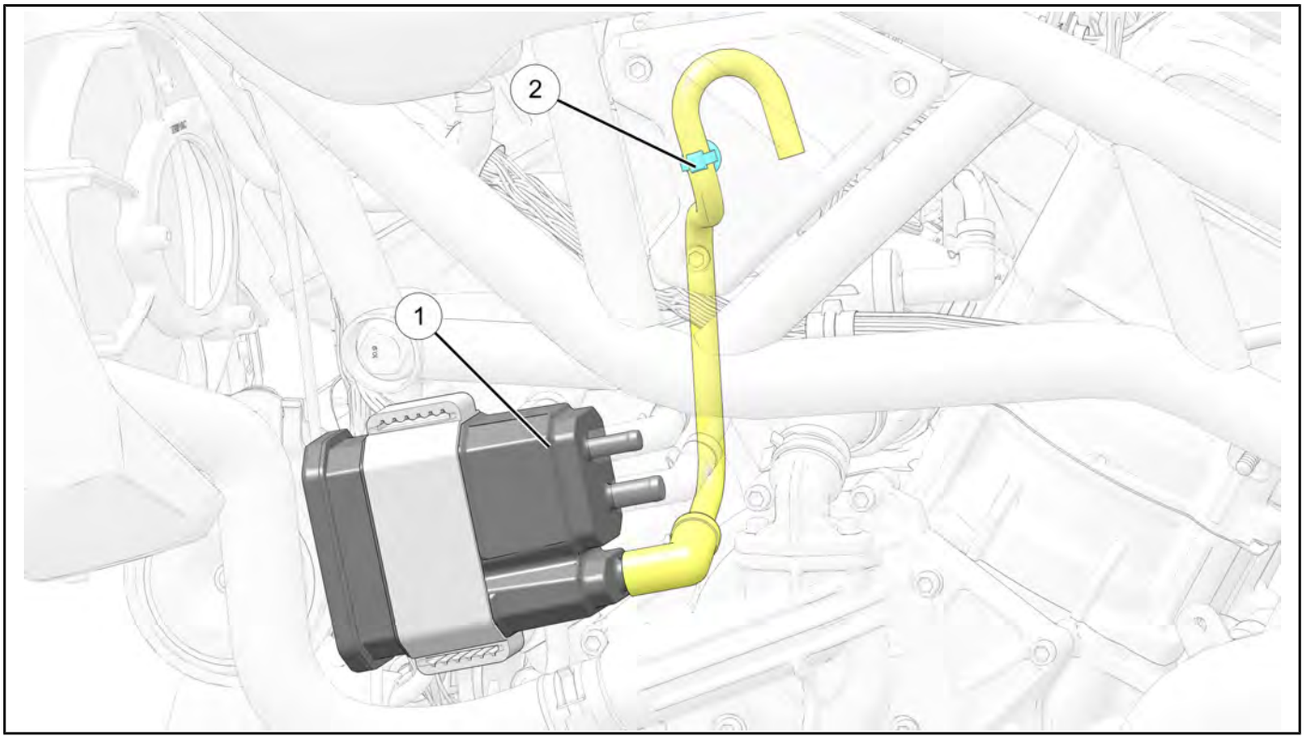
NUMBER	DESCRIPTION
①	Vent Valve
②	Routing Clip
③	Carbon Canister

Purge Hose Routing / Retention



NUMBER	DESCRIPTION
①	Throttle Body Assembly
②	Purge Valve
③	Carbon Canister

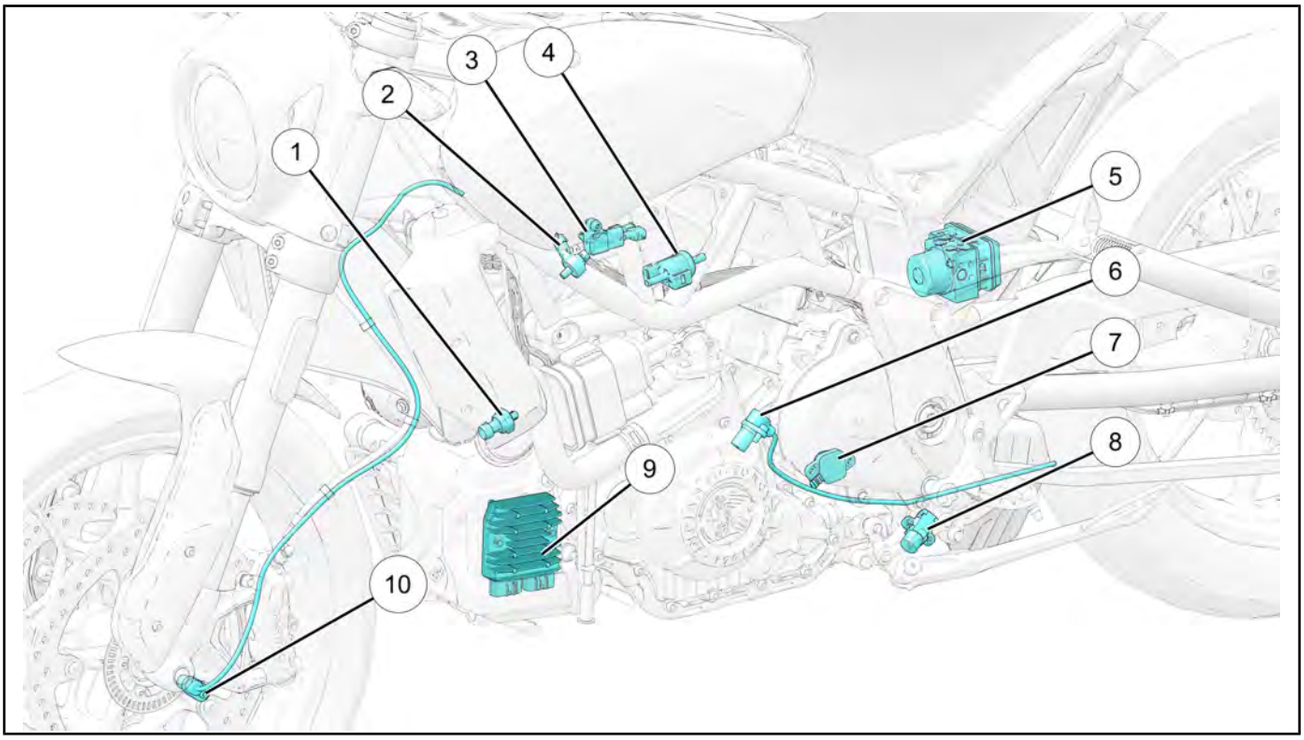
Vapor Canister Vent Line Routing / Retention



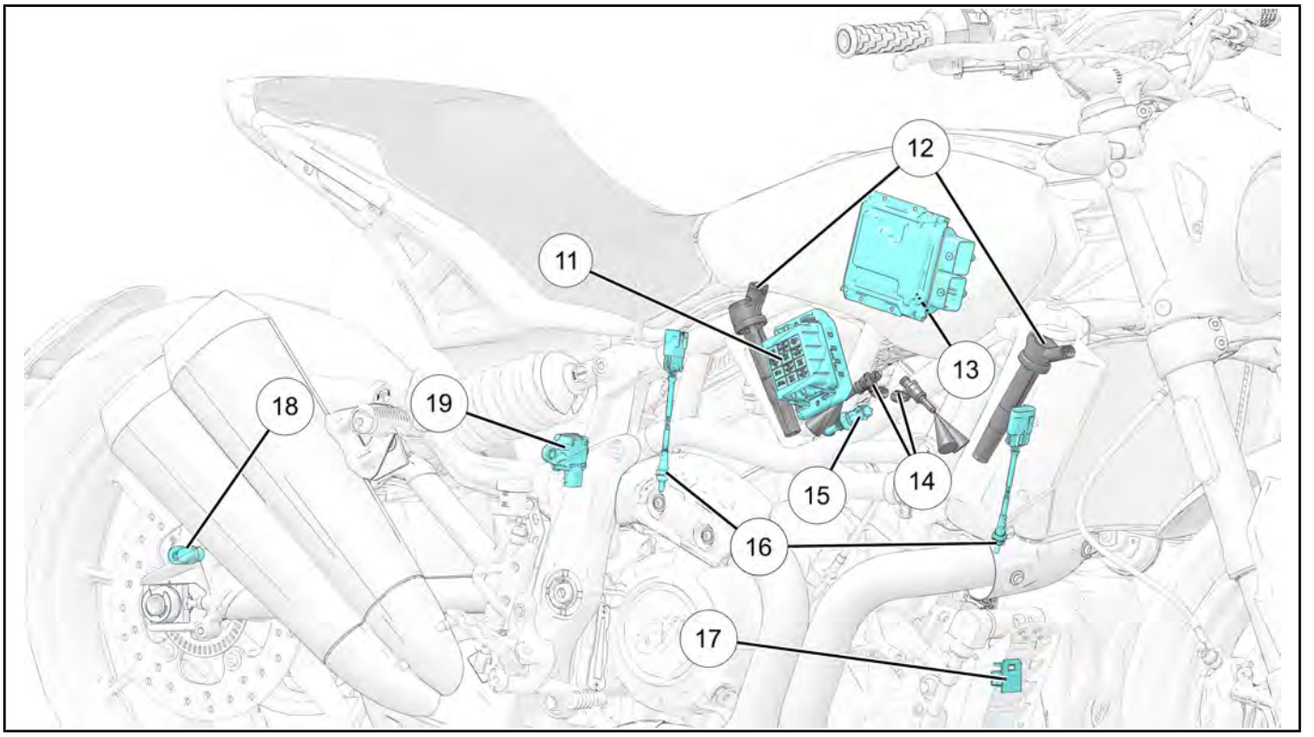
NUMBER	DESCRIPTION
①	Carbon Canister
②	Routing Clip

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

SENSORS – POWERTRAIN MANAGEMENT COMPONENTS



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Oil Pressure Switch	**10 ft-lbs (14 N·m)**
②	Knock Sensor Fastener	**14 ft-lbs (19 N·m)**
③	TMAP Sensor Fastener	**53 in-lbs (6 N·m)**
④	Purge Valve	-
⑤	ABS Module	-
⑥	Crankshaft Position Sensor Fastener	**88 in-lbs (10 N·m)**
⑦	Gear Position Sensor Fastener	**53 in-lbs (6 N·m)**
⑧	Side-Stand Switch Fasteners	**60 in-lbs (7 N·m)**
⑨	Regulator / Rectifier Nut	**30 in-lbs (3 N·m)**
⑩	Wheel Speed Sensor Fastener	**88 in-lbs (10 N·m)**
	Wheel Bearing Speed Sensor	—

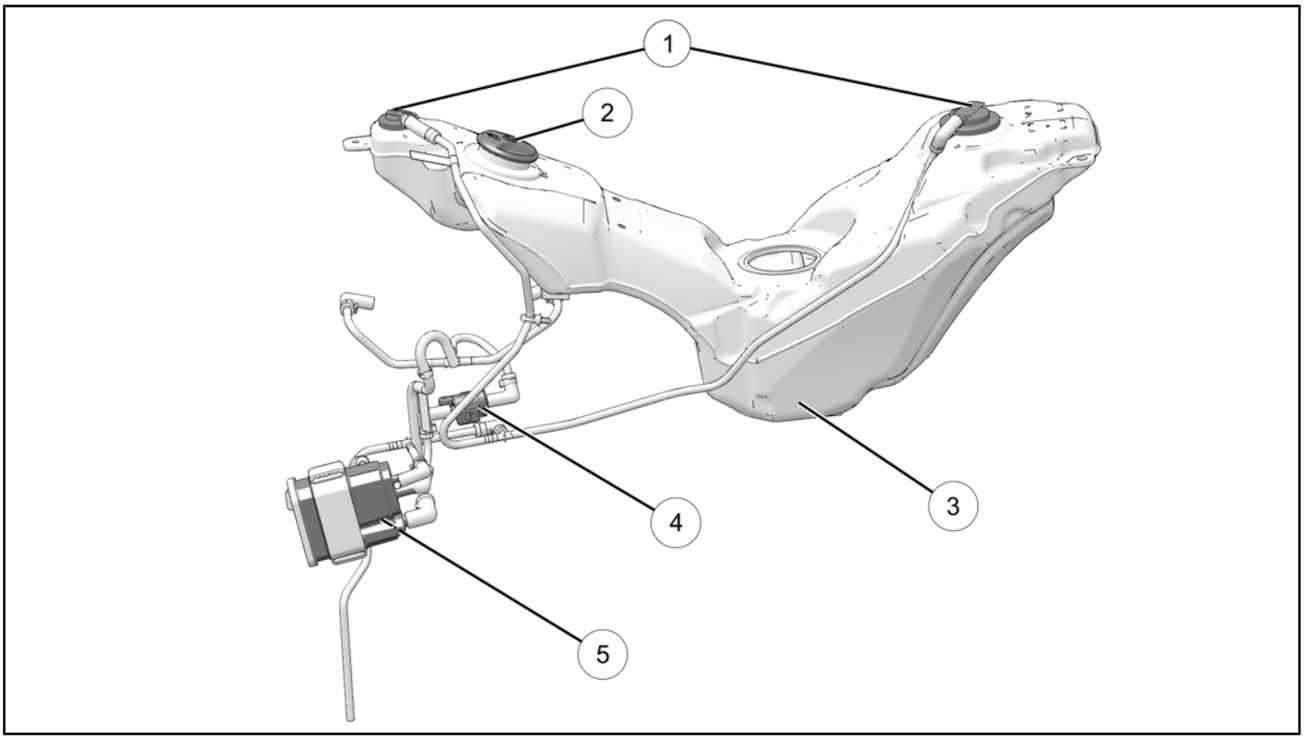


NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
⑪	Fuse Box	-
⑫	Ignition Coil Fastener	**88 in-lbs (10 N·m)**
⑬	ECM	-
⑭	Fuel Injector / Fuel Rail Fastener	**88 in-lbs (10 N·m)**
⑮	Coolant Temperature Sensor	**17 ft-lbs (23 N·m)**
⑯	Oxygen Sensor	**14 ft-lbs (19 N·m)**
⑰	Angle Sensor	-
⑱	Wheel Speed Sensor Fastener	**88 in-lbs (10 N·m)**
⑲	IMU Sensor Fasteners	**84 in-lbs (9 N·m)**

EVAP SYSTEM

EVAP SYSTEM OVERVIEW

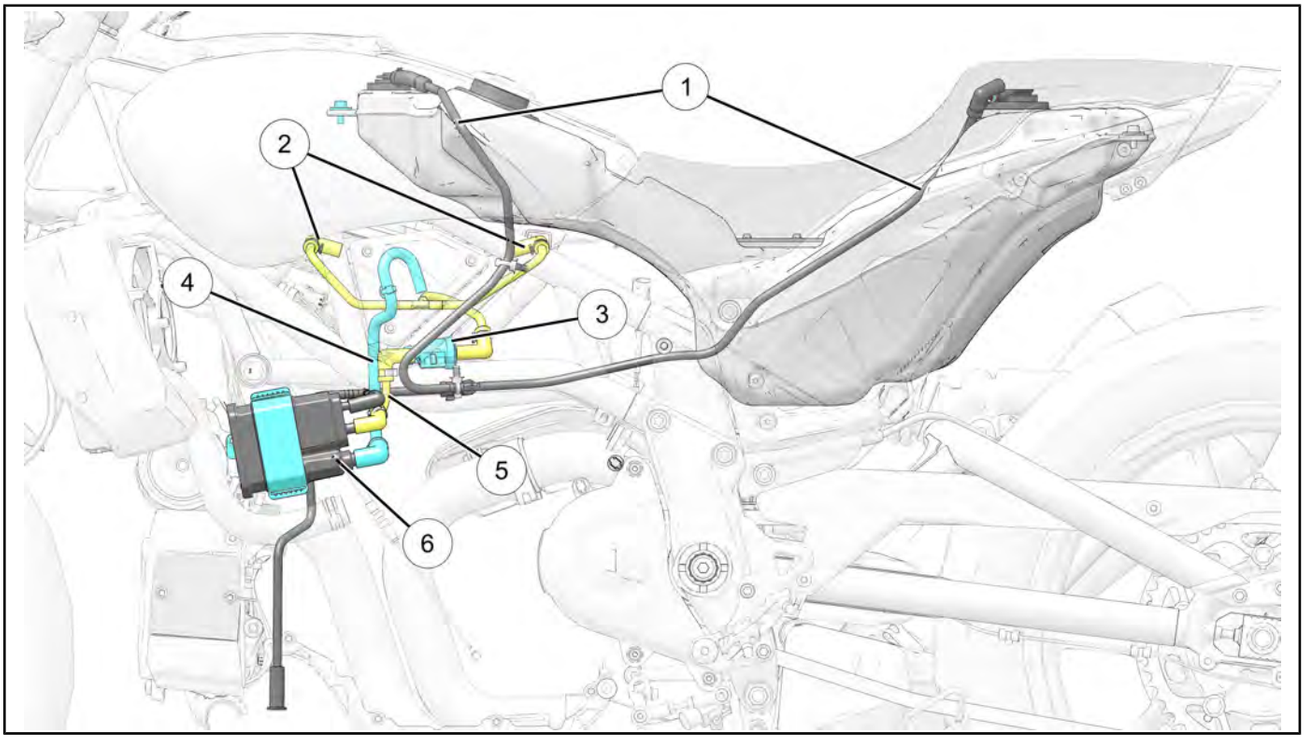
An evaporative emission control system is a system that captures fuel tank vapors that would otherwise be vented to atmosphere. The EVAP system components consist of:



ITEM	DESCRIPTION
①	**Fuel Vent Valve:** The fuel vent valves direct fuel vapors down into the canister.
②	**Fuel Cap:** It is important to note that Indian Motorcycle does not use an enhanced EVAP control system. This means the system does not detect a gross leak, or restrictions in the EVAP system such as a missing or loose fuel cap. No check engine light will illuminate if the fuel cap is loose or missing.
③	**Fuel Tank:** The fuel tank has built in grade vent valves to prevent liquid fuel from entering the EVAP system in case of an incident such as the vehicle being on its side.
④	**Purge Valve:** The purge valve is located near the throttle body and is controlled by the ECU. There are two hose assemblies that connect the two purge ports at the throttle bodies. The purge valve must be installed with the arrow pointing rearward (the direction the air flows toward the engine during a purge event).
⑤	**Carbon Canister:** The carbon canister is mounted left side of the unit. Fuel vapors from the tank are routed to and adsorbed by the canister's carbon granules. When the vehicle is running, vapors are drawn into the engine by intake vacuum. The purge valve controls the movement of the vapors from the canister to the throttle body.

EVAPORATIVE EMISSION CONTROL SYSTEM

IMPORTANT
The fuel tank vent line is routed to a carbon canister where the fuel vapors are stored until specific operating parameters are met and the ECM opens the purge valve. Fuel vapor is then routed out of the carbon canister, through the purge valve and into the throttle body for combustion. Inspect all EVAP lines for abrasion or wear. Check that all connections for both vent and canister purge systems are securely attached.



NUMBER	DESCRIPTION
①	Fuel Tank Vent Hose
②	Purge Hose (Purge Valve to Throttle Body)
③	Purge Valve
④	Evaporative Emissions Carbon Canister Vent Hose
⑤	Purge Hose (Canister to Purge Valve)
⑥	Evaporative Emissions Carbon Canister

EVAP CONDITIONS AND SYMPTOMS

The following conditions and symptoms should be taken into consideration when working on a vehicle with an EVAP System:

- Cracks in an EVAP hose or canister may cause
  - Fuel odor
  - Trouble codes being set

NOTICE
A loose fuel cap will NOT trigger a trouble code, but may cause a fuel odor.

Excessive hydrocarbon emissions may be caused by any of the following:

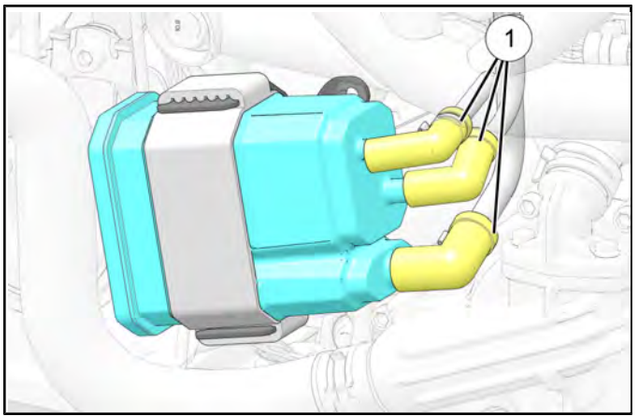
- An ignition misfire
- Improper ignition timing
- Excessively lean or rich air/fuel mixture
- Low Compression
- Worn valves or guides
- Worn cylinder or piston rings
- Vacuum leaks
- Dirty fuel injector
- Defective sensor or damaged sensor wiring

Excessive carbon monoxide emissions may be caused by any of the following:

- Rich air/fuel mixture
- Dirty air filter
- Leaking fuel injectors
- Fuel pressure too high/bad regulator

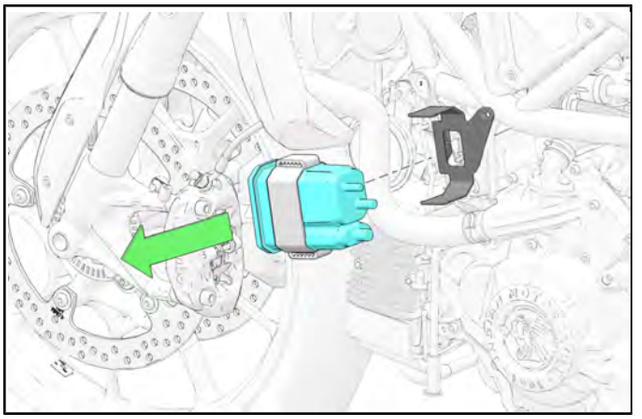
CARBON CANISTER REPLACEMENT

1. Remove the rubber elbows connected to the carbon canister ①.



IMPORTANT
Note the location of each line for reassembly.

2. Carefully remove the canister and its rubber mount by sliding it off the bracket.

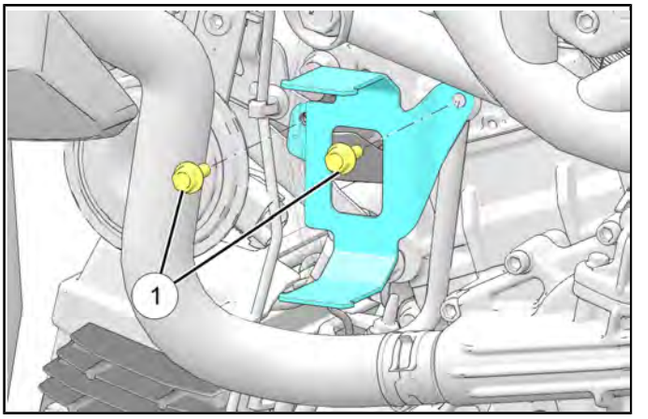


NOTICE
Soapy water may be used to aid in removal of the rubber mount.

3. **Installation is performed by reversing the removal procedure.**

CARBON CANISTER BRACKET REPLACEMENT

1. Remove carbon canister. See **Carbon Canister Replacement page 4.16**.
2. Remove two carbon canister bracket fasteners ①.

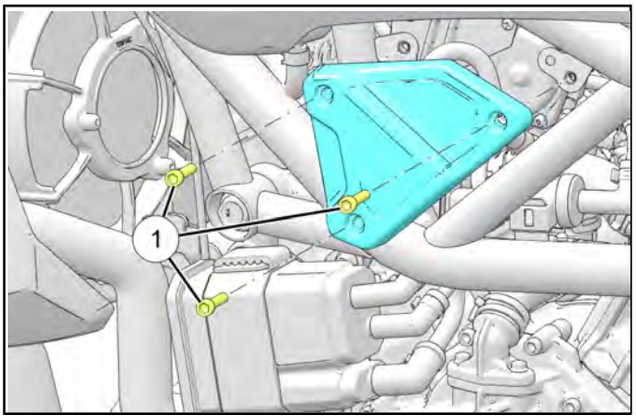


3. Remove carbon canister bracket.
4. **Installation is performed by reversing the removal procedure.**

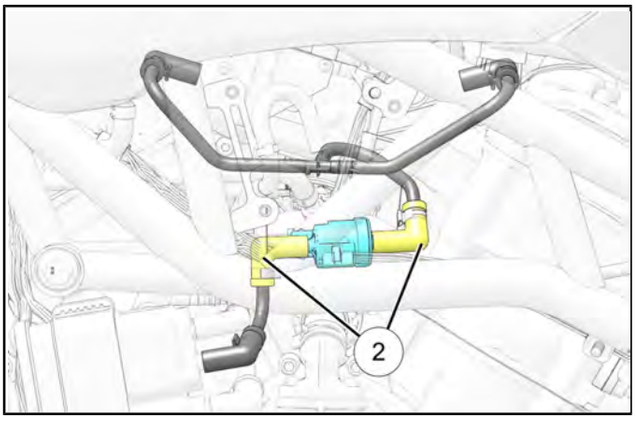
TORQUE
Carbon Canister Bracket Fastener: **48 in-lbs (5 N·m)**

PURGE VALVE REPLACEMENT

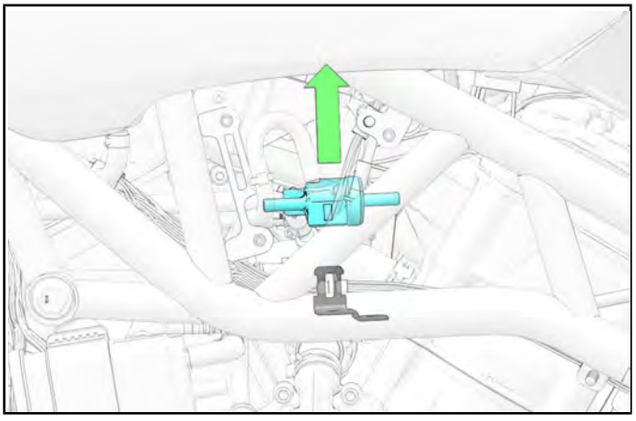
1. Remove three fasteners ① securing left side v-cover.



2. Disconnect the elbows ② connected to the purge valve.



3. Unplug purge valve electrical connection.
4. Remove the purge valve from its bracket.



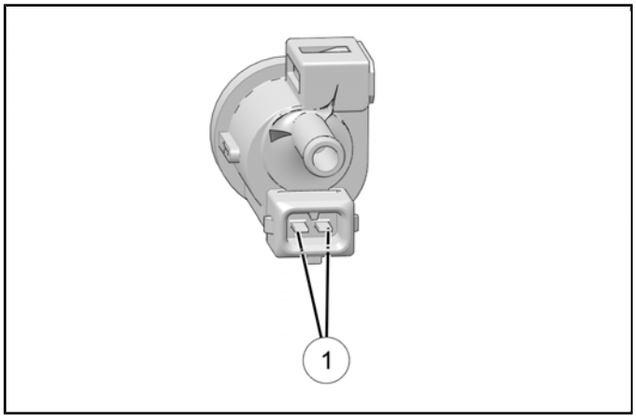
NOTICE
Soapy water may be used to aid in removal of purge valve from bracket.

5. **Installation is performed by reversing the removal procedure.**

TORQUE
V-Cover Fasteners: **36 in-lbs (4 N·m)**

PURGE VALVE OHM TEST

Use a multimeter to test the resistance of purge valve ① as shown.



Specification
17 ± 2 Ω

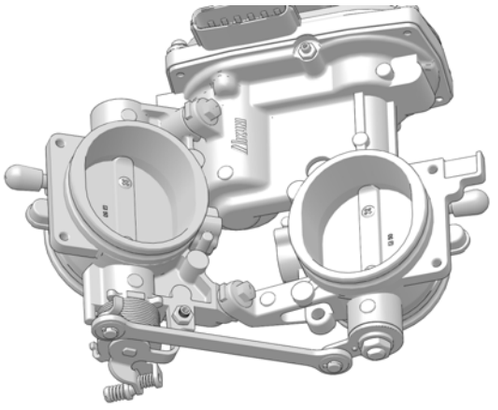
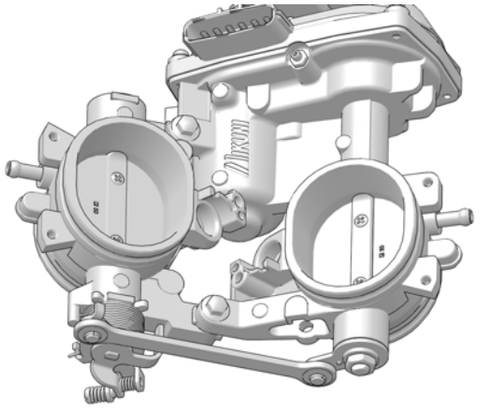
Compare the with the value above and replace if not within specification.

4

FUEL DELIVERY SERVICE

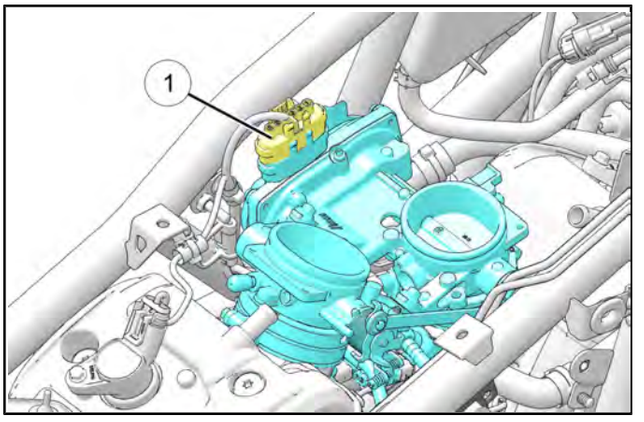
THROTTLE BODY ASSEMBLY REMOVAL / INSTALLATION

NOTICE
The throttle body is different based off of the motorcycle build date. They are not interchangeable.

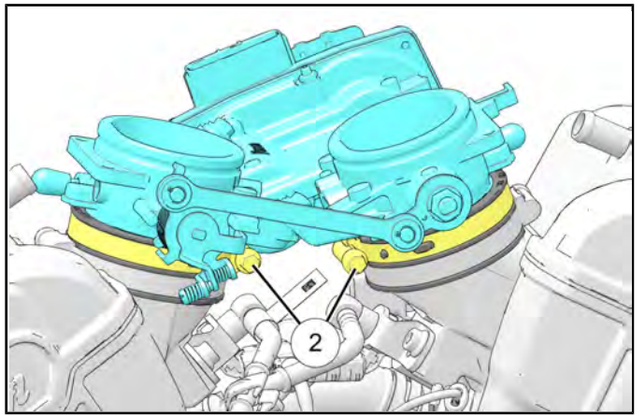
2019–2020	2022+
	

Removal

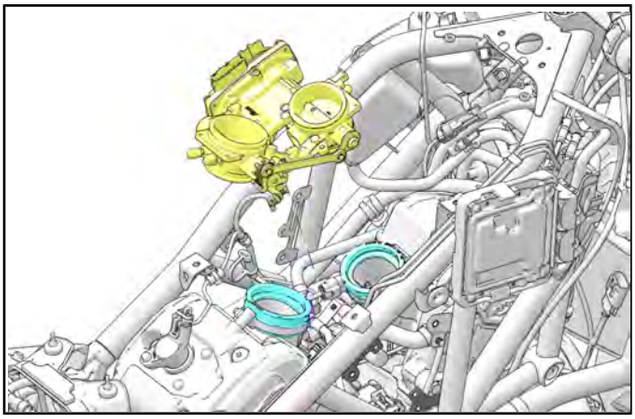
1. Remove air box. See **Air Box Removal page 3.14**.
2. Remove throttle body electrical connector ①.



3. Disconnect purge lines from throttle body assembly.
4. Loosen the upper clamps ② securing the throttle body assembly to the throttle adapters.



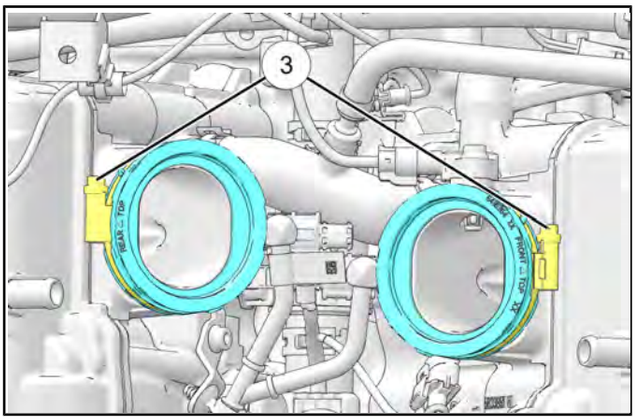
5. Remove the throttle body assembly from the throttle adapters.



6. If throttle adapters are to be removed, loosen lower clamps ③ remove.

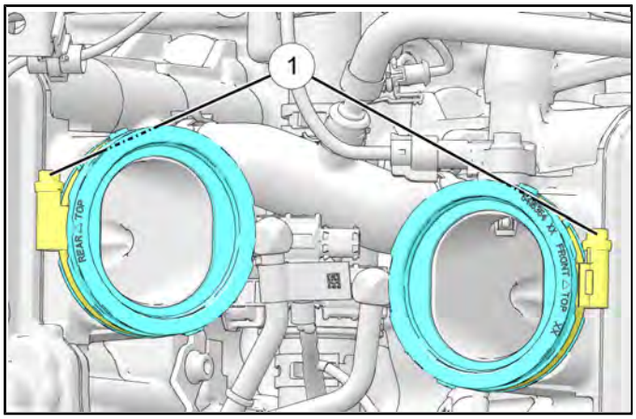
NOTICE

Throttle adapters have text referring to orientation as well as an arrow pointing toward its respective cylinder.



Installation

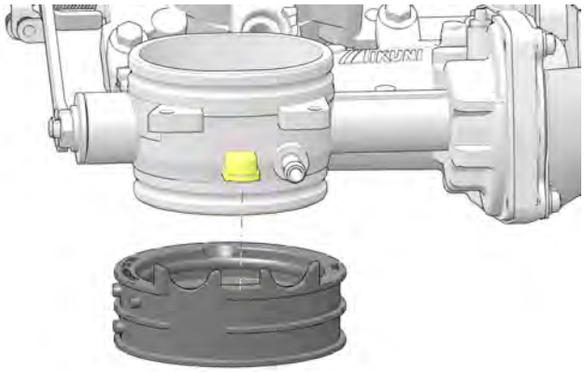
1. If removed, install throttle adapters orientated correctly.



TORQUE
Throttle Body Clamp: **17 in-lbs (2 N·m)**

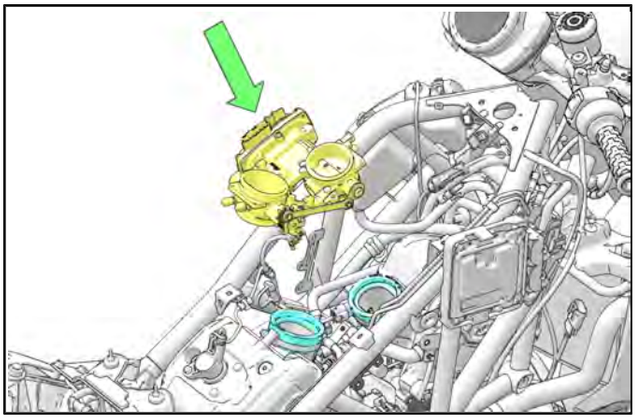
NOTICE

2022+ Models:
Align the clocking feature in the throttle body adapter to the throttle body as shown.

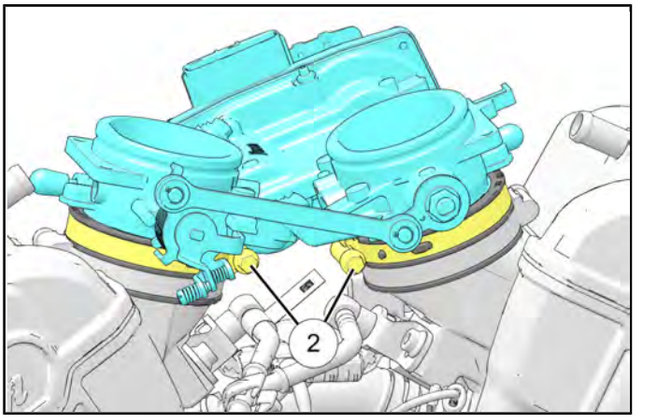


4

2. Install throttle body assembly into throttle adapters.



3. Torque upper clamps securing the throttle body assembly to the throttle adapters.



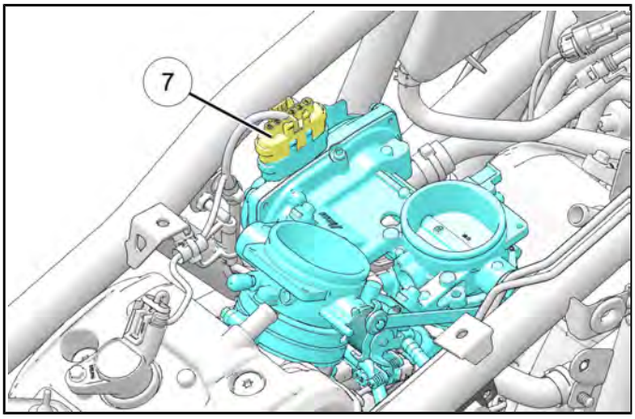
NOTICE

2022+ Models:
Align the band clamps in the adapter as shown.

TORQUE
Throttle Body Clamp: **17 in-lbs (2 N·m)**

4. Reconnect purge lines to throttle body assembly.

5. Reconnect throttle body electrical connector ⑦.



6. Reinstall air box. See **Air Box Installation page 3.16**.

FUEL PUMP PRESSURE INSPECTION

⚠ WARNING

Gasoline is extremely flammable. Work in a well ventilated area. Open flames, sparks and cigarettes must be kept away from gasoline. KEEP GASOLINE OUT OF THE REACH OF CHILDREN!

⚠ CAUTION

Wear safety glasses or a face shield when working around the fuel system to protect your eyes.

1. Depressurize fuel system and disconnect fuel line at fuel rail. See **Fuel System Depressurization page 4.22**.
2. Install fuel pressure gauge **PU-43506-A** and fuel pressure gauge adapter **PV-48656**.
3. Start engine and record fuel pressure (or press the power switch ON and cycle the Engine Stop switch to read pressure when pump cycles for 2-3 seconds).

Minimum Fuel pressure
3.8 BAR (380 kPa) (55 psi)

4. Turn ignition switch off. Disconnect gauge adapter and re-connect fuel line.

FUEL PRESSURE TROUBLESHOOTING	
FUEL PRESSURE TOO LOW: INSPECT	FUEL PRESSURE TOO HIGH: INSPECT
* Low fuel level (add fuel) * Pump not running (Fuel pump or circuit malfunction) * Restricted fitting, fuel supply line, or gauge adapter hose * Fuel line kinked or restricted (from tank fitting to rail) * Fuel line leaking (leaking air in or fuel out) * Vent or carbon canister restriction * Plugged fuel pickup filter (located in fuel tank) * Pressure regulator malfunction (located on pump) * Fuel pump malfunction (Pump should run for about 2-3 seconds the instant that the key switch and Engine Stop switch are turned ON.	* Plugged fuel return (in tank on pressure regulator) * Pressure regulator malfunction (located on pump).

FUEL SYSTEM DEPRESSURIZATION

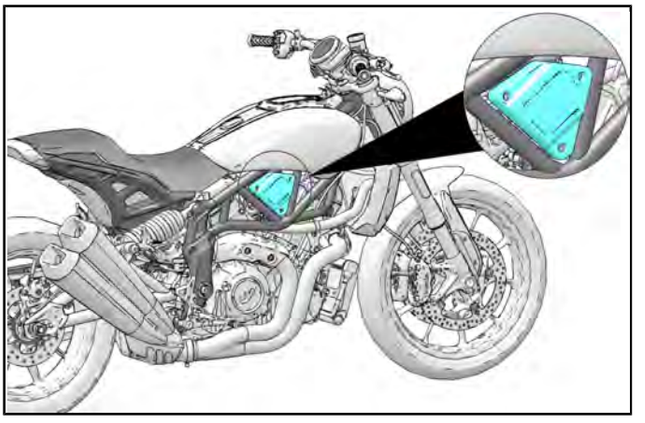
⚠ CAUTION

Fuel lines remain under pressure at all times. Use caution when disconnecting lines for service. Always depressurize the fuel system prior to service.

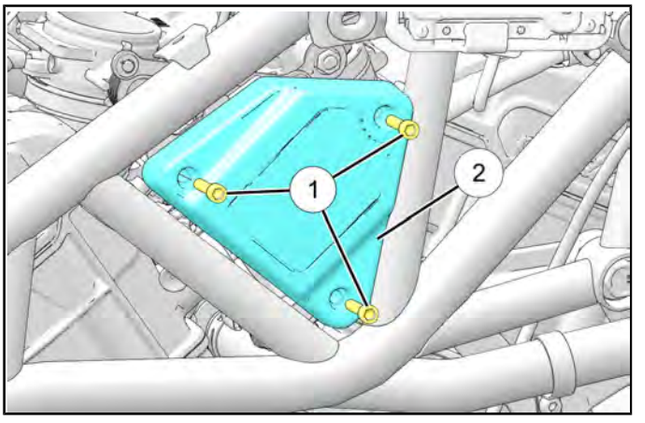
⚠ WARNING

Allow engine and exhaust to cool completely before disconnecting fuel line or removing tank. Wear eye protection.

1. Locate the V-cover on the right side of the unit.



2. Remove the three fasteners ① securing the V-cover ②.

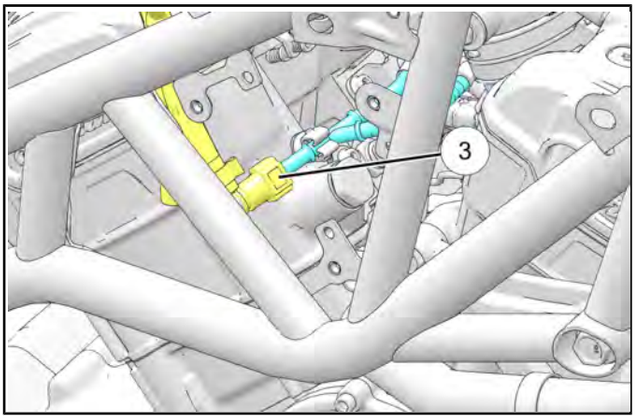


3. Locate the fuel pump power fuse. See **Electrical > Chassis Electrical > Fuse Box**.
4. Pull the fuel pump power fuse and crank the engine over for 5 seconds to release pressure.

5. Wrap a clean shop towel around fuel line fitting ③ and squeeze both release buttons.

⚠ CAUTION

Do not use anything other than fingers to remove the quick connection. The use of tools can damage the connection.



6. Squeeze both release buttons (one on each side of fitting) and hold. Gently slide fitting straight off fuel rail.
7. Cover fuel fittings to keep debris out.

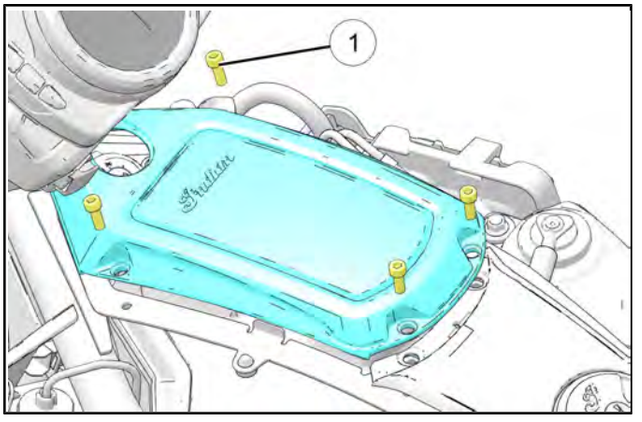
FUEL TANK REMOVAL

⚠ WARNING

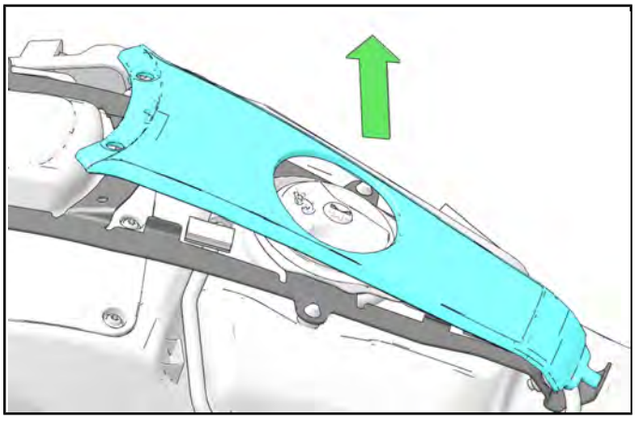
Allow engine and exhaust to cool completely before disconnecting fuel line or removing tank. Protect air box cover finish when removing, storing, and installing tank.

Be prepared to place the fuel tank in a secure location with a drain pan positioned to catch any fuel that may leak or drip from disconnected hoses or fittings.

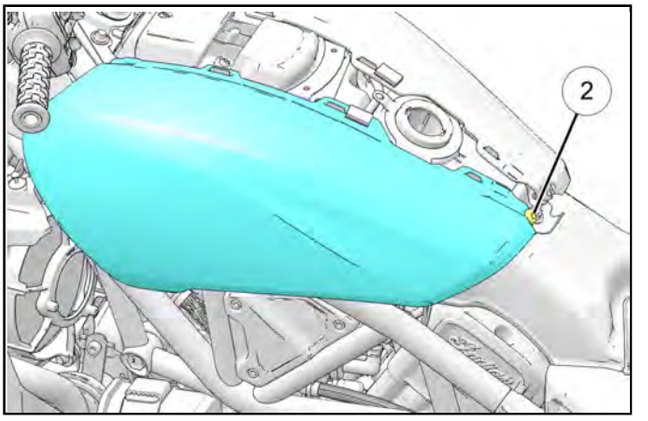
1. Remove the seat. See **Seat Removal / Installation page 7.19**.
2. Disconnect the battery. See **Battery Disconnect page 10.12**.
3. Remove four fasteners ① securing air box bezel.



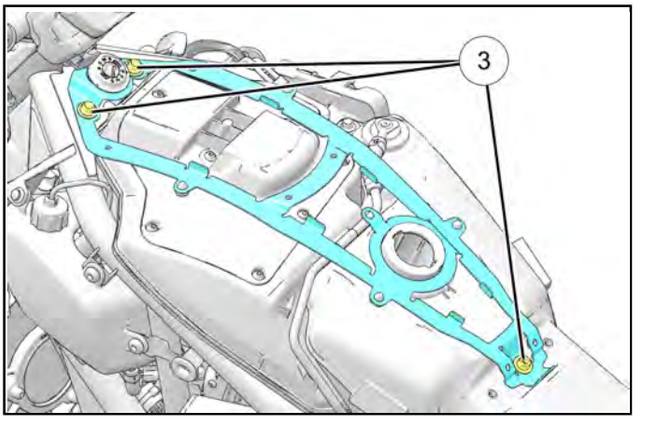
4. Remove the center console cover from the alignment bracket.



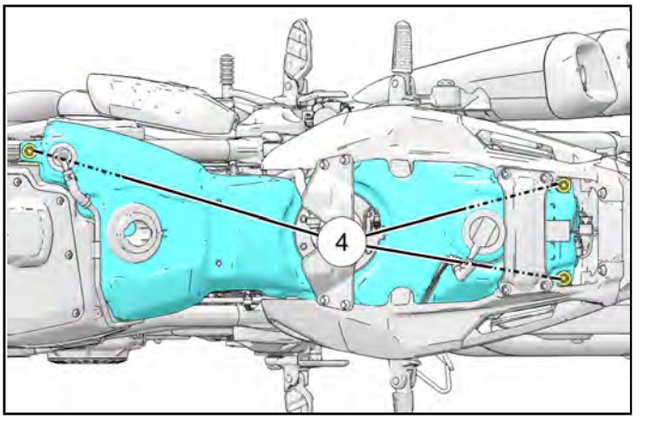
5. Remove the gas cap.
6. Remove fastener securing the air box cover ② and remove air box cover by pulling up and out.



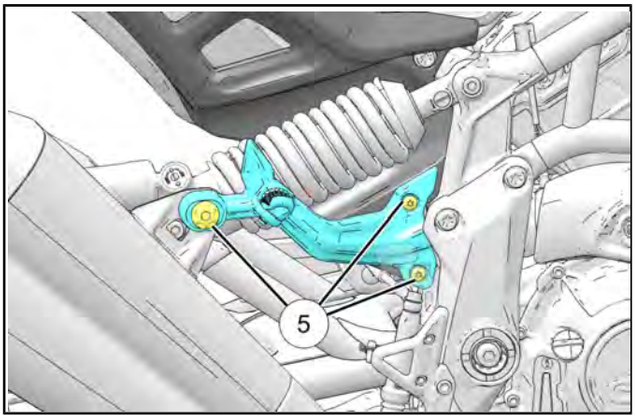
7. Remove three fasteners ③ to remove alignment bracket.



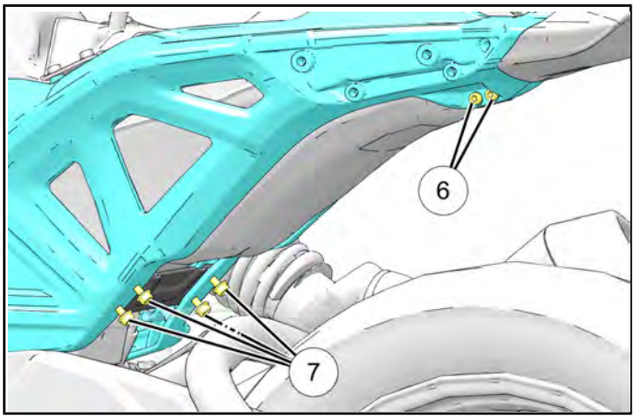
8. Reinstall gas cap.
9. Remove three fasteners ④ securing fuel tank.



10. Remove passenger foot peg mount by removing its fasteners ⑤. Repeat step for remaining side.



11. Remove two fasteners ⑥ securing left and right sub-frame.

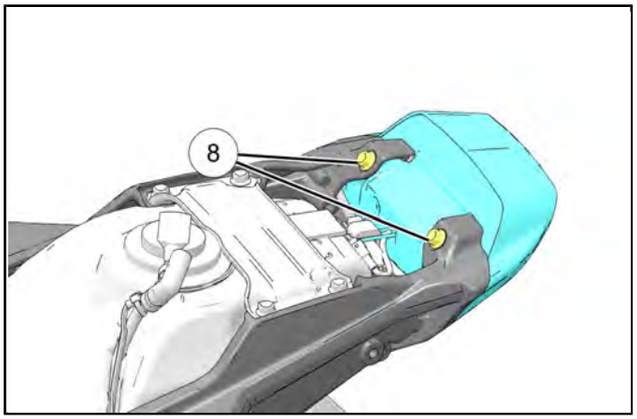


12. Remove four fasteners ⑦ securing rear sub-frame to bottom fuel tank support.

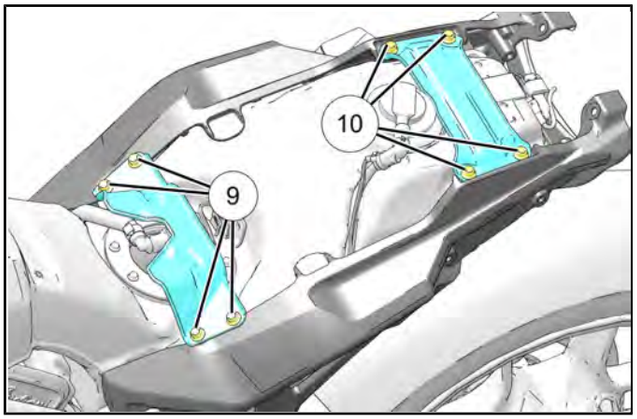
IMPORTANT

Pay attention to bottom fuel tank support orientation for reinstallation.

13. Remove tail light by removing two fasteners ⑧ and disconnecting electrical connection.



14. Remove front seat support bracket by removing its fasteners ⑨.



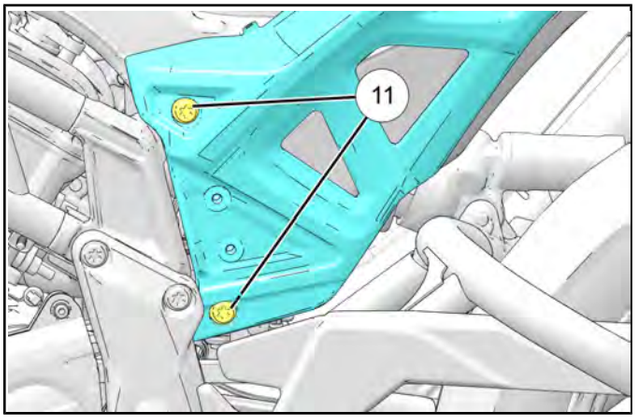
15. Remove rear seat support bracket by removing its fasteners ⑩.
16. Disconnect fuel tank electrical connection.
17. Disconnect vent lines from fuel tank.
18. Wrap a clean shop towel around fuel line fitting and squeeze both release buttons.

⚠ CAUTION

Do not use anything other than fingers to remove the quick connection. The use of tools can damage the connection.

19. Squeeze both release buttons (one on each side of fitting) and hold. Gently slide fitting straight off fuel rail.
20. Cover fuel fittings to keep debris out.

21. Remove left hand sub-frame by removing two fasteners ⑪.



22. Repeat the previous step for opposite side.

NOTICE

To aid in removal, lift fuel tank up when removing right hand sub-frame.

23. Remove the fuel tank.

FUEL PUMP REMOVAL

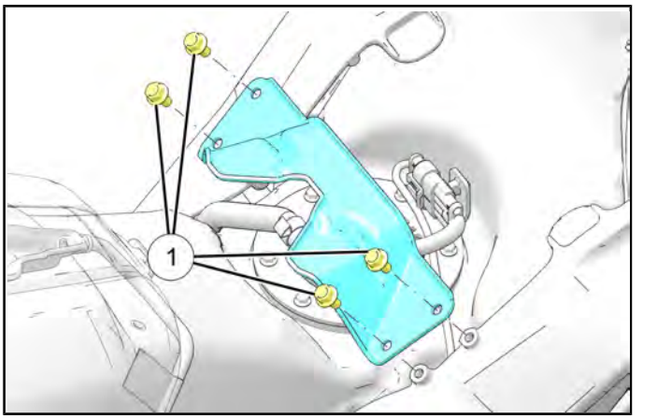
⚠ WARNING

Replace all mounting screws and pump seal O-ring any time pump is removed for service or fuel filter maintenance. Do not kink or bend fuel pickup hose upon removal. Review gasoline warnings outlined in the beginning of this chapter.

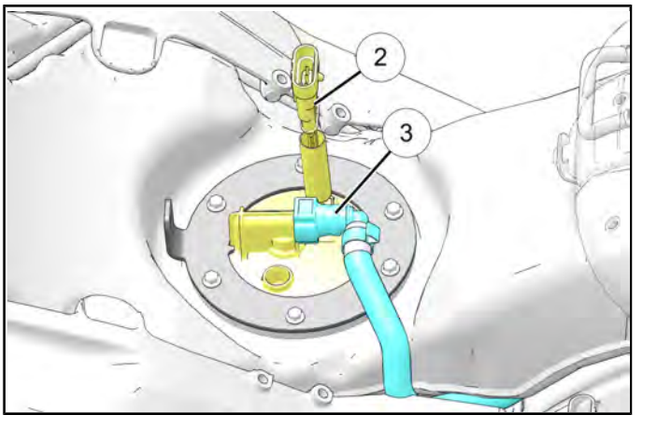
⚠ CAUTION

Be careful when performing this procedure to avoid damaging the fuel pump, electrical wiring, or hoses. Always inspect wires and hoses closely for damage after removing the fuel pump.

1. Remove the seat. See **Seat Removal / Installation page 7.19**.
2. Disconnect the battery. See **Battery Disconnect page 10.12**.
3. Remove front seat support bracket by removing its fasteners ①.



4. Disconnect fuel pump electrical connector ②.

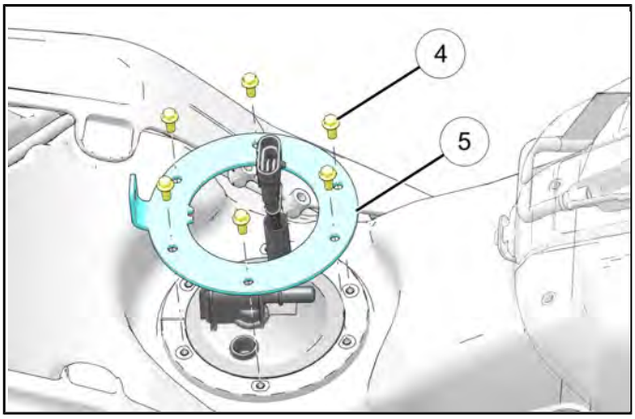


5. Wrap a clean shop towel around fuel line fitting ③ and squeeze both release buttons.

⚠ CAUTION

Do not use anything other than fingers to remove the quick connection. The use of tools can damage the connection.

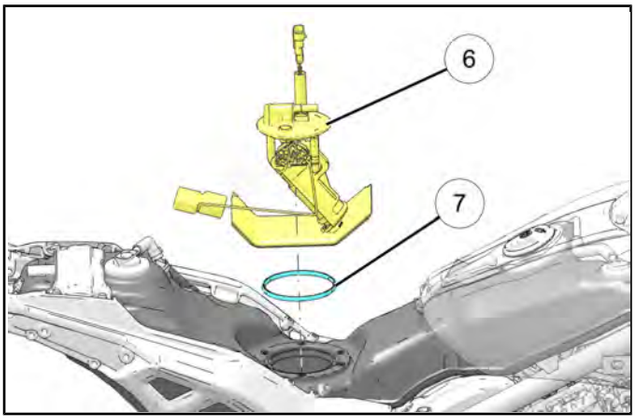
6. Squeeze both release buttons (one on each side of fitting) and hold. Gently slide fitting straight off fuel pump.
7. Cover fuel fittings to keep debris out.
8. Remove fuel pump fasteners ④ to remove the Fuel Pump Lock Ring ⑤.



9. Remove the fuel pump assembly ⑥ and Fuel Pump Seal ⑦.

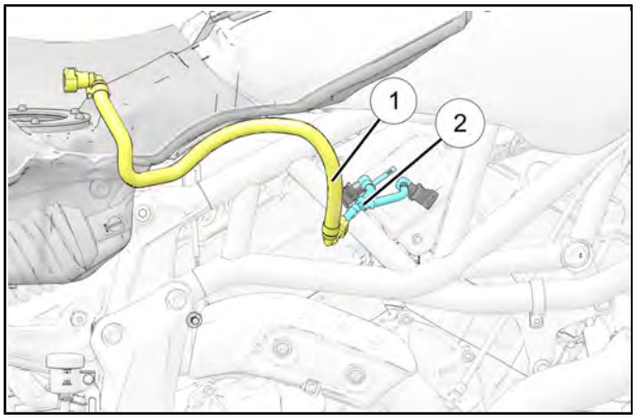
IMPORTANT

To aid in removal, rotate the fuel pump slightly counterclockwise. Use care when manipulating the fuel pump to avoid damage to pump or float.



FUEL LINE / FUEL RAIL INSPECTION

1. The fuel line and fuel rail are located on the right side of the engine behind the v-cover.
2. Inspect fuel line ① and fuel rail ② for deterioration, damage, leakage, or kinked areas. Inspect fuel connections for signs of leakage.



3. Replace any components that fail inspection with genuine Indian Motorcycle replacement parts.

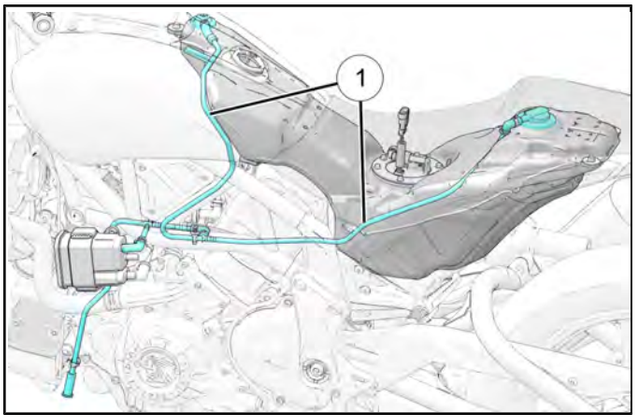
⚠ WARNING

The fuel line exiting fuel pump is subjected to high pressure. Replace with genuine Indian Motorcycle replacement parts to reduce the possibility of fuel line failure. Be sure the fuel line is routed properly and does not come in contact with sharp or hot objects, or anything that may cause wear or damage.

FUEL TANK VENT INSPECTION

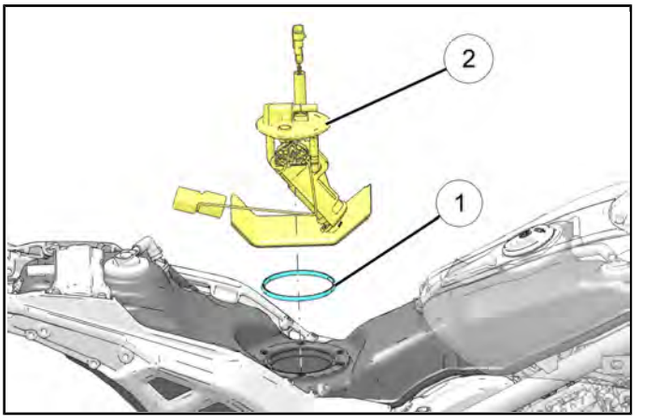
1. To access the fuel tank ventilation hoses first perform the following procedures:
   - **Seat Removal / Installation page 7.19**
   - Remove the air box covers by following **Air Box Removal page 3.14**

2. Inspect fuel tank vent hose ① in accordance with periodic maintenance schedule and any time fuel tank has been removed and installed. Be sure the hose is not pinched or kinked, and that all connections are tight.

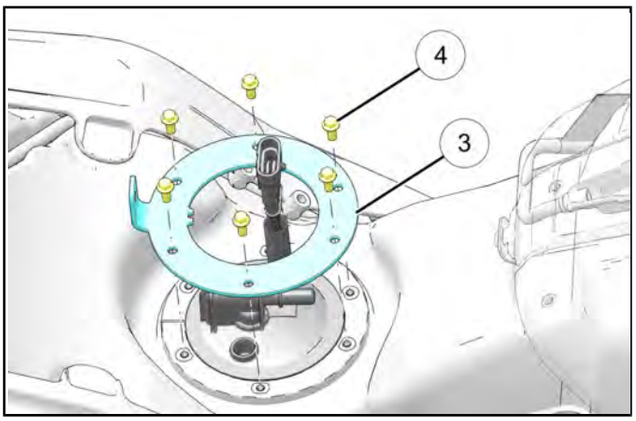


FUEL PUMP INSTALLATION

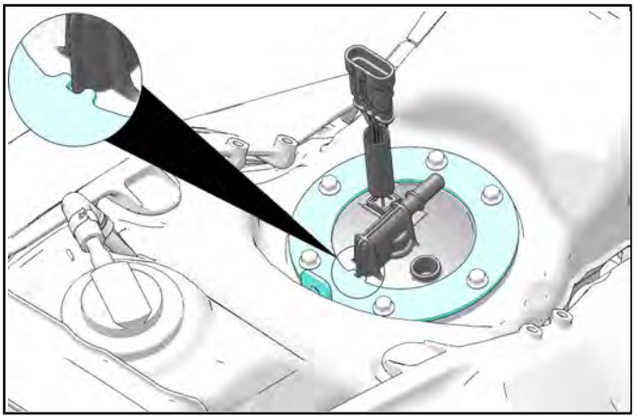
1. Install the NEW Fuel Pump Seal ① and Fuel Pump Assembly ②.



2. Install Fuel Pump Lock Ring ③ and secure with fasteners ④.

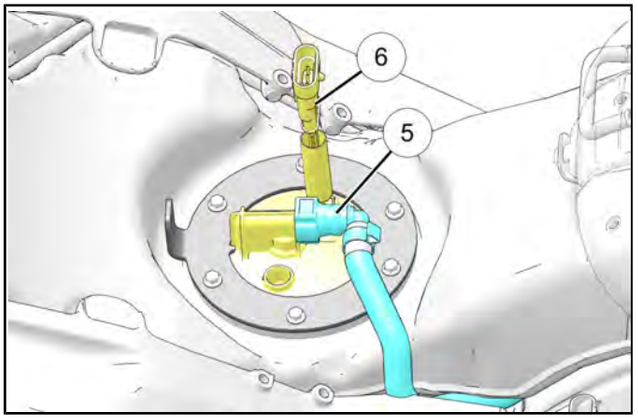


IMPORTANT
Ensure fuel pump is indexed with the lock ring as shown.



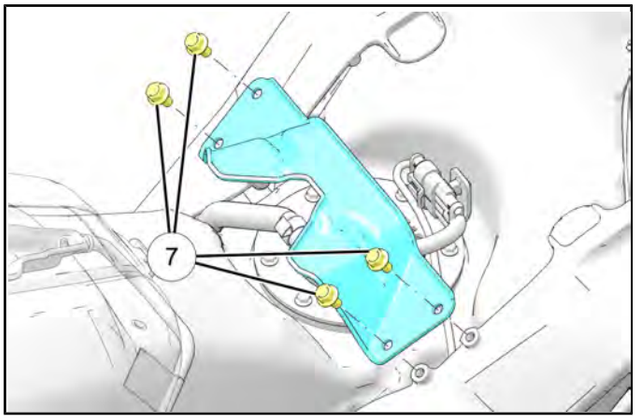
TORQUE
Fuel Pump Fasteners **80 in-lbs (9 N·m)**

3. Connect the fuel line ⑤.



IMPORTANT
Verify fuel line is properly seated and locked in place by listening for audible "click" when pressing into place. Pull gently on quick connector once seated to ensure a proper connection has been made.

4. Connect fuel pump electrical connector ⑥.
5. Install front seat support bracket and fasteners ⑦.



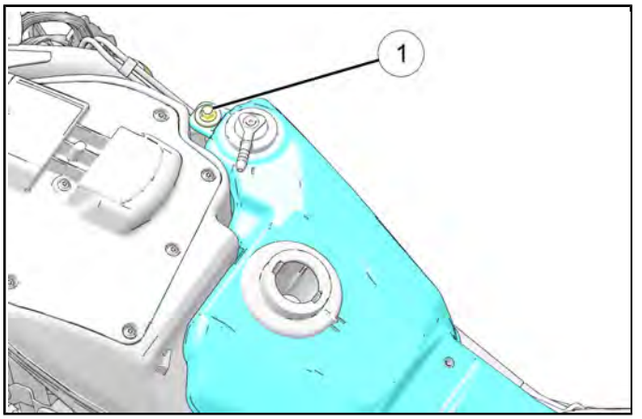
TORQUE
Seat Support Bracket Fastener (Front): **96 in-lbs (11 N·m)**

6. Prime the fuel system by keying the ignition on and off while looking for leaks.
7. Install seat. See **Seat Removal / Installation page 7.19**.

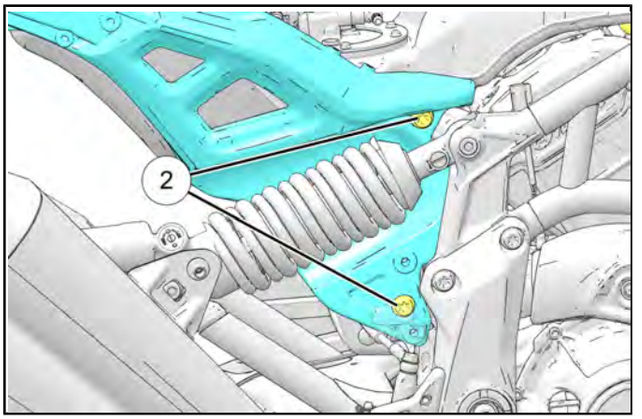
FUEL TANK INSTALLATION

IMPORTANT
The air box has to be installed prior to fuel tank installation.

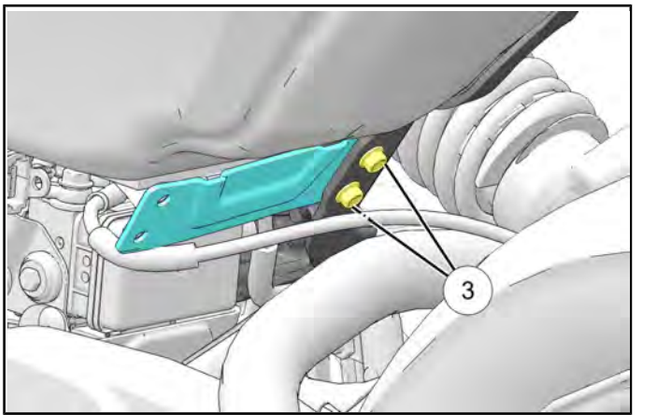
1. Set the fuel tank onto the unit.
2. Loosely install front fuel tank fastener ① and washer.



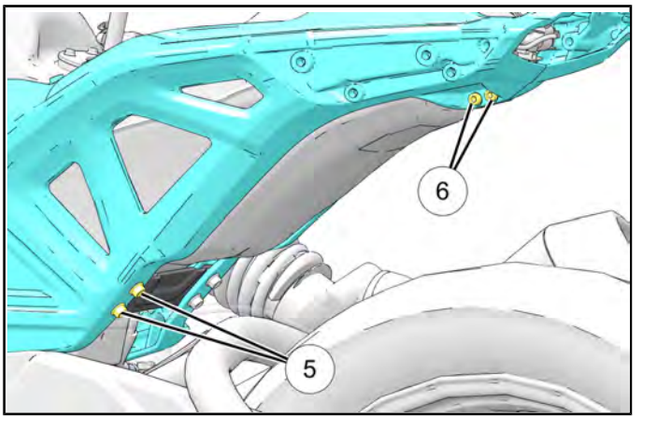
3. Install right hand sub-frame and loosely install its fasteners ②.



4. Install the bottom fuel tank support and loosely install two fasteners ③.



5. Install the left hand sub-frame and loosely install its fasteners.
6. Hand tighten the remaining two fuel tank support fasteners ⑤.



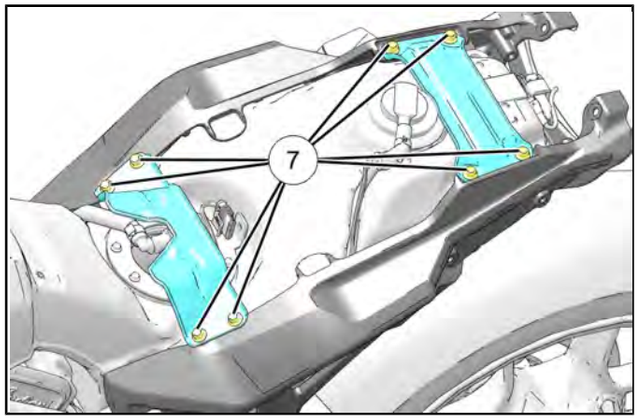
7. Loosely install the fasteners securing the left and right sub-frame ⑥
8. Connect fuel pump electrical connector.

IMPORTANT
Ensure the main wiring harness is routed underneath the fuel pump harness.

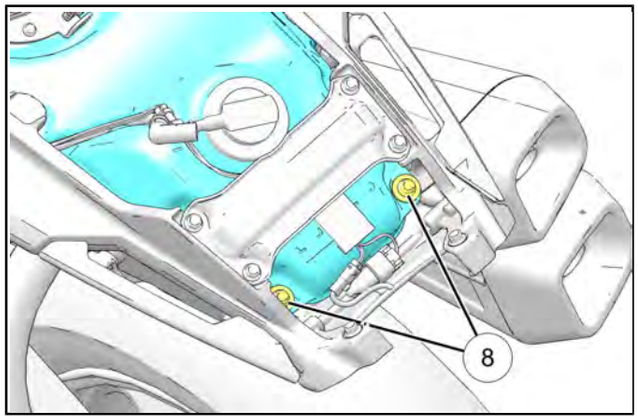
9. Connect the fuel line and fuel tank vent line.

IMPORTANT
Verify fuel line is properly seated and locked in place by listening for audible "click" when pressing into place. Pull gently on quick connector once seated to ensure a proper connection has been made.

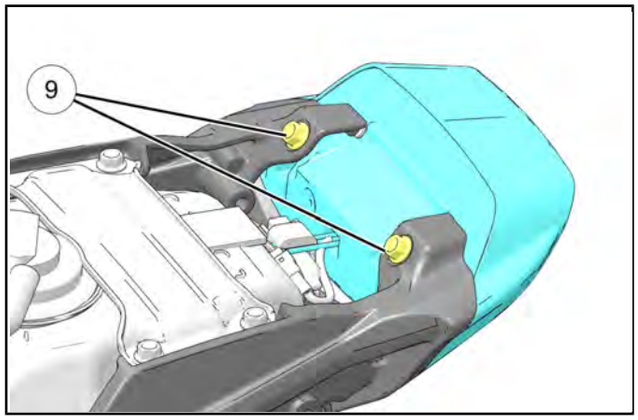
10. Install the front and rear seat support brackets and hand tighten their fasteners ⑦.



11. Loosely install the two rear fuel tank fasteners. ⑧ and washers.



12. Install the rear taillight and loosely install fasteners⑨.



13. Torque fasteners to specification.

TORQUE
Sub-frame Fasteners M10: **47 ft-lbs (64 N·m)**

TORQUE
Sub-frame Fasteners M6: **96 in-lbs (11 N·m)**

TORQUE
Fuel Tank Support Fasteners (Bottom): **96 in-lbs (11 N·m)**

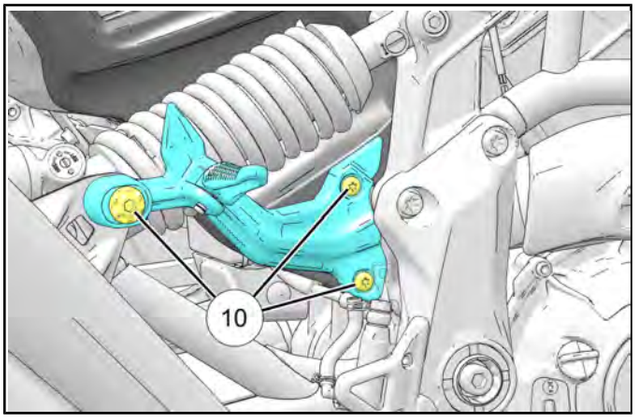
TORQUE
Seat Support Bracket Fasteners (Front): **96 in-lbs (11 N·m)**

TORQUE
Seat Support Bracket Fasteners (Rear): **96 in-lbs (11 N·m)**

TORQUE
Fuel Tank Fasteners: **88 in-lbs (10 N·m)**

TORQUE
Tail Light Fasteners: **88 in-lbs (10 N·m)**

14. Install passenger foot peg bracket and fasteners ⑩.



TORQUE
Footpeg Bracket Fasteners (Passenger): **17 ft-lbs (23 N·m)**

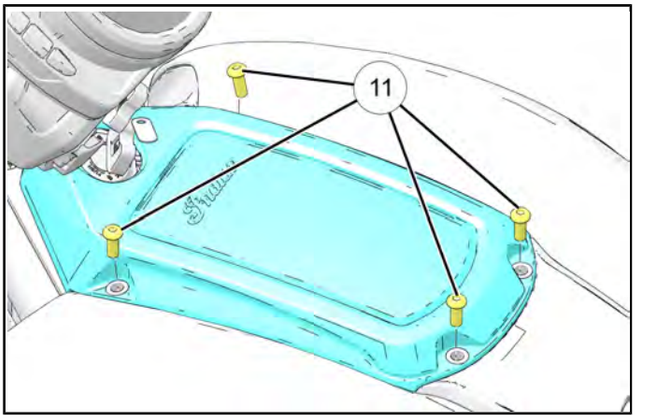
15. Install the bodywork alignment bracket.

TORQUE
Bodywork Alignment Bracket Fastener: **36 in-lbs (4 N·m)**

16. Install air box covers and fasteners.

TORQUE
Air Box Cover Fastener: **36 in-lbs (4 N·m)**

17. Install fuel cap.
18. Install center console onto alignment bracket.
19. Install four fasteners ⑪ securing air box bezel.



TORQUE
Air Box Bezel Fastener: **36 in-lbs (4 N·m)**

20. Reconnect battery connections and install battery cover.

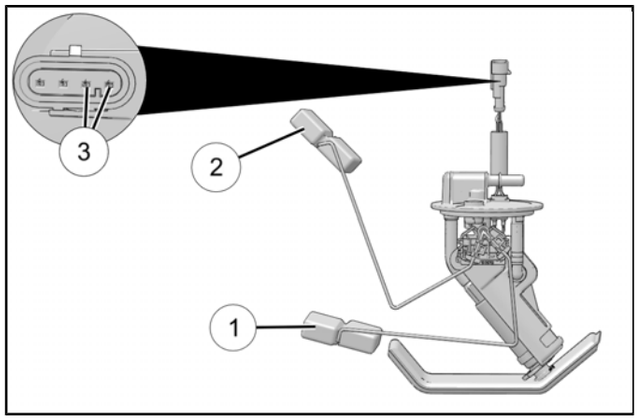
TORQUE
Battery Terminal Fastener: **25 in-lbs (3 N·m)**

TORQUE
Battery Cover Fastener: **36 in-lbs (4 N·m)**

21. Install seat. See **Seat Removal / Installation page 7.19**.

FUEL LEVEL SENSOR RESISTANCE TEST

1. Remove the fuel pump. See **Fuel Pump Removal page 4.26**.
2. Set multimeter to measure resistance. Attach suitable test probe adaptors to meter leads (**from kit PV-43526**).
3. On the *fuel pump* side of the connector, measure resistance of the fuel sender as shown below.

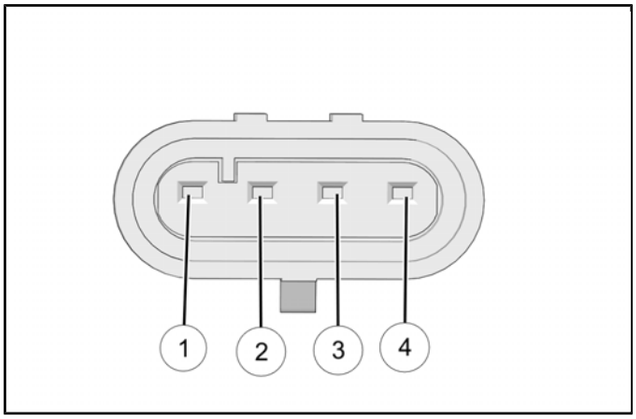


FLOAT POSITION	APPROXIMATE RESISTANCE LIMITS
① EMPTY	100 ± 10% Ω
② FULL	450 ± 10% Ω
③ Measure between two pins	-

FUEL PUMP SUPPLY VOLTAGE TEST

Before performing this test, verify that battery is fully charged and in good operating condition.

1. Remove the seat assembly. See **Seat Removal / Installation page 7.19**.
2. Disconnect the fuel pump / level sensor electrical connector.
3. Connect meter across terminals 3 & 4 on the *wire harness* side of connector.



ITEM	WIRE COLOR	FUNCTION
①	BK / DG	Fuel Level Sensor Signal
②	BK / BU	Fuel Lever Sensor Signal Return
③	VT / YE	Fuel Pump Power
④	BK	Fuel Pump Ground

4. Turn the ignition switch to the "ON" position to power up the motorcycle electrical system.
5. Turn Engine Stop switch to RUN and read DC voltage on meter when switch is first turned on. Voltage reading should be close to battery voltage for 2-3 seconds after switching Engine Stop switch to RUN.
6. If low or no voltage is delivered to the fuel pump, verify ground wire (Pin 4, BK) has good continuity to battery (-) post.
7. If ground is OK, check Gray wire from fuel pump relay terminal 31 to ECM Pin #142 . The Gray wire receives a momentary ground from the ECM (for 2-3 seconds) and activates the fuel pump relay which supplies power to the pump on the VT/YE wire.

8. Trace both power and ground circuits to determine fault if battery voltage is not present for 2-3 seconds after ignition switch and STOP / RUN switch are turned on.
9. When a CPS signal is received by the ECM (engine is cranking or running) the ECM maintains the ground on Pin # 142 (Gray wire), keeping the pump powered.

FUEL PUMP CURRENT DRAW TEST

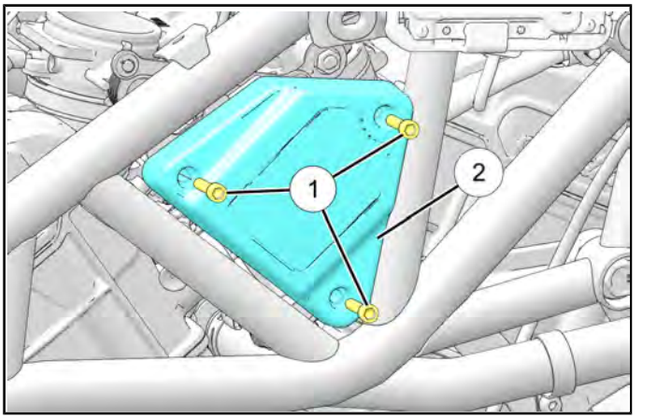
NOTICE

Fuel pump current draw is an indicator of pump condition. Perform draw test if fuel pump operation is suspect, or if fuel pump fuse is found open (blown).

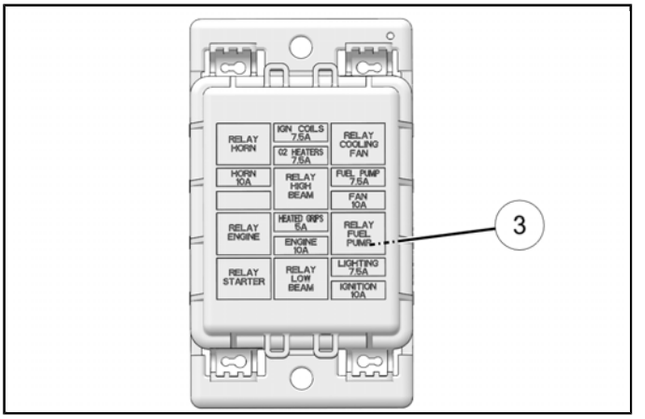
IMPORTANT

When meter leads are inserted the pump will run, and current draw will be displayed on the meter, even with key and stop switch off. Fuel tank must be completely installed and have enough fuel in it to cover the fuel pickup screens for an accurate test.

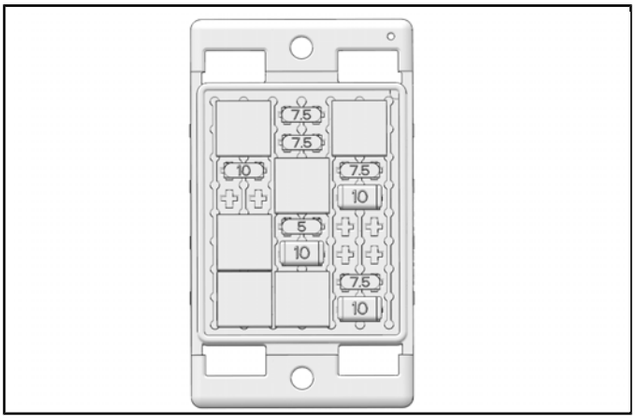
1. Remove three fasteners ① and cover ② on the right side of the unit to access the fuse panel.



2. Remove Fuel pump Releay ③.



3. Insert red meter lead in pin socket B5 (7) and black meter lead in pin socket A4 (4) of relay block.



4. Inspect fuel pump circuit wiring or replace fuel pump if current draw exceeds specification.

SPECIFICATION: Fuel Pump Current Draw
Maximum: 6 DC Amps

PRIMING THE FUEL SYSTEM

Prime procedure should be performed:

- If a new fuel pump is installed or if tank is run completely dry.
- Whenever fuel system is serviced (fuel line is disconnected).
- Whenever battery disconnected.

1. Fill the fuel tank. (unless testing for proper fuel pump pickup location).
2. Turn Engine Stop switch OFF.
3. Turn the ignition switch to ON.
4. Turn stop switch to RUN.
5. Allow switch to remain in RUN position until pump stops running (about 2-3 seconds).
6. Turn stop switch OFF.
7. Turn the ignition switch to OFF.
8. *WAIT* approximately 10 seconds.
9. Repeat Steps 4-8 about 4 times to complete the priming procedure.

IMPORTANT
Fuel level in tank must be high enough to submerge pickup screen on fuel pump.

10. Once system is pressurized, carefully check all fuel connections, joints and lines for leaks.

EFI SERVICE

FUEL INJECTION SYSTEM - OVERVIEW OF OPERATION

The Electronic Fuel Injection (EFI) system functions to provide the engine with precisely metered fuel under varying loads and conditions.

The Engine Control Module or "ECM", is located adjacent to the battery box. It is programmed to provide the correct fuel/air mixture and ignition timing based on several sensor input signals (engine load, temp, altitude, manifold pressure etc.). The ECM also provides grounds or voltage to other *EFI related* circuits of the electrical and fuel delivery systems.

An Electronic Throttle Control (ETC) system takes the place of a conventional, cable-operated throttle body. The ETC controls throttle blade angle and provides rate-of-change feedback to the ECM.

The ETC also serves as a plausibility check for the Temperature Manifold Absolute Pressure (TMAP) sensor. The MAP portion of the TMAP sensor is the primary air flow and load sensing device.

An electric fuel pump, mounted inside the fuel tank supplies fuel pressure to the injectors continuously when the engine is running or cranking. A pressure regulator incorporated on the pump keeps fuel pressure steady at approximately 4 Bar (400 kPa / 58 PSI). The fuel pump cycles "ON" for 2-3 seconds when the motorcycle is powered up and the Engine Stop switch is turned ON to pressurize the system for start-up.

The fuel injectors inject fuel when they are grounded by drivers inside the ECM. The duration of an injector pulse (length of time the injector circuit is grounded) is controlled by the ECM. Pulse duration determines the amount of fuel delivered to the engine (longer cycles = more fuel). The ECM selects the correct fuel injector pulse by calculating the airflow from the MAP sensor measurement and referencing a three dimensional "map" for the desired air-to-fuel ratio (AFR). The ECM calculates an injection time based on the measured airflow and desired AFR.

Although TMAP and engine RPM are the most influential inputs for selecting a map reference point, the ECM also evaluates feedback from minor sensors in the system, to obtain a more accurate "picture" of the fuel needs at any given moment.

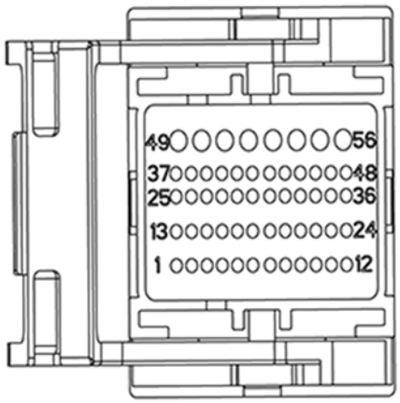
The fuel control system is closed loop. When the engine is at a warm idle and typical cruising engine speeds and loads, the ECM will operate in "closed loop fuel control" mode. The oxygen sensors in each head pipe provides feedback to the ECM and the injection time will be adjusted for each cylinder to achieve the target AFR.

The locations of sensors and other EFI system related components are outlined in this chapter. See **Sensors - Powertrain Management Components page 4.11**.

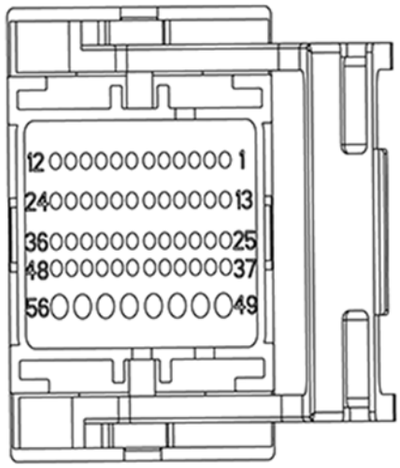
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

ECM CONNECTOR MAP

ECM 1



ECM 2



4

NOTICE
Unused pins are not included in the list below

IMPORTANT
Last 2 digits of 100 series number correspond to connector cavity number. (Example: 110 = cavity 10)

PIN ECM 1	COLOR	FUNCTION	PIN ECM 2	COLOR	FUNCTION
101	BK/RD	HIGH BEAM RELAY CONTROL GROUND	201	BK	CRANKSHAFT POSITION SENSOR NEGATIVE SIGNAL
102	GY/OG	HORN RELAY CONTROL GROUND	202	GY/DB	FRONT HEATED OXYGEN (HO2) SENSOR SIGNAL 2
103	YE/BK	PEAL POSITION SENSOR 2 RETURN	203	OG/YE	THROTTLE POSITION SENSOR 1 SIGNAL
104	BN/GN	E104 SIGNAL RETURN SPLICE FEED	204	BN/YE	E204 SIGNAL RETURN SPLICE FEED
105	BN/WH	TPS SIGNAL RETURN	205	BG/WH	FRONT HEATED OXYGEN (HO2) SENSOR RETURN 2
106	WH/BK	PEDAL POSITION SENSOR 1 RETURN	206	BK/BU	FUEL LEVEL SENSOR SIGNAL RETURN
110	BK/PK	GEAR SELECT SWITCH OUTPUT (TO ECM)	207	BG	REAR HEATED OXYGEN (HO2) SENSOR RETURN 1
111	YE/GN	PEDAL POSITION SENSOR 2 SIGNAL	208	OG/BK	ENGINE COOLANT TEMPERATURE SENSOR RETURN
112	BK/DG	FUEL LEVEL SENSOR SIGNAL	210	WH/RD	PEDAL POSITION SENSOR 1 +5V SUPPLY (VS1)
115	GY/BK	ENGINE RELAY CONTROL GROUND	212	DB	FRONT LEFT TS LAMP OUTPUT

116	PK	ECM SWITCHED POWER	213	WH	CRANKSHAFT POSITION SENSOR POSITIVE SIGNAL
121	WH/GN	PEDAL POSITION SENSOR 1 SIGNAL	215	OG/DB	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
			216	OG/BD	AMBIENT AIR TEMP SENSOR SIGNAL
123	RD/BK	RUN/STOP SWITCH OUTPUT GROUND	217	BK/YE	REAR BRAKE PRESSURE SWITCH OUTPUT GROUND
125	YE/RD	PEDAL POSITION SENSOR 2 +5V SUPPLY (VS3)	218	OG/WH	TIP-OVER SENSOR (TOS) SIGNAL
126	BN/GN	TIP-OVER SENSOR +5V SUPPLY (VS1)	219	OG/BN	TMAP SENSOR MANIFOLD ABSOLUTE PRESSURE SIGNAL
131	BK/OG	COOLING FAN RELAY CONTROL GROUND	220	VT/RD	THROTTLE POSITION SENSOR 2 SIGNAL
132	YE	ECM CAN HIGH	223	BN/PK	TMAP SENSOR +5V SUPPLY
133	YE	ECM HS CAN HIGH	224	DB/RD	FRONT RIGHT TS LAMP OUTPUT GROUND
135 (2022 Models)	BN/PK	OFF / ACC DETECTION INPUT	225	BK/BN	OIL PRESSURE SENSOR SIGNAL
137	BN/RD	E137 +5V SUPPLY (VS3) SPLICE FEED	227	OG/DG	TMAP INTAKE AIR TEMPERATURE SIGNAL
138	BN/DB	TPS +3.3V SUPPLY (VS2)	230	GY/RD	REAR HEATED OXYGEN (HO2) SENSOR SIGNAL 1
140	DG/BK	LOW BEAM RELAY CONTROL GROUND	235	DB/BK	CANISTER PURGE VALVE (CPV) CONTROL
141	WH/YE	STARTER SOLENOID RELAY CONTROL GROUND	236	DB	REAR LEFT TS LAMP GROUND OUTPUT GROUND
142	GY	FUEL PUMP RELAY CONTROL GROUND	237	RD	KNOCK SENSOR SIGNAL
144	DG	ECM CAN LOW	238	BK	KNOCK SENSOR SIGNAL RETURN
145	DG	ECM HS CAN LOW	239	GY/YE	FRONT HEATED OXYGEN SENSOR (HO2) CONTROL 2
147	BG/BK	SIDE-STAND SWITCH OUTPUT GROUND	243	WH/GY	FRONT FUEL INJECTOR DRIVER 2
151	PK/DB	STOP LAMP POWER OUTPUT	244	WH/DB	REAR FUEL INJECTOR DRIVER 1
153	BK/WH	ECM POWER GROUND 2	246	GY/WH	REAR HEATED OXYGEN (HO2) SENSOR CONTROL 1
154	BK/WH	ECM POWER GROUND 3	247	BK/WH	ECM ELECTRONIC GROUND
155	VT/PK	ECM SWITCHED POWER 2	248	DB/RD	REAR RIGHT TS LAMP GROUND OUTPUT GROUND
156	VT/PK	ECM SWITCHED POWER 2	250	BK/WH	ECM POWER GROUND 1
			251	PK/RD	ETC MOTOR (+)
			252	YE	ETC MOTOR (-)
			254	WH	FRONT COIL SIGNAL 2
			256	WH	FRONT COIL SIGNAL 1

DIAGNOSTIC TROUBLE CODES

SPN	FMI	COMPONENT	CONDITION	MIL	CODE
29	3	Accelerator Position 2	Voltage Too High	ON	P1228
	4		Voltage Too Low	ON	P1227
51	3	Throttle Position Sensor 1	Voltage Too High	ON	P0123
	4		Voltage Too Low	ON	P0122
84	19	Vehicle Speed Signal	Received Vehicle Speed has error	ON	P106B
91	3	Accelerator Position 1	Voltage Too High	ON	P0228
	4		Voltage Too Low	ON	P0227
96	3	Fuel Level Signal	Voltage Too High	OFF	P0463
	4		Voltage Too Low	OFF	P0462
100	3	Engine Oil Pressure Sensor	Pressure Too High	ON	P0523
	4		Pressure Too Low	ON	P0522
102	2	Manifold Absolute Pressure Sensor	Circuit Range / Performance	ON	P0106
	3		Voltage Too High	ON	P0108
	4		Voltage Too Low	ON	P0107
105	2	Intake Air Temperature Sensor	Circuit Range / Performance	ON	P0111
	3		Voltage Too High	ON	P0113
	4		Voltage Too Low	ON	P0112
110	2	Engine Temperature Sensor	Circuit Range / Performance	ON	P0116
	3		Voltage Too High	ON	P0118
	4		Voltage Too Low	ON	P0117
	16		Temperature Too High	OFF	P0217
	15		Temperature Above Normal Range	OFF	P1116
	10		Circuit Intermittent / Erratic	OFF	P0119
168	3	System Power (Battery Potential / Power Input)	Voltage Too High	OFF	P0563
	4		Voltage Too Low	OFF	P0562
	1		Voltage Below Critical Level	OFF	P1563
171	3	Ambient Air Temp Sensor	Voltage Too High	ON	P0073
	4		Voltage Too Low	ON	P0072
190	31	Engine Speed	Error in Engine Speed Computation	ON	P121C
523	2	Gear Sensor Signal	Circuit Fault	ON	P0914
	3		Voltage Too High	ON	P0917
	4		Voltage Too Low	ON	P0916
	11		Signal Fault	ON	P0915
527	22	Cruise Control	Input Message Counter Not Incremented	ON	U1405
	23		Invalid Data Received from Module	ON	U0405
597	19	Brake Switch	Error Received from ABS Module	ON	U1418
	22		Brake Switch Error	ON	U2604
	23			ON	U2605
598	2	Clutch Switch Signal	Signal Fault	ON	P0704
628	12	ECU Memory	EEPROM Read / Write Failure	ON	P1602
651	3	Injector 1 (Front)	Driver Circuit Short to B+	ON	P0262
	4		Driver Circuit Grounded	ON	P0261

SPN	FMI	COMPONENT	CONDITION	MIL	CODE
	5		Driver Circuit Open	ON	P0201
652	3	Injector 2 (Rear)	Driver Circuit Short to B+	ON	P0265
	4		Driver Circuit Grounded	ON	P0264
	5		Driver Circuit Open	ON	P0202
677	5	Starter Solenoid Driver Circuit	Driver Circuit Open/Grounded	OFF	P0615
	3		Driver Circuit Short to B+	OFF	P0617
	4		Driver Circuit Grounded	OFF	P0616
731	2	Knock Sensor 1	Circuit Range / Performance	ON	P0326
1071	5	Fan Relay Driver	Driver Circuit Open/Grounded	OFF	P1481
	3		Driver Circuit Short to B+	OFF	P1482
	4		Driver Circuit Grounded	OFF	P1483
1347	5	Fuel Pump Driver Circuit	Driver Circuit Open/Grounded	OFF	P0230
	3		Driver Circuit Short to B+	OFF	P0232
	4		Driver Circuit Grounded	OFF	P0231
2348	3	High Beam Lamp	Voltage Above Normal, Or Shorted To High Source	ON	C207F
	4		Voltage Above Normal, Or Shorted To Low Source	ON	C2081
	5		Current Below Normal Or Open Circuit	ON	C207E
	19		Received Network Data In Error	ON	C24F4
3056	2	Oxygen Sensor 1 (Front)	Sensor Signal Shorted to Heater	ON	P2231
	3		Voltage High	ON	P0132
	4		Voltage Low	ON	P0131
	5		Circuit Fault	ON	P0130
	12		Sensor Circuit Slow Response	ON	P0133
3057	2	Oxygen Sensor 2 (Rear)	Sensor Signal Shorted to Heater	ON	P2234
	3		Voltage High	ON	P0152
	4		Voltage Low	ON	P0151
	5		Circuit Fault	ON	P0150
	12		Sensor Circuit Slow Response	ON	P0153
3597	3	ECU Output Supply Voltage 1	Voltage Too High	ON	P16A2
	4		Voltage Too Low	ON	P16A1
3598	3	ECU Output Supply Voltage 2	Voltage Too High	ON	P16A9
	4		Voltage Too Low	ON	P16A8
3599	3	ECU Output Supply Voltage 3	Voltage Too High	ON	P17AA
	4		Voltage Too Low	ON	P17AB
65557	22	Torque Request CAN Message	Counter Error	ON	U2200
	23		Checksum Error	ON	U1FFB
65613	2	ETC Accelerator Position Sensor Outputs 1 & 2 Correlation	Correlation Fault	ON	P1135
65590	7	Cylinder Not Identified	Misfire Confirmed	ON	P0314
65591	7	Cylinder 1	Misfire Detected	ON	P0301
65592	7	Cylinder 2	Misfire Detected	ON	P0302
516125	2	Low Speed CAN Bus	Data erratic, Intermittent, or Incorrect	ON	U0019
	5		Current Below Normal, or Open Circuit	ON	U0020

SPN	FMI	COMPONENT	CONDITION	MIL	CODE
520198	3	Throttle Position Sensor 2	Voltage Too High	ON	P0223
	4		Voltage Too Low	ON	P0222
520200	2	Tipover Sensor	Signal Fault	OFF	P1501
	3		Voltage High	OFF	P1503
	4		Voltage Low	OFF	P1502
	14		Condition Exists (tip over condition detected)	OFF	P1504
	5		Open Circuit	OFF	P1512
520202	5	Canister Purge Valve	Driver Circuit Open/Grounded	ON	P0444
	3		Driver Circuit Short to B+	ON	P0443
	4		Driver Circuit Grounded	ON	P0445
520208	5	Chassis/Acc Relay	Driver Circuit Open/Grounded	OFF	P1611
	3		Driver Circuit Short to B+	OFF	P1614
	4		Driver Circuit Grounded	OFF	P1613
520209	2	Oxygen Sensor Heater 1 (pre) (front)	Data Erratic, Intermittent, or Incorrect	ON	P0135
	5		Driver Circuit Open/Grounded	ON	P0030
	3		Driver Circuit Short to B+	ON	P0032
	4		Driver Circuit Grounded	ON	P0031
520210	5	Oxygen Sensor Heater 2 (post) (rear)	Driver Circuit Open/Grounded	ON	P0050
	3		Driver Circuit Short to B+	ON	P0052
	4		Driver Circuit Grounded	ON	P0051
	2		Data erratic, intermittent, or incorrect	ON	P0155
520211	14	Engine Idle Shutdown	Unattended Idle Warning Timer is Running	ON	P1514
	31		Has Shutdown Engine	ON	P1516
520267	31	Side-Stand Switch	Condition Exists (engine disabled due to extended side-stand)	OFF	P181C
520276	2	Throttle Position Sensor (1 or 2 Indeterminable)	Position Sensor Correlation Fault (One okay, one failed)	ON	P150C
520277	3	Throttle Body Control - Power Stage	Maximum	ON	P150D
	4		Minimum	ON	P150E
	2		Not Plausible	ON	P151A
	8		Signal Error	ON	P151B
520279	31	Throttle Body Control - Adaption Aborted	Condition Exists	ON	P151D
520280	31	Throttle Body Control - Limp Home Position Check Failed	Condition Exists	ON	P151E
520281	31	Throttle Body Control - Mechanical Stop Adaptation Failure	Condition Exists	ON	P152A
520282	31	Throttle Body Control	Condition Exists	ON	P152B
520283	3	Throttle Body Control	Maximum	ON	P152C
	4		Minimum	ON	P152D
520284	31	Throttle Body Control - Position Deviation Fault	Condition Exists	ON	P152E
520286	31	ECU Monitoring Error	Condition Exists	ON	P1540
520287	31	ECU Monitoring Error (Level 3)	Condition Exists	ON	P1541
520288	31	ECU Monitoring of Injection Cut Off(Level 1)	Condition Exists	ON	P1542
520289	31	ECU Monitoring of Injection Cut Off(Level 2)	Condition Exists	ON	P1543

SPN	FMI	COMPONENT	CONDITION	MIL	CODE
520305	31	Throttle Body Control - requested throttle angle not plausible	Condition Exists	ON	P1530
520306	31	ECU ADC Fault	No Load Condition Exists	ON	P1531
520307	31	ECU ADC Fault	Voltage Condition Exists	ON	P1532
520308	31	Accelerator Sensor Synchronicity Fault	Sensor Difference Exceeds Limit	ON	P1533
520309	31	ECU Fault	ICO Condition Exists	ON	P1534
520311	31	ECU Fault – Hardware Disruption	Condition Exists	ON	P1537
520320	5	Brake Light	Open Circuit	OFF	P1593
	3		Shorted to Battery	OFF	P1594
	4		Shorted to Ground	OFF	P1595
520322	4	Front Brake Switch	Shorted to Ground		P159A
520323	3	Rear Brake Switch	Voltage Too High	ON	P159C
520329	9	Operator Switch Status (pOSS1)	Abnormal Update Rate	ON	P1063
520331	3	Knock Sensor Positive Line	Voltage Too High	ON	P1327
	4		Voltage Too Low	ON	P1328
520332	3	Knock Sensor Negative Line	Voltage Too High	ON	P132A
	4		Voltage Too Low	ON	P132B
520344	15	Adaptive Fuel Correction Bank 1	Data Valid But Above Normal Operating Range - Least Severe Level (System Too Rich)	ON	P2178
	17		Data Valid But Below Normal Operating Range - Least Severe Level (System Too Lean)	ON	P2177
520545	3	Front Left Turn Driver Circuit	Voltage Above Normal, Or Shorted To High Source	OFF	P17A0
	4		Voltage Above Normal, Or Shorted To Low Source	OFF	P17A1
	5		Current Below Normal Or Open Circuit	OFF	P17A2
520546	3	Front Right Turn Driver Circuit	Voltage Above Normal, Or Shorted To High Source	OFF	P17A3
	4		Voltage Above Normal, Or Shorted To Low Source	OFF	P17A4
	5		Current Below Normal Or Open Circuit	OFF	P17A5
520547	3	Rear Left Turn Driver Circuit	Voltage Above Normal, Or Shorted To High Source	OFF	P17A6
	4		Voltage Above Normal, Or Shorted To Low Source	OFF	P17A7
	5		Current Below Normal Or Open Circuit	OFF	P17A8
520548	3	Rear Right Turn Driver Circuit	Voltage Above Normal, Or Shorted To High Source	OFF	P1803
	4		Voltage Above Normal, Or Shorted To Low Source	OFF	P1804
	5		Current Below Normal Or Open Circuit	OFF	P1805
524040	2	Run Stop Switch	Circuit Range / Performance	ON	P05BD
	9		Run / Stop Message Timeout	ON	U1FF9
	19		Run / Stop Switch CAN Error	ON	U1FFE
524046	9	Start Button	Abnormal Update Rate	OFF	U1FFD
524067	9	Drive Mode Request	Lost Communication with Front Controls / Display Interface Module	OFF	U0257

ABS Trouble Codes

SPN	FMI	COMPONENT	CONDITION	ABS LAMP ON (YES / NO)	TRACTION CONTROL LAMP ON (YES / NO)	CODE	SERVICE ACTION
520140	12	ABS ECU	Bad Intelligent Device	Yes	Yes	C2437	Replace Module
520131	12	ABS Valve Relay	Condition Exists	Yes	Yes	C2420	Replace Module
520254	31	ABS Solenoid (Front In)	Condition Exists	Yes	Yes	C1326	Replace Module
520255	31	ABS Solenoid (Front Out)	Condition Exists	Yes	Yes	C1327	Replace Module
520252	31	ABS Solenoid (Rear In)	Condition Exists	Yes	Yes	C1330	Replace Module
520253	31	ABS Solenoid (Rear Out)	Condition Exists	Yes	Yes	C1332	Replace Module
520262	0	ABS Controller Source Voltage	Data valid but above normal operational range	Yes	Yes	C2422	Check Battery Voltage
	1		Data valid but above below operational range	Yes	Yes	2421	
	3		Voltage above normal	No	Yes	1039	
	4		Voltage below normal	No	Yes	1038	
520132	31	ABS Pressure Sensor	ABS internal pressure sensor supply voltage faulty	Yes	Yes	C2423	Replace ABS Module
520133	12	ABS Internal Pressure Sensor	Bad Intelligent Device	Yes	Yes	C2424	Replace ABS Module
	2		Data Erratic, intermittent, or incorrect	Yes	Yes	C2439	Cycle Key 3–4 times. Replace module if unsuccessful
520260	12	ABS Motor	Bad Intelligent Device	Yes	Yes	C101C	Replace ABS Module
520134	31	ABS Motor Supply Failure	Condition Exists	Yes	Yes	C2425	Check Motor Supply Voltage. Check Fuses
904	2	Front Wheel Speed Sensor	Data Erratic, Intermittent, or Incorrect	Yes	Yes	C1031	Check Tone Ring for any abnormalities , Check for Bad Airgap and wheel vibrations
	3		Voltage Above Normal	Yes	Yes	C2426	Check Signal Line Voltage
	4		Voltage Below Normal	Yes	Yes	C2427	Check Supply/ Signal Line Voltage
907	2	Rear Wheel Speed Sensor	Data Erratic, Intermittent, or Incorrect	Yes	Yes	C103D	Check Tone Ring for any abnormalities , Check for Bad Airgap and wheel vibrations
	3		Voltage Above Normal	Yes	Yes	C113D	Check Signal Line Voltage

SPN	FMI	COMPONENT	CONDITION	ABS LAMP ON (YES / NO)	TRACTION CONTROL LAMP ON (YES / NO)	CODE	SERVICE ACTION
	4		Voltage Below Normal	Yes	Yes	C123D	Check Supply/ Signal Line Voltage
520135	31	Wheel Speed Sensor	Wheel Speed Sensor Signal Error	Yes	Yes	C2430	Check Tone Wheel Alignment /Airgap.
65559	31	CAN1 Bus Hardware	CAN Controller Failure	Yes	Yes	C1130	Replace the ABS Module if multiple key cycles do not recover module.
520141	31	CAN1 Bus Wiring	CAN Wiring Issue	Yes	Yes	C2438	Check the CAN wiring going into the module
520136	7	IMU (Inertial Measurement Unit)	Mechanical System Failure or Out of Adjustment	No	No	C2431	Verify IMU Installation and Connections for abnormalities.
	2		Data Erratic or Incorrect or Intermittent	No	No	C2432	Verify IMU Installation and Connections for abnormalities.
	9		Abnormal Update Rate	No	No	U0132	Verify IMU Installation and Connections for abnormalities.
	22		Counter Fault	No	No	U0133	Verify IMU Installation and Connections for abnormalities.
	23		Checksum Fault	No	No	U0134	Verify IMU Installation and Connections for abnormalities.
520137	31	ABS Manually Disabled	Condition Exists	Yes	No	C2433	No Service Action Required
520138	31	TC Manually Disabled	Condition Exists	No	Yes	C2434	No Service Action Required
520265	7	ABS Module	Un-Filled Component	Yes (Flashing)	Yes	C1042	—
524077	2	pDrive Mode Commanded	Data Invalid or Intermittent or Incorrect	No	No	C2435	Check Wiring and Connection to ECM and ABS
	9		Abnormal Update Rate	No	No	U0135	
520139	9	pTSCF1	Abnormal Update Rate	No	Yes	U0136	Check wiring and connection to ECM and ABS
	22		Counter Fault	No	Yes	U0137	
	23		Checksum Fault	No	Yes	U0138	
513118	9	65314 Timing	Abnormal Update Rate	No	Yes	U1109	Check wiring and connection to ECM and ABS
516121	9	61445 Timing Gear Position	Abnormal Update Rate	No	Yes	U1111	Check wiring and connection to ECM and ABS

SPN	FMI	COMPONENT	CONDITION	ABS LAMP ON (YES / NO)	TRACTION CONTROL LAMP ON (YES / NO)	CODE	SERVICE ACTION
516136	31	PGN 61441 Missing EBC1–Lamp Info	Condition Exists	No	No	U1112	Check wiring and connection to Gauge and ABS
516120	9	PGN 65265 Missing CCVS - Clutch Status	Abnormal Update Rate	No	Yes	U1106	Check wiring and connections for Hand Controls and ABS
520319	31	Variant Invalid	Condition Exists	Yes	Yes	C1082	Follow Variant Write Procedure within DW.
	14		Data not Read Properly	Yes	Yes	C2436	Verify the ABS Variant Procedure was successful

SENSOR DIAGNOSTICS

If a sensor fails or reads outside a "normal" range, a "pre-programmed" (default) value is substituted by the ECM until sensor reading returns to normal.

Sensor values can be viewed in Digital Wrench on the "Sensor Data Grid Or Graphs" screen. Since the sensor reading may either be actual feedback from the sensor OR a default value set by the ECM in the event of a fault in the sensor or wiring, it is important to verify the condition of the sensor.

The Malfunction Indicator Light (MIL) may or may not illuminate to alert the rider of a possible problem, depending on which system fault has occurred. The first step following illumination of the MIL is to perform a visual inspection to see if a cause can be determined.

Connect Digital Wrench to see what codes are present in memory, and focus your diagnostics on that sensor and the related wiring for that circuit. Refer to wiring diagrams and system break-out diagrams to narrow a problem search.

If multiple codes are set, refer to the wiring diagram and focus your efforts on wiring and connections common to each of the sensors, such as a power supply or common ground. Multiple sensor failure is extremely unlikely.

Many sensor tests described in this section are performed at the ECM wire connector. This method ensures that the data from a sensor is reaching the ECM. Sensor tests can be performed at the sensor if easily accessible, but the wiring between the sensor and the two 56-pin ECM connectors should always be closely examined and the path between the sensor and ECM verified if the sensor itself passes the test.

Poor or corroded connections are the most common cause of system faults. Always check the integrity of the male pins and female receptacles of the connectors in the affected circuit. These may include the sensor connector, the ECM connector, and any wiring between the two, such as jumper harnesses where applicable.

ECM PINOUT TESTING

NOTICE

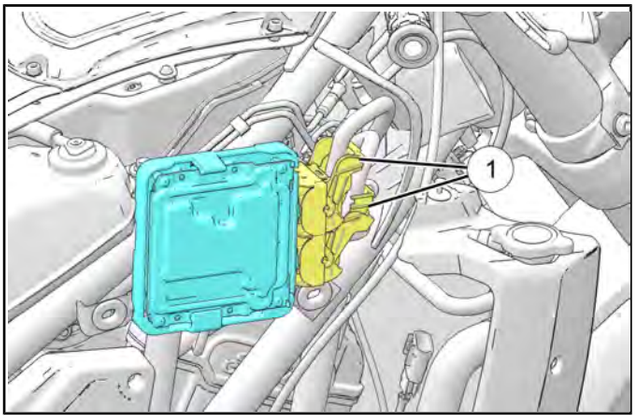
Tests in this section may require reading resistance and voltages at ECM connector. Once ECM connector has been removed from the ECM:

- Do not touch pins on ECM. Static electricity from your body can damage the ECM.
- Do not attempt to perform tests on the ECM unit.
- Always use the appropriate test connector from the Electrical Connector Test Adapter Kit (PV-43526) or an appropriate test probe that will not damage (expand) the connector pin socket.
- DO NOT attempt to use standard meter probes or other devices to probe connector pin sockets as this could expand a terminal socket or damage the connector, create a problem where none existed before, and complicate the diagnostic process.
- Sensor tests on the following pages can often be performed at the sensor connector itself or at the ECM connector based on accessibility of the connector or wiring.
- If a sensor tests within the specified range (OK), then test the circuit wiring. This usually originates at the ECM connectors, but may include other connections.

ECM CONNECTOR DISCONNECT / INSTALLATION

ECM Connector Disconnect:

1. Remove right side air box cover. Reference **Air Box Removal page 3.14**.
2. Locate the ECM connectors ①.



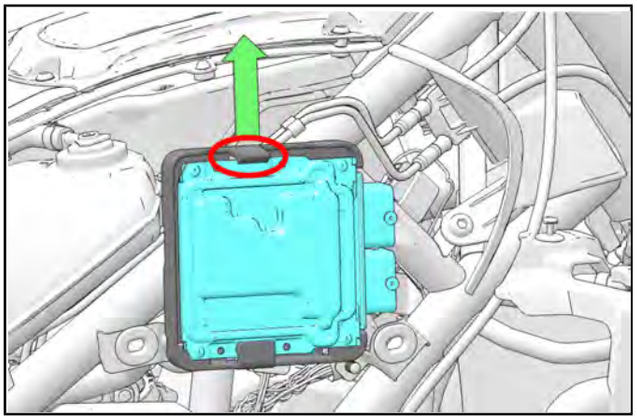
3. Remove the panduit strap securing the connector lock lever (if equipped).
4. Slide the lock lever toward the rear of the vehicle until connector is disengaged from the ECM.
5. Lift the connector straight off of the ECM.

ECM Connector Installation:

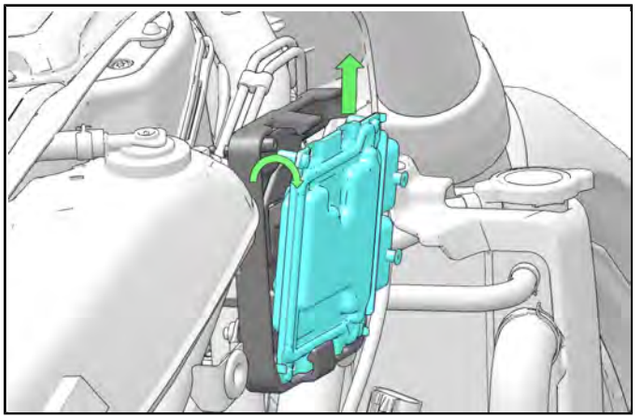
1. Carefully align the ECM connector *straight* with the flange on the ECM. (Do not tip or rotate the connector into the ECM).
2. Gently apply straight inward pressure on the connector while sliding the lock lever back toward the connector until the lever stops and the connector is fully seated.
3. Secure a new panduit strap ② around the ECM rear connector lock lever and harness.

ECM REMOVAL / INSTALLATION

1. Disconnect Battery. See **Battery Disconnect page 10.12**.
2. Remove air box cover. Reference **Air Box Removal page 3.14**.
3. Disconnect the ECM connectors. See **ECM Connector Disconnect / Installation page 4.47**.
4. lift the retaining tab upward to allow ECM to rotate out of retaining bracket.



5. Slide the ECM out of the retaining bracket as shown.

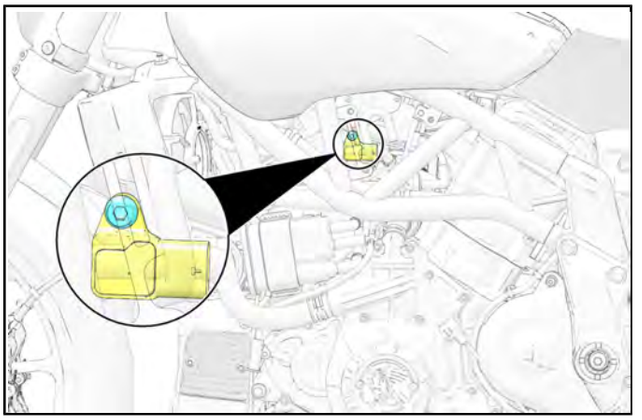


6. **Reverse the removal procedure to install.**

TEMPERATURE MANIFOLD ABSOLUTE PRESSURE SENSOR (TMAP) REPLACEMENT

Operation Overview

Mounted on the intake manifold, the TMAP sensor performs two functions in one unit.\



Air passing through the intake is measured by the TMAP and relayed to the ECM. These signals, comprised of separate air temperature and manifold absolute pressure readings, are processed by the ECM and compared to its programming for determining the fuel and ignition requirements during operation. The TMAP sensor provides the ECM with engine load data.

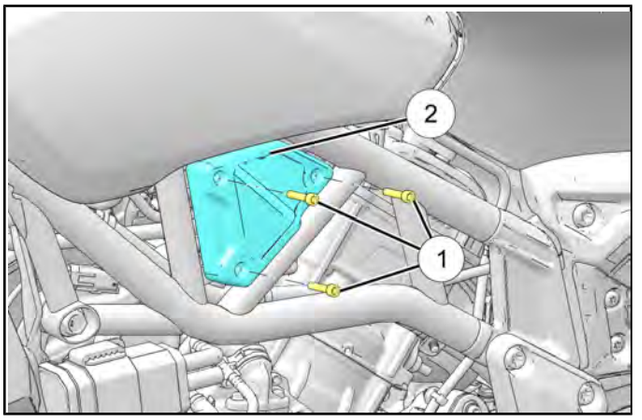
TMAP Sensor Test

The TMAP sensor is a non-serviceable item. If it is faulty, it must be replaced

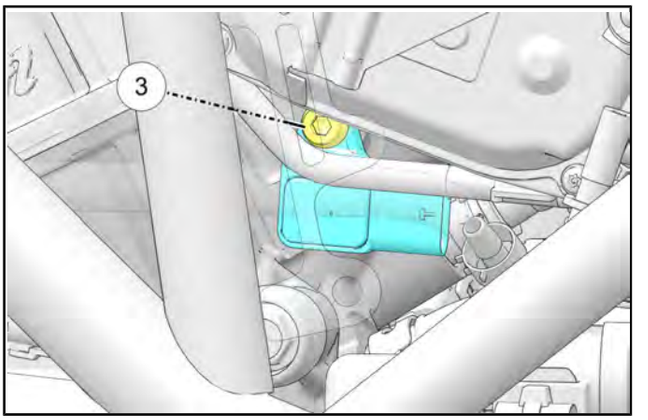
IMPORTANT
This sensor should only be tested using Digital Wrench Diagnostic Software.

TMAP Sensor Replacement

1. From the left side of the unit remove three fasteners ① retaining the cover ② to the frame.



2. Disconnect TMAP electrical connector.
3. Remove TMAP fastener ③.



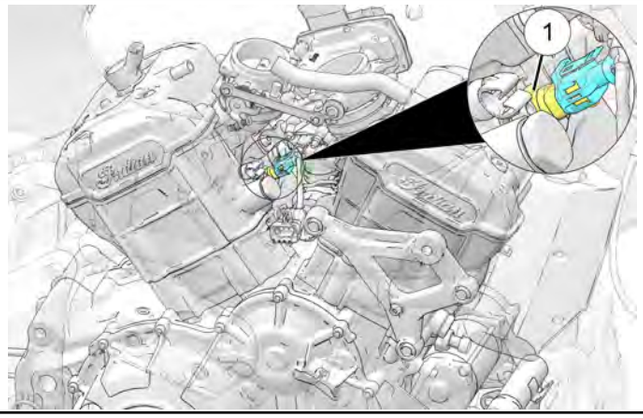
4. **Installation is performed by reversing the removal procedure.**

TORQUE
TMAP Sensor Fastener: **53 in-lbs (6 N·m)**

TORQUE
V-Cover Fasteners: **36 in-lbs (4 N·m)**

COOLANT TEMPERATURE SENSOR, TEST

Testing



CHT TEST OVERVIEW		
INDICATES	INSPECT	LOCATION
Voltage received at ECM from CTS sensor is outside of parameters.	Resistance readings through sensor and wiring at ECM 2 connector (ECM disconnected). This will test will inspect the wiring, connectors, and CHT sensor resistance.	Under rear cylinder intake port.

1. Disconnect ECM #2 connector. See **ECM Connector Disconnect / Installation page 4.47**.
2. Attach test lead adapters to meter leads.
3. Set multimeter to measure resistance.
4. Measure resistance between pin 208 and pin 215 of the ECM #2 connector and compare to specification. See **ECM Connector Map page 4.37**.
5. If resistance is out of specified range, disconnect sensor and measure the resistance through each wire from ECM connector to the sensor connector. Resistance should be less than 1 Ohm (good continuity).
6. If Step 5 continuity is good, measure the resistance through the sensor and compare to specification.

COMPONENT	METER SETTING	SPECIFICATIONS (±10%)
COOLANT TEMPERATURE SENSOR	OHMS	20.5 K Ohms +/- 1.5 K Ohms

Replacement

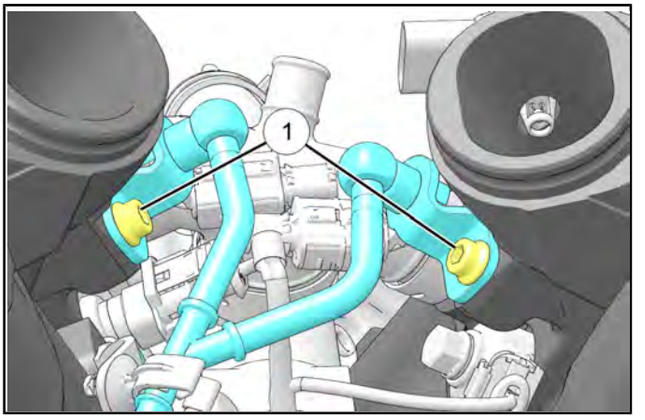
1. If replacement is needed, reference **Coolant Temperature Sensor Replacement page 3.65**.

FUEL INJECTOR REMOVAL / INSTALLATION

1. Remove the seat assembly. See **Seat Removal / Installation page 7.19**.
2. Depressurize fuel system. See **Fuel System Depressurization page 4.22**
3. Remove fuel tank. See **Fuel Tank Removal page 4.24**.
4. Remove the air box. See **Air Box Removal page 3.14**.
5. Remove Throttle body assembly. See **Throttle Body Assembly Removal / Installation page 4.18**
6. Remove fasteners:

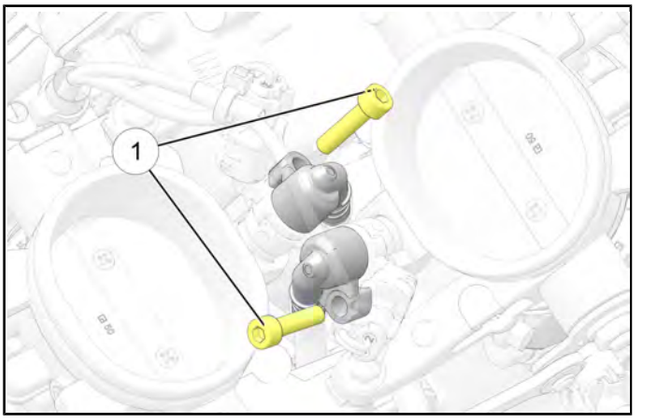
- **2019–2020**

  ① securing fuel rail.

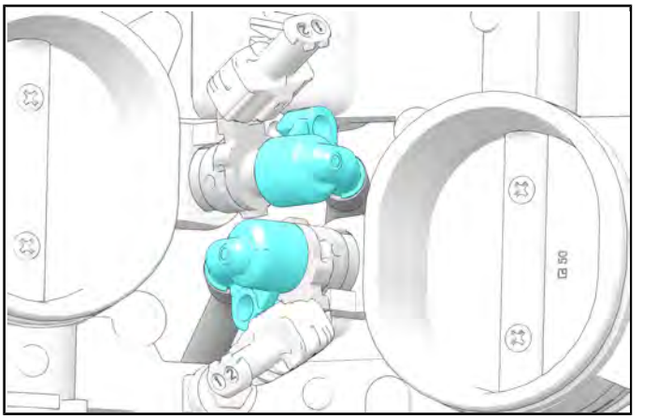


- **2022+**

  ① securing the fuel injectors.



- Remove the fuel lines from the injectors.

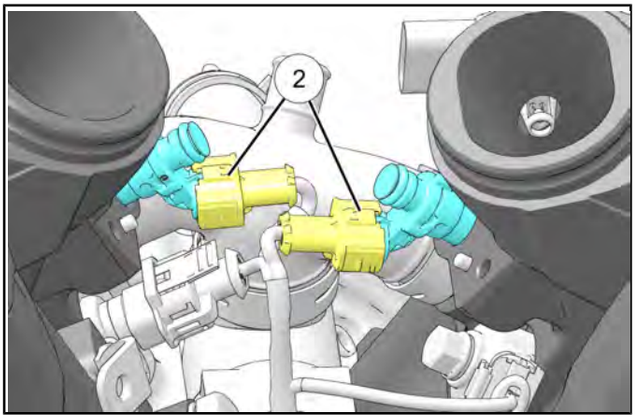


7. Disconnect the fuel rail from the injectors.

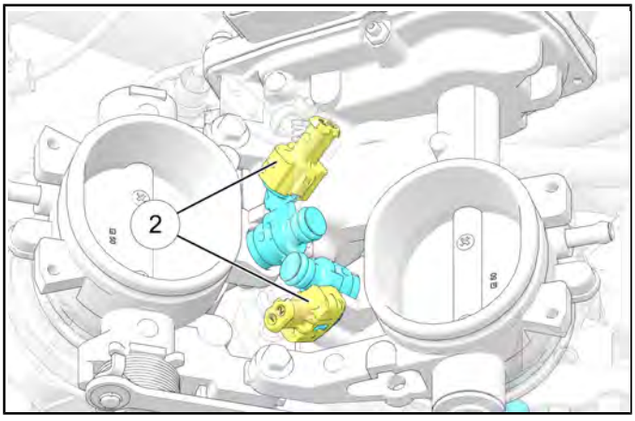
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

8. Disconnect fuel injector electrical connections ②.

2019–2020



2022+

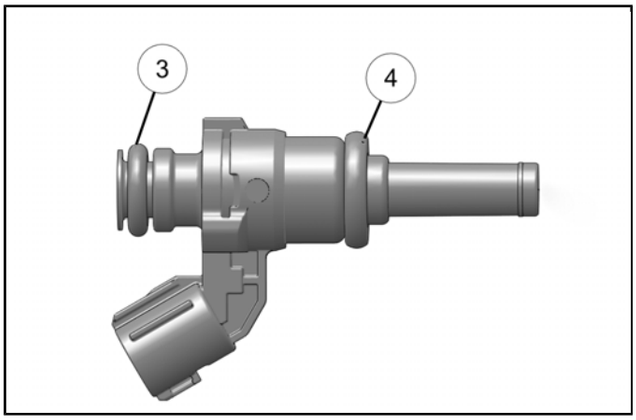


9. Firmly pull injectors to remove. Note orientation for reassembly.

IMPORTANT
Any time the fuel rail or injector is removed, you must replace the O-ring and grommet. See **Fuel Injector O-Rings page 4.52**.

10. **Installation is performed by reversing the removal procedure.**

11. To aid in installation of injectors, use non-silicone motor oil to lubricate the circumference of the o-ring ③ and grommet ④ prior to assembly.



TORQUE
Fuel Rail Fastener: **88 in-lbs (10 N·m)**

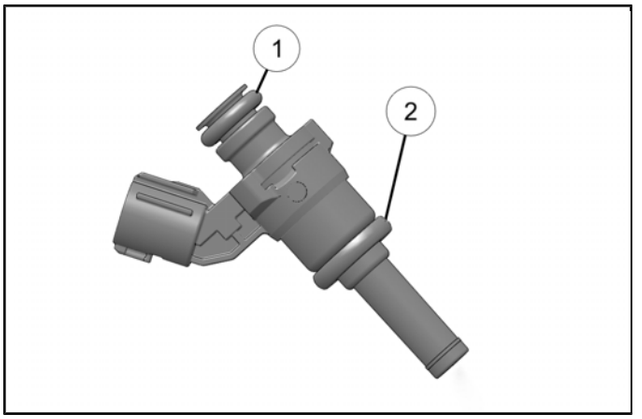
12. Reinstall throttle body assembly. See **Throttle Body Assembly Removal / Installation page 4.18**
13. Reinstall fuel tank. See **Fuel Tank Installation page 4.30**
14. Reinstall air box. See **Air Box Installation page 3.16**
15. Reinstall seat. See **Seat Removal / Installation page 7.19**

FUEL INJECTOR O-RINGS

1. Any time an injector is removed, you must replace the upper and lower O-rings.
2. Always lubricate NEW injector o-rings with clean, silicone-free motor oil.

IMPORTANT
Apply oil sparingly and avoid contaminating the pintle valve / jet surface and upper inlet port.

3. Install NEW o-rings onto top and bottom of injector



ITE-M	PART NUMBER	COLOR	POSITION
①	5416412	Blue	TOP OF INJECTOR
②	5416413	Black	BOTTOM OF INJECTOR

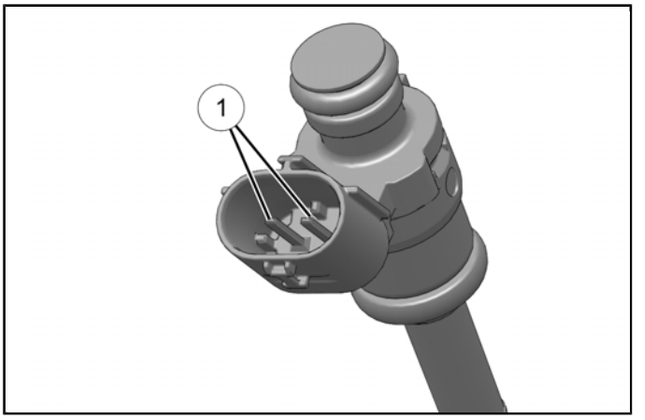
IMPORTANT
Always install NEW o-rings when removing the fuel rail or injectors.

IMPORTANT
Verify that the new top and bottom o-rings are installed in the correct position and are lubricated with clean, silicone-free oil.

FUEL INJECTOR RESISTANCE TEST

IMPORTANT
Take note of front and rear fuel injector harness connectors before disconnecting them.

The fuel injectors are non-serviceable. If diagnosis indicates a problem with either injector, test the resistance of the fuel injector(s) by measuring between the two pin terminals ①.

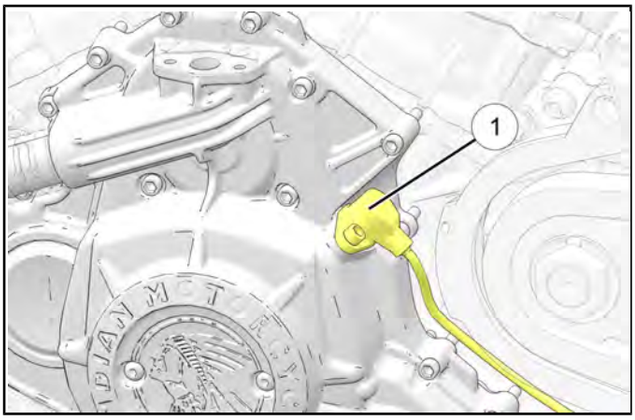


Fuel Injector Resistance Specification:
11.4 Ω - 12.6 Ω

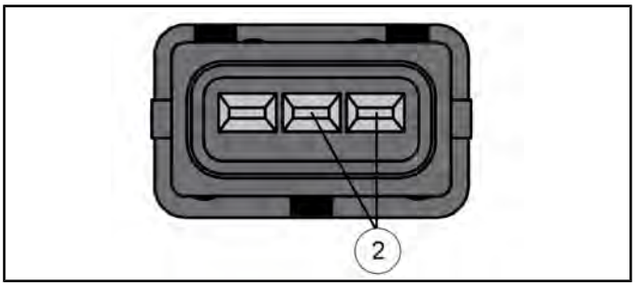
CRANKSHAFT POSITION SENSOR, TEST / REPLACE

Crankshaft Position Sensor (CPS) Test

1. Locate the CPS sensor ① .



2. Trace the wire to its connector and disconnect.
3. Connect an ohmmeter between the pin terminals ② and compare resistance readings to specification below.

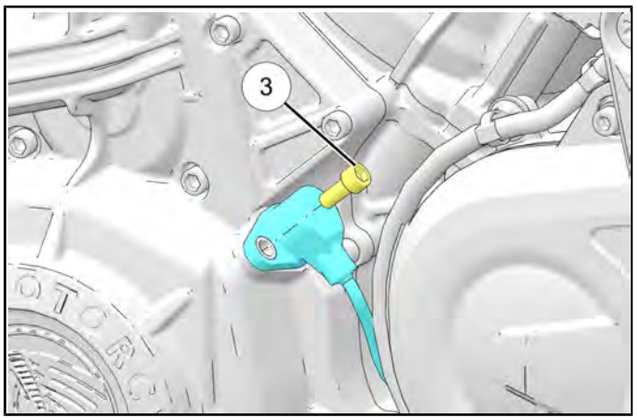


4. If resistance is correct, check to see that the sensor is mounted properly and that the fly wheel has not been damaged and is securely mounted to the crankshaft assembly.

Crankshaft Position Sensor: **860 Ohms @ 20°C (68°F)**

Crankshaft Position Sensor (CPS) Replacement

1. Remove regulator / rectifier assembly and bracket. See **Regulator / Rectifier Replacement page 10.40**.
2. Disconnect the CPS sensor from the vehicle harness and release flying lead from plastic darts and cable ties.
3. Remove the screw ③ securing the CPS sensor to the engine case and remove sensor.



4. **Installation is performed by reversing the removal procedure.**

IMPORTANT
Apply rubber lubricant to the CPS sensor o-ring to ease installation.

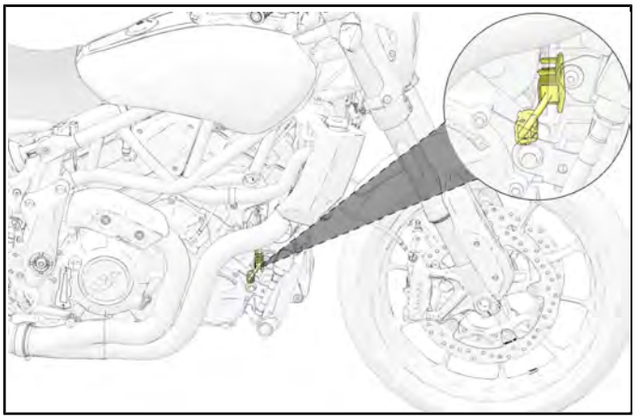
5. Torque the CPS retaining fastener to specification.

TORQUE
Crankshaft Position Sensor Fastener: **88 in-lbs (10 N·m)**

4

LEAN ANGLE SENSOR

The Lean Angle Sensor is located on the back side of the battery tray.



The Lean Angle Sensor interrupts the ignition/fuel supply which prevents engine operation after a tip over event.

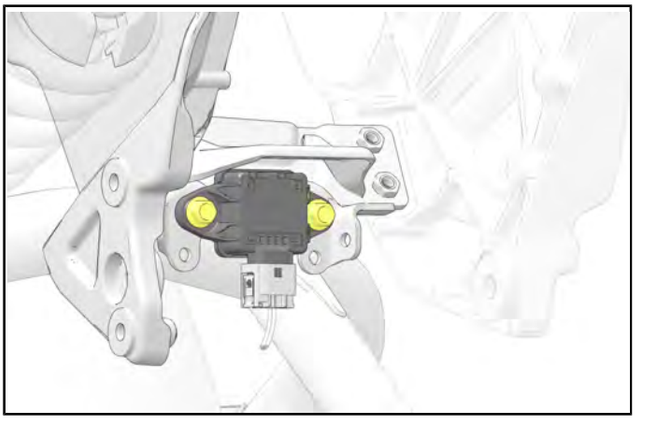
If the unit remains leaned over more than 65 degrees for more than three seconds, the ECM will cut fuel and ignition and activate the hazard lamps. A trouble code will also be set.

An ignition key cycle is required to restart the unit.

For replacement reference **Lean Angle Sensor Replacement page 10.72**

IMU (INTERNAL MEASURING UNIT) OVERVIEW

The IMU is located behind the ABS module in front of the rear tire, secured to the inside of the frame by two fasteners. The IMU provides raw acceleration data to the ABS module allowing it to calculate for stability control and wheelie mitigation. The IMU does not have any firmware or software and can not be programmed. The IMU does not have any checks that can be performed such as checking resistance or connectivity.



If the IMU is exhibiting diagnostic trouble codes (see Diagnostic Trouble Codes page 4.39) the only items that can be checked are:

- Is the IMU mounted correctly? Are the bolts torqued to the correct specification?

TORQUE
IMU Sensor Fasteners: **84 in-lbs (9 N·m)**

- Is the wiring good? Connectivity can be checked on the harness and pins.

REAR CYLINDER DEACTIVATION

NOTICE
Rear Cylinder Deactivation is only available on 2022 + models.

Designed as an aid to reduce engine and exhaust heat to the rider, Rear Cylinder Deactivation shuts down the rear cylinder when the engine is at operating temperature and at idle speed.

The following condition must be met for Rear Cylinder Deactivation to be enabled.

- Engine coolant temperature must be above 176 °F (80 °C)
- Ambient Temperature must exceed 59 °F (15 °C)
- Engine speed must be below 2200 rpm
- Throttle must be in the closed position (0% throttle)

Rear Cylinder Deactivation can be turned on and off by accessing the settings menu. Cylinder Deactivation controls are in the Vehicle Settings menu. When Rear Cylinder Deactivation is functioning, an icon will illuminate at the right of the Ride Command display screen.

For models not equipped with Ride Command, do the following to disable Rear Cylinder Deactivation:

1. Navigate to the ambient air temperature display mode on the

   multi-function display (MFD).
2. Long press the right-hand trigger until "CYLdeAC" displays.
3. Pressing the right-hand trigger will allow operator to toggle between "CD ON" or "CD OFF."
4. Press and hold hand right-hand trigger to save settings.
   - CYLdeAC ON: rear cylinder can deactivate
   - CYLdeAC OFF: rear cylinder cannot deactivate

   When the cylinder deactivation feature activates and the cylinder is deactivated, a "CylDeAc" message is shown on the MFD for 1 second. When the feature deactivates and the cylinder activates, a "CylAc" message is shown on the MFD for 1 second.

CYLINDER MISFIRE DETECTION

The ECU monitors crankshaft speed via the crankshaft position sensor. A misfire will cause a fluctuation in crankshaft speed. A code will set and flash the check engine light after an engine misfire threshold/rate is detected that is above a pre-determined limit. This threshold varies based on engine speed.

One or more of the following codes will be set if a misfire occurs:

- P0301 (SPN 65591/FMI 7) Misfire Detected, Cylinder 1 (Front)
- P0302 (SPN 65592/FMI 7) Misfire Detected, Cylinder 2 (Rear)
- P0314 (SPN 65590/FMI 7) Misfire Confirmed

If a misfire is detected, the following events will occur:

- The check engine indicator lamp will begin to flash and fuel will be cut to the affected cylinder(s). The check engine indicator lamp will continue to flash until the ignition switch has been moved to the off position. Restarting the engine will clear the flashing indicator and restore fuel to both cylinders. During normal operation, the motorcycle will shut down after 15 minutes at idle without user input. During a misfire, the motorcycle will shut down after 5 minutes without user input.
- If a 2nd misfire occurs, the check engine indicator lamp will resume flashing and fuel will once again be cut to the affected cylinder(s).
- After the 3rd misfire, P0314 misfire fault is determined & set, the check engine light will remain on and fuel will be cut to the affected cylinder(s). If this occurs, follow the troubleshooting section below.

In cases where cylinder misfire is intermittent, or has been repaired in the field (e.g. loose spark plug wire has been reattached), Misfire Detection utilizes a self-healing feature to allow continued operation. Following the 1st or 2nd misfire event, when the ignition is cycled OFF and ON again, the misfire code becomes historic and the MIL turns off. When P0314 is set, after the 3rd misfire event, the MIL will stay on for 3 fault free drive cycles before turning off.

If the MIL turned on solid due to P0314, it will stay on until the misfire condition has been removed and 3 fault free drive cycles have occurred.

NOTICE
DRIVE CYCLE: A drive cycle consists of cycling the ignition from OFF to ON, then start the engine and run at idle for a period of approximately 4 minutes. Finally, turn off the ignition for approximately 2 1/2 minutes.

If it does not turn off, diagnose by verifying the following items:

TROUBLESHOOTING
• Ignition Coil and connections are good • Spark plugs wires are secure • The correct spark plugs are installed and the plugs are not fouled • Crankshaft Position Sensor tests good • Wiring to the Crankshaft Position Sensor, ECU and Ignition Coil are not damaged. Chassis ground is clean and tight • Fuel pressure is within specification • Fresh/good quality fuel is in the fuel tank • Engine mechanical is good (leak down, timing)

IMPORTANT
Once the systems is repaired and functioning normally, connect to Digital Wrench to clear active and historic codes. Retest to verify the condition is no longer present.

DIGITAL WRENCH

DIGITAL WRENCH II USER MANUAL

Review the Digital Wrench II user manual for information and details regarding the following:

- Software Installation
- Software Updates
- Software Screens/Menus
- Connecting to a Vehicle

Click HERE to view the Digital Wrench II user manual or visit "Other Publications" on the left navigation menu of the DEX STOP site.

DIGITAL WRENCH DIAGNOSTIC SOFTWARE OVERVIEW

NOTICE
Refer to Section 2, 3 and 4 in the Instruction Manual provided in the Digital Wrench Diagnostic Kit to install the Digital Wrench diagnostic software on your computer.

The Digital Wrench diagnostic software allows the technician to perform the following tests and observations:

- View or clear trouble codes
- Analyze real-time engine data
- Reflash ECU calibration files
- Perform guided diagnostic procedures
- Create customer service account records
- Perform output state control tests (some models)

DIAGNOSTIC SOFTWARE VERSION

Always use the most current version of the Digital Wrench software to ensure you have the latest updates or enhancements. New reprogramming files and guided diagnostic procedures are added to these updates as they become available.

ECM REPLACEMENT

Although the need for ECM replacement is unlikely, a specific replacement procedure is required to ensure that all essential data contained within the original ECU is transferred to the replacement ECU.

Refer to procedure and carefully follow all instructions provided in Digital Wrench.

GUIDED DIAGNOSTIC AVAILABLE

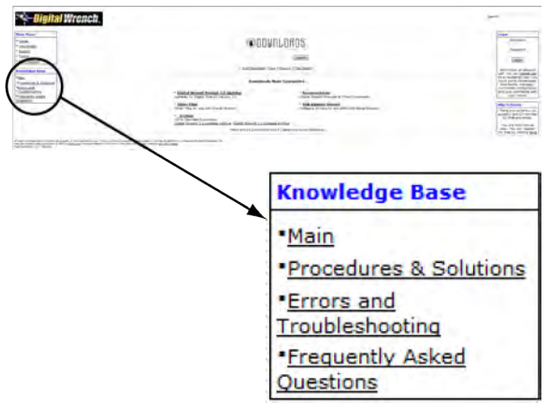
Guided diagnostics are available within Digital Wrench for most supported Diagnostic Trouble Codes (DTCs). That is, any fault that will turn on the 'Check Engine' indicator.

In addition, guided diagnostics are also available for many other electrical sub systems.

Diagnostic procedures are added to subsequent versions of Digital Wrench as they become available. Check your release version often and upgrade when available to be sure you are using the most current software available.

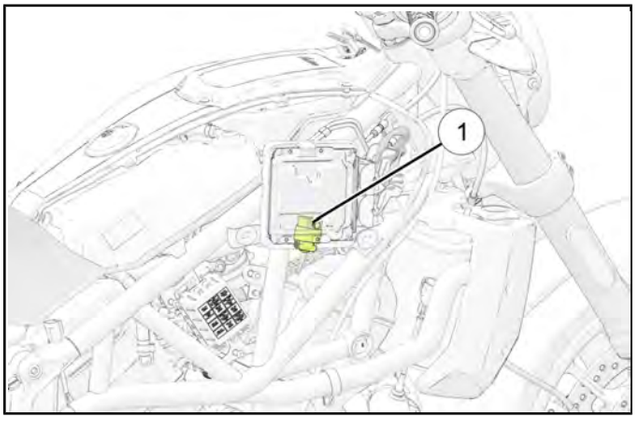
DIGITAL WRENCH COMMUNICATION ERRORS

If you experience problems connecting to a vehicle or any other Digital Wrench related problem, visit the Digital Wrench Knowledge Base for the most current troubleshooting information, FAQs, downloads and software updates at: *http://polaris.diagsys.com/.*



DIGITAL WRENCH DIAGNOSTIC CONNECTOR

The diagnostic connector ① is located behind the ECU on the right side of the unit.



Follow these steps to connect the diagnostic interface cable to the vehicle:

1. Assemble the MultiLink XP Module and attach the PC Interface Cable to your laptop.
2. Unplug the Digital Wrench connector from it's protective receptacle.
3. Connect the Vehicle Interface Cable to the Digital Wrench diagnostic connector.
4. Press the ON button to power up the motorcycle electrical system and switch the STOP / RUN switch to the RUN position.
5. Select the appropriate vehicle and wait for the status to display 'Connected' in the lower left corner of the screen.
6. Once connected, proceed with using Digital Wrench.

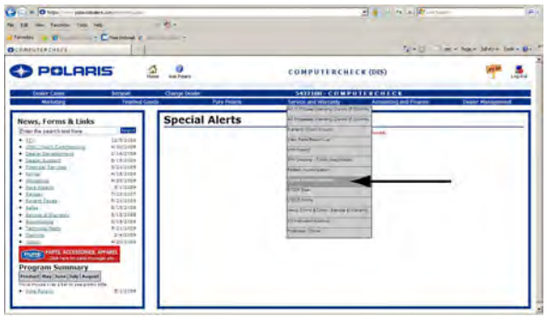
DIGITAL WRENCH UPDATES

Updates are released for Digital Wrench via the Internet at: *http://polaris.diagsys.com*. The Digital Wrench website can also be accessed through the dealer website at: *www.polarisdealers.com*.

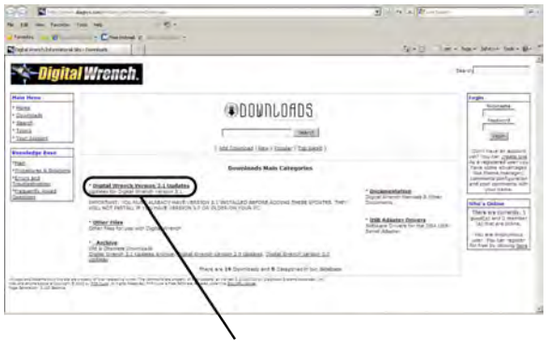
IMPORTANT

Only authorized Indian Motorcycle dealers and distributors can access the dealer website.

1. Log on to *www.polarisdealers.com*.
2. Locate the **Service and Warranty** drop-down menu.
3. Click on **Digital Wrench Updates**.



4. The Digital Wrench portal website should appear in a new web browser.
5. Click on **Digital Wrench Version Updates**.

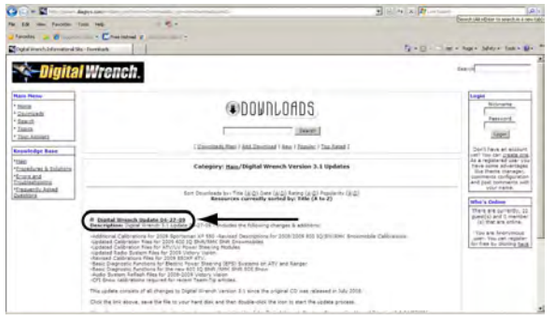


Digital Wrench Update

IMPORTANT

You must already have the current version installed before adding an update. Updates will not install if you are using an older version loaded on your PC.

6. If the update file date listed is newer than your current version and update, download the file.



7. Click on the link shown above, save the file to your hard disk and then double-click the icon to start the update process.

IMPORTANT

Do not "run" or "open" the file from where they are. Select "save" and download them to your PC before running the install.

8. When the update is complete, the version shown on the right side of the Digital Wrench start-up screen should match the update you just downloaded.

NOTICE

Versions and updates are subject to change.

ENGINE CONTROLLER REPROGRAMMING (REFLASH)

Process Overview

The reprogramming feature is in the Special Tests menu on the Digital Wrench screen. Start Digital Wrench and click on the Special Tests menu icon (red tool box). A technician should be familiar with the process and with computer operation in general before attempting to reprogram an ECM.

The Digital Wrench Engine Controller Reprogramming (or "Reflash") feature allows reprogramming of the ECM fuel and ignition map. To successfully reprogram the ECM, an Authorization Key must be obtained by entering a Request Code in the box provided on the Reflash Authorization site. The Request Code is automatically generated by Digital Wrench during the reprogramming process. The Reflash Authorization site is located under the **Service and Warranty** drop down menu on the dealer website at: *www.polarisdealers.com*.

IMPORTANT
Failure to follow the reprogramming instructions completely and correctly can result in an engine that does not run! Replacement ECMs are programmed as "no-start" and require a reflash for them to work.

Reprogramming (Reflash) Tips:

- BATTERY VOLTAGE: The majority of problems with reprogramming can be attributed to a low battery. Be sure the battery voltage (no load) is at least 13 volts and at least 12.5 volts with the key 'ON'. Connect a battery charger if necessary to bring voltage level above minimum. Fully charge the battery before you attempt to reprogram.
- DEDICATED LAPTOP: Best results are obtained using a laptop computer that is "dedicated to Digital Wrench". A laptop that is used by a variety of people and in several applications around the dealership is more likely to cause a reprogramming problem than one dedicated to Digital Wrench diagnostics only.
- OBTAINING THE LATEST UPDATE: Reprogramming updates are provided periodically and contain the most recent calibrations.
- CLOSE NON-ESSENTIAL PROGRAMS: It is recommended that you DO NOT install non-essential programs on a Service Department laptop. Camera detection software, Virus Scanners, Tool Bars, etc. may clog up memory if running in the background and make it harder for the diagnostic software to operate.
- KNOW THE PROCESS: If you are not familiar with the entire reprogramming process, review the HELP section of the diagnostic software before you attempt reprogramming. Click on the **?** on the tool bar or press F11. The information in the on-line help is the most current and complete information available. This should be your first step until you are familiar with the process.
- COMMUNICATION PROBLEMS: If you have had problems communicating with a vehicle while performing diagnostic functions, do not attempt reprogramming until the cause has been identified and fixed. Check all connections, and be sure battery voltage is as specified.

- Proceed to *http://polaris.diagsys.com* for specific information and FAQs on how to troubleshoot communication problems.
- DON'T DISTURB THE PC: While reprogramming is in progress, don't move the mouse and don't touch the keyboard. The process only takes a few minutes, and is best left alone until complete.

Reprogramming (Reflash) Procedure:

If you are not familiar with the reprogramming process, review the "Reprogramming (Reflash) Tips" before you begin. Follow the on-screen instructions as you progress through the steps. If you encounter a problem, always check the On-Line help for current tips and information.

1. Verify the most current update has been downloaded and loaded into Digital Wrench.
2. Connect MultiLink XP Module cables to PC and vehicle.
3. Open the Digital Wrench program.
4. Select the model year, product line and vehicle description by selecting the "Change Vehicle Type" icon.
5. Select the "Special Tests" icon.
6. Select "Engine Controller Reprogramming".
7. Select the file you want to load into the ECU then click the "Continue" icon to proceed to the Integrity Check and obtain a Request Code.

8. Copy (CTRL+C) the Request Code that will be required on the dealer website in the next step. DO NOT CLOSE Digital Wrench or the Request Code will be invalid.

NOTICE
All characters are letters; there are no numbers in a request code.

NOTICE
Request Codes and Authorization Keys must be entered EXACTLY as they appear on the screen.

9. Go to *www.polarisdealers.com* and click on "ReFlash Authorization" from the "Service and Warranty" drop-down menu.
10. Enter or paste (CTRL+V) the Request Code into the box.
11. Select the same file type from the list that you selected previously while in Digital Wrench. Enter the VIN along with the customer's name and address. When completed, click the Authorize button *once* to proceed.
12. An "Authorization Key" will appear in the upper left corner of the screen. Copy (CTRL+C) this key exactly as it appears.
13. Enter or paste (CTRL+V) the Authorization Key in the box located on the Digital Wrench screen. Click the 'Continue' button and follow instructions provided on the screen to complete reprogramming procedure.
14. At this point the reflash process will begin. Do not touch the vehicle or PC during the process.
15. Once the ECU reprogramming procedure is complete, click the 'Finish' button on the screen. Verify the reflash was a success by starting the vehicle.
16. Run engine to full operating temperature for ten minutes with cylinder deactivation turned off in the settings (if equipped) to allow engine calibration adoption.

TROUBLESHOOTING

FUEL SYSTEM TROUBLESHOOTING PART 1

PROBLEM	POSSIBLE CAUSE	AFFECTED PART(S)	REPAIR RECOMMENDED
Engine turns over with electric starter, but won't start	Compression too low	See engine section	
	No spark at spark plugs	See ignition system	
	No fuel reaching intake tract	Out of fuel Blown Fuse Plugged fuel filters / lines Fuel pump not working Fuel pressure regulator Faulty fuel pump relay Open wiring / connector Faulty connection at ECM	Add Fuel Replace Clean/Replace Test / Replace Test / Replace Test / Replace Inspect / Repair Inspect / Repair
	Excessively rich or lean fuel mixture	Fuel pump Fuel pressure regulator Crank Position Sensor Low Battery TMAP sensor CHT sensor Fuel Injector	Test / Replace Test / Replace Test / Replace Test / Replace Test / Replace Test / Replace Test / Replace
	Spark at wrong time or no spark. Fuel delivery timing incorrect.	Timing Wheel or CPS installed incorrectly, damaged, or dirty; faulty CPS	Install correctly, inspect for proper air gap (gap is preset but cover, sensor, and timing wheel must be clean and in good condition).
Poor idle	Excessively rich or lean fuel mixture	Air Leaks Air restriction in IAC Fuel Pump Fuel injector / Fuel Rail obstructed or leaking Air Filter Wrong Fuel / Old Fuel Crank Position Sensor	Inspect IAC system Inspect IAC hoses and fittings Inspect fuel pressure Replace Replace Inspect / Replace Inspect / Replace
Poor Running in Higher RPM Range	Air intake restriction Oil Overfilled Ignition problems Low Battery Voltage Loose, corroded, or wet connector(s) Valve train problems	Air filter Ignition Coil(s) / plug wires Battery ECM and wiring harness Valve springs, valve, head	Inspect Refer to ignition section. Charge or replace Unplug connections - inspect Inspect cylinder head & valves

FUEL SYSTEM TROUBLESHOOTING PART 2

PROBLEM	POSSIBLE CAUSE	AFFECTED PART(S)	REPAIR RECOMMENDED
Engine Stalls	Fuel Pump Problem	Low battery voltage Faulty fuel pump No signal from ECM Wiring problem	Battery/Charging system Check fuel pressure Repair Wiring Repair/Chk Pump Relay
	Excessive rich or lean fuel/air mixture	TMAP Sensor Plugged fuel filter Fuel pump (pressure) Fuel pressure regulator Vacuum leak Wiring problem Air Filter Low battery voltage	Repair / Replace Replace Test / Replace Test / Replace Pump Assembly Repair / Replace hoses Repair Replace Ck battery & charging system
	Control Circuit/ Sensors not functioning correctly	Fuel pressure regulator TPS Engine speed sensor Fuel pump relay Rotor Fuse ECM Relay Low battery voltage ECM	Test Pressure / Replace Test / Replace Test / Replace Test / Replace Inspect / Install correctly Replace Replace Inspect Charging system
	Valve train problems or Compression low	Refer to Engine / Cooling / Exhaust Chapter (Cylinder Head / Valves)	
	Idle not adapted		Idle vehicle at operating temp with cylinder deactivation off to allow idle adapation.
Backfiring	Low Battery Voltage Ignition Problem Air leaks Restricted air intake or throttle body	Battery Spark plug fouled, poor wire connection for ignition or fuel injection, loose pin in multi-pin connector for ECM or wiring harness Inlet and Exhaust Intake tract / Throttle body	Refer to battery section Replace plugs / diagnose Inspect wiring connections Disconnect and check pin connections Seal intake or exhaust leaks Clean air inlet tract and throttle body

FUEL SYSTEM TROUBLESHOOTING PART 3

PROBLEM	POSSIBLE CAUSE	AFFECTED PART(S)	REPAIR RECOMMENDED
Poor Running in upper rpm ranges	Control Circuit/ Sensors not functioning correctly	CPS ETC Air temperature sensor Manifold Absolute Pressure sensor Intermittent wiring /connector problem ECM	Test / Replace Test / Replace Test / Replace Test / Replace Repair/Replace Test / Replace
	Fuel delivery incorrect	Plugged or kinked fuel and/or vent hoses Fuel pump Fuel regulator Fuel filter Battery/Charging System Fuel Injector plugged Contaminated fuel (water, additives, etc.) Inadequate octane Defective ETC Low battery voltage	Repair/Replace Test / Replace Test Pressure / Replace Test / Replace Charge/Replace Clean/Replace Clean/Replace Use correct fuel Test / Replace Charging system
	Air intake restriction	Dirty Air Cleaner Intake restriction	Clean Repair
	Air Leak	ETC gasket surfaces Intake manifold ETC	Repair/Replace Repair/Replace Repair/Replace
Engine lacks power	Engine component problems Ignition problems Overfilled with oil	See Engine / Cooling / Exhaust Chapters See Electrical Chapter (Ignition System) See Maintenance Chapter	
	Improper fuel delivery	Plugged fuel injector Dirty air cleaner Vacuum leaks Fuel pump Fuel pressure regulator Air temperature sensor TMAP sensor Plugged vent hose Low battery voltage ECM	Repair / Replace Replace Repair Test / Replace Test / Replace Test / Replace Test / Replace Clear Test batt./Charging system
	Throttle Pedal Fault		Digital Wrench diagnostic

FUEL SYSTEM TROUBLESHOOTING PART 4

PROBLEM	POSSIBLE CAUSE	AFFECTED PART(S)	REPAIR RECOMMENDED
Engine overheats	Internal Engine Parts Low or incorrect oil Ignition timing incorrect Spark plug(s) Low battery voltage	Cooling System Engine Oil Ignition Coils Faulty ECM Charging System Faulty Battery Faulty Wiring	Refer to Engine / Cooling / Exhaust Chapter Refer to Engine / Cooling / Exhaust Chapter Refer to Electrical Chapter Replace Test / Repair Replace Repair
	Brakes dragging	Brake systems	Refer to Brakes Chapter
	Drive chain too tight	Drive Chain	Refer to Steering / Suspension Chapter
	Lean Air/Fuel mixture	Fuel pressure regulator Air leak Fuel injector plugged CTS Vent hose plugged / kinked Air leak at throttle body to manifold seal	Repair/Replace Repair Clean/Replace Test / Replace Repair Test / Repair
	Radiator fin damage or blockage	Radiator	Clean out radiator fins with compressed air or radiator cleaner. Straighten damaged radiator fins or replace radiator.
Won't Accept New Calibration	Non-Current Calibration File Set Low Battery Voltage Attempting Re-Flash Without Proper VIN, Calibration I.D. number, or calibration authorization code		Go to Dealer website and download the most current Indian Motorcycle Calibration File Set Attach Battery Charger During Re-Flash, and Re-Charge Battery When Re-Flash Is Completed Enter Authorization Code Sent With Accessory Kit

CHAPTER 5
CLUTCH / PRIMARY / SHIFT

GENERAL INFORMATION

SERVICE NOTES

- Clutch and external transmission shift linkage service can be accomplished with the engine in the frame.
- Internal transmission or internal shifting mechanism service requires engine removal and crankcase separation.
- Oil additives of any kind are not recommended by Indian Motorcycle. Using oil additives or oil of the wrong viscosity can have a detrimental affect on clutch performance, operation, and service life.
- Burnt clutch plates are not an indication of defective clutch plates. Burnt clutch plates indicate that a problem exists within the clutch system, the clutch has been used improperly, or plates were contaminated by improper oil or additives.
- Indian Motorcycle 15W/60 motorcycle oil is recommended for all operating temperatures. If Indian Motorcycle 15W/60 oil is not available, a high quality 15W/60 motorcycle oil suitable for use in wet clutch transmissions can be used.
- Lubricate parts during assembly as described in the procedures.
- Corroded or sticking shift linkage pivot points can cause abnormal shifting. Replace any linkage components that are damaged or do not move freely, and lubricate at regular intervals.

SPECIAL TOOLS - CLUTCH

TOOL DESCRIPTION	PART NUMBER
Case Splitting / Assembly Tool	PF-51234-A
Engine Lock Tool - Transmission	PF-51612
Engine Lock Tool - Crankshaft	PF-51235-A
Engine Stand Adapter	PF-51609
Flywheel Puller	PA-49316–A

Bosch Automotive Service Solutions: 1–800–328–6657 or https://polaris.service-solutions.com/

5

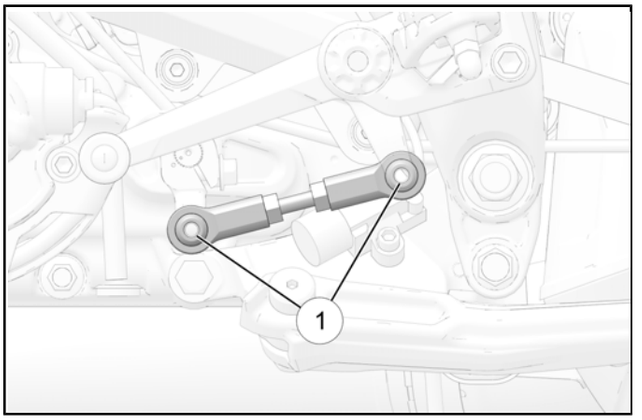
SERVICE SPECIFICATIONS - CLUTCH

ITEM		SPECIFICATIONS
Clutch / Gear Shift / Linkage	Clutch Type	Wet, Multi-Disk
	Clutch Operating Mechanism	Manual / Cable Operated
	Primary Reduction Ratio	1.674 : 1
	Transmission Shift Mechanism	Manually Operated, Spring Centered
	Gearshift Pattern	1-N-2-3-4-5-6
	Clutch Spring (Coil Type, QTY.3)	Spring Height - Free: 49.1 mm / Installed 34.4 mm
	Clutch Lever Free Play (Cable)	.50-1.50 mm (.019 - .059")

CLUTCH - MAINTENANCE

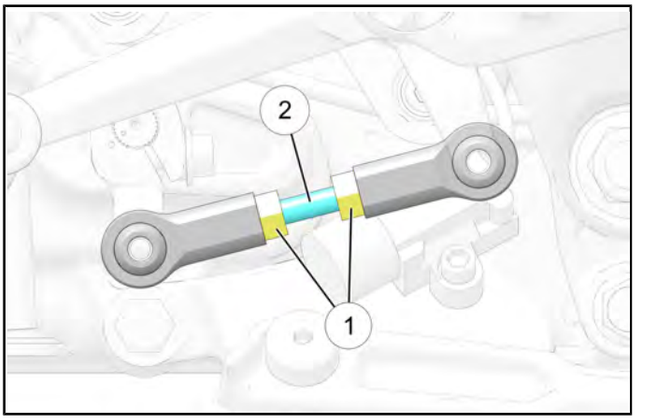
SHIFT PEDAL INSPECTION / LUBRICATION

1. Check all shift pedal and linkage fasteners to be sure they are tight. Torque fasteners to specification. See **Shift Pedal Adjustment page 5.4**.
2. Lubricate shift pedal pivot bushing and all pivots ① with all-purpose lubricant.



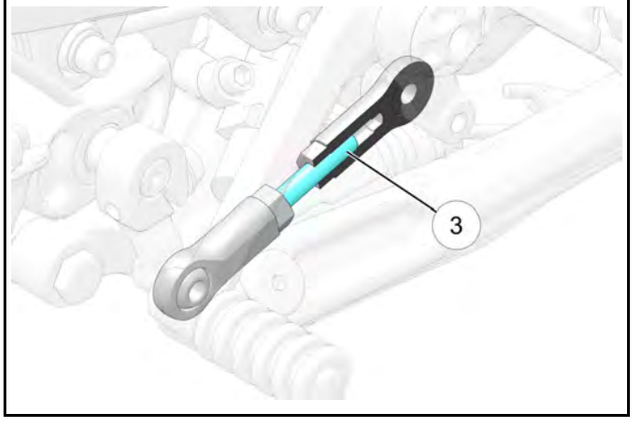
SHIFT PEDAL ADJUSTMENT

1. Loosen jam nuts ①.
2. Rotate linkage rod ② until pedal angle is correct.



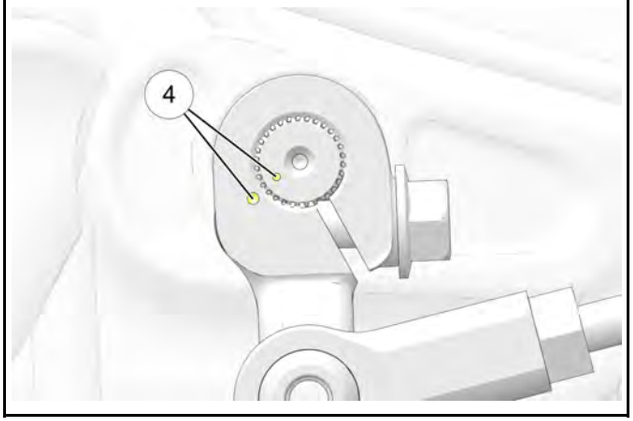
IMPORTANT

The shift linkage rod ③ must be threaded into each pivot end a minimum of seven complete turns.



IMPORTANT

Make sure Dots ④ are properly aligned.



- Tighten jam nuts ① to specification.

TORQUE

Shift Rod Jam Nuts:
88 in-lbs (10 N·m)

⚠ CAUTION

Do not remove and reposition the shift arm on the shift shaft to adjust gear shift pedal height. Dots on shift shaft and shift arm must be aligned for gears to shift correctly.

CLUTCH CABLE INSPECTION / LUBRICATION

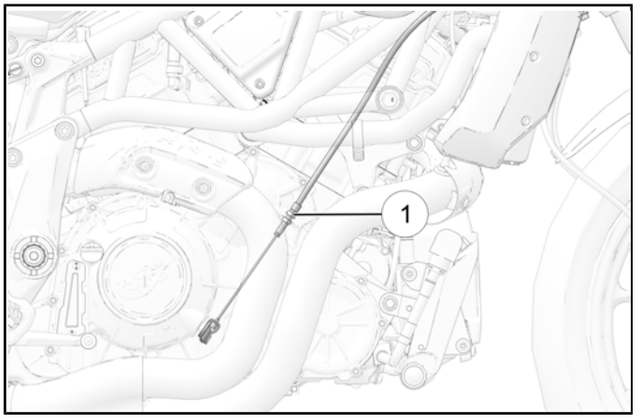
NOTICE

Control cable casings are lined with a low friction sleeve and are factory lubricated for reliable operation. Periodic lubrication of cables is not required and could be detrimental to cable performance. Only cable *ends* must be periodically inspected and lubricated in accordance with the Periodic Maintenance Schedule. See **Maintenance Intervals page 2.4**.

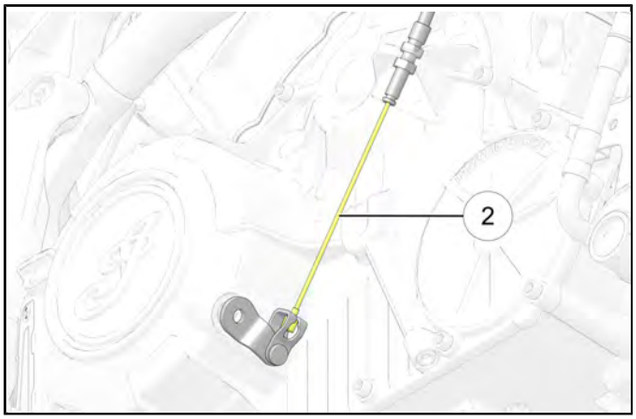
⚠ CAUTION

Inspect inner cable for fraying. Do not kink, bend or twist inner cable or cable casing during removal or installation.

1. Inspect the clutch cable ① for proper routing, smooth movement, and damage to the external casing.



2. Inspect the lower cable end ② for damage or frayed wires.



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3. Remove the jam nut ③ that retains the clutch cable in the lower cable guide. using an adjustable wrench, rotate the clutch pinion arm ④ so the lower cable end can be disconnected from the clutch pinion arm. Remove the cable housing from the mounting boss.

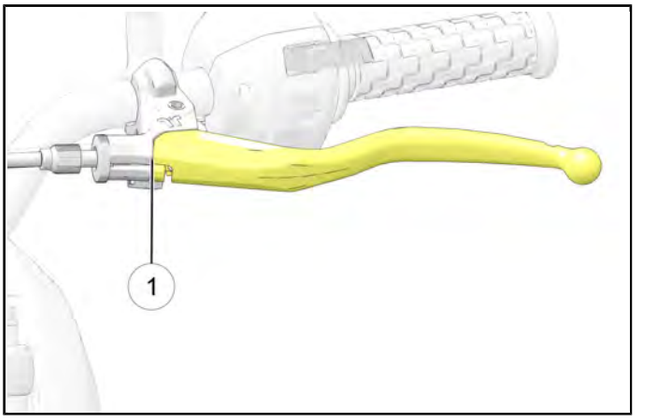
4. **Installation is performed by reversing the removal procedure.**

TORQUE
Cable Guide Jam Nut: **48 in-lbs (5 N·m)**

5. Adjust cable free play. See **Clutch Lever Free Play page 5.6**.

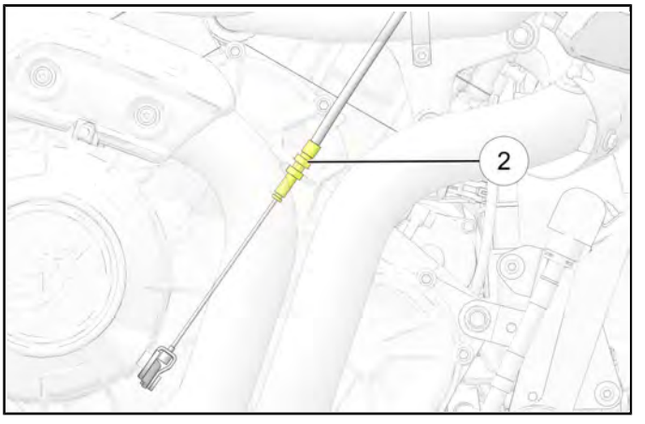
CLUTCH LEVER FREE PLAY

1. With handlebars pointing straight ahead, measure the clutch lever free play at point shown ① between lever and perch.



MEASUREMENT
Clutch Lever Free Play: **0.019–0.059” (0.5–1.5 mm)**

2. Compare measurement to specification. If adjustment is required, proceed to Step 3.
3. Locate the jam nut ② and barrel adjuster.

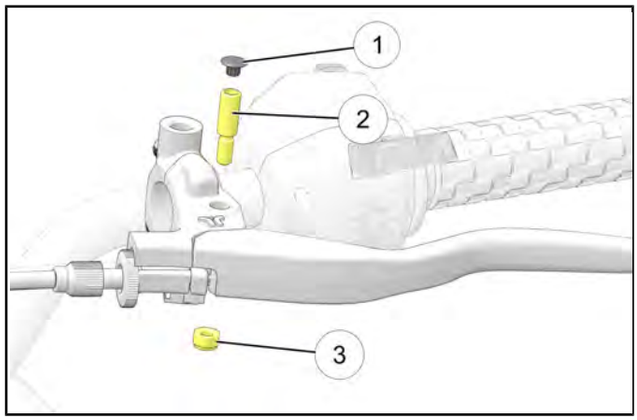


4. Hold cable and loosen the adjuster jam nut.
5. Turn cable adjuster in or out until clutch free play is correct.
6. Tighten adjuster jam nut to specification.

TORQUE
Clutch Cable Adjuster Jam Nut: **48 in-lbs (5 N·m)**

CLUTCH LEVER LUBRICATION

1. Disconnect clutch cable at primary cover. See**Clutch Cable Inspection / Lubrication page 5.5**.
2. Remove cable housing out of lever perch by unscrewing the fine adjustment screw and remove barrel from clutch lever. Do not kink cable.
3. Remove the pivot bolt cap ①, nut ③ and push pivot bolt ② upward to remove.



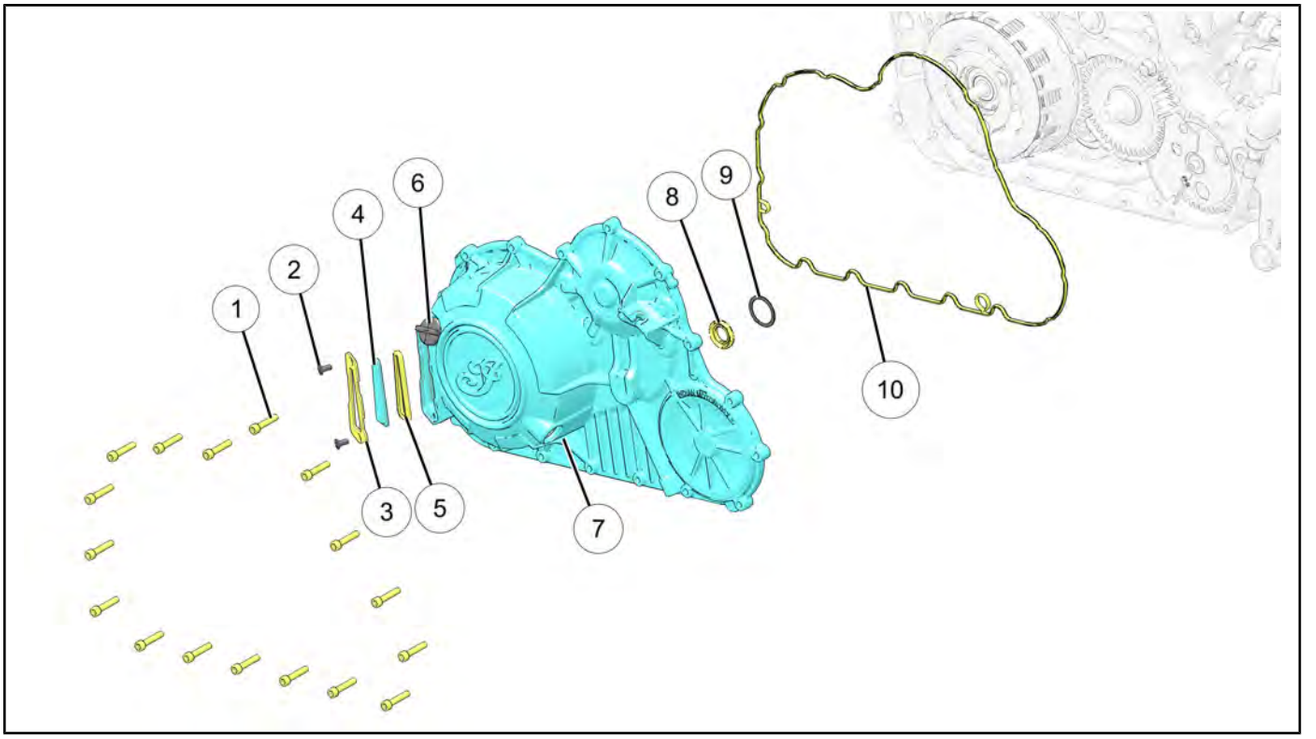
4. Inspect both ends of inner cable for frayed strands. Clean parts and apply moly paste to pivot bolt and cable ends.
5. Assemble lever.
6. Install the pivot bolt and torque the nut to specification.

TORQUE
Clutch Lever Pivot Nut: **53 in-lbs (6 N·m)**

7. Install cable to lever. Rotate cable back through slot in perch, and screw fine adjuster into perch recess.
8. Attach lower end of cable to clutch pinion arm on primary cover.
9. Adjust clutch lever free play. See **Clutch Lever Free Play page 5.6**.

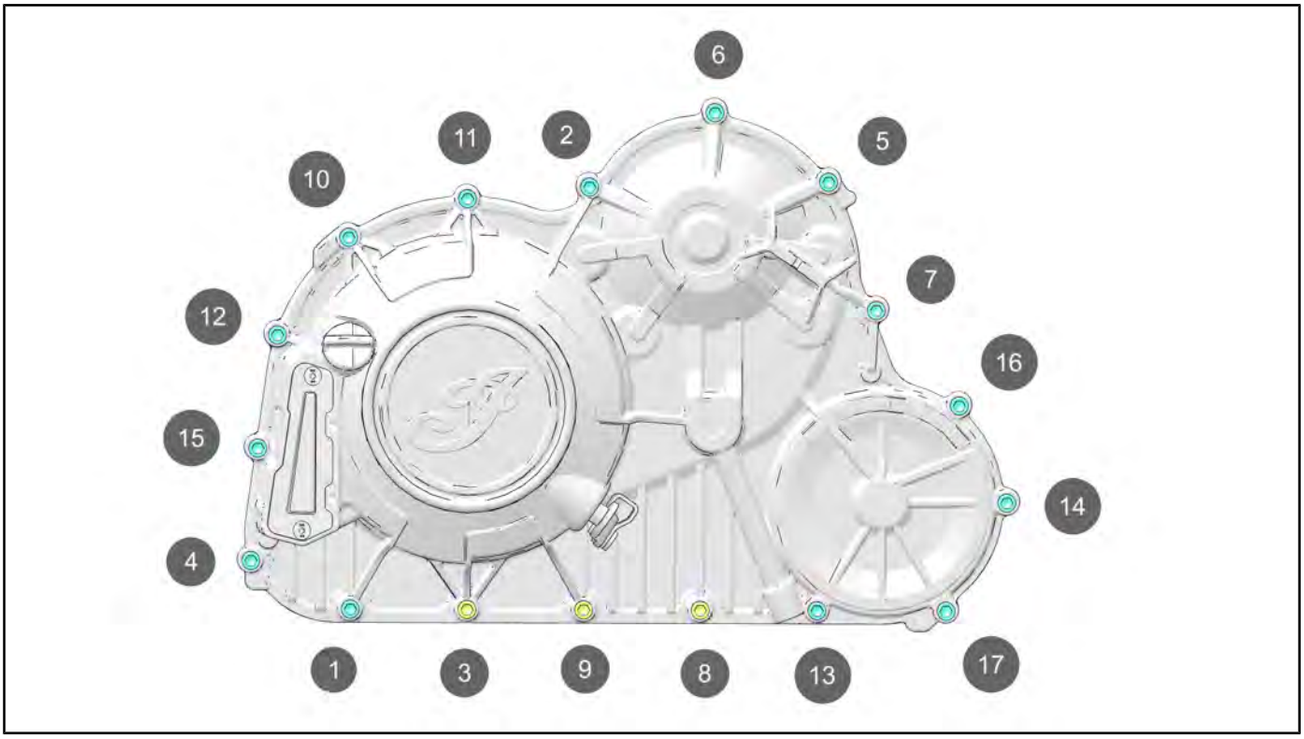
ASSEMBLY VIEWS

PRIMARY COVER ASSEMBLY VIEW



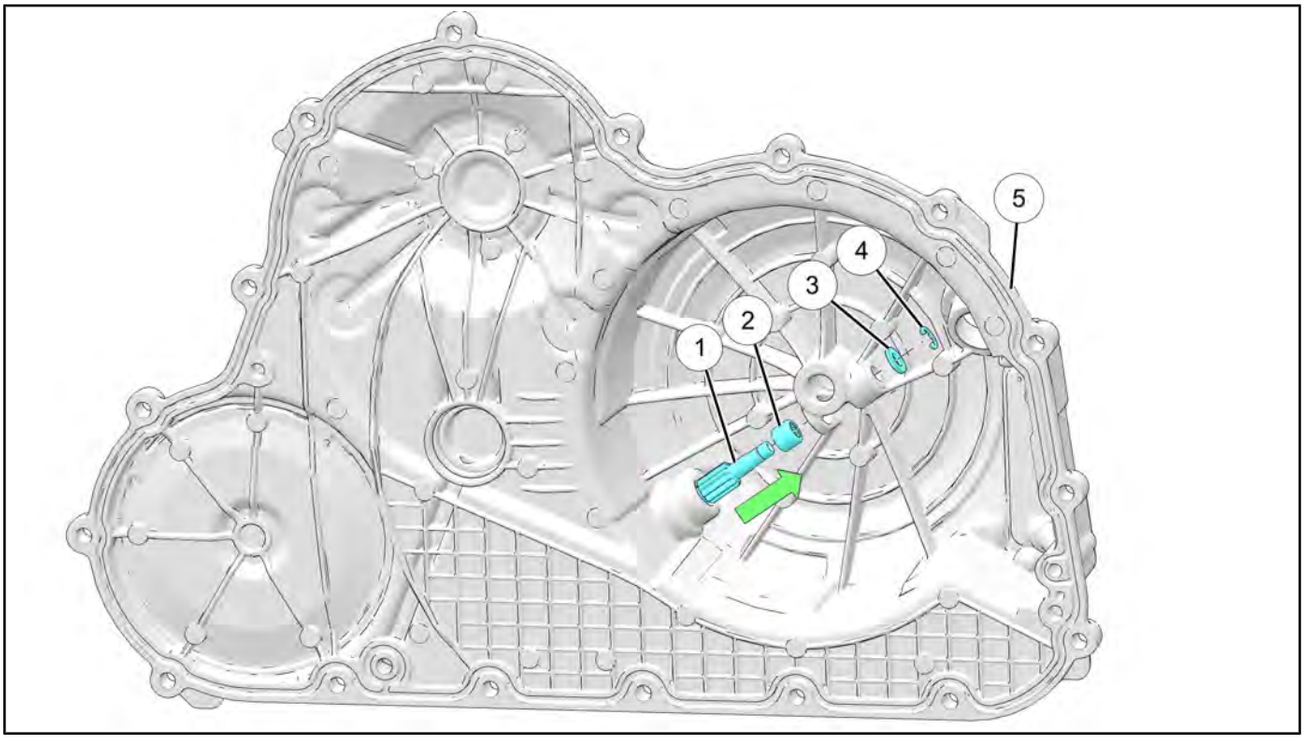
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Primary Cover Fastener	**106 in-lbs (12 N·m)**
②	Sight Glass Fastener	**44 in-lbs (5 N·m)**
③	Sight Glass Cover	-
④	Sight Glass	-
⑤	Sight Glass Seal	-
⑥	Primary Cover	-
⑦	Oil Fill Plug	-
⑧	Crankshaft Lip Seal	-
⑨	Spiral Lock Ring	-
⑩	Primary Cover Gasket	-

Primary Cover Torque Sequence



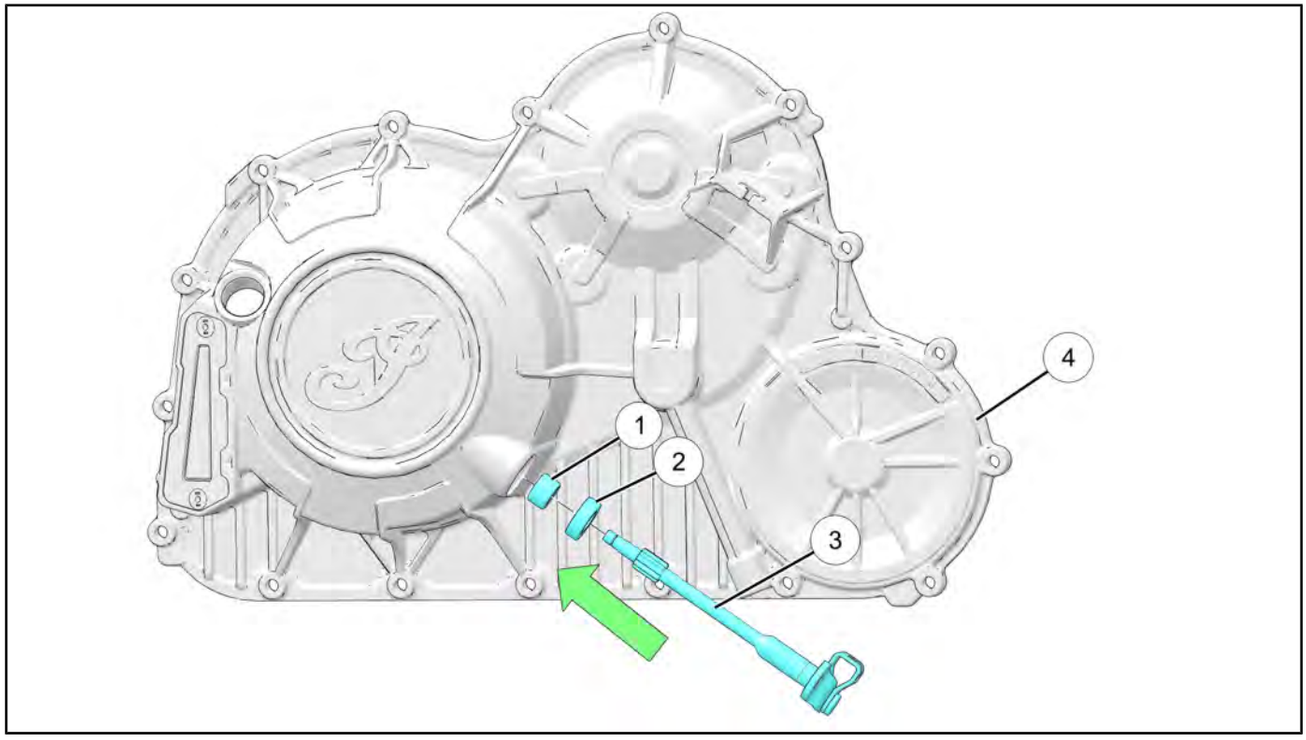
CLUTCH PINION SHAFT ASSEMBLY VIEW

Internal View



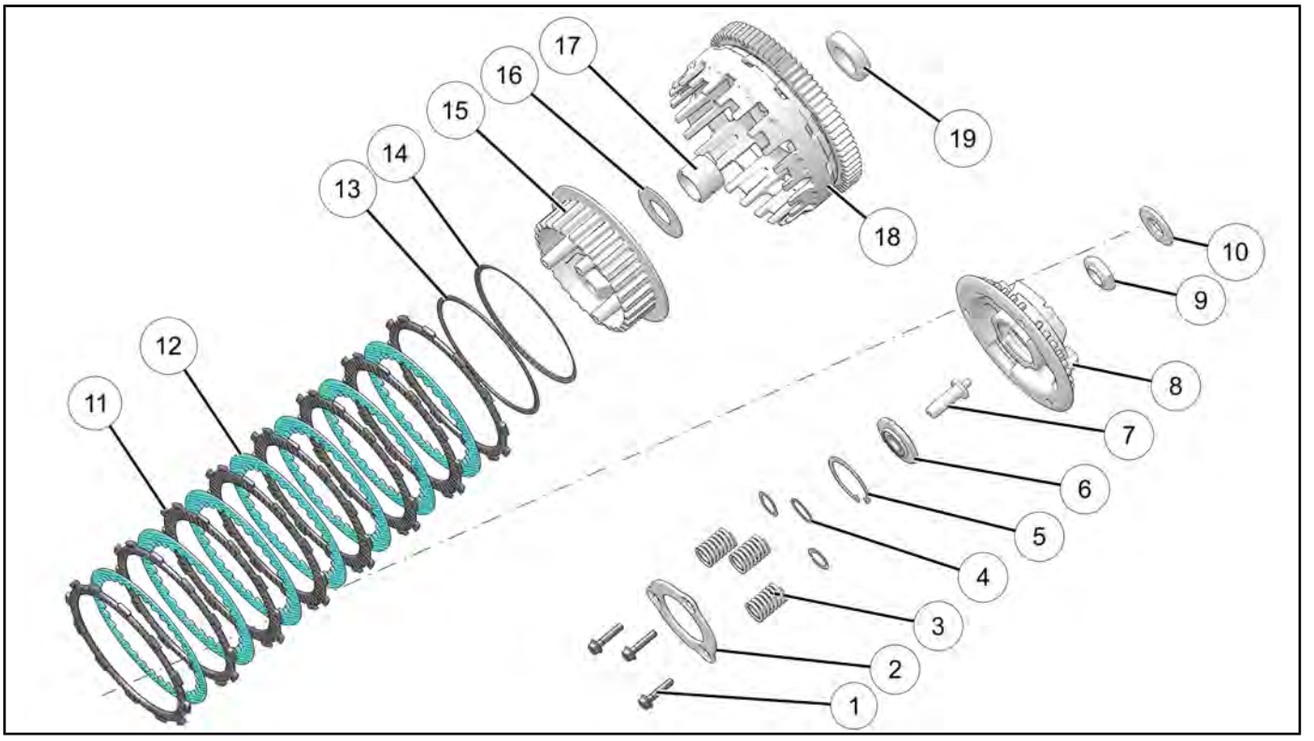
NUMBER	DESCRIPTION
①	Clutch Pinion Shaft
②	Pinion Shaft End Bearing
③	Washer
④	External E-Clip
⑤	Primary Cover

External View



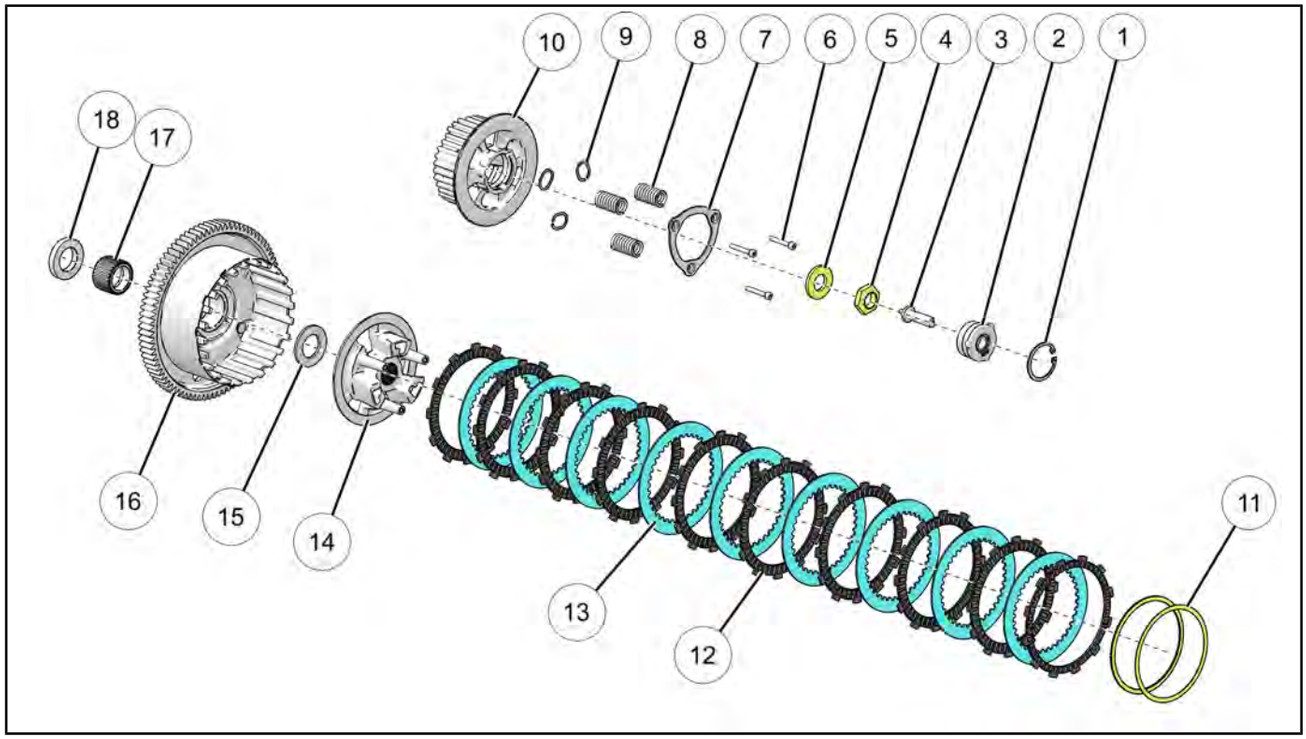
NUMBER	DESCRIPTION
①	Shaft Bearing (Clutch Pinion Shaft)
②	Shaft Seal
③	Clutch Pinion Shaft
④	Primary Cover

CLUTCH ASSEMBLY VIEW



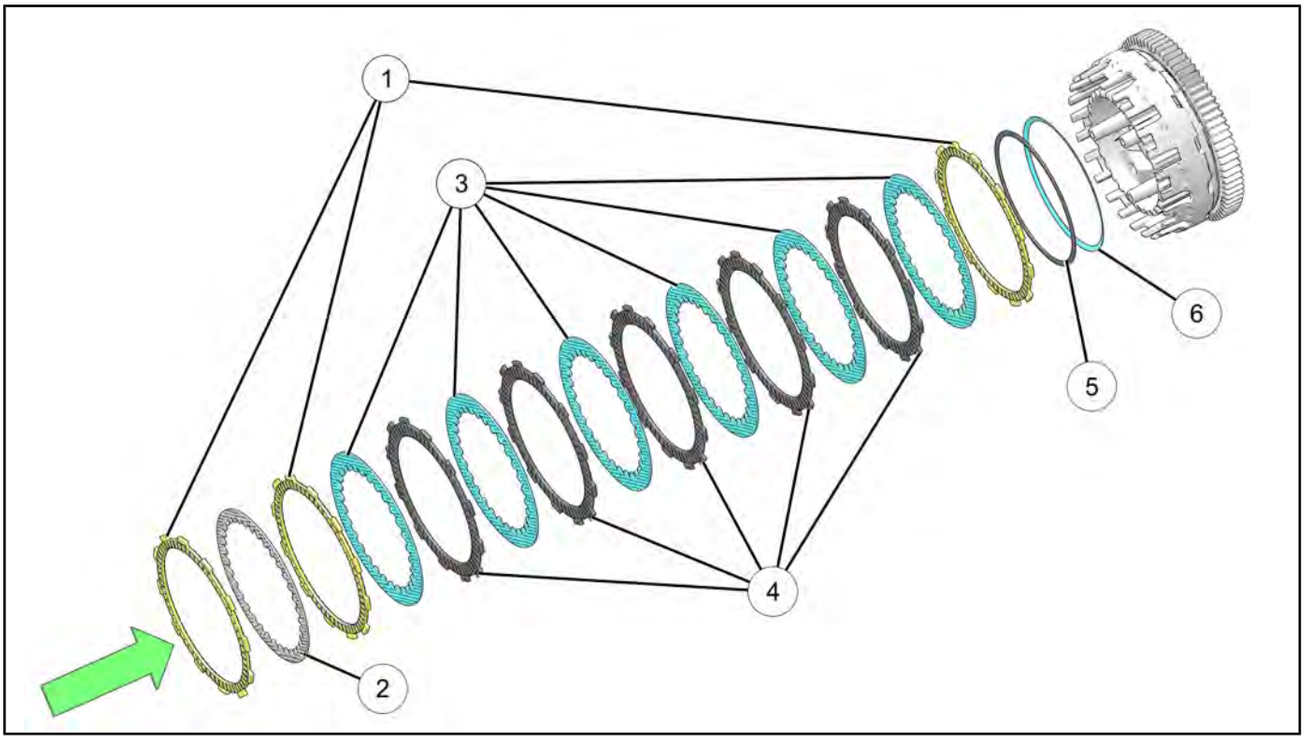
NUMBER	DESCRIPTION	NUMBER	DESCRIPTION
①	Clutch Pressure Plate Fasteners (QTY: 3) **88 in-lbs (10 N·m)**	⑪	Clutch Friction Disc
②	Stopper Plate	⑫	Clutch Steel Disc
③	Clutch Springs (QTY: 3)	⑬	Judder Spring
④	Clutch Seat Spring	⑭	Judder Spring Seat
⑤	Internal Retaining Ring	⑮	Inner Clutch Hub
⑥	Clutch Lifter	⑯	Thrust Washer
⑦	Clutch Lifter Shaft	⑰	Bearing Collar
⑧	Clutch Pressure Plate	⑱	Outer Basket Assembly
⑨	Staked Nut, Clutch **125 ft-lbs (170 N·m)**	⑲	Clutch Spacer
⑩	Washer		

CLUTCH (2023)



REF	DESCRIPTION	TORQUE	REF	DESCRIPTION	TORQUE
①	Lift Rack	—	⑩	Pressure Plate	—
②	Internal Retaining Ring	—	⑪	Judder Spring	—
③	Clutch Lifter	—	⑫	Friction Plate	—
④	Stake Nut, Clutch	**125 ft-lbs (170 N·m)**	⑬	Separator Plate	—
⑤	Washer	—	⑭	Inner Clutch Hub	—
⑥	Stopper Plate Fastener	**88 in-lbs (10 N·m)**	⑮	Washer	—
⑦	Stopper Plate	—	⑯	Outer Basket Assembly	—
⑧	Clutch Spring	—	⑰	Needle Bearing	—
⑨	Clutch Seat Spring	—	⑱	Clutch Spacer	—

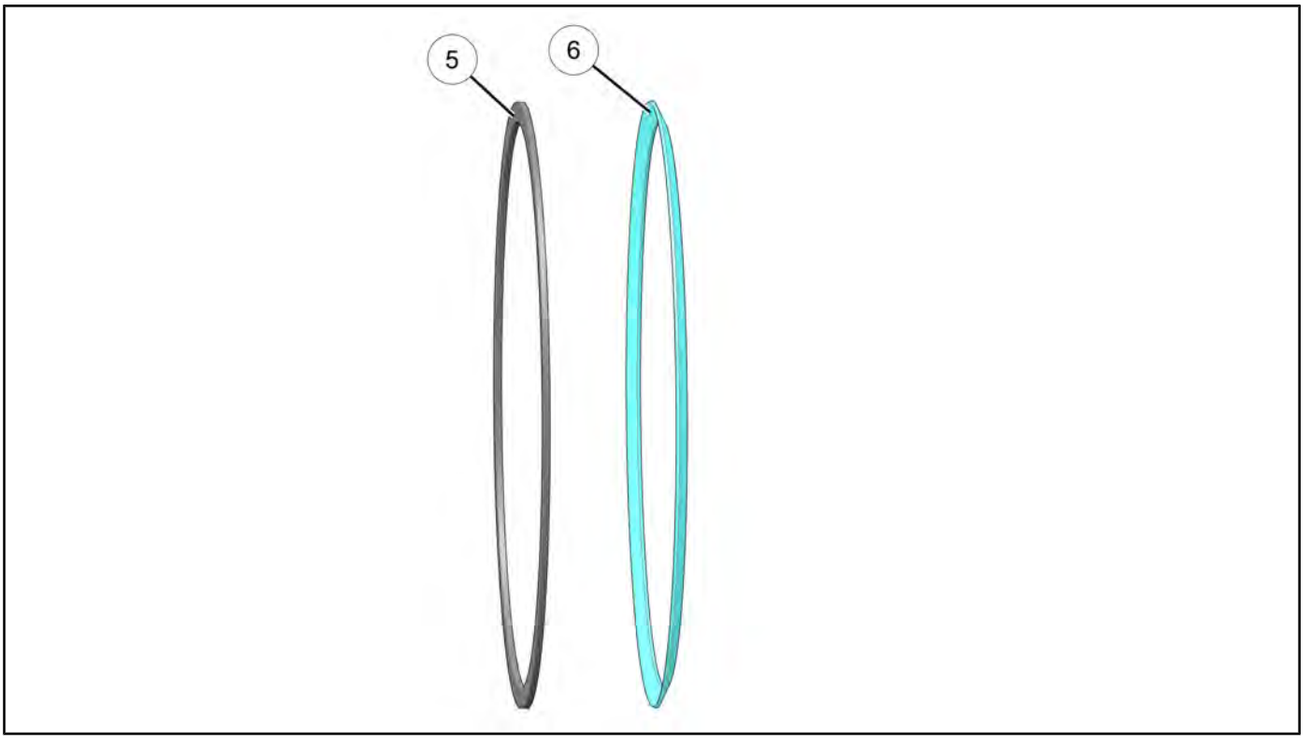
CLUTCH PLATE ASSEMBLY VIEW



NUMBER	DESCRIPTION	QTY
①	Friction Plate B	3
②	Separator Plate B	1
③	Clutch Separator Plate	6
④	Friction Disc A	5
⑤	Judder Spring	1
⑥	Judder Spring Seat	1

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

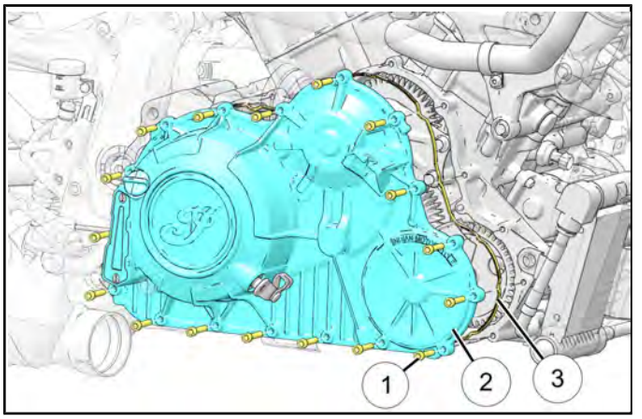
Judder Spring Orientation



SERVICE PROCEDURES

PRIMARY COVER REMOVAL

1. Place motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Drain oil from engine. See **Engine Oil & Filter Change page 2.22**.
3. Remove the exhaust headpipe. See **Front Head Pipe Removal / Installation, 2019–2020 models page 3.128**.
4. Disconnect clutch cable from engine clutch lever. See **Clutch Cable Removal / Installation page 8.28**.
5. Remove primary cover fasteners ①, primary cover, ② and gasket ③.



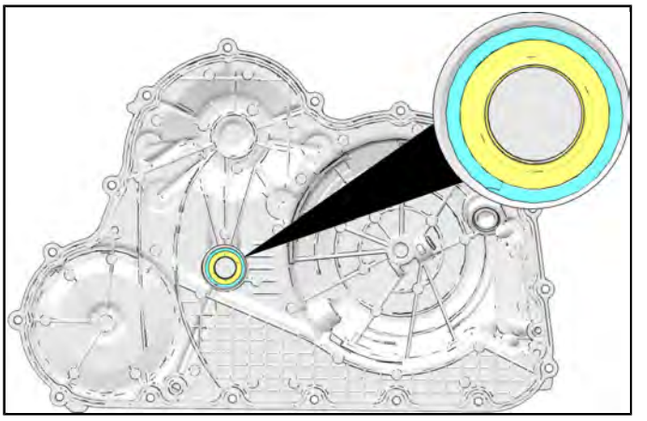
IMPORTANT

The pinion shaft must be pointed toward the engine upon removal.

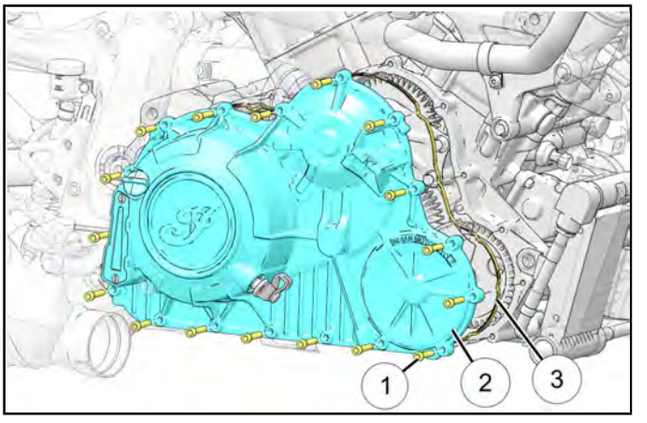
PRIMARY DRIVE / CLUTCH COVER INSTALLATION

⚠ CAUTION

Inspect the Crankshaft lip seal upon primary cover installation. If the seal is folded or damaged, it MUST be replaced. Upon replacement the crankshaft lip seal must have LUBRIPLATE 1242 applied. Failure to do so many cause sever engine damage and possible failure. If lip seal requires replacement, reference Primary Cover Lip Seal Replacement page 5.17. The spiral lock ring MUST be replaced if the lip seal is replaced.

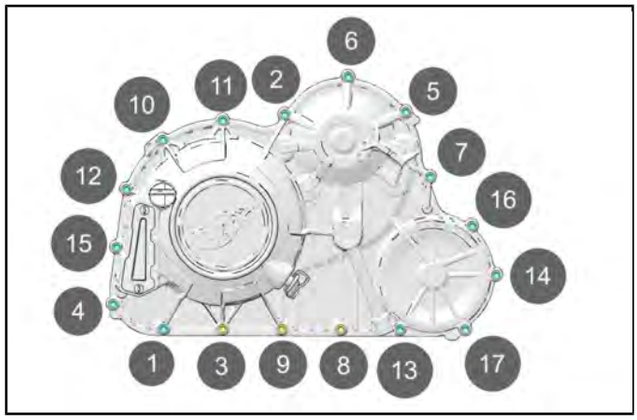


1. Clean gasket surfaces of crankcase and cover.
2. Install a new primary drive cover gasket ③ with flat side towards primary cover ②.



3. Torque the primary drive cover fasteners ① to specification following the torque sequence.

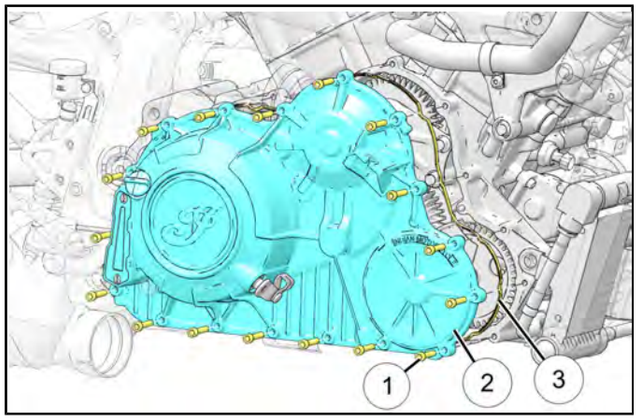
TORQUE
Primary Cover Fasteners: **106 in-lbs (12 N·m)**



4. Connect the clutch cable. See **Clutch Cable Removal / Installation page 8.28**.
5. Install exhaust system. See **Rear Head Pipe Removal / Installation, All models page 3.132**.
6. Check engine oil level. See **Engine Oil Level Check page 2.21**.

PRIMARY COVER LIP SEAL REPLACEMENT

1. Place motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Drain oil from engine. See **Engine Oil & Filter Change page 2.22**.
3. Remove the exhaust headpipe. See **Front Head Pipe Removal / Installation, 2019–2020 models page 3.128**.
4. Disconnect clutch cable from engine clutch lever. See **Clutch Cable Removal / Installation page 8.28**.
5. Remove primary drive cover fasteners ①, primary cover, ② and gasket ③.



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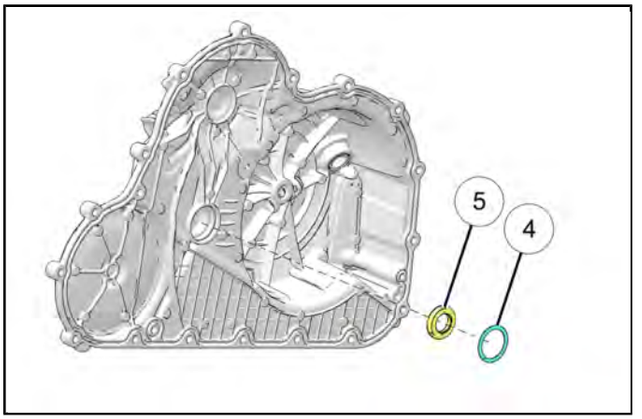
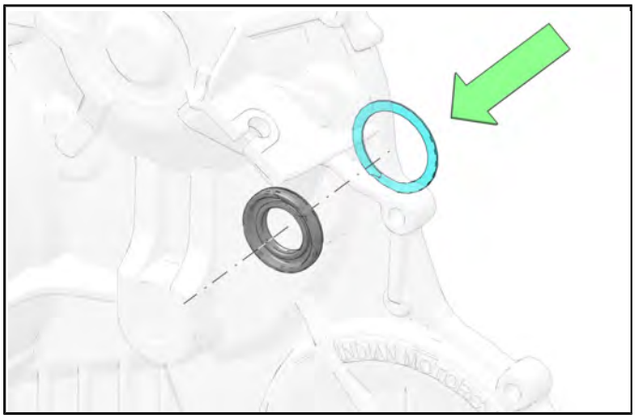
6. From the inside of the cover, remove and discard the spiral lock ring ④ and the lip seal ⑤.



To watch a video of this procedure, scan the QR code or click **HERE**.

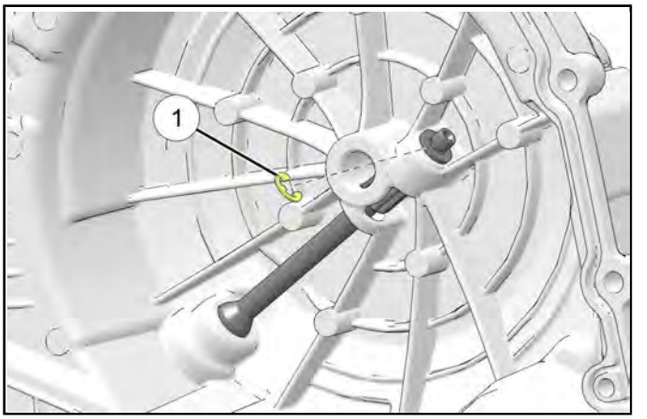
7. Upon installation, coat the ID of the **NEW** lip seal with Lubriplate 1242.
8. Install lip seal with recess toward the primary cover as shown.



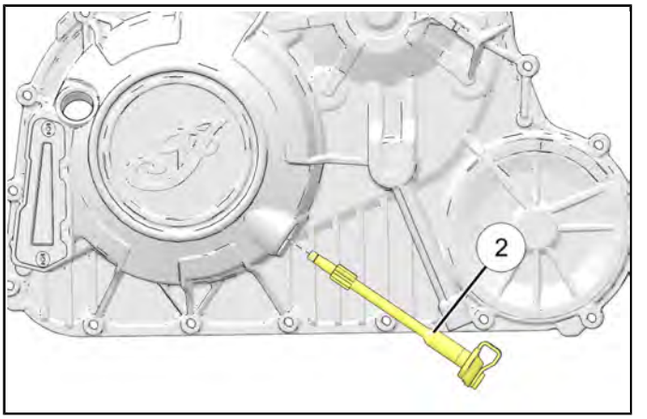
9. Install **NEW** spiral lock ring.
10. Install primary cover. See **Primary Drive / Clutch Cover Installation page 5.16**

CLUTCH PINION SHAFT REMOVAL

1. Remove the Clutch Cover . See **Primary Cover Removal page 5.16**.
2. Remove the E-clip ① and washer from the end of the clutch pinion shaft as shown.



3. Slide the pinion shaft ② out of the primary cover.

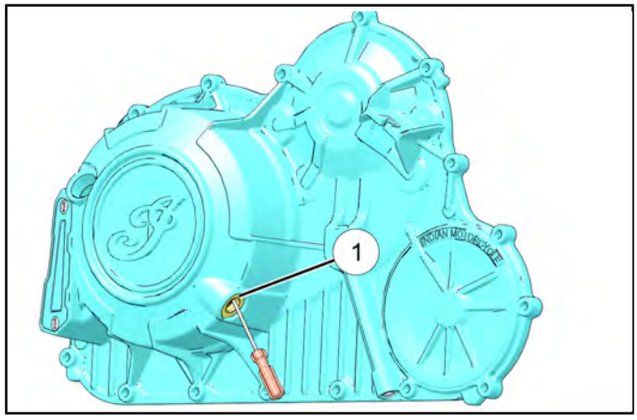


CLUTCH PINION SHAFT BEARING INSPECTION

1. Apply engine oil to the bearings.
2. Temporarily install pinion shaft into primary cover.
3. Turn shaft by hand. Replace bearings that feel rough, notched, or loose.

CLUTCH PINION SHAFT SEAL REPLACEMENT

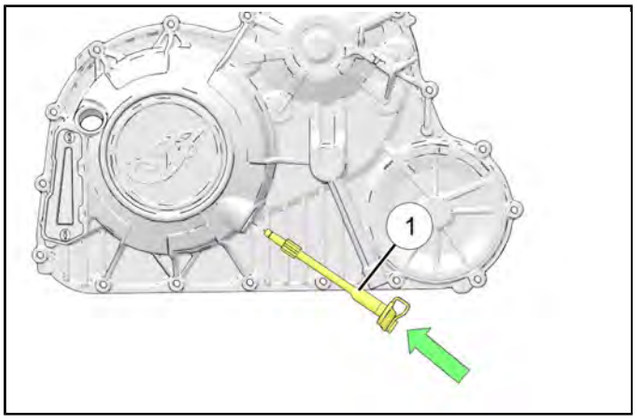
1. Remove clutch pinion shaft. See **Clutch Pinion Shaft Removal page 5.18**.
2. Protect cosmetic surfaces and carefully pry seal ① out of primary cover.



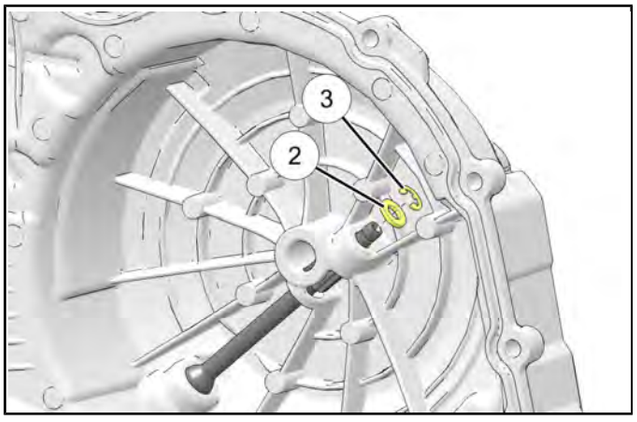
3. Lubricate outer edge of new seal with engine oil and sealing lip with grease.
4. Drive seal into place with a suitable driver.

CLUTCH PINION SHAFT INSTALLATION

1. Lubricate and install clutch pinion shaft ① until fully seated in bearings.



2. Install washer ② and **NEW** E-clip ③.



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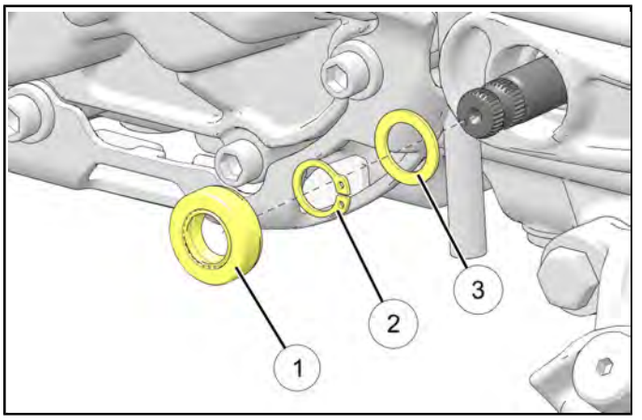
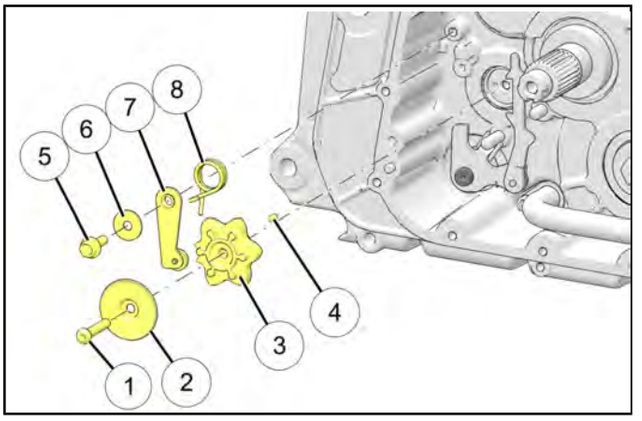
SHIFT RATCHET REMOVAL / INSPECTION

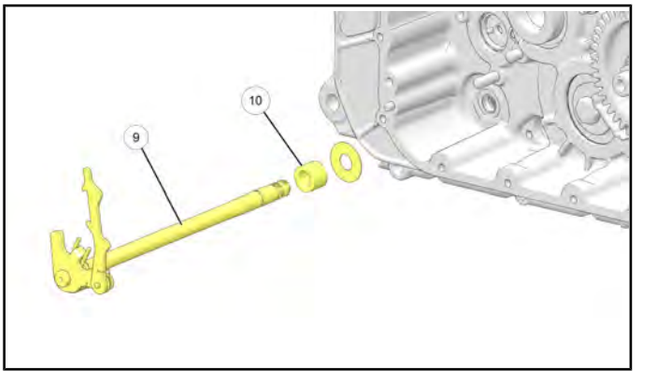
1. Place motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Shift transmission into neutral.
3. Remove shift pedal linkage from shift shaft.
4. Gently pry out shaft seal ①.



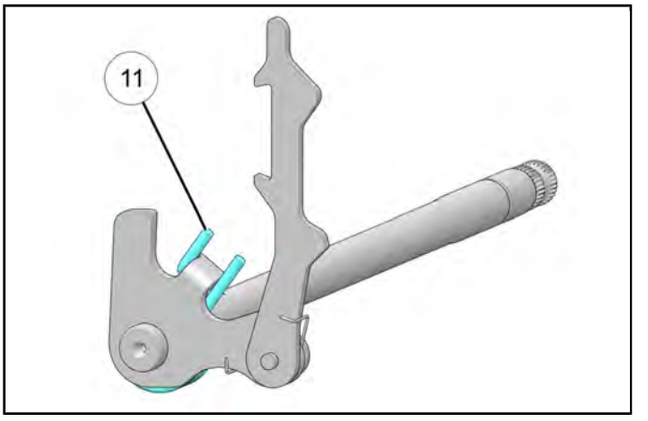
5. Remove external ring retaining ② and thrust washer ③.
6. Remove primary drive / clutch cover. See **Primary Cover Removal page 5.16**.
7. Remove clutch assembly. See **Clutch Removal page 5.24**.
8. Using a 4 mm torx wrench, remove the screw ① securing the shift star ② to the shift drum and remove shift star ③. Secure locating pin ④ for reassembly.



9. Rotate the detent lever ⑦ so the spring ⑧ is relaxed. Using a 10 mm socket, remove the bolt ⑤ and washer ⑥ securing the detent lever to the engine case.
10. Pull the shift shaft and spring assembly ⑨ out of the bore.

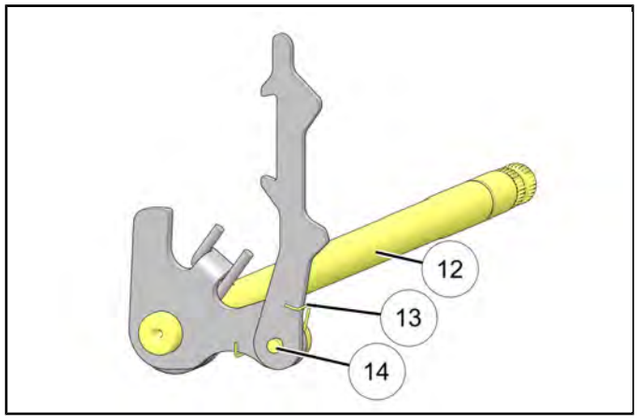


11. Remove Spring Spacer ⑩.
12. Inspect shift shaft return spring ⑪ for cracks or loss of tension. The spring should have enough tension to keep the shift shaft centered.



13. Inspect shift shaft ⑫ for wear or damage.
14. Inspect ratchet arm return spring ⑬ for tension. The spring should apply enough tension on the shift ratchet mechanism to keep it engaged with the shift star.

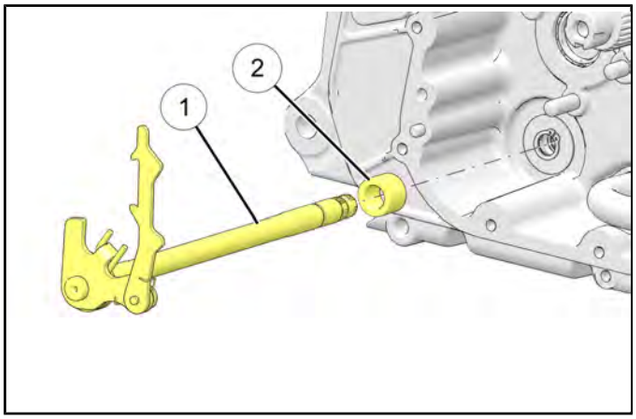
15. Inspect fit of rivet ⑭ on shift ratchet assembly. It should allow for free movement, but not be excessively loose.



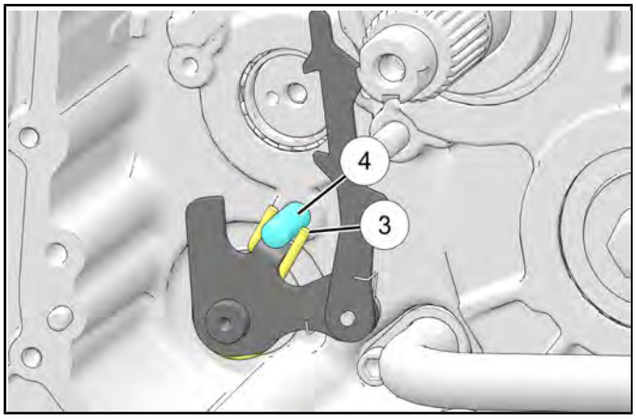
16. Inspect shift star for wear.
17. Inspect detent roller arm for wear or damage.
18. Inspect detent roller arm spring for cracks or fatigue.

SHIFT RATCHET INSTALLATION

1. Lubricate the shift shaft ① with engine oil and slide into bore with spring spacer ② until fully seated.

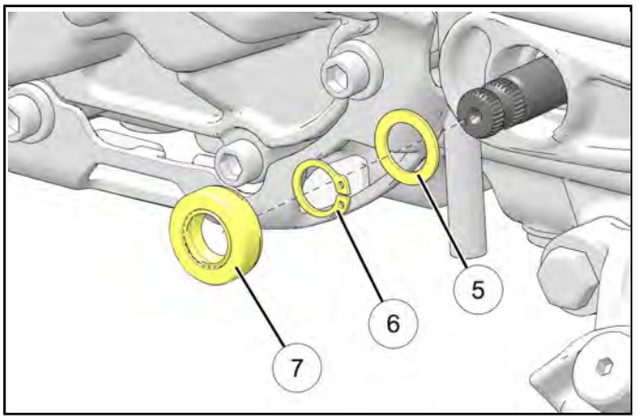


IMPORTANT
Verify that the return spring ③ has properly engaged the dowel ④ as shown.

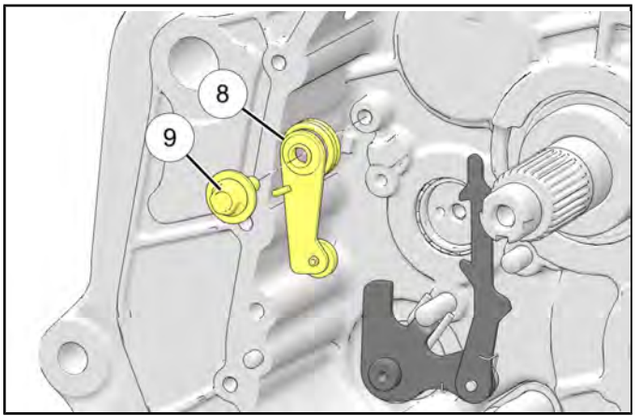


5

2. Install thrust washer ⑤ external ring retaining ⑥ and press new oil seal ⑦ into position until flush with crankcase. Reference **Shift Shaft Seal Replacement page 5.23**



3. Install the detent roller arm and spring assembly ⑧. Torque fastener ⑨ to specification.

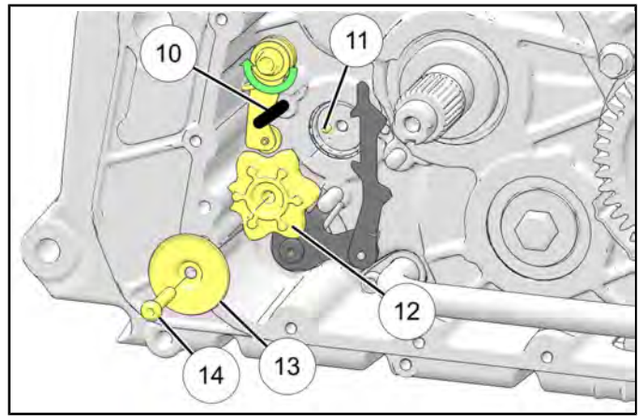


TORQUE
Detent Roller Arm Fastener: **88 in-lbs (10 N·m)**

4. Rotate the detent roller arm against the spring and install a suitable locking pin ⑩ to hold it in position.
5. Verify that the shift star dowel ⑪ is in place in the shift drum and install the shift star ⑫.
6. Install the shift star washer ⑬ and fastener ⑭ and torque to specification.

TORQUE
Shift Star Fastener: **88 in-lbs (10 N·m)**

7. Remove locking pin ⑩ to release the detent roller arm.

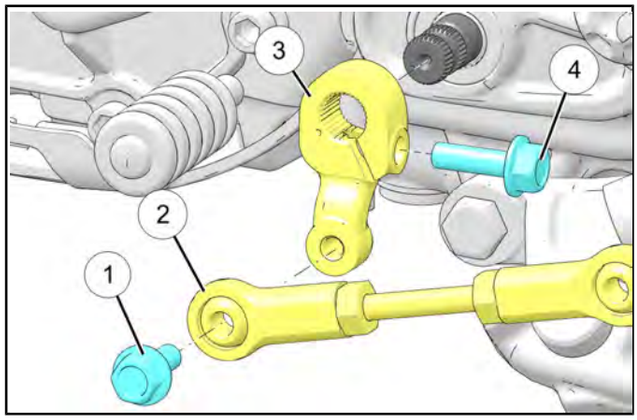


8. Install the shift arm.
9. Install clutch assembly. See **Clutch Installation page 5.29**.
10. Install the primary cover. See **Primary Drive / Clutch Cover Installation page 5.16**.

SHIFT LEVER REMOVAL / INSTALLATION

Removal

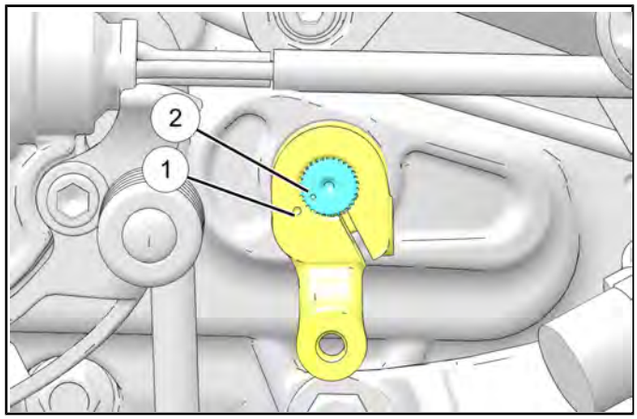
1. Remove shift linkage fastener ① to disengage shift linkage ② from shift lever ③.



2. Remove shift lever fastener ④ to remove shift lever ③.

Installation

1. Install shift lever onto the shift shaft. Ensure dot on shift lever ① lines up with dot on shift shaft ②.



2. Install shift lever fastener.

TORQUE
Shift Lever Fastener: **88 in-lbs (10 N·m)**

3. Install shift linkage and fastener.

TORQUE
Shift Linkage Fastener: **88 in-lbs (10 N·m)**

SHIFT SHAFT SEAL REPLACEMENT

1. Remove shift shaft assembly. See **Shift Ratchet Removal / Inspection page 5.20**.
2. Apply assembly lube to inner & outer surfaces of new bearing with engine oil or lithium grease.

IMPORTANT
The Shift Shaft Seal requires removal as part of the shift shaft removal procedure.

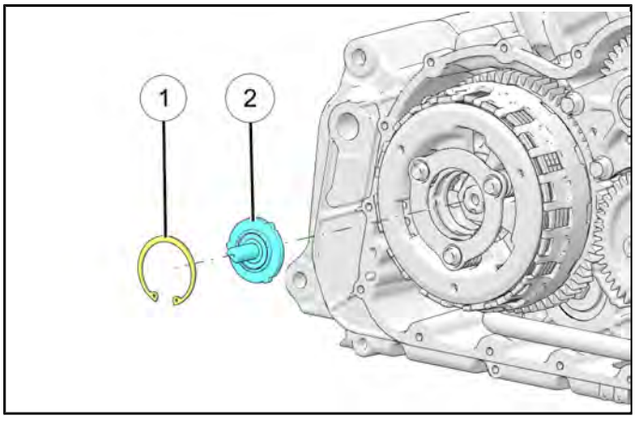
3. Apply a small amount of grease to lip of seal and apply engine oil to outside of seal.
4. Drive seal into place with a seal driver slightly smaller than the O.D. of seal.
5. Install primary cover. See **Primary Drive / Clutch Cover Installation page 5.16**.
6. After installing primary cover, be sure shift shaft returns freely to the centered position after rotating up or down.

CLUTCH SERVICE

CLUTCH SERVICE (2019-2020, 2022)

CLUTCH RACK REMOVAL / INSTALLATION

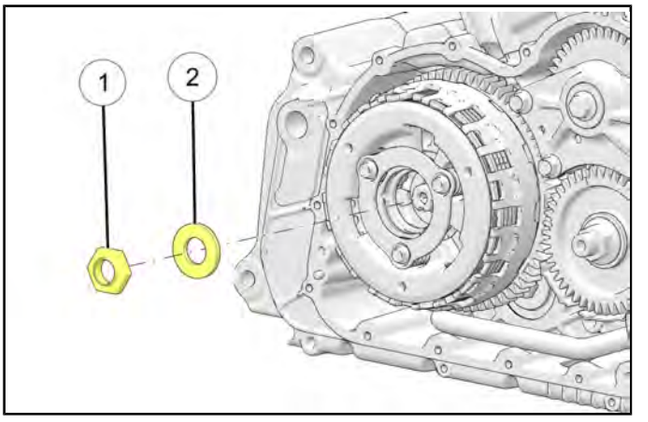
1. Remove the clutch cover. See **Primary Cover Removal page 5.16**
2. Using an internal snap ring pliers, remove snap ring ① and clutch rack ②.



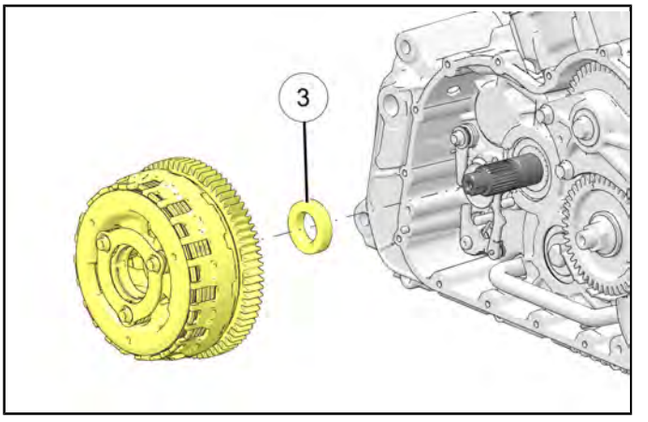
3. **Installation is performed by reversing the removal procedure.**
4. Reinstall clutch cover. See **Primary Drive / Clutch Cover Installation page 5.16**.

CLUTCH REMOVAL

1. Remove primary cover. See **Primary Cover Removal page 5.16**.
2. Remove clutch rack. See **Clutch Rack Removal / Installation page 5.24**.
3. Perform the crankshaft locking procedure. See **Locking the Crankshaft for Service page 6.6**
4. Remove clutch stake nut ① and washer.



5. Remove clutch assembly from input shaft along with clutch spacer ③.



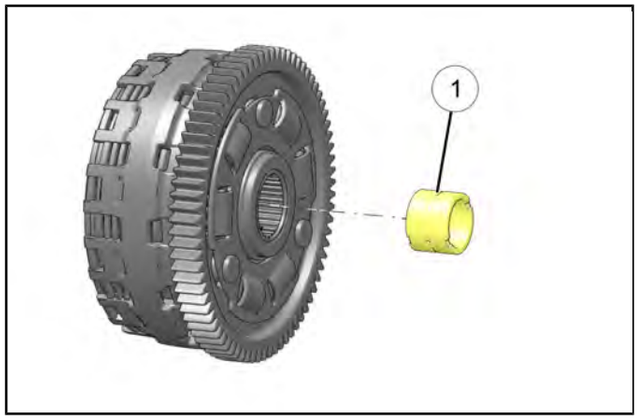
6. A new stake nut **MUST** be installed upon assembly.

CLUTCH DISASSEMBLY

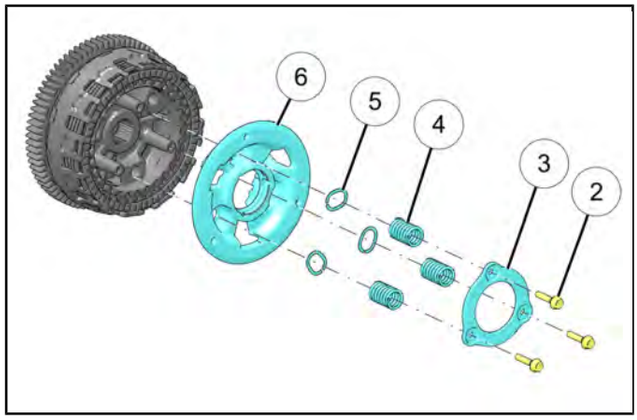
⚠ CAUTION

Clutch is under spring pressure.
WEAR EYE PROTECTION.

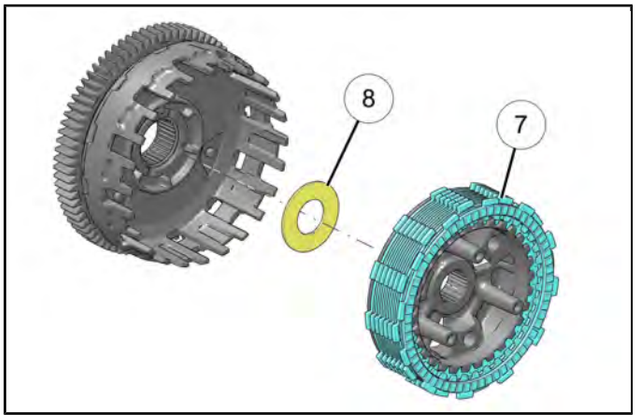
1. Remove the clutch. See **Clutch Removal page 5.24**.
2. Remove the sleeve ① from the back side of the clutch assembly.



3. Set the cltuch assembly on a clean, flat work surface.
4. Alternately loosen the three pressure plate fasteners ② until spring tension has relaxed.



5. Remove pressure plate fasteners ②.
6. Remove stopper plate ③.
7. Remove clutch springs ④.
8. Remove internal retaining rings ⑤.
9. Remove pressure plate ⑥.
10. Lift the clutch assembly ⑦ out of the basket and set aside.



11. Remove thrust washer ⑧.
12. Remove the friction plates and separator plates from the assembly as well as the Judder spring and Judder spring seat.

IMPORTANT

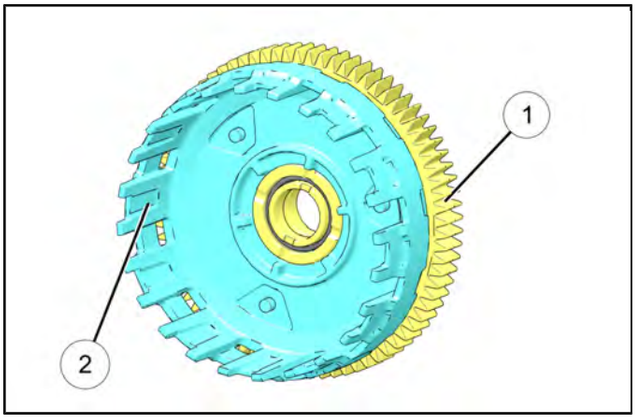
Pay attention to order and orientation during disassembly to aid in assembly.

13. Reference clutch plate assembly view for disassembly. See **Clutch Plate Assembly View page 5.14**.

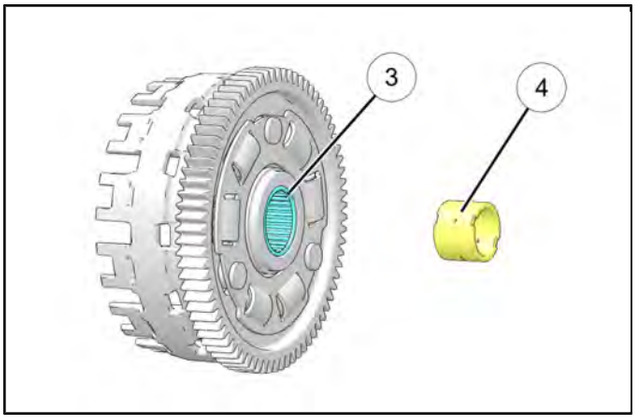
5

CLUTCH INSPECTION

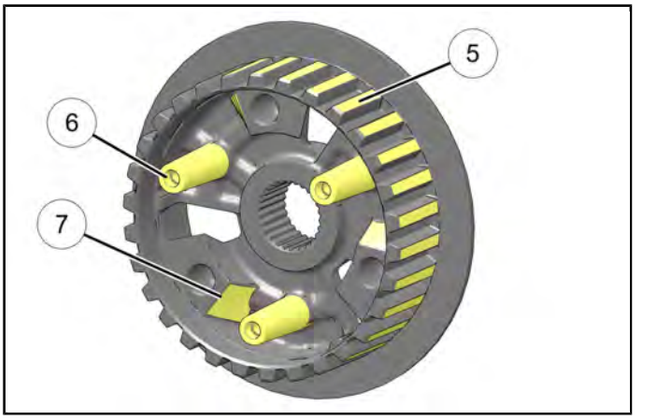
1. Clean clutch plates, inner hub, and outer basket.
2. Inspect clutch gear teeth ① for wear, cracks or damage.
3. Inspect inside surfaces ② of basket for cracks or wear (grooves) from clutch plates.



4. Replace parts that fail inspection.
5. Rotate basket bearing ③. Check for smooth rotation. Inner race should have no detectable radial movement.
6. Lubricate bearing ③ and collar ④ with engine oil.



7. Inspect surface of steel plate guides ⑤ on outer edge of hub for wear, grooves, or damage. Check all posts ⑥ for cracks or damage. Check the slip ramps ⑦ for damage.



8. Visually inspect friction and steel plates for wear or damage on both surfaces. Replace plates as a set if any plate is worn or damaged.
9. Replace steel plates if grooved, distorted or discolored. Inspect plates for distortion by placing each plate on a precision flat surface. Insert a feeler gauge between plate and flat surface in several places.

MEASUREMENT
Clutch Steel Plate Warp Service Limit: **.008 in (.20 mm)**

10. Measure thickness of friction plates in several places. Thickness should be the same at each place. Replace plates that fail inspection.

MEASUREMENT
Friction Plate Thickness (Minimum): **.142 in (3.6 mm)**

Clutch Pressure Plate

11. Inspect pressure plate for cracks, scoring, or wear on friction surface.

Clutch Springs

12. Inspect clutch springs for cracks or distortion.

Clutch Release Rack and Bearing

IMPORTANT
Clutch rack bearing plate is serviceable as an assembly only.

13. Inspect clutch rack for broken or damaged teeth.

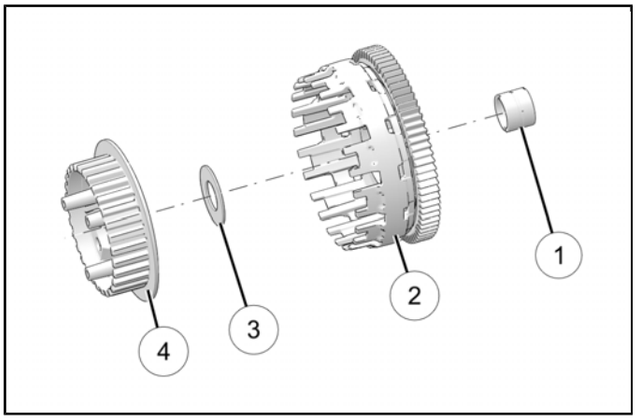
14. Inspect lifter bearing visually for any signs or wear or discoloration. Rotate bearing inner race with your finger and check for smooth movement and no play.
15. Replace clutch rack assembly if necessary.

CLUTCH ASSEMBLY

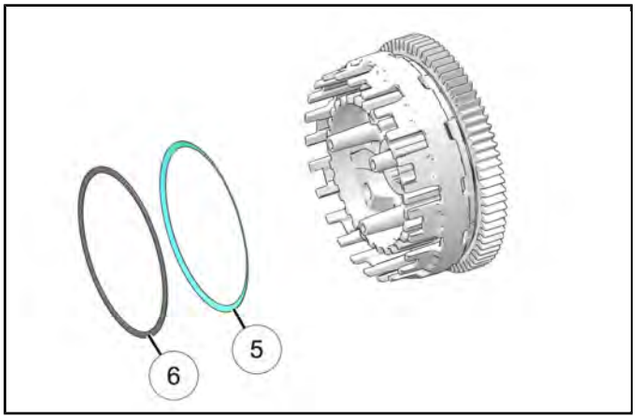
IMPORTANT

Apply a thin coat of engine oil to all clutch components prior to assembly.

1. Install the bearing collar ① into the clutch basket ② followed by the thrust washer ③ and clutch hub ④.



2. Apply engine oil to judder spring seat ⑤ and spring ⑥.
3. Install judder spring seat (flat ring), then judder spring.



IMPORTANT

The judder spring must be installed with concave side facing UP (toward outside of clutch). The tallest edge of spring will be outermost.

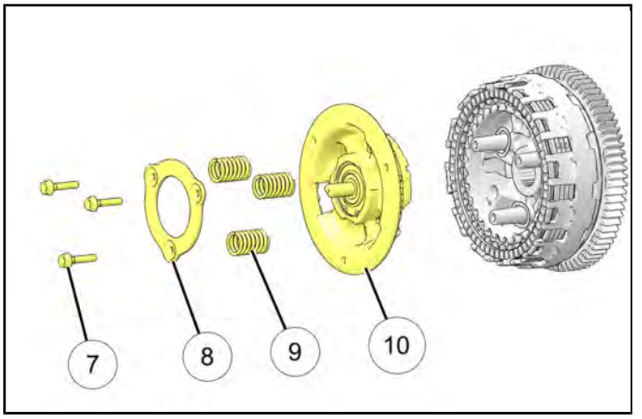
4. Apply engine oil to hub bearing.

5. Refer to the Clutch Plate Assembly View outlined in this chapter for clutch plate orientation. See **Clutch Plate Assembly View page 5.14**

IMPORTANT
The first friction plate to be installed has a larger inner diameter, allowing it to fit around the judder spring.

IMPORTANT
If friction plates are new, soak them in clean engine oil for a few minutes before installing.

6. Install the pressure plate ⑩, springs ⑨, stopper plate ⑧, and fasteners ⑦. **Alternately tighten the clutch spring screws until fully seated.**



7. Torque pressure plate fasteners to specification.

TORQUE
Clutch Pressure Plate Fasteners: **88 in-lbs (10 N·m)**

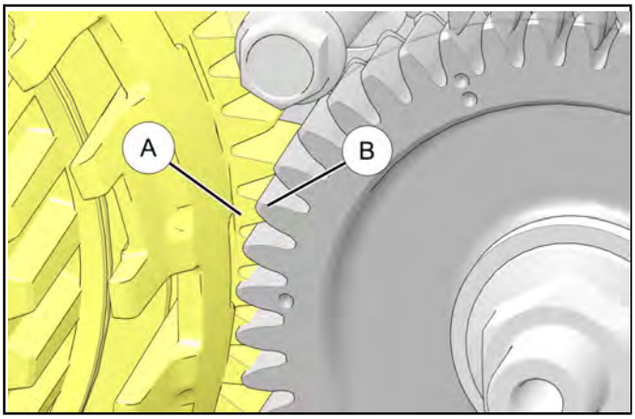
CLUTCH INSTALLATION

1. Remove the pressure plate from the clutch assembly and set aside.
2. Using a pin punch or similar tool ①, preload the teeth of the primary drive split gear and hold in place.
3. Install the clutch spacer onto the transmission input shaft.
4. Slide the clutch assembly ② onto the transmission input shaft until fully seated.

⚠ CAUTION

Crankshaft bearing damage will occur if the clutch assembly is not fully seated.

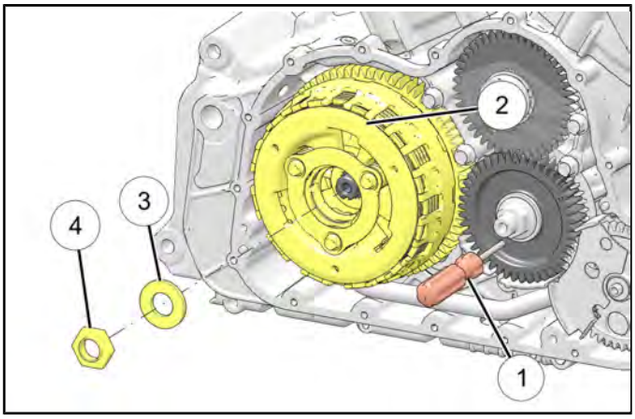
5. Verify the outer face of the clutch gear Ⓐ is inset from the primary drive split gear Ⓑ.



IMPORTANT

Clutch assembly installation inspection.

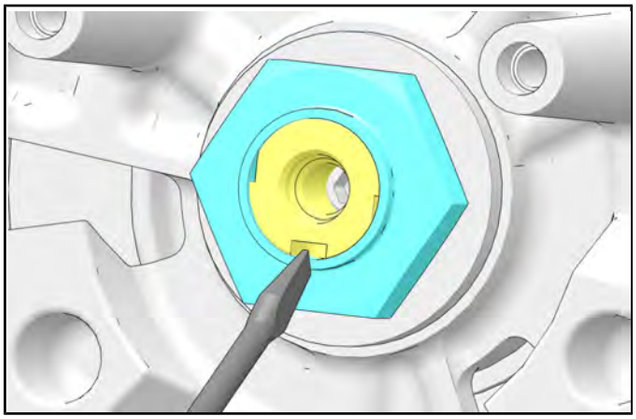
6. Install washer ③ and a *New* stake nut ④.



7. Lock the crankshaft. See **Locking the Crankshaft for Service page 6.6**.
8. Torque the stake nut to specification.

TORQUE
Stake Nut, Clutch: **125 ft-lbs (170 N·m)**

9. Using a punch and a hammer, stake the nut.



10. Install clutch pressure plate assembly and torque fasteners to specification.

TORQUE
Clutch Pressure Plate Fastener: **88 in-lbs (10 N·m)**

11. Install primary cover. See **Primary Drive / Clutch Cover Installation page 5.16**.
12. Check engine oil and fill to proper level. See **Engine Oil Level Check page 2.21**

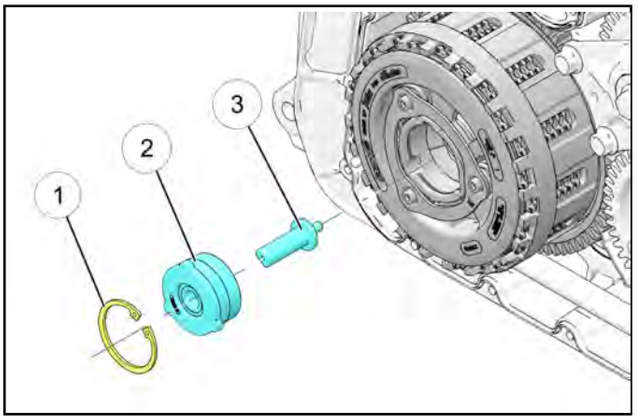
5

CLUTCH SERVICE (2023)

CLUTCH RACK, REMOVAL / INSTALLATION (2023)

REMOVAL

1. Remove primary cover. See **Primary Cover Removal page 5.16**.
2. Using an internal snap ring pliers, remove snap ring ①, clutch rack ②, and lift rack ③.



INSTALLATION

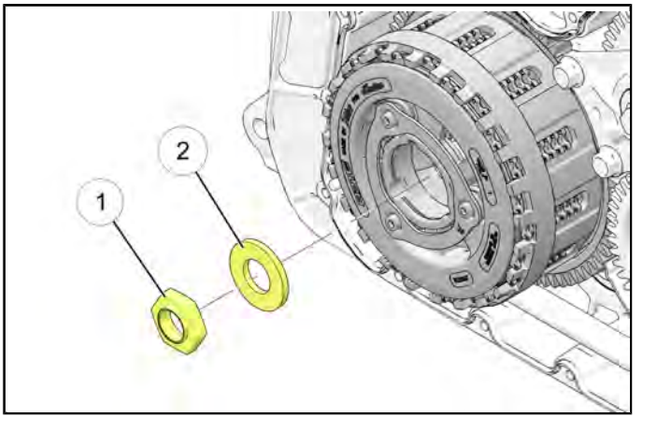
1. Install the clutch rack and lift rack.

> **⚠ CAUTION**
>
> The clutch rack is to be installed with the flat face facing outward. Failure to correctly install the clutch rack will cause improper operation.

2. Install snap ring to retain clutch rack.

CLUTCH REMOVAL

1. Remove primary cover. See **Primary Cover Removal page 5.16**.
2. Remove clutch rack. See **Clutch Rack, Removal / Installation (2023) page 5.30**.
3. Perform the crankshaft locking procedure. See **Locking the Crankshaft for Service page 6.6**.
4. Remove stake nut ① and washer ②. Discard the stake nut.



> **IMPORTANT**
>
> A new stake nut must be installed upon assembly.

5. Remove clutch assembly from input shaft.

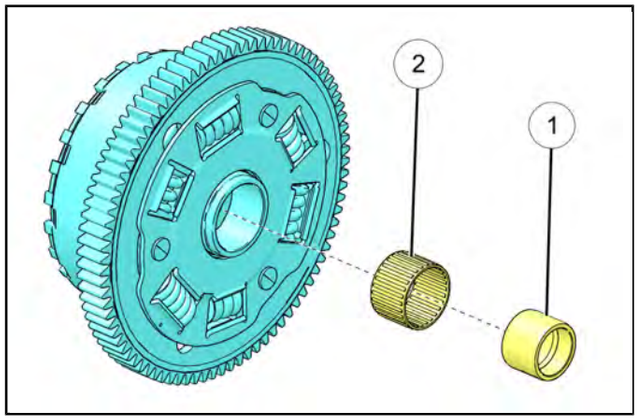
> **IMPORTANT**
>
> Make sure to retrieve the clutch spacer after removing the clutch.

CLUTCH DISASSEMBLY

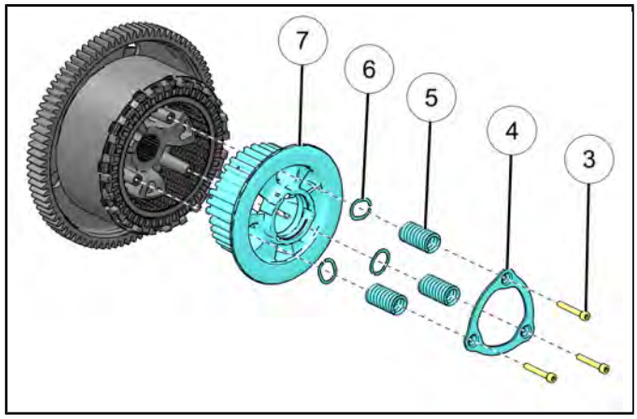
> **⚠ CAUTION**
>
> Clutch is under spring pressure. WEAR EYE PROTECTION.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

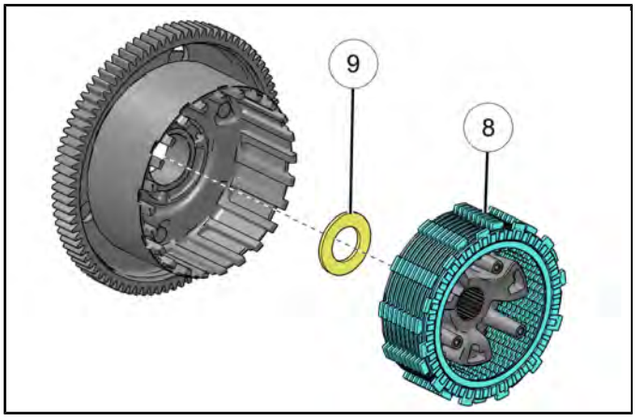
1. Remove the clutch. See **Clutch Removal page 5.30**.
2. Remove the sleeve ① and needle bearing ② from the back side of the clutch assembly.



3. Alternately loosen the pressure plate fasteners ③ until spring tension has released.



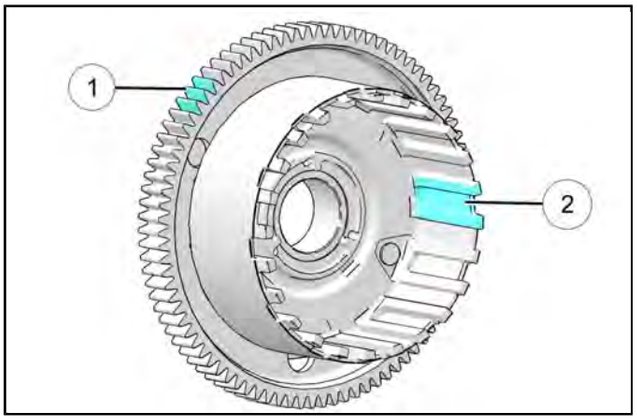
4. Remove stopper plate ④.
5. Remove clutch springs ⑤ and retaining rings ⑥.
6. Remove outer hub ⑦.
7. Remove inner hub and clutch assembly ⑧.



8. Remove thrust washer ⑨.

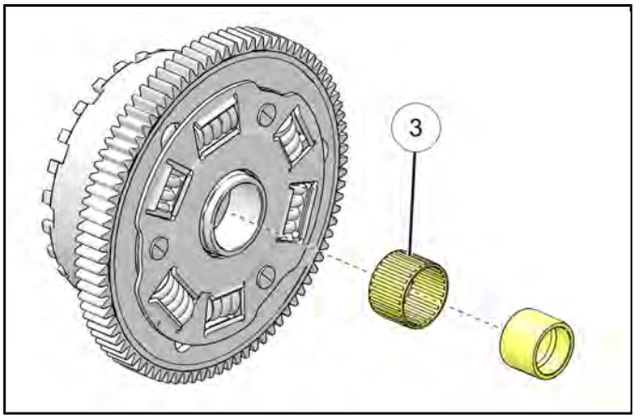
CLUTCH INSPECTION

1. Clean clutch plates, inner hub, and outer basket.
2. **Clutch Basket** Inspect clutch gear teeth ① for wear, cracks or damage.
3. Inspect inside surfaces ② of basket for cracks or wear (grooves) from clutch plates.

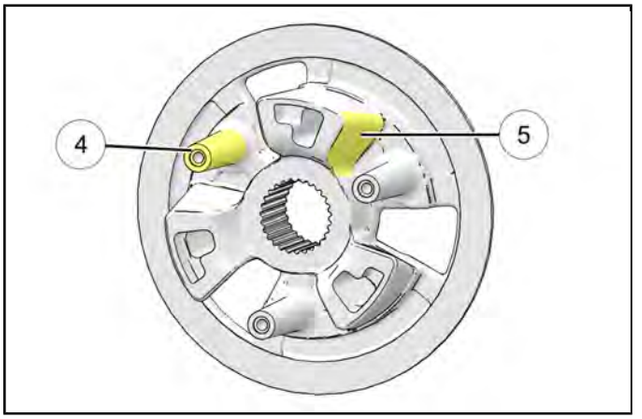


4. Replace parts that fail inspection
5. Rotate hub bearing. Check for smooth rotation. Inner race should have no detectable radial movement.

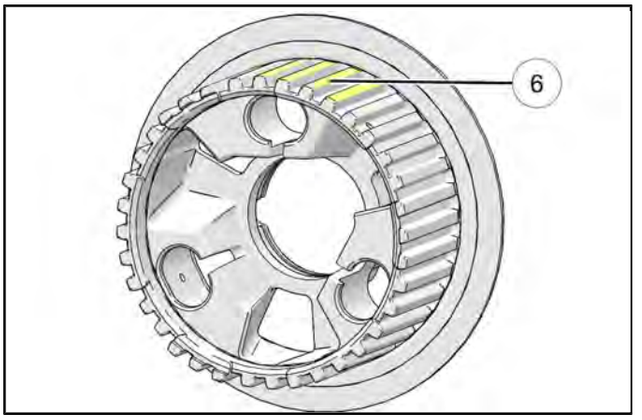
6. Lubricate bearing ③ with engine oil.



7. Inspect posts ④ for cracks or damage.



8. Check the slip ramps ⑤ for damage.
9. Inspect surface of steel plate guides ⑥ on outer edge of hub for wear, groves, or damage.



10. Visually inspect friction and steel plates for wear or damage on both surfaces. Replace plates as a set if any plate is worn or damaged.
11. Replace steel plates if grooved, distorted or discolored. Inspect plates for distortion by placing each plate on a precision flat surface. Insert a feeler gauge between plate and flat surface in several places.

Clutch Steel Plate Warp Service Limit: **.008 in (.20 mm)**

12. Measure thickness of friction plates in several places. Thickness should be the same at each place. Replace plates that fail inspection.

Friction Plate Thickness (Minimum): **.126 in (3.2 mm)**

13. Inspect pressure plate for cracks, scoring, or wear on friction surface. **Clutch Springs**
14. Inspect clutch springs for cracks or distortion.

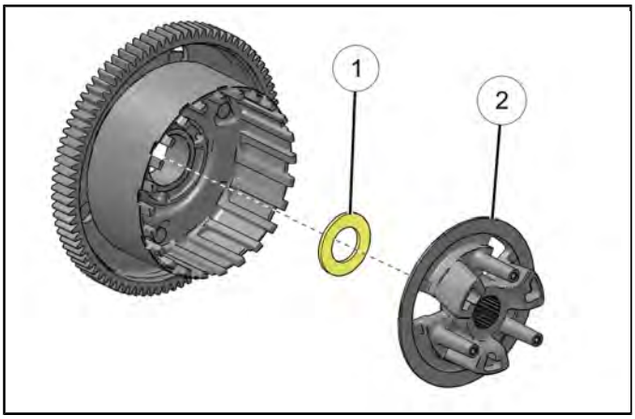
Clutch Release Rack and Bearing

NOTICE
Clutch rack is serviceable as an assembly only.

15. Inspect clutch rack for broken or damaged teeth.
16. Inspect lifter bearing visually for any signs or wear or discoloration. Rotate bearing inner race with your finger and check for smooth movement and no play.
17. Replace clutch rack assembly if necessary.

CLUTCH ASSEMBLY

1. Install the thrust washer ① and the clutch hub ② into the clutch basket.

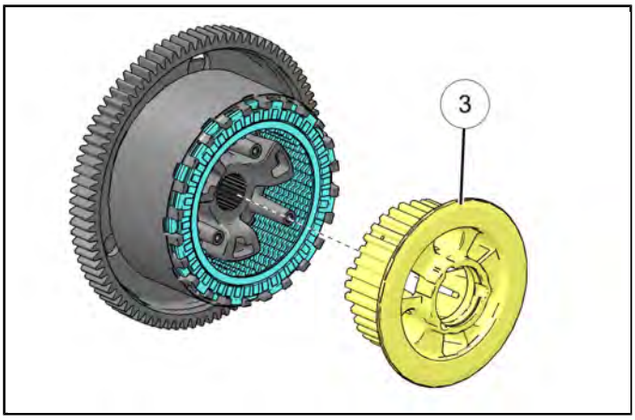


Refer to the Clutch Assembly View outlined in this chapter for clutch plate orientation. See Clutch (2023) page 5.13 .

NOTICE

If friction plates are new, soak them in clean engine oil for a few minutes before installing.

2. Install pressure plate ③.

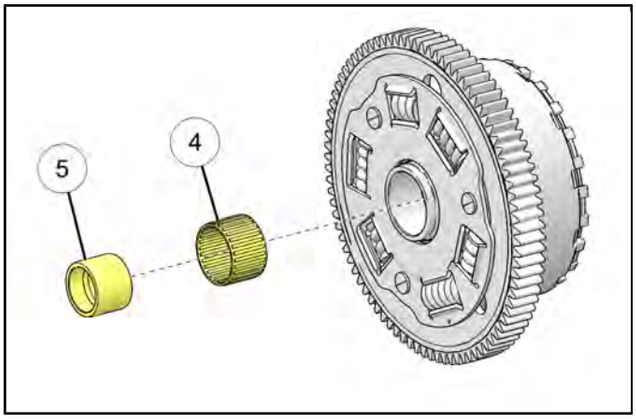


NOTICE

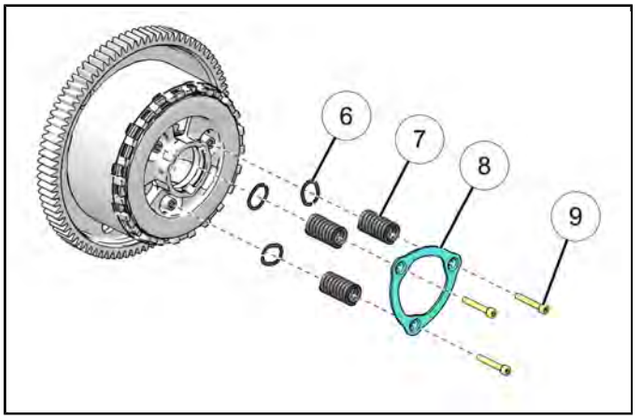
Use care while installing to prevent damage to friction plates and separator plates

3. Apply engine oil to hub bearing ④ .

4. Install the hub bearing and sleeve ⑤ into the clutch assembly.



5. Install spring retaining rings ⑥.



6. Install clutch springs ⑦.

7. Install the stopper plate ⑧ and clutch springs and fasteners ⑨ .

IMPORTANT

Alternately tighten the clutch spring fasteners in a star pattern until fully seated.

TORQUE
Stopper Plate Fastener: **88 in-lbs (10 N·m)**

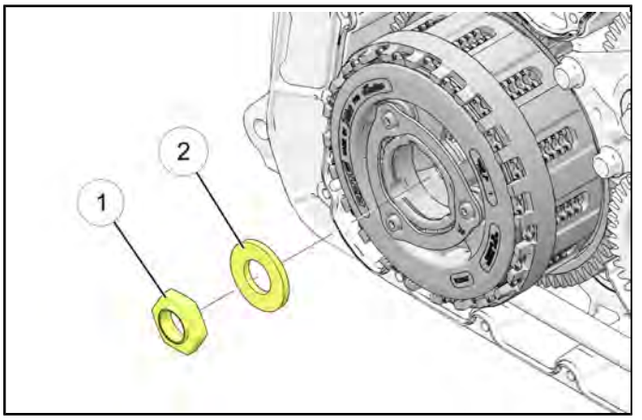
CLUTCH INSTALLATION

IMPORTANT

When installing clutch assembly on the input shaft, make sure that the thrust washer between the clutch basket and the clutch hub goes onto the shaft and does not fall between hub and basket.

1. Slide the clutch assembly onto the transmission input shaft until fully seated.
2. Install washer ② and **NEW** stake nut ①.

TORQUE
Clutch Stake Nut **125 ft-lbs (170 N·m)**



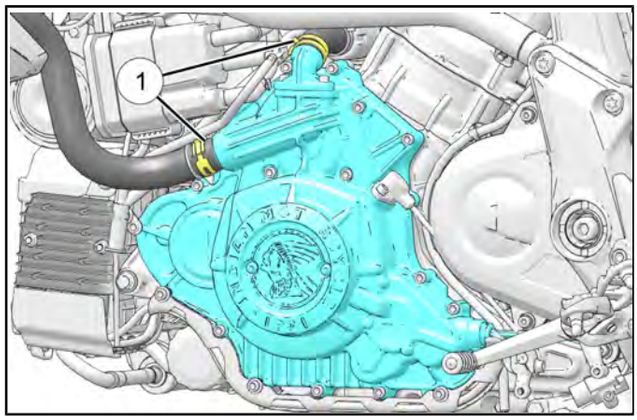
3. Stake the nut.
4. Install clutch rack. See **Clutch Rack, Removal / Installation (2023) page 5.30**.
5. Install primary cover. See **Primary Drive / Clutch Cover Installation page 5.16**.

FLYWHEEL SERVICE

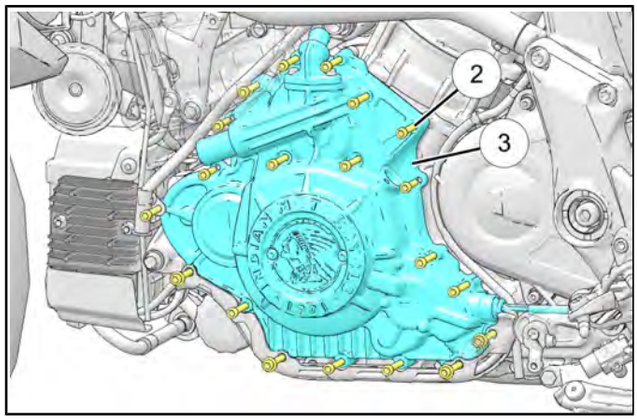
STATOR COVER REMOVAL

NOTICE
Coolant may be present at the water pump weep hole due to normal water pump function. Verify integrity of the water pump seal with a cooling system pressure test.

1. Drain cooling system. See **Coolant Drain / Fill page 3.44**.
2. Disconnect coolant bypass return hose ① from the stator cover.



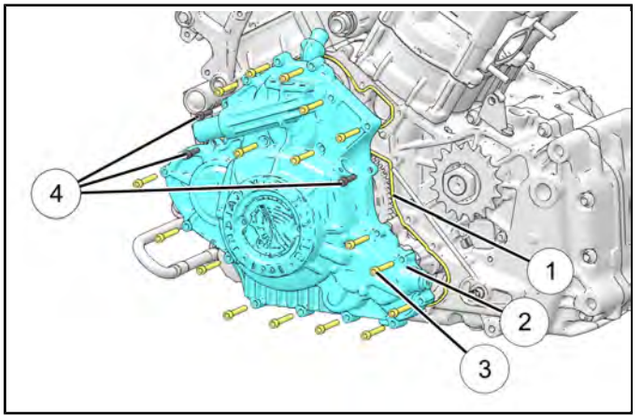
3. Remove the crankshaft position sensor CPS. See **Crankshaft Position Sensor, Test / Replace page 4.53**.
4. Disconnect the stator electrical connector.
5. Remove the fasteners ② securing the stator cover ③.



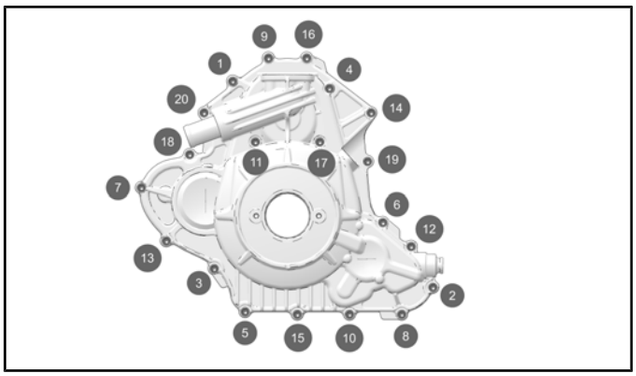
IMPORTANT
There are two different length fasteners securing the stator cover.

STATOR COVER INSTALLATION

1. Assemble new gasket ① on stator cover ② with the gasket flat surface facing the engine.



2. Install fasteners ③ and ④ in the locations illustrated.
3. Install remaining stator cover fasteners and torque all fasteners in sequence to specifications.



TORQUE
Stator Cover Fasteners: **106 in-lbs (12 N·m)**

4. Connect coolant hoses to stator cover.
5. Install the crankshaft position sensor and torque fastener to specifications.

TORQUE
CPS (Crankshaft Position Sensor) Fastener: **88 in-lbs (10 N·m)**

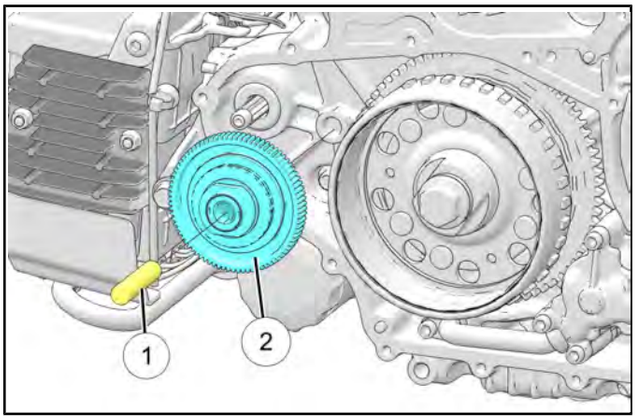
6. Connect the stator connector.
7. Fill the cooling system with 50/50 Premix Extended Life Coolant. See **Coolant Drain / Fill page 3.44**.

FLYWHEEL REMOVAL

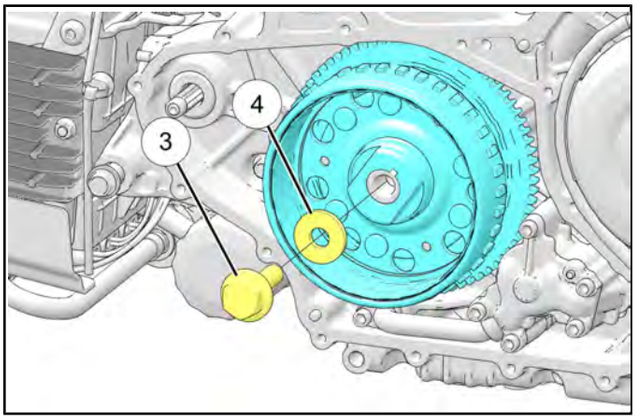
⚠ WARNING

The flywheel contains powerful magnets. Use caution when lifting stator cover off of flywheel to avoid personal injury.

1. Remove stator cover. See **Stator Cover Removal page 5.35**.
2. Remove the torque limiter gear pin ① and torque limiter assembly ②.



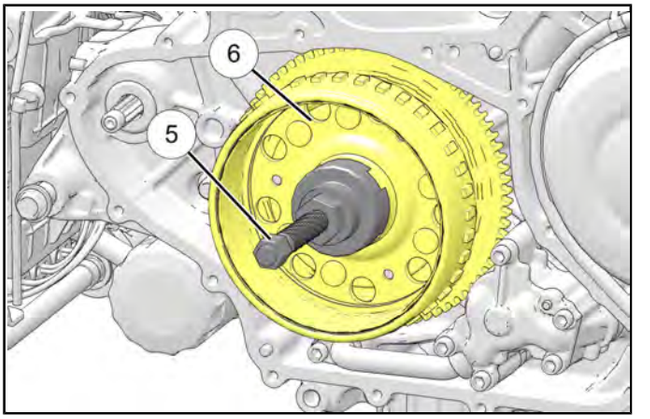
3. Remove flywheel bolt ③ and washer ④.



4. Install flywheel remove tool **PA-49316-A** ⑤ on the flywheel ⑥ and tighten puller to remove flywheel assembly.

⚠ CAUTION

The puller has left hand threads. Ensure the tool is fully threaded to prevent damage.



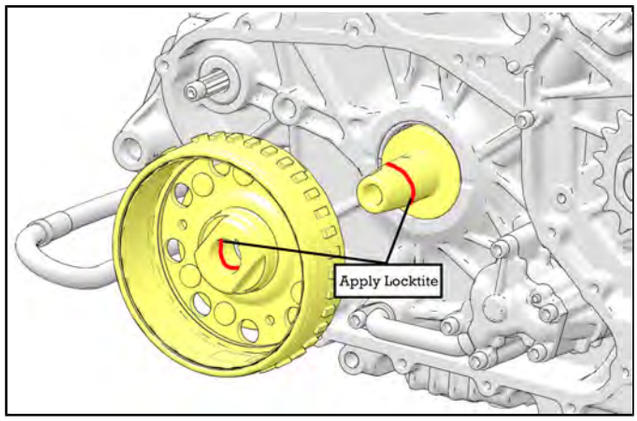
5. Grasp flywheel assembly and lift off the crankshaft.

FLYWHEEL INSTALLATION

⚠ CAUTION

The flywheel contains powerful magnets. Use caution when installing flywheel onto crankshaft to avoid personal injury.

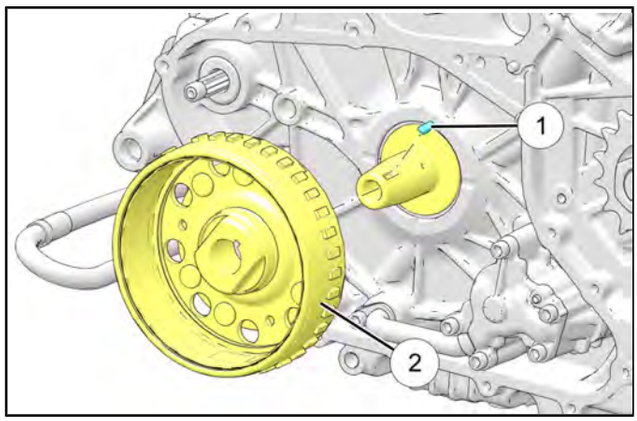
1. Clean flywheel and crankshaft taper thoroughly with isopropyl alcohol or similar.
2. Inspect crankshaft taper surface and replace if damaged.
3. Apply a bead of Loctite® 641 (Yellow) to the internal flywheel taper and crankshaft external taper surfaces. Refer to image below.



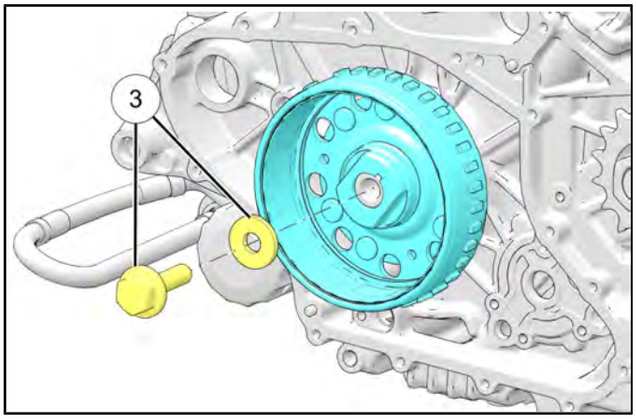
IMPORTANT

Do not allow Loctite® to contact the starter gear bearing.

4. Install woodruff key ① and install flywheel assembly ② onto crankshaft.



5. Install flywheel fastener with washer ③ and torque to specification.



TORQUE
Flywheel Fastener: **STEP 1: TIGHTEN FASTENER TO 129 ft-lbs (175 N·m)STEP 2: BACK OUT FASTENER 180° AND RE-TORQUE TO SPEC**

6. Install stator cover assembly. See **Stator Cover Installation page 5.35**.
7. Check engine oil level. See **Engine Oil Level Check page 2.21**.

TROUBLESHOOTING CLUTCH / PRIMARY / SHIFT

PROBLEM	POSSIBLE CAUSE	PART(S) AFFECTED	REPAIR RECOMMENDED
Clutch Lever Pulls Excessively Hard	Clutch lever pivot, bushings need lubrication	Clutch lever pivot points	Lubricate
	Drive plates catching on primary driven gear basket	Clutch primary driven gear / clutch plates	Replace necessary parts
	Clutch rack bearing damage	Clutch rack	Replace
	Clutch pinion shaft bearing binding	Pinion shaft bearings	Replace
Clutch Slips	Clutch springs weak	Clutch springs	Replace
	Pressure plate worn or distorted	Pressure plate	Replace
	Clutch plates worn, warped or distorted	Clutch Friction / Separator Plates	Replace plates as necessary
	Clutch rack mechanism sticking	Clutch rack mechanism	Replace
	Engine oil level low	Oil level	Correct oil level
	Oil additives present in oil or used previously	Oil quality	Replace oil & filter (clutch plates may need to be replaced
Dragging clutch (doesn't disengage completely, creeping)	Clutch lever, pivot, cable, or lifter arm sticking	Lever, pivots, bushings, bearings, cable	Inspect
	Oil additives present in oil or used previously	Oil quality	Replace oil & filter (clutch plates may need to be replaced
	Oil level too high	Oil level	Correct oil level
	Oil viscosity too high	Oil quality	Replace oil & filter
	Pressure plate worn, warped or distorted	Pressure plate	Replace
	Clutch plate(s) worn, warped or distorted	Driven plates and / or drive plates	Replace
	Weak clutch springs	Clutch springs	Replace

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

PROBLEM	POSSIBLE CAUSE	PART(S) AFFECTED	REPAIR RECOMMENDED
Transmission Will Not Shift	Broken shift drum	Shift drum	Replace shift drum
	Bent shift forks	Shift fork	Replace shift forks
	Worn shift drum	Shift drum	Replace shift drum
	Broken gears	Transmission gears	Replace broken gear(s)
	Damaged/broken bearings	Transmission, shift cam bearings	Replace bearings that fail inspection
	Worn gear shift pawl ratchet mechanism	Shift pawl mechanism	Replace parts that fail inspection
	Broken or dislodged shift shaft return spring	Shift shaft return spring	Repair or replace
	Roller detent arm stuck	Roller detent arm	Repair or replace parts
	Bent shift shaft (internal)	Shift shaft	Repair or replace
	External shift linkage binding or damaged	External shift linkage	Repair or replace
	Bent or distorted shift forks	Shift fork	Replace
	Bent or distorted shift fork rails	Shift fork rail	Replace
	Broken transmission components	Transmission components	Repair or replace
Transmission Hard to Shift	Improper clutch operation	Clutch	Inspect, repair
	Incorrect oil viscosity	Oil quality	Replace engine oil
	Incorrect clutch cable adjustment	-	Adjust
	Shift shaft damaged	Shift shaft components	Repair or replace
	Sticking pivot point, bent external shift linkage	External shift linkage	Repair or replace
	Bent or distorted shift forks	Shift forks	Replace
	Damaged shift drum grooves	Shift drum	Repair or replace
	Shift detent plunger stuck	Shift detent plunger	Repair or replace
	Bent/binding shift fork rails	Shift fork rails	Repair or replace
Transmission Jumps Out of Gear	Broken / loose stop pin	Shift stop pin	Replace
	Worn shift drum or shift drum ratchet	Shift drum or shift linkage	Replace
	Broken shift return spring	Shift return spring	Replace
	Damaged shift drum grooves	Shift drum	Replace
	Bent or worn shift forks	Shift forks	Replace
	Bent/binding shift fork rails	Shift fork rails	Replace
	Worn engagement dogs on transmission gears	Transmission gears	Replace
Transmission Noise	Drive chain tension incorrect	Drive Chain	Adjust or replace
	Clutch plates bind or drag when clutch is disengaged	Clutch plates / hubs	Adjust / repair / replace
	Gear/bearing wear/damage	Transmission components	Inspect / replace

NOTES

CHAPTER 6
TRANSMISSION / CRANKSHAFT

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

GENERAL INFORMATION

SERVICE NOTES

- Remove engine from frame to service internal transmission and/or crankshaft components. See **Preparation For Engine Removal page 3.20**.
- The crankcase must be separated to access internal transmission components and crankshaft.
- Label and store parts neatly to speed the assembly process and ensure that matched parts like connecting rods, camshafts and bearings can be installed in their original location
- Crankshafts and connecting rods are color coded for manufacturing tolerances with a white or red paint mark (or stamped “R” or W”).
- All torque specifications are "dry" unless specified for oil or locking agent. Refer to exploded views
- When locking agents are required, use Loctite® Primer N to clean fastener before applying locking agent Primer N reduces cure time of thread locking agent in addition to preparing the surfaces

SPECIAL TOOLS - TRANSMISSION / CRANKSHAFT

TOOL DESCRIPTION	PART NUMBER
Case Splitting / Assembly Tool	PF-51234-A
Crankcase Installation Adapter (5/16)	PV-47429
Engine Case Assembly Cup	PF-51663
Clutch Holding Tool	PF-51612
Crankshaft Locking Pin	PF-52135-A
Output Shaft Seal Tool	PF-51243
Cup Adapter	PF-51665
Mainshaft / Crankcase Installer	PV-45030

Bosch Automotive Service Solutions: 1-800-345-2233 or https://polaris.service-solutions.com/

SERVICE SPECIFICATIONS - TRANSMISSION / CRANKSHAFT

CONNECTING ROD / CRANKSHAFT SPECIFICATIONS

ITEM	PART SPECIFIC	STANDARD	SERVICE LIMIT
Connecting Rod	Connecting Rod to Crankshaft Side Clearance	.18 - .46 mm (.0070 - .0181")	.5 mm (.0196")
	Connecting Rod Bearing to Crankshaft Oil Clearance	.038 - .062 mm (.0014 - .0024")	.075 mm (.0029")
	Connecting Rod Small End I.D.	22.03 - 22.045 mm (.8673 - .8679")	22.065. mm (.8687")
	Connecting Rod Width (Big End)	19.26–19.36 mm (.7582 - .7622")	19.5. mm (.7677")
	Connecting Rod Big End I. D. (White)	50.840–50.847 mm (2.0015 - 2.0018")	50.867. mm (2.002")
	Connecting Rod Big End I. D. (Red)	50.848–50.856 mm (2.001 - 2.002")	50.876. mm (2.003")
Crankshaft Main Bearing / Rod Journals	Connecting Rod Journal Width	88.90–88.98 mm (3.50 - 3.503")	. mm (.")
	Crankshaft Rod Journal O. D. (White)	47.9704–47.978 mm (1.8885 - 1.8888")	. mm (.")
	Crankshaft Rod Journal O. D. (Red)	47.9281–47.9857 mm (1.8869 - 1.8892")	. mm (.")
	Crankshaft Main Bearing Journal	White: 55.9525–55.9625 mm (2.2028–2.2032") Red: 55.9626–55.9725 mm (2.2032–2.2036")	-
	Main Bearing Oil Clearance	0.035–0.068 mm (.0014–.0027")	.075 mm (.")
	Crankshaft End Play	.11–.71 mm (.0043 - .0279")	-
Balance Shaft	Journal O.D., Left (Primary Side) / Journal O.D., Right (Cam Side)	29.953 - 29.943 mm / 29.979 - 29.969 mm	-

TRANSMISSION SPECIFICATIONS

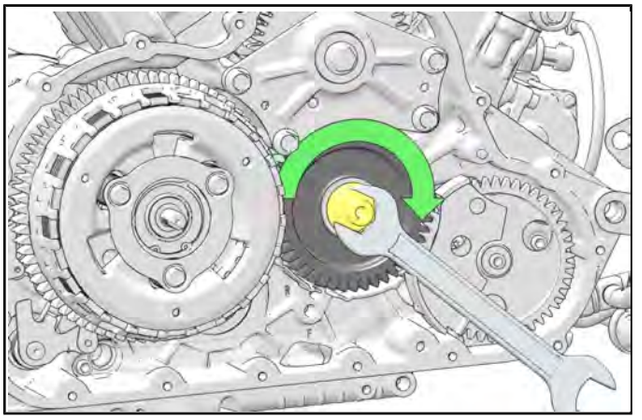
ITEM	PART SPECIFIC	STANDARD	SERVICE LIMIT
Shift Fork	Shift Fork I.D. (Rail)	10.00 - 10.022 mm (.3937 - .3945")	10.082 mm (0.3969")
	Shift Fork Pin O.D.	6.95–7.00 mm (.273 - .275")	6.50 mm (0.2559 ")
Shift Fork Rail	Shift Fork Rail O.D.	9.972–9.987 mm (.392 - .393")	9.902 mm (0.3898")
	Shift Fork Rail Runout	-	.025 mm (.001")
Shift Drum	Shift Drum Groove	-	Replace drum if any wear is evident

ITEM		SPECIFICATIONS
Drive Train (General)	Transmission	6 Speed / Constant-Mesh / Foot Shift
	Primary Reduction Ratio	1.674: 1
	Final Reduction Ratio	2.882: 1
	Final Reduction Ratio (China)	2.529:1
Drive Train (Gear Ratios)	Gear Ratio: 1st Gear	2.769 : 1
	Gear Ratio: 2nd Gear	1.882 : 1
	Gear Ratio: 3rd Gear	1.500 : 1
	Gear Ratio: 4th Gear	1.273 : 1
	Gear Ratio: 5th Gear	1.125 : 1
	Gear Ratio: 6th Gear (Overdrive)	1.036 : 1

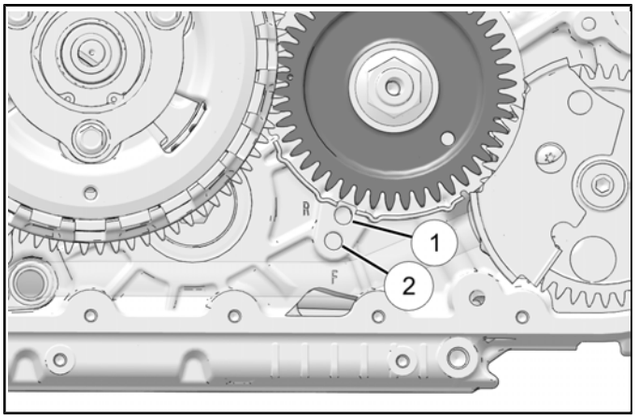
LOCKING THE CRANKSHAFT FOR SERVICE

This procedure describes how to lock the crankshaft in the Top Dead Center (TDC) position for the front *or* rear pistons using the Crankshaft Locking Tool: **PF-51235-A** or equivalent (5/16" punch).

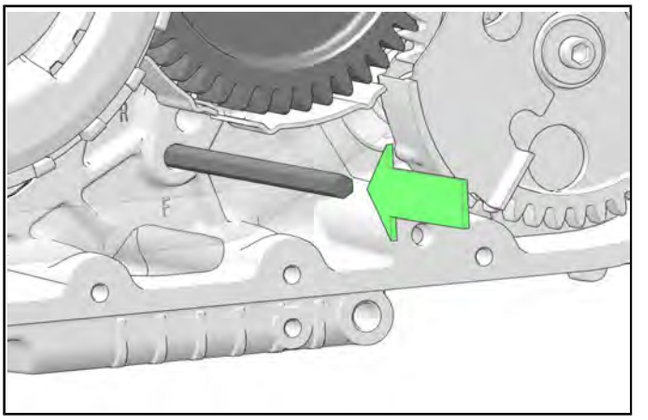
1. Remove the spark plugs. See **Spark Plug Removal page 3.8**.
2. Remove the primary cover. See **Primary Cover Removal page 5.16**.
3. Using a 24 wrench or socket, rotate the crankshaft clockwise (primary side) until the front piston is at TDC. See **Camshaft Timing Marks page 3.76**.



4. Locate the two holes (① and ② in the illustration), marked "R" for rear piston and "F" for front piston, beneath the primary drive gear.



5. Lock the crankshaft by inserting the Crankshaft Locking tool **(PF-51235-A)** or equivalent into the desired locking hole.



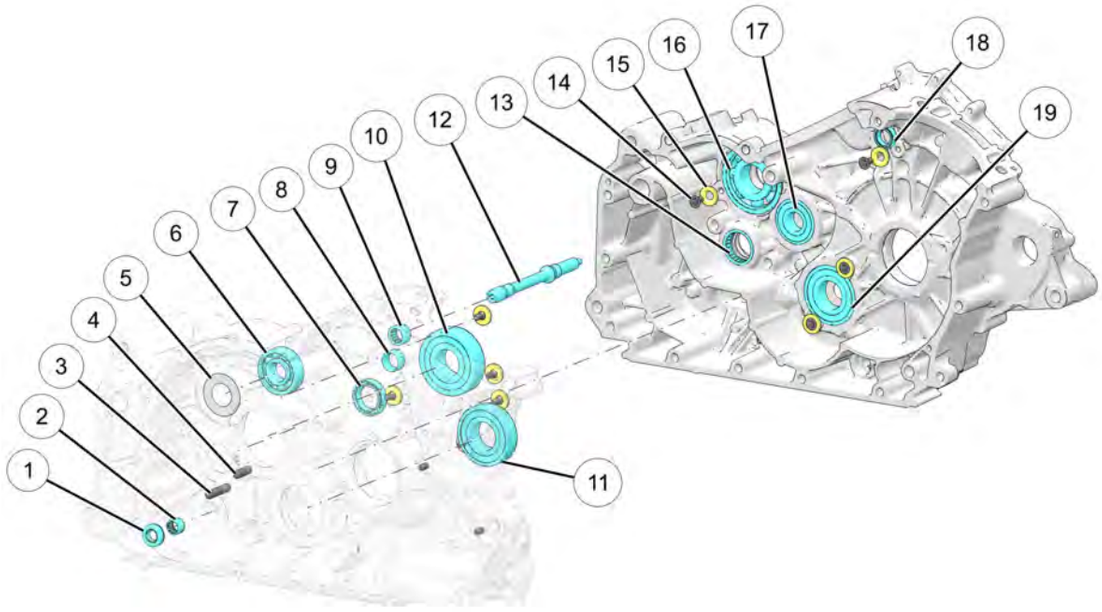
IMPORTANT

It may be necessary to rotate the crankshaft slight forward or back to properly align holes.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

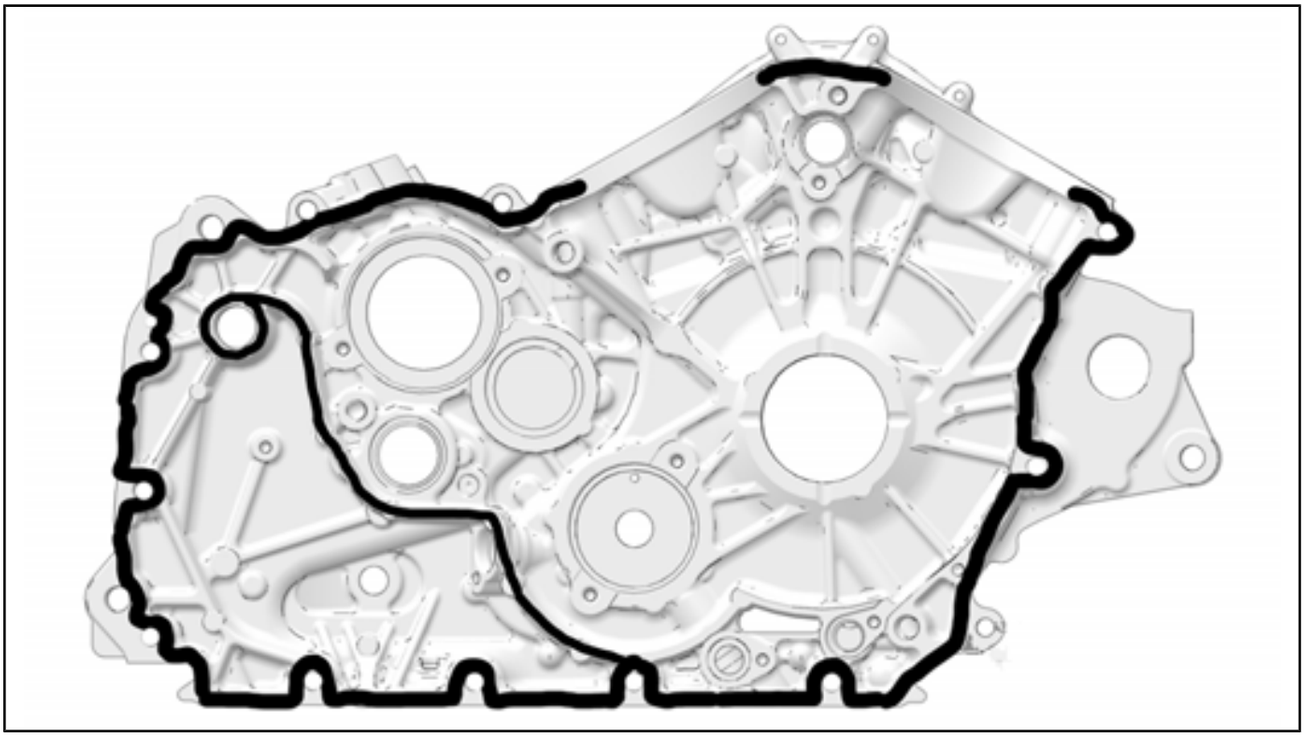
ASSEMBLY VIEWS

CRANKCASE ASSEMBLY VIEW

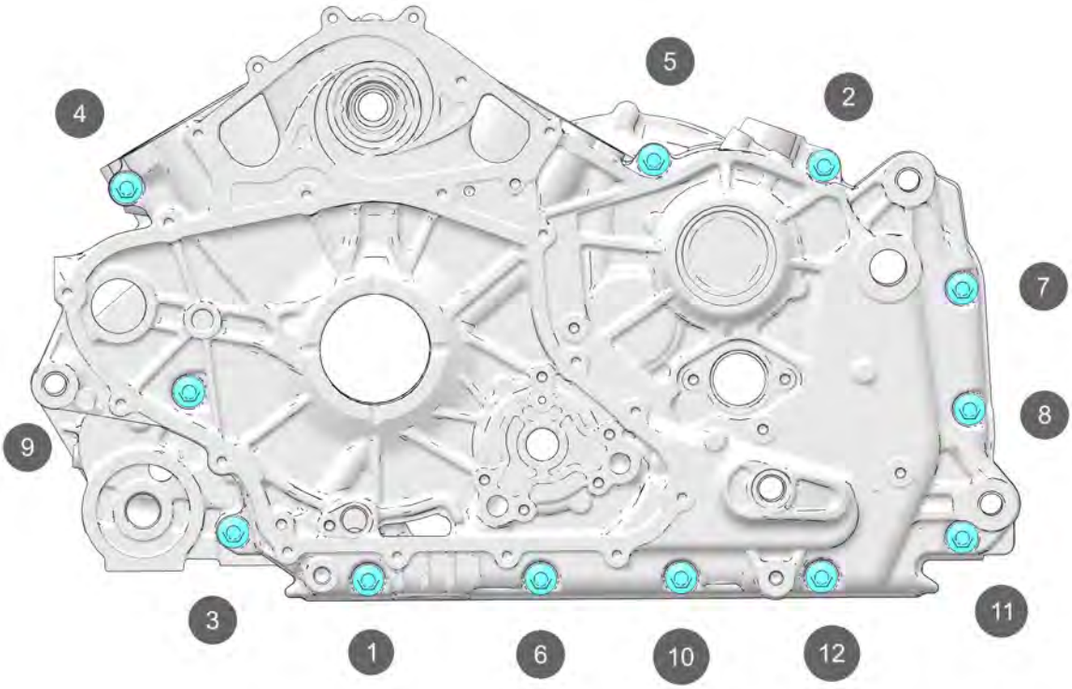


NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Shift Shaft Seal	-
②	Needle Shift Shaft Bearing	-
③	Solid Pin	-
④	Solid Pin	-
⑤	Oil Deflector Plate	-
⑥	Ball Transmission Input Shaft Bearing	-
⑦	Ball Shift Drum Bearing	-
⑧	Cam Idler Bearing	-
⑨	Needle Water Pump Shaft Bearing	-
⑩	Ball Transmission Input Shaft Bearing	-
⑪	Ball Balance Shaft Right Bearing	-
⑫	Water Pump Shaft	-
⑬	Needle Shift Drum Bearing	-
⑭	Bearing Retainer Fastener	**88 in-lbs (10 N·m)**
⑮	Bearing Retainer	-
⑯	Ball Transmission Output Shaft Bearing	-
⑰	Ball Transmission Input Shaft Bearing	-
⑱	Water Pump Shaft Bearing	-
⑲	Ball Balance Shaft Left Bearing	-

Crankcase Sealing path



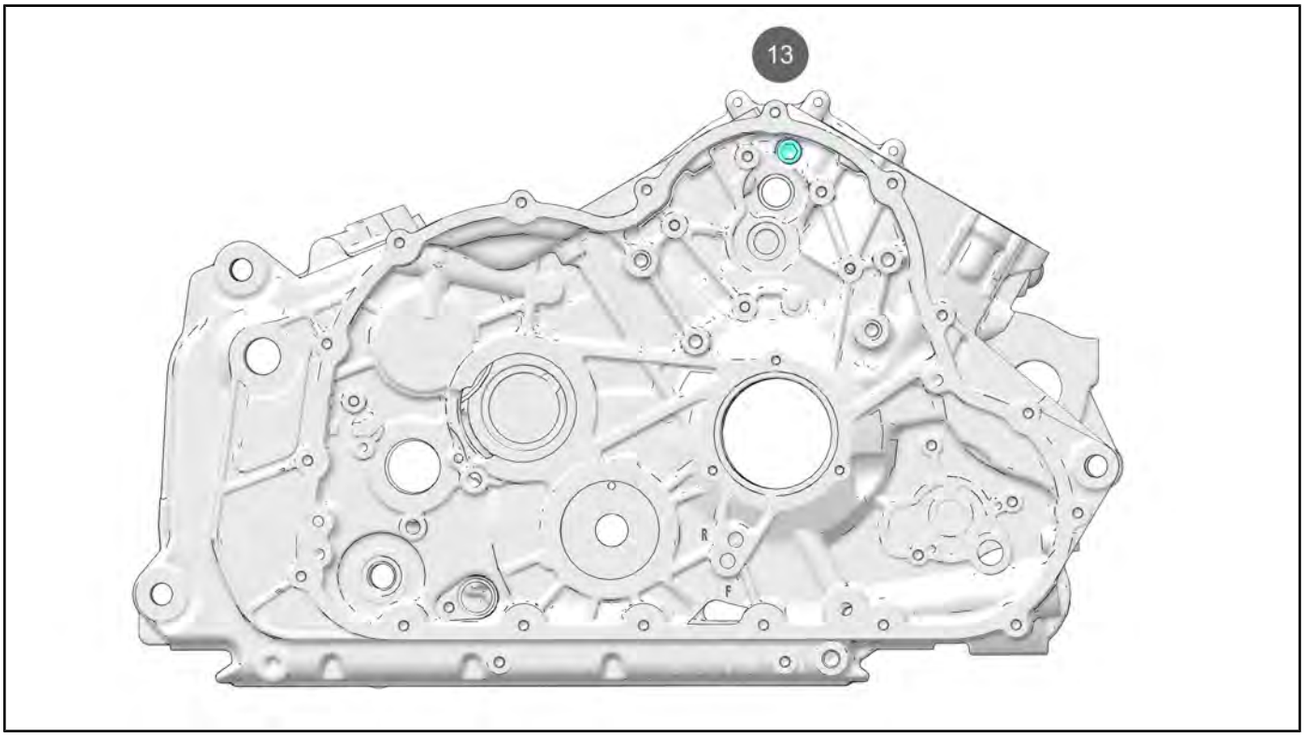
Crankcase Torque Pattern



IMPORTANT
Left crankcase bolts ③,②, and ⑤ are M8 x 1.25 x 40. The rest of the fasteners are M8 x 1.25 x 75.

Torque case bolts to specification following the torque sequence.

TORQUE
Crankcase Fasteners: **22 ft-lbs (30 N·m)**

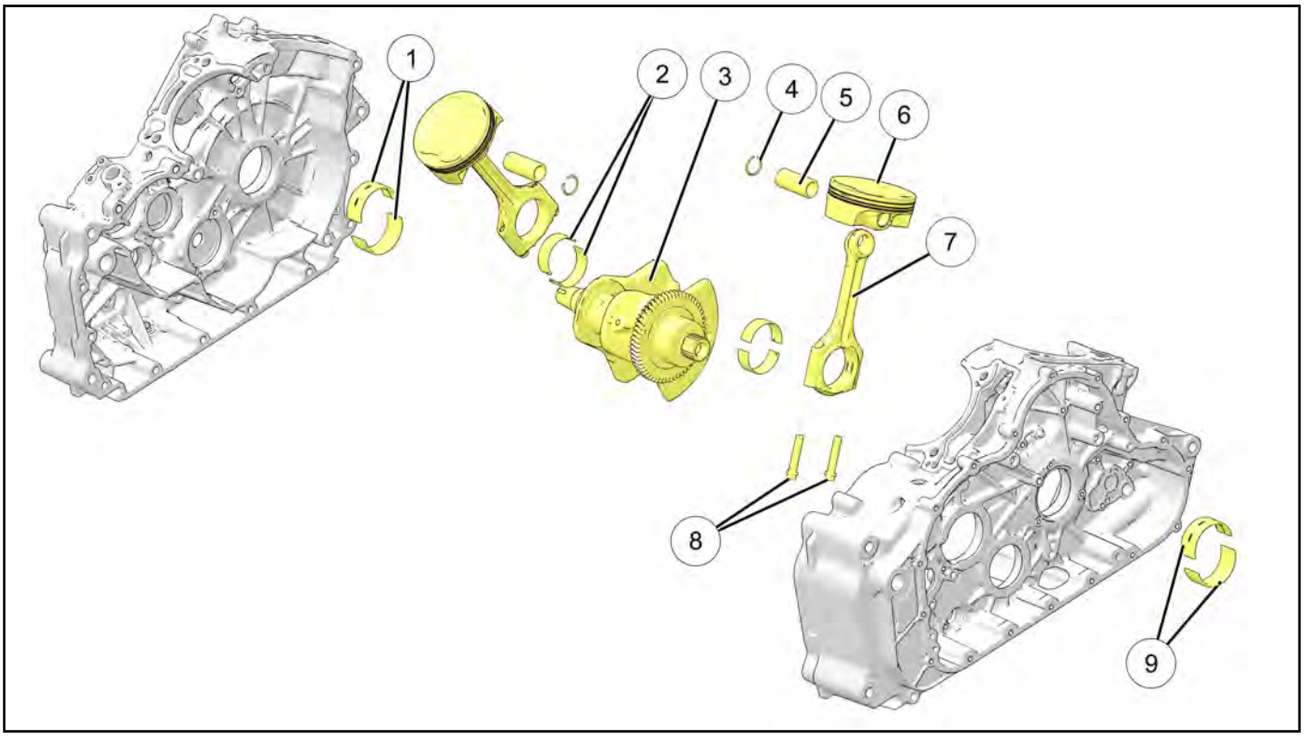


IMPORTANT
Right crankcase bolt ⑬ is M8 x 1.25 x 60.

Torque case bolts to specification following the torque sequence.

TORQUE
Crankcase Fasteners: **22 ft-lbs (30 N·m)**

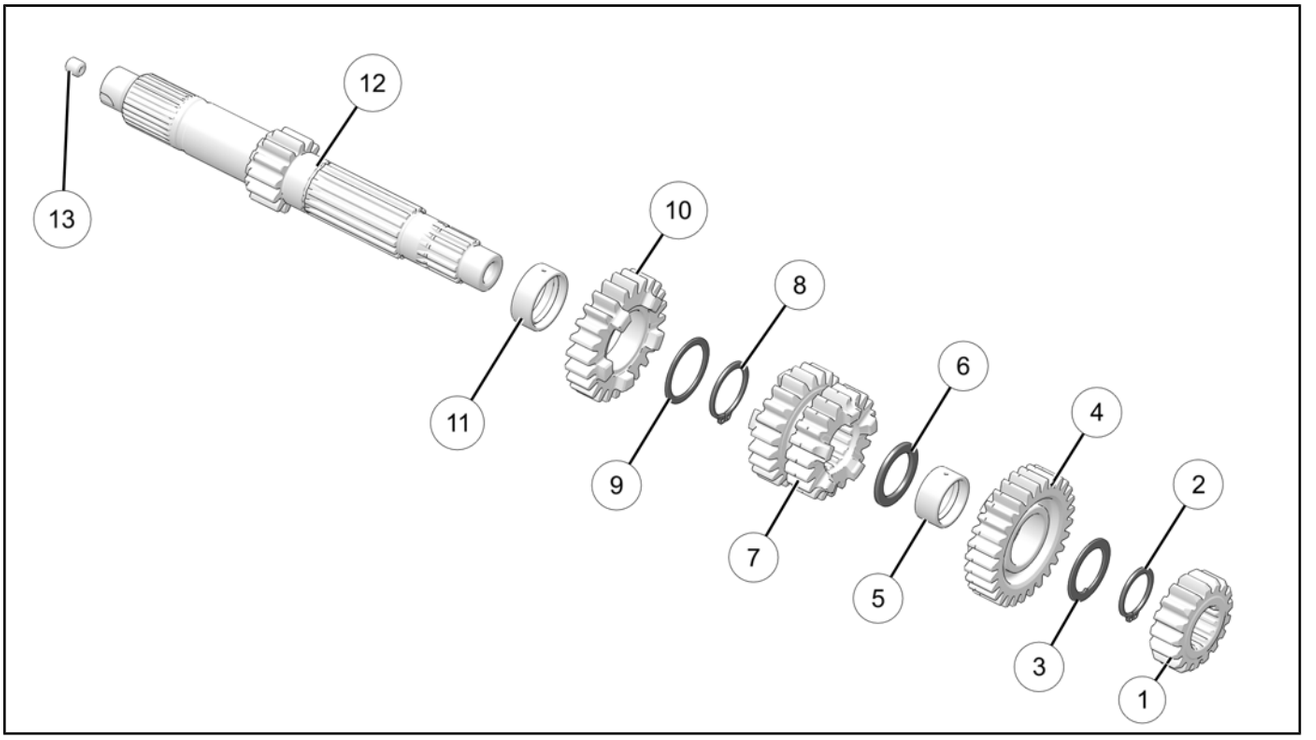
CRANKSHAFT ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Crankshaft Main (left-hand) Bearing	-
②	Connecting Rod Bearings (big end)	-
③	Crankshaft Assembly	-
④	Wrist Pin Circlip	-
⑤	Piston Wrist Pin	-
⑥	Piston Assembly	-
⑦	Connecting Rod Assembly	-
⑧	Connecting Rod Fasteners (QTY.4)	**Step 1: Torque both fasteners to 22 ft-lbs (30 N·m)** **Step 2: Tighten both fasteners an additional 90°**
⑨	Crankshaft Main (right-hand) Bearing	-

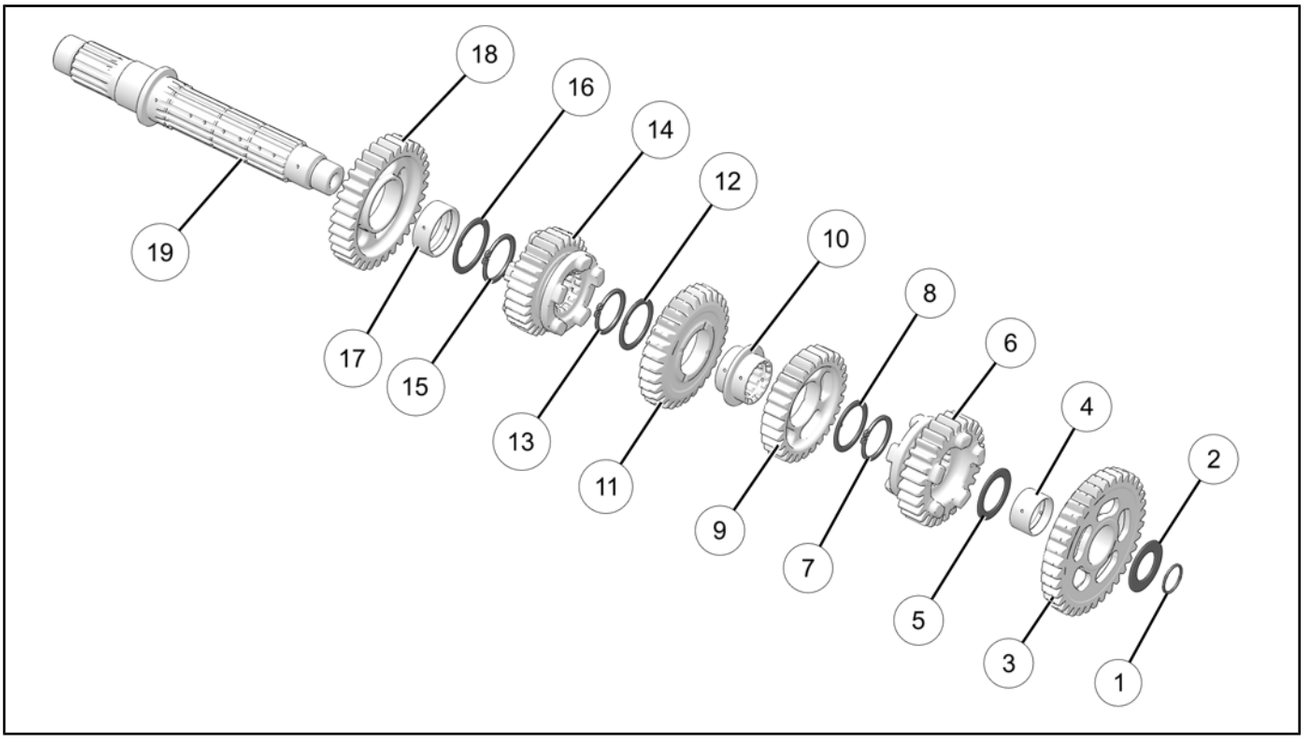
TRANSMISSION ASSEMBLY VIEW

2019–2020 INPUT SHAFT



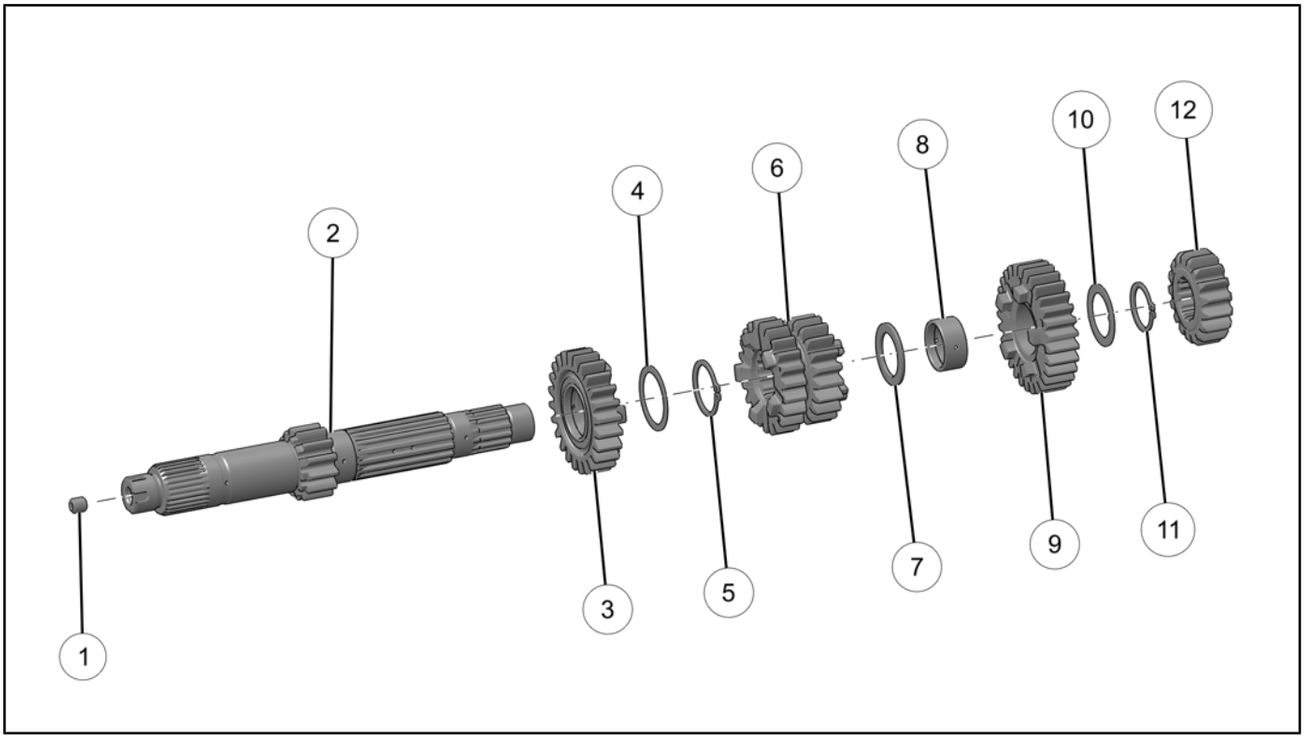
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Input Gear, 2nd	-
②	External Retention Ring	-
③	Flat Washer	-
④	Input Gear, 6th	-
⑤	Plain Bushing	-
⑥	Flat Washer	-
⑦	Input Gear, 3rd/4th	-
⑧	External Retention Ring	-
⑨	Flat Washer	-
⑩	Input Gear, 5th	-
⑪	Plain Bushing	-
⑫	Input shaft	-
⑬	Oil Plug	**159 in-lbs (18 N·m)**

2019-2020 OUTPUT SHAFT



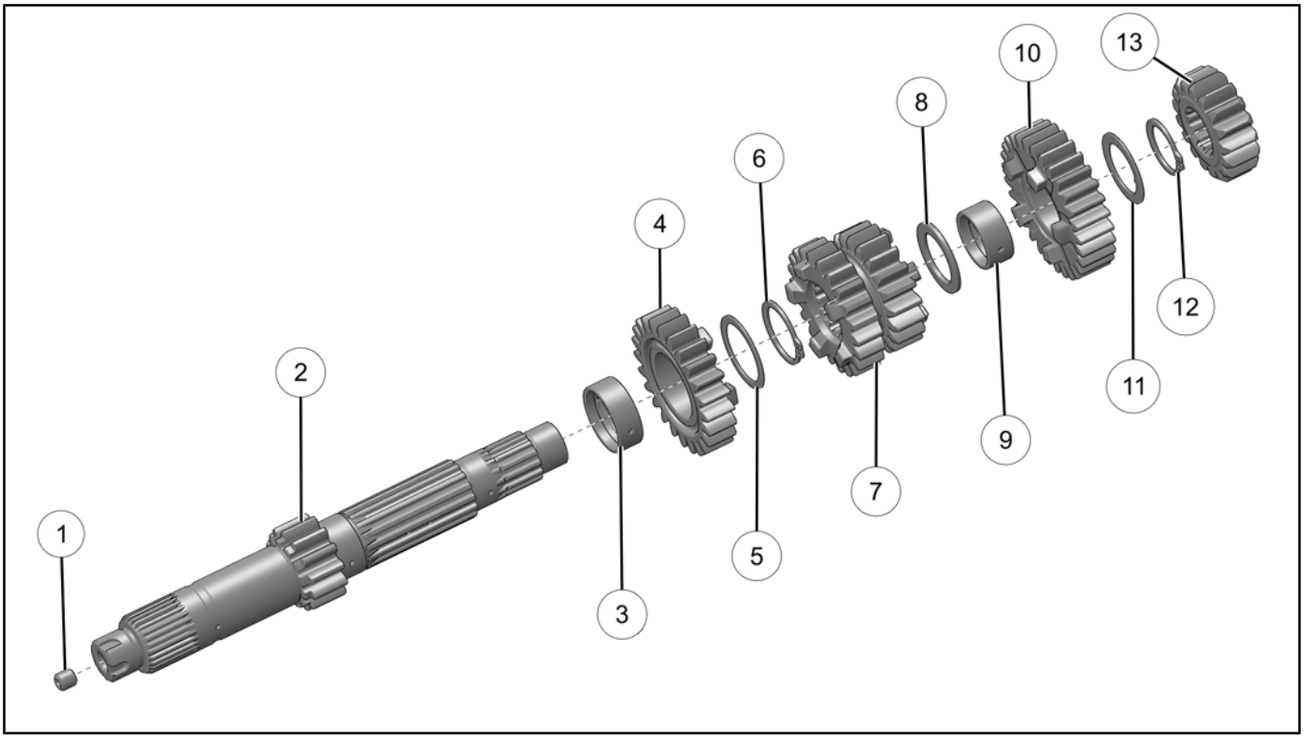
NUMBER	DESCRIPTION
①	O-Ring
②	Flat Washer
③	Output Gear, 1st
④	Plain Bushing
⑤	Flat Washer
⑥	Output Gear, 5th
⑦	External Retaining Ring
⑧	Flat Tooth Washer
⑨	Output Gear, 4th
⑩	Splined Bushing
⑪	Output Gear, 3rd
⑫	Flat Tooth Washer
⑬	External Retaining Ring
⑭	Output Gear, 6th
⑮	External Retaining Ring
⑯	Flat Tooth Washer
⑰	Plain Bushing (34mm)
⑱	Output Gear, 2nd
⑲	Output Shaft

2022 INPUT SHAFT (INASAKA)



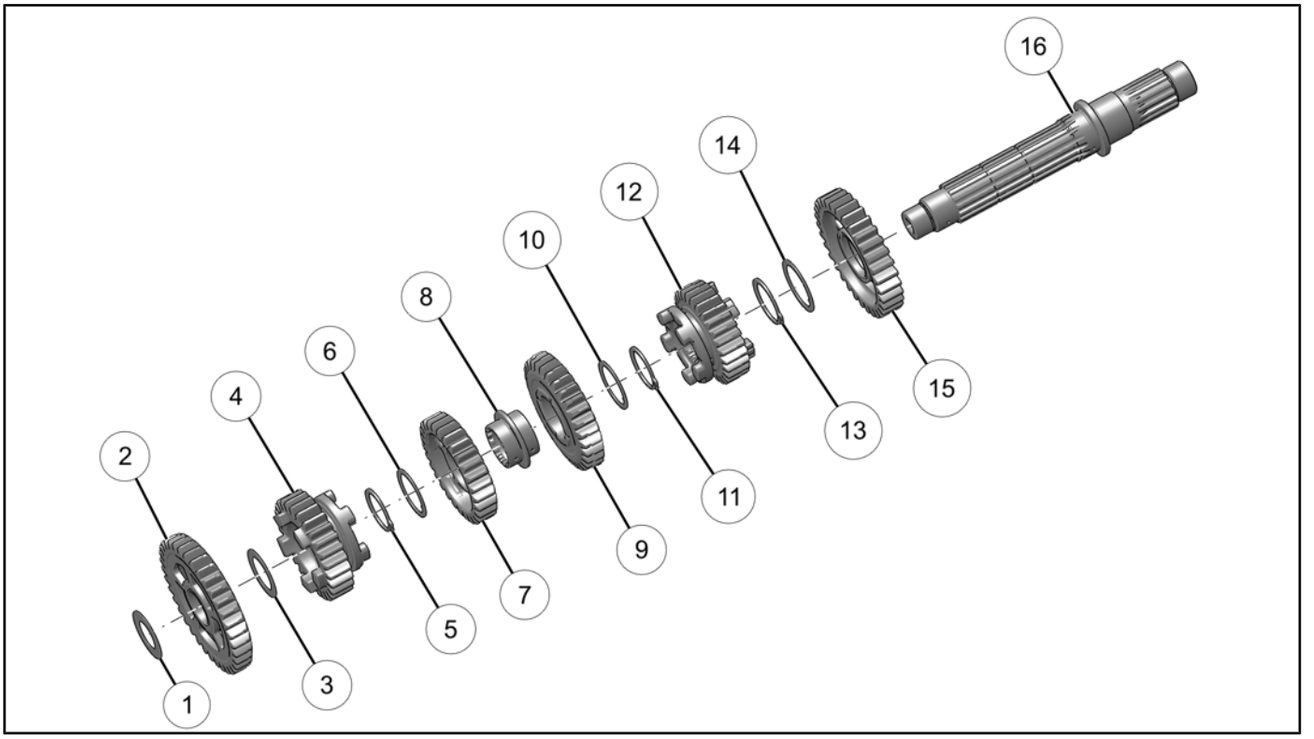
NUMBER	DESCRIPTION
①	Input Shaft Plug
②	Transmission Input Shaft
③	5th Input Gear
④	Flat Washer
⑤	Retaining Ring
⑥	3rd & 4th Input Gear
⑦	Washer
⑧	Plain Bushing
⑨	6th Input Gear
⑩	Washer
⑪	Retaining Ring
⑫	2nd Input Gear

2022+ INPUT SHAFT (MUSASHI)



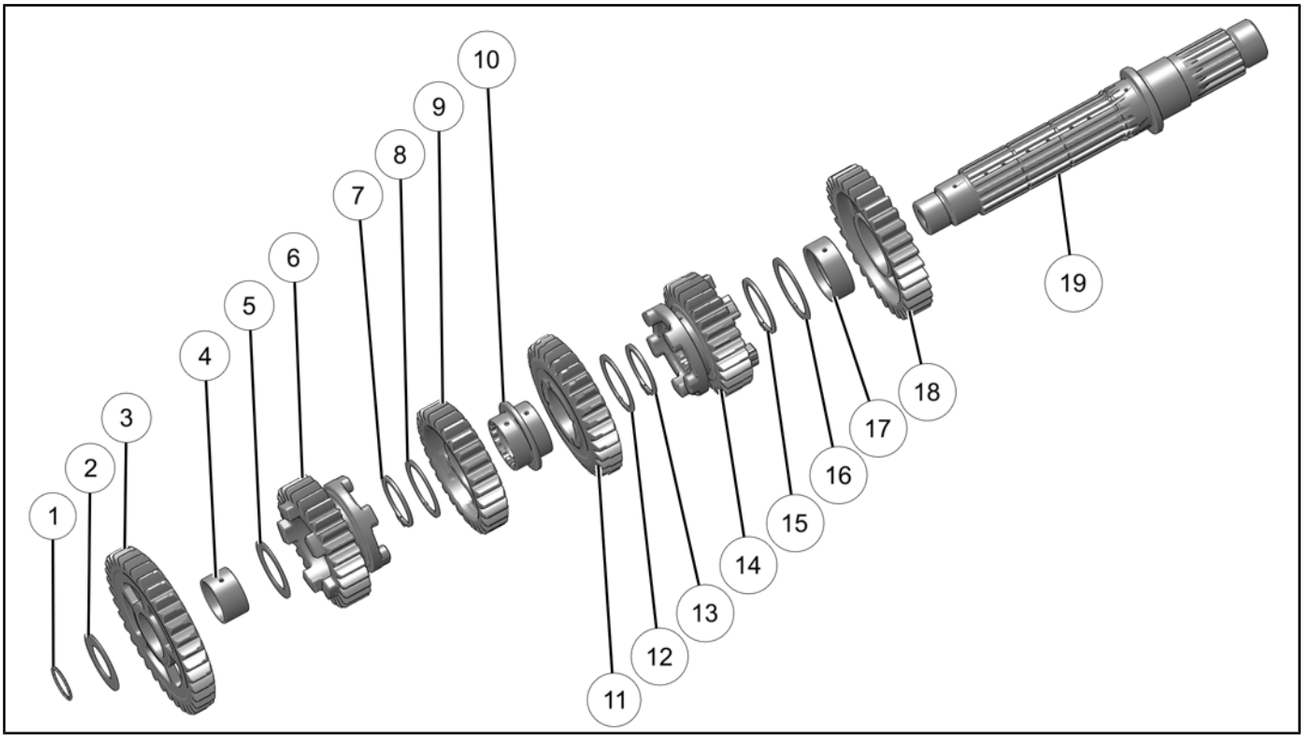
NUMBER	DESCRIPTION
①	Input Shaft Plug
②	Transmission Input Shaft
③	Bushing
④	5th Input Gear
⑤	Flat Washer
⑥	Retaining Ring
⑦	3rd & 4th Input Gear
⑧	Washer
⑨	Plain Bushing
⑩	6th Input Gear
⑪	Washer
⑫	Retaining Ring
⑬	2nd Input Gear

2022 OUTPUT SHAFT (INASAKA)



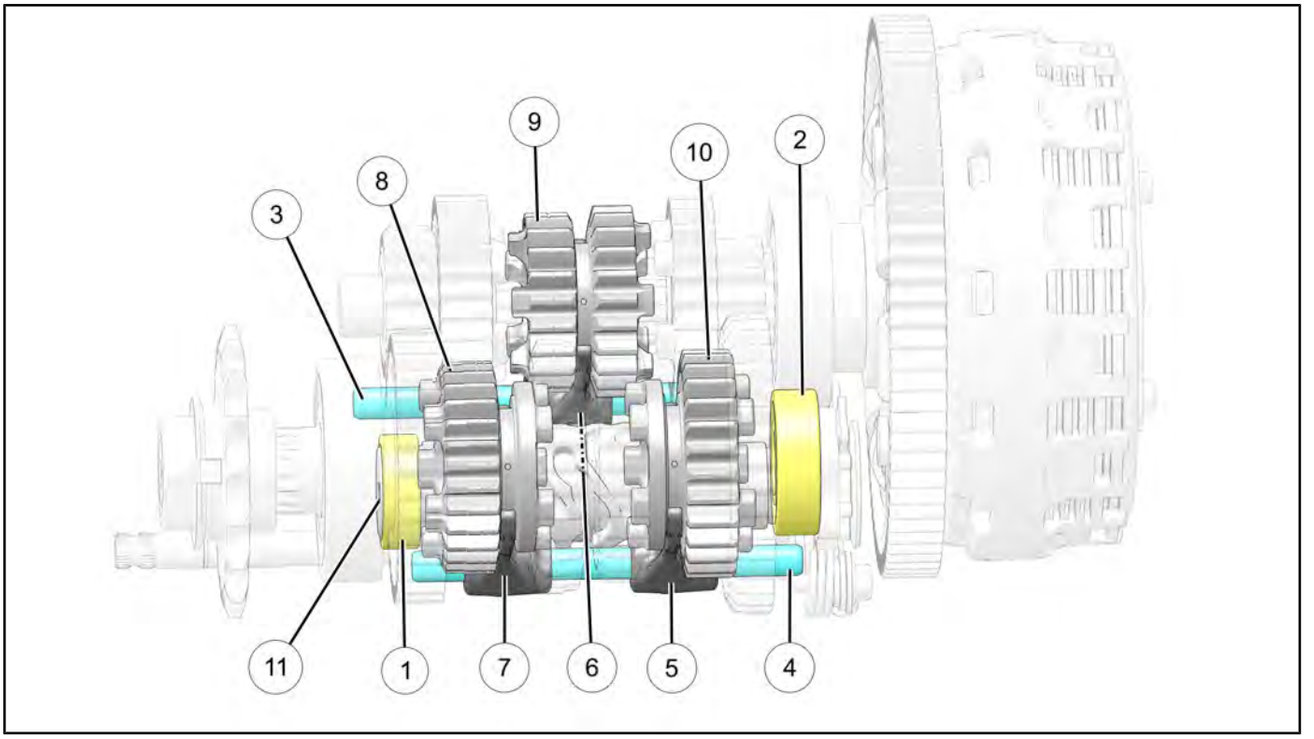
NUMBER	DESCRIPTION	NUMBER	DESCRIPTION
①	Flat Washer	⑨	3rd Output Gear
②	1st Output Gear	⑩	Flat Washer
③	Flat Washer	⑪	Retaining Ring
④	5th Output Gear	⑫	6th Output Gear
⑤	Retaining Ring	⑬	Retaining Ring
⑥	Flat Washer	⑭	Lock 1T Washer
⑦	4th Output Gear	⑮	2nd Input Gear
⑧	Splined Bushing	⑯	Transmission Output Shaft

2022+ OUTPUT SHAFT (MUSASHI)



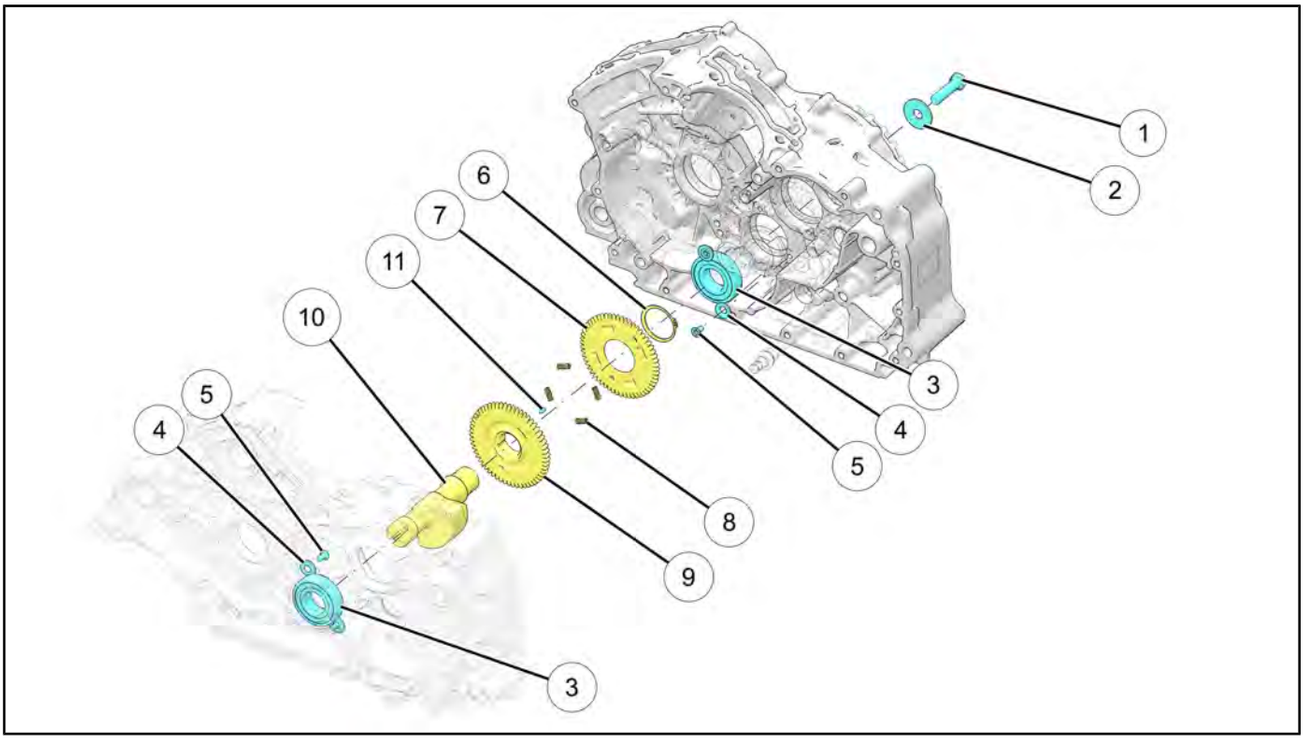
NUMBER	DESCRIPTION	NUMBER	DESCRIPTION
①	O-Ring	⑪	3rd Output Gear
②	Flat Washer	⑫	Flat Washer
③	1st Output Gear	⑬	Retaining Ring
④	Bushing	⑭	6th Output Gear
⑤	Flat Washer	⑮	Retaining Ring
⑥	5th Output Gear	⑯	Lock 1T Washer
⑦	Retaining Ring	⑰	Bushing
⑧	Flat Washer	⑱	2nd Input Gear
⑨	4th Output Gear	⑲	Transmission Output Shaft
⑩	Splined Bushing		

SHIFT DRUM / SHIFT FORK ASSEMBLY VIEW



NUMBER	DESCRIPTION
①	Bearing, Shift Drum - Drive Sprocket Side
②	Bearing, Shift Drum - Primary Side
③	Shift Rail
④	Shift Rail
⑤	Shift Fork, 1st and 4th
⑥	Shift Fork, 5th & 6th
⑦	Shift Fork, 2nd & 3rd
⑧	Gear, 6th Output
⑨	Gear, 3rd & 4th Input
⑩	Gear, 5th Output
⑪	Shift Drum

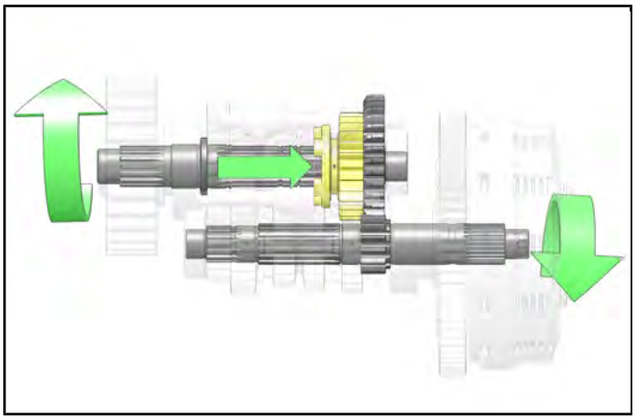
BALANCE SHAFT ASSEMBLY VIEW



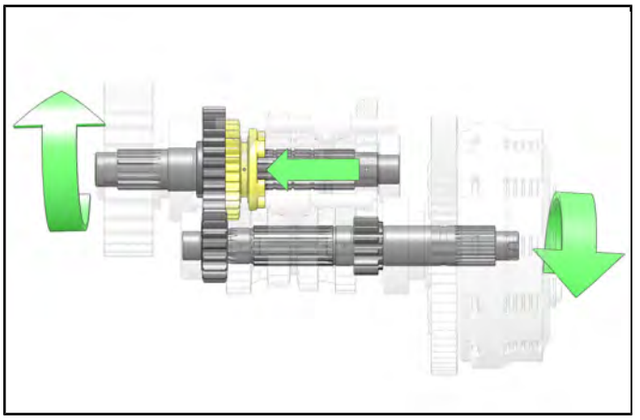
NUMBER	DESCRIPTION
①	Balance Shaft Gear Fasteners (QTY.1) **83 ft-lbs (112 N·m)**
②	Washer
③	Balance Shaft Bearings
④	Bearing Retainer Plate Washer
⑤	Bearing Retainer Plate Screws (QTY.3) **88 in-lbs (10 N·m)**
⑥	Balance shaft Snap-Ring (Inner) - Non-Serviceable
⑦	Balance Shaft Gear (Inner) - Non-Servicable
⑧	Pre-Load Springs - Non-Serviceable
⑨	Balance Shaft Gear (Outer) - Non-Serviceable
⑩	Balance Shaft
⑪	Balance Shaft Retaining Key

GEAR TRAIN POWER FLOW

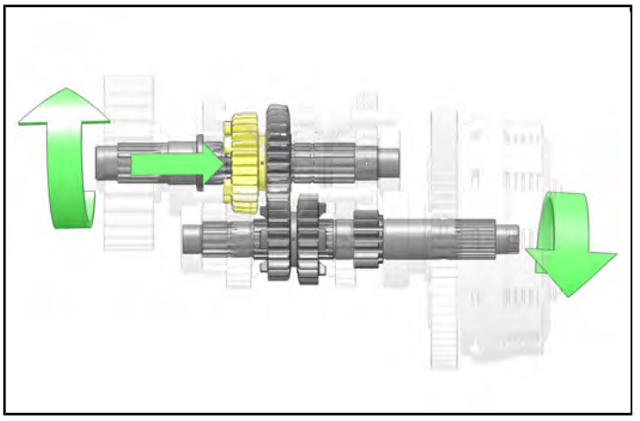
1st Gear



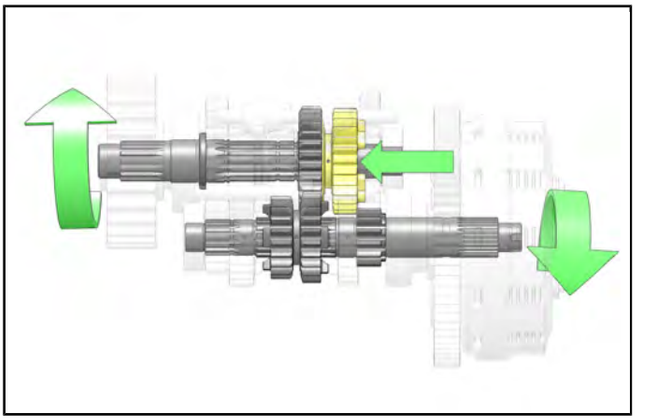
2nd Gear



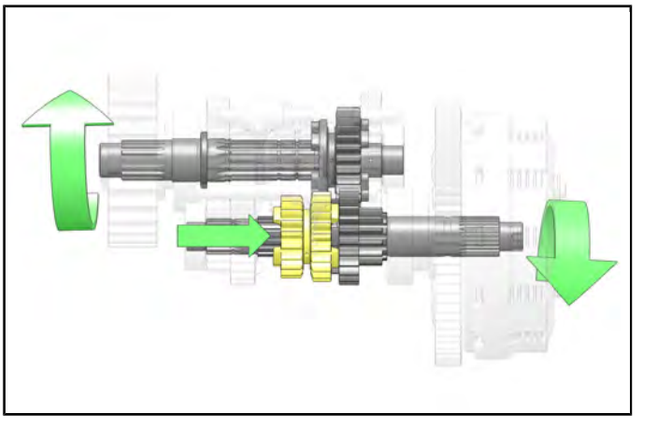
3rd Gear



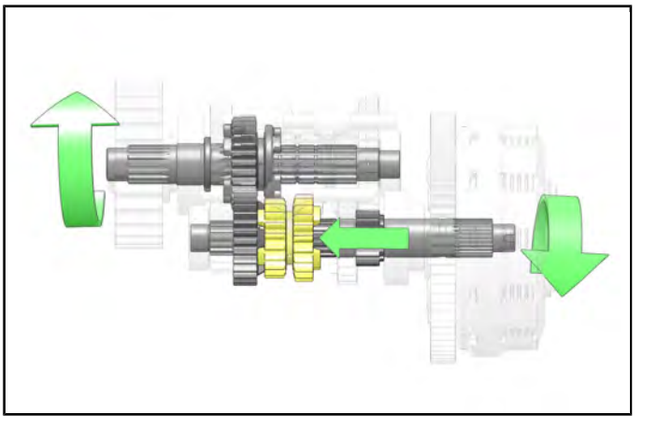
4th Gear



5th Gear



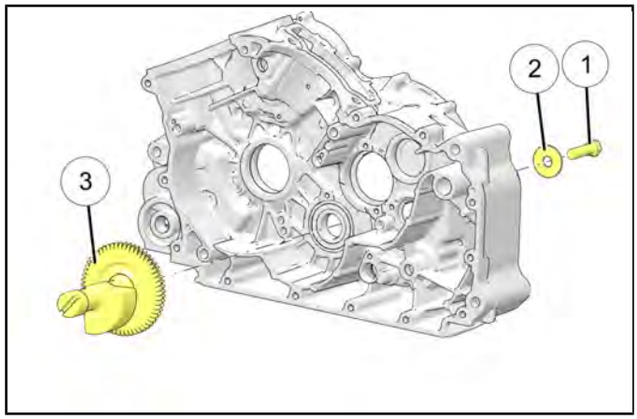
6th Gear



BALANCE SHAFT SERVICE

BALANCE SHAFT REMOVAL

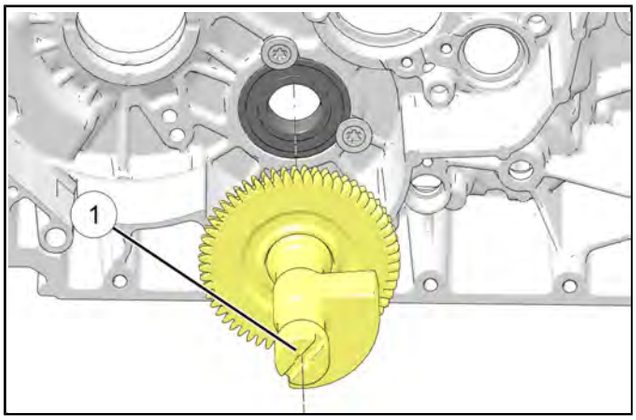
1. Remove the engine from the chassis. See **Preparation For Engine Removal page 3.20**.
2. Separate the engine cases. See **Crankcase Separation page 6.26**.
3. Remove crankshaft assembly. See **Crankshaft Removal page 6.33**.
4. Remove balance shaft retaining bolt ① and washer ②.



5. Grasp balance shaft assembly ③ and remove from right engine case assembly.
6. Inspect gear teeth for wear or damage.
7. Check balance shaft for runout.
8. Rotate right and left balance shaft bearings by hand while observing bearing rotation. Bearings should run smooth and quiet and shaft should be a snug fit in bearings.
9. Visually inspect bearings for damage.

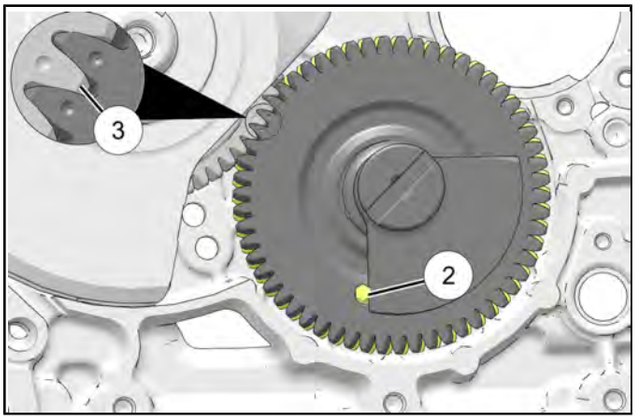
BALANCE SHAFT INSTALLATION

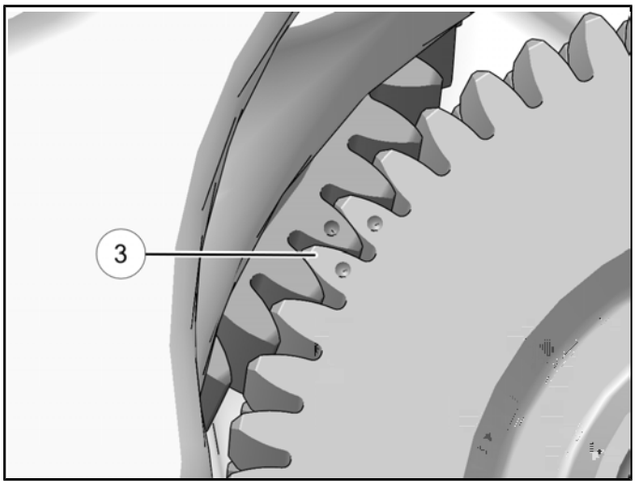
1. Lubricate balance shaft bearings with engine oil.
2. Install the balance shaft assembly ① until fully seated in bearing bore.



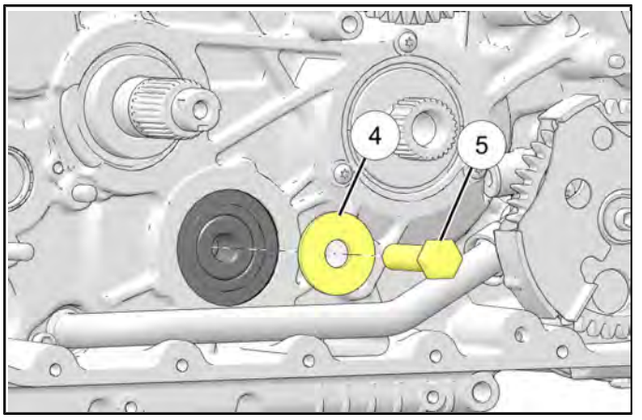
3. Preload the teeth of the split-gear on the balance shaft and lock in place with a pin punch or similar tool ②.

4. Fit the crankshaft assembly into the engine case and align the timing marks ③ on the crank and balance shaft gears as shown.





5. Install the balance shaft washer ④ and bolt ⑤. Torque to specification.



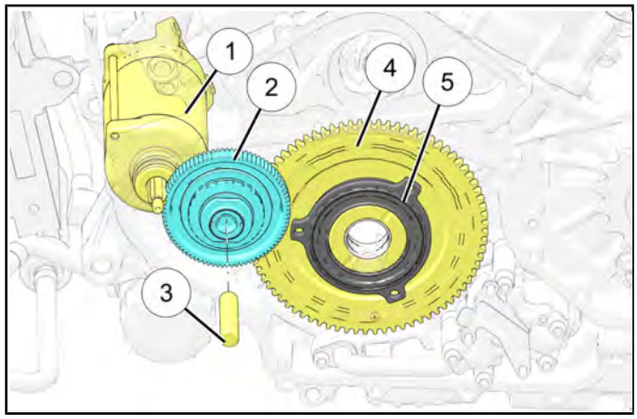
TORQUE
Balance Shaft Gear Fastener: **83 ft-lbs (112 N·m)**

6. Assemble the crankcase. See **Crankcase Assembly page 6.50**.
7. Rotate the engine to verify smooth operation and install in motorcycle chassis.

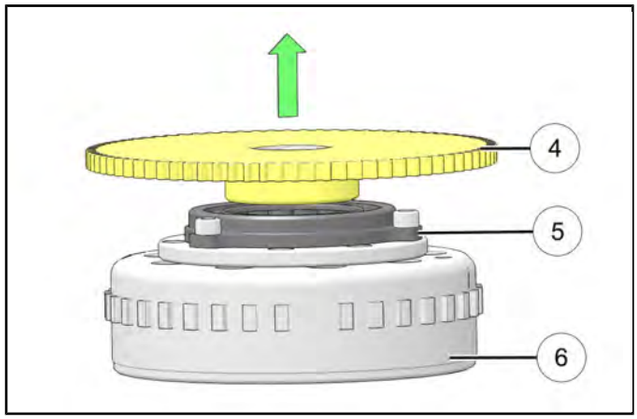
STARTER DRIVE SERVICE

STARTER DRIVE REMOVAL

1. Remove the stator cover. See **Stator Cover Removal page 5.35**.
2. Disconnect negative battery cable at battery to prevent starter motor ① from operating.
3. Slide pin ③ out of the torque limiting gear ② and remove from the engine.

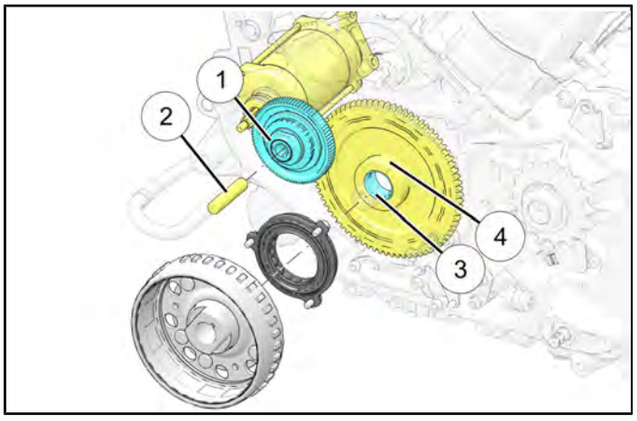


4. Remove the flywheel assembly to access the starter crank drive gear ④ and one-way clutch ⑤. See **Flywheel Removal page 5.36**.
5. Lift and rotate the starter crank drive gear ④ to remove from one-way clutch ⑤ on flywheel ⑥.

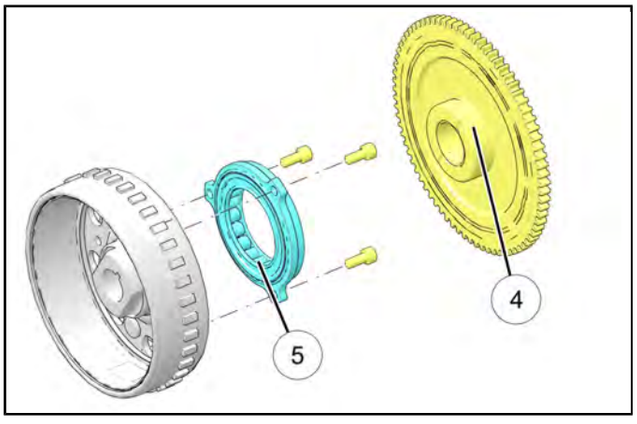


STARTER DRIVE INSPECTION

1. Inspect gear teeth for chips, cracks or excessive wear.
2. Inspect shaft surfaces ② and bushing surface in torque limiting gear ① for excessive wear and scoring.



3. Inspect bushing ③ in starter drive crank gear.
4. Inspect one-way clutch hub surfaces ④ for wear, scoring or damage.
5. Inspect one-way clutch cams ⑤ for wear, scoring or damage.



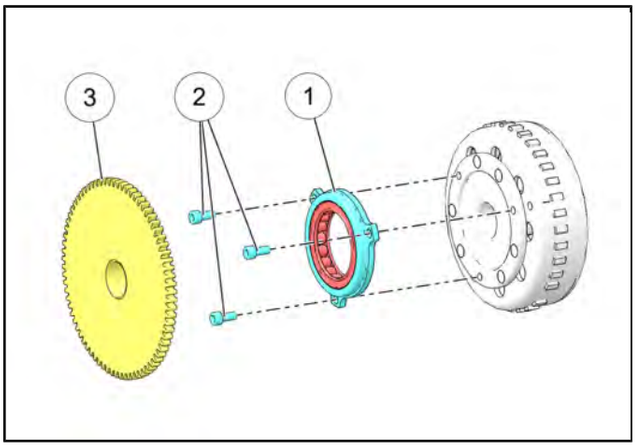
6. Replace any worn or damaged components.

STARTER DRIVE INSTALLATION

⚠ CAUTION

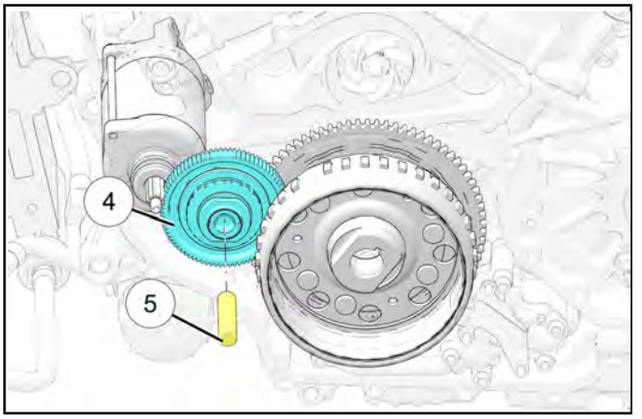
This procedure requires the replacement of a fastener, Please review the procedure to identify the fastener needed and verify it is readily avaliable before proceeding. Failure to do so can result in serious damage or failure.

1. Install one-way clutch assembly ① onto the flywheel and torque *new* fasteners ② to specification..



TORQUE
Starter Clutch Fasteners: **88 in-lbs (10 N·m)**

2. Insert the starter drive gear ③ into the one-way clutch ①.
3. For proper flywheel installation perform steps 1–5 in **Flywheel Installation page 5.37**.
4. Install the starter torque limiter gear ④ and insert shaft ⑤ into the crankcase bore.



5. Install the stator cover. See **Stator Cover Installation page 5.35**.
6. Check engine oil and fill to proper level. See **Engine Oil Level Check page 2.21**.

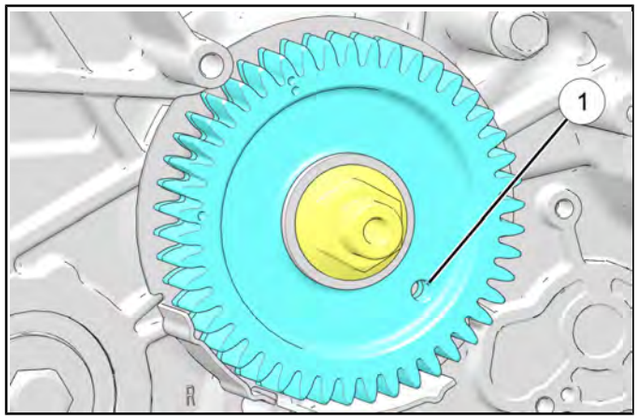
CRANKSHAFT SERVICE

CRANKSHAFT GEAR REMOVAL / INSTALLATION

IMPORTANT

This procedure requires the replacement of a fastener upon reinstallation, please review the procedure to identify the fastener needed and verify it is readily available before proceeding.

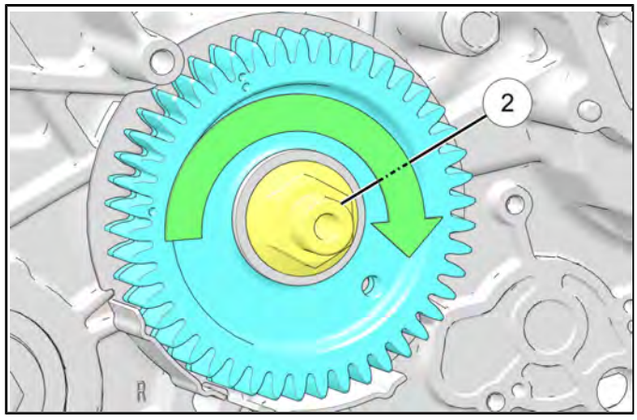
1. Lock crankshaft for service. See **Locking the Crankshaft for Service page 6.6**
2. Preload the teeth of the split-gear on the crankshaft gear and lock in place with a pin punch or similar tool ①.



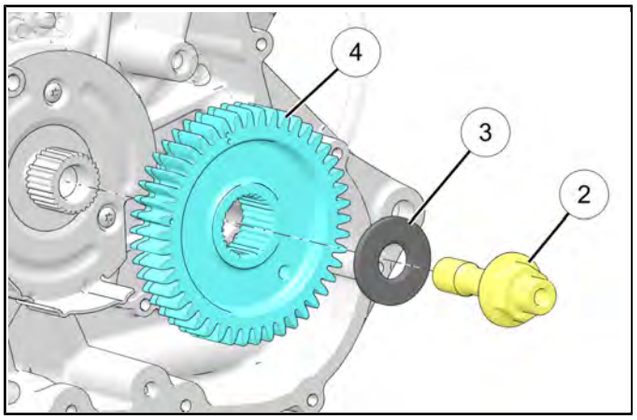
3. Remove the crankshaft spud ②.

⚠ CAUTION

The crankshaft center feed spud has left hand threads. Turn in the clockwise direction to loosen and counter-clockwise to tighten.



4. Remove the crankshaft spud ②, washer ③, and crankshaft gear ④.



5. **Installation is performed by reversing the removal procedure.**

IMPORTANT

The crankshaft gear is splined onto the crankshaft. It will only go on one way.

⚠ CAUTION

The crankshaft spud MUST be replaced upon reassembly. Failure to do so may result in serious engine damage.

⚠ CAUTION

The crankshaft center feed spud has left hand threads. Turn in the clockwise direction to loosen and counter-clockwise to tighten.

6

CRANKCASE SEPARATION

1. Drain engine oil. See **Engine Oil & Filter Change page 2.22**.
2. Drain cooling system. See **Coolant Drain / Fill page 3.44**.
3. Remove engine from frame. See **Preparation For Engine Removal page 3.20**.
4. Mount engine securely on an engine stand using Engine Stand Adapter tool **PF-51609**.
5. Remove the cam chains/chain guides. See **Cam Chain Removal page 3.82**.
6. Remove cylinder heads. See **Cylinder Head Removal page 3.92**.
7. Remove cylinders. See **Cylinder Removal page 3.109**.
8. Remove primary cover. See **Primary Cover Removal page 5.16**.
9. Remove clutch assembly. See **Clutch Removal page 5.24**.
10. Remove flywheel. See **Flywheel Removal page 5.36**.
11. Remove stator cover. See **Stator Cover Removal page 5.35**.
12. Remove the starter drive. See **Starter Drive Removal page 6.23**.
13. Remove the balance shaft driven gear and drive gear. See **Balance Shaft Removal page 6.21**.
14. Remove the drive sprocket. See **Drive Sprocket Removal page 8.81**.
15. Remove the oil filter. See **Engine Oil & Filter Change page 2.22**.
16. Remove the oil cooler adapter assembly.
17. Remove the shifter shaft assembly. See **Shift Ratchet Removal / Inspection page 5.20**

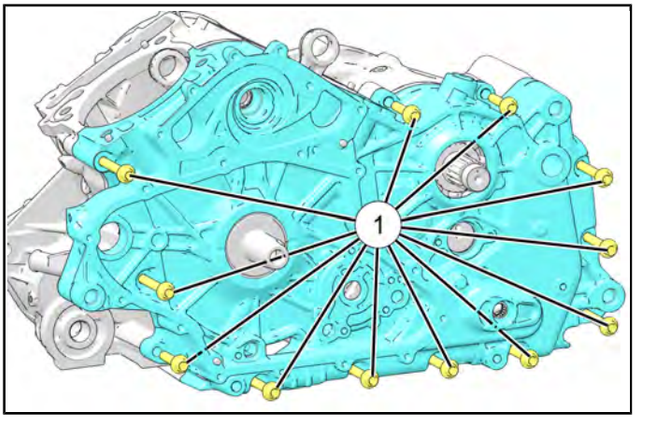
⚠ CAUTION

Severe damage to the engine cases and shift shaft assembly may occur if attempting to separate cases with shift shaft installed.

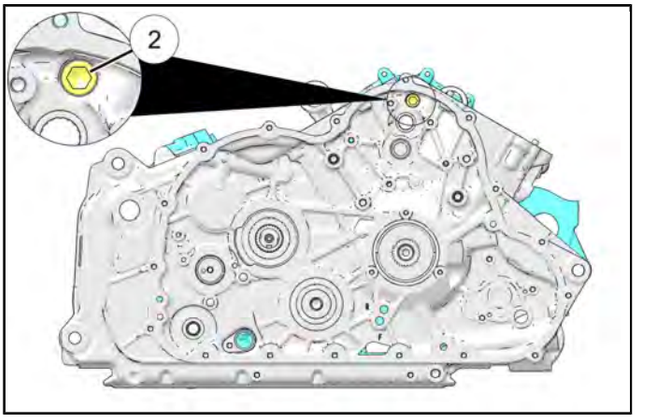
IMPORTANT

Special Tool **PF-51234-A** is required to for this procedure.

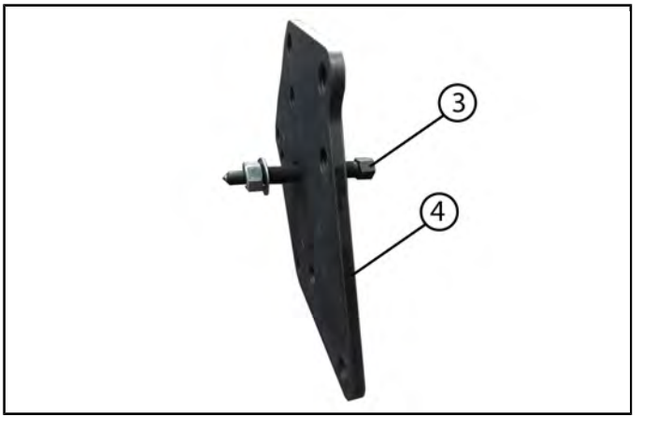
18. Remove the gear position switch. See **Sensors - Powertrain Management Components page 4.11**.
19. Remove twelve case bolts ① from left case half.



20. Remove Allen fastener ② from the right case half.



21. Rotate the engine stand so the engine is lying flat with the output shaft pointing UP.
22. Insert the case splitting center tool ③ into the un-threaded hole in the main plate ④.

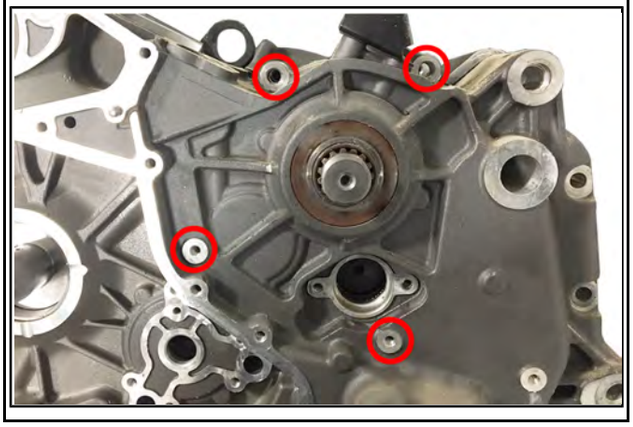


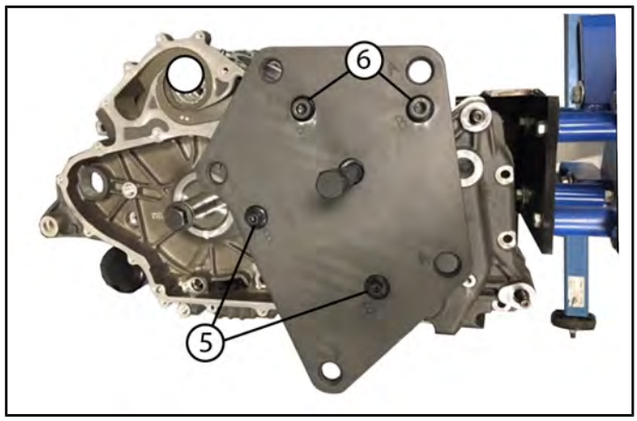
23. Install washer and nut onto center splitting tool.

24. Insert two M6 threaded spacers ⑤ with fasteners into the two lower “B” threaded holes and two M12 threaded spacers with fasteners into the upper “B” threaded holes as shown.

IMPORTANT

Ensure the main plate is orientated as shown.





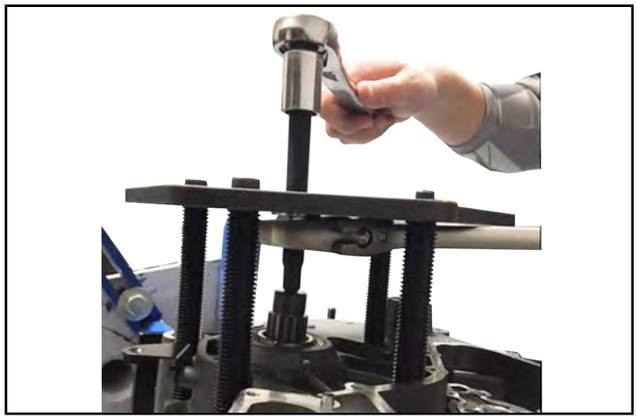
25. Tighten the fasteners.

TORQUE

Main Plate Mounting Fasteners (All):
88 in-lbs (10 N·m)

26. Tighten the nut on the center splitting tool so it is against the main plate.

27. While holding the nut with a wrench, tighten the center splitting tool to separate the case.



IMPORTANT

Ensure the case is separating evenly to prevent possible case damage.

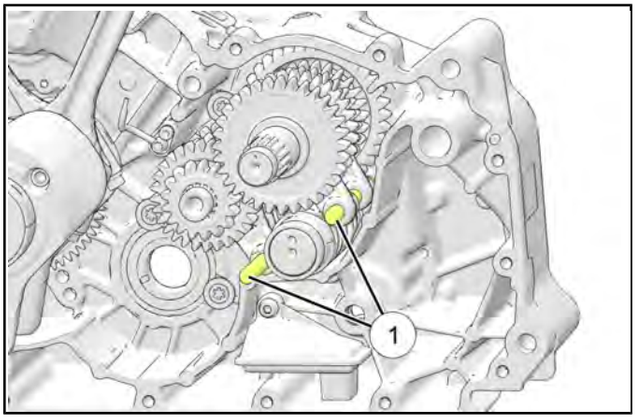
28. Using a soft-faced mallet, work around the seam of the engine cases tapping lightly to release the sealed bond.

TRANSMISSION REMOVAL

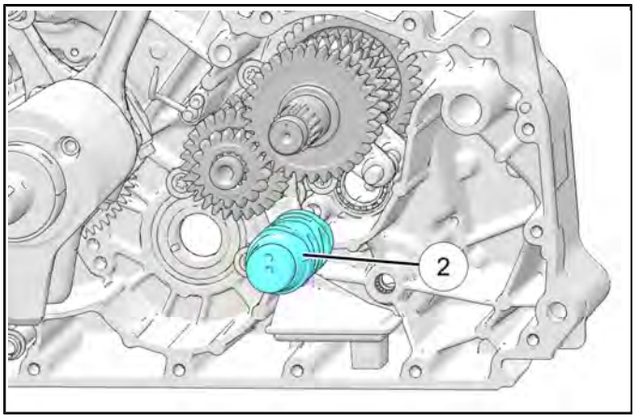
⚠ CAUTION

Gloves should be worn at all times while working on the transmission assembly to avoid personal injury.

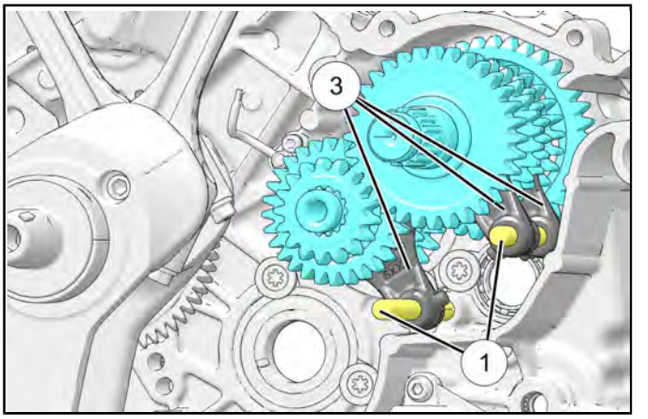
1. Remove the shift ratchet assembly. See **Shift Ratchet Removal / Inspection page 5.20**.
2. Separate engine cases. See **Crankcase Separation page 6.26**.
3. Lift both of the shift fork rails ① out of the crankcase just enough so the ends clear the crankcase bores. Rotate rails and forks away from the shift drum.



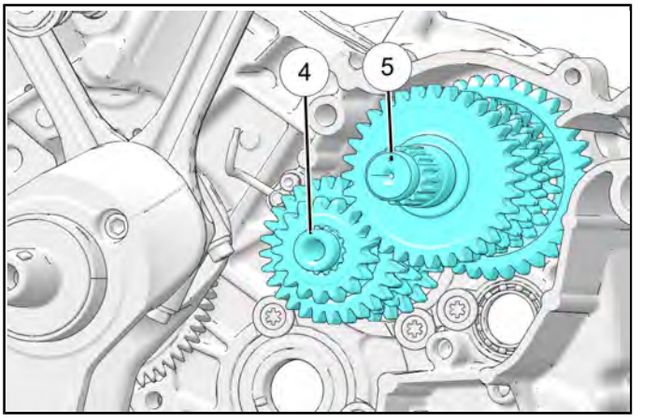
4. Lift the shift drum ② out of the bearing.



5. Remove shift rails ① and shift forks ③.

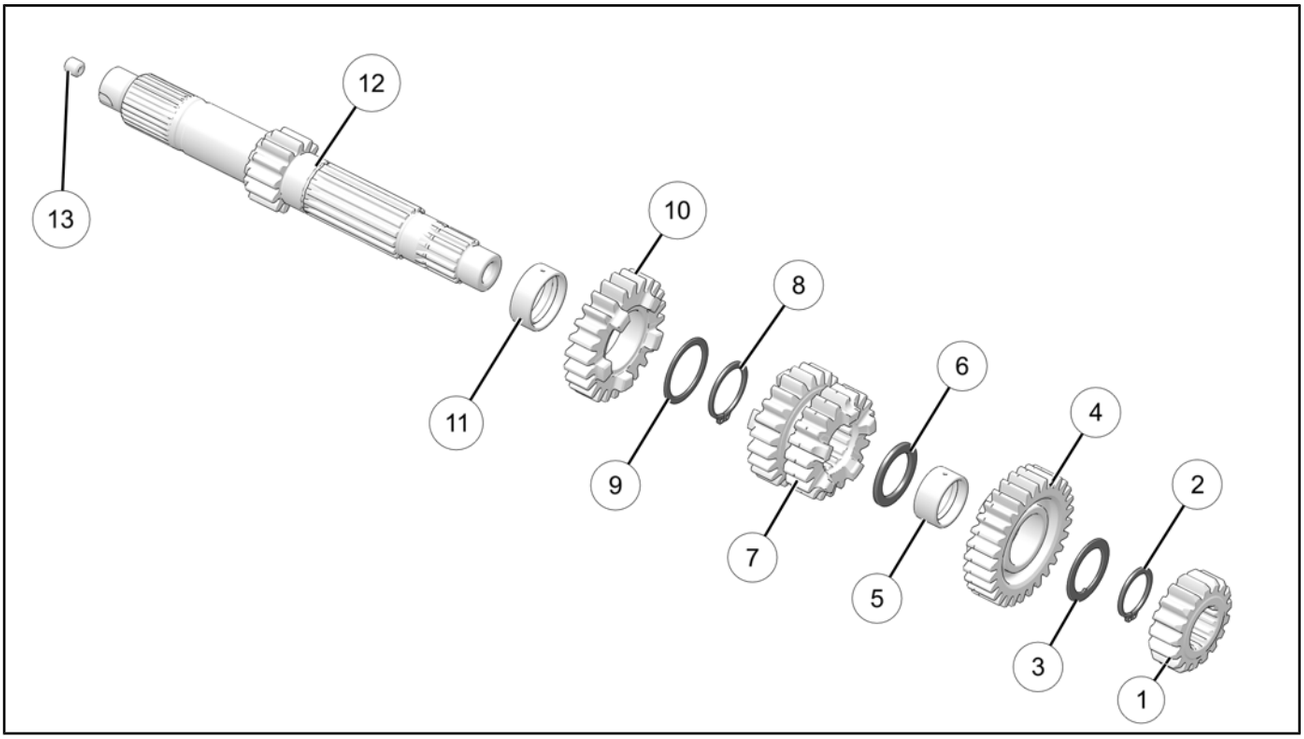


6. Remove input shaft ④ and output shaft ⑤.



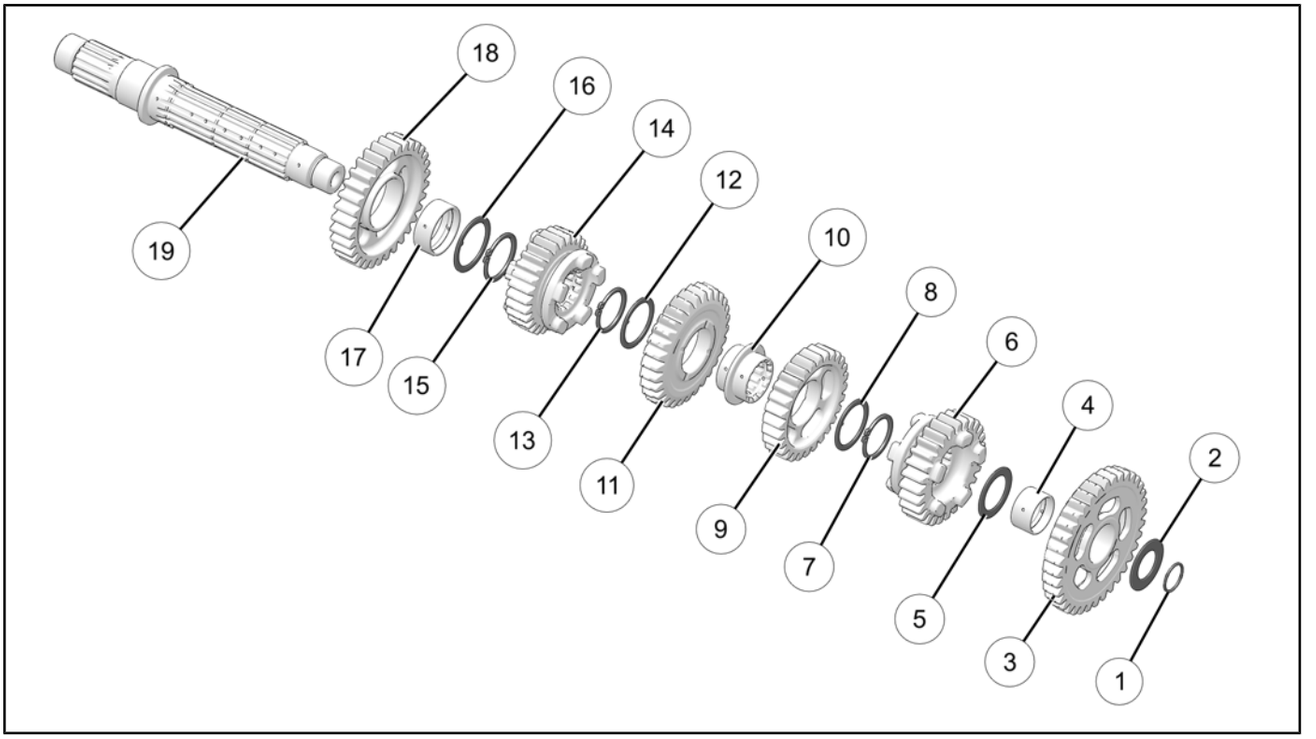
TRANSMISSION INSPECTION

Input Shaft



NUMBER	MEASUREMENT LOCATION	SPECIFICATION
①	Gear, 2nd - Input	OD: 50.80 - 51.00 mm ID: 28.000 - 28.021 mm
②	Retaining Ring, External	24 mm
③	Shim	24.4 x 34 x 1 mm
④	Gear, 6th - Input	OD: 70.384 mm - 70.584 ID: 28.000 - 28.021 mm
⑤	Bushing	24 x 28 mm
⑥	Shim	25 x 34 x 2 mm
⑦	Gear, 3rd & 4th - Input	OD: 57.665 - 57.865 mm ID: 44.15 - 44.55 mm
⑧	Retaining Ring, External	28 mm
⑨	Washer, Flat	28 x 35 mm
⑩	Gear, 5th - Input	OD: 68.639 - 68.727 mm ID: 52.43 - 52.83 mm
⑪	Bushing	28 x 32 mm
⑫	Shaft, Input & 1st Gear	–
⑬	Oil Plug Transmission Input Shaft	**159 in-lbs (18 N·m)**

Output Shaft



NUMBER	MEASUREMENT LOCATION	SPECIFICATION
①	O-Ring	17.5 x 1.5 mm
②	Flat Washer	20.4 x 35 x 0.08 mm
③	Gear, 1st, Output	OD: 96.75 – 97.25 mm ID: 27.00 – 27.021 mm
④	Plain Bushing	OD: 26.96 – 26.98 mm ID: 24.02 – 24.04 mm
⑤	Flat washer	24.4 x 35 x 0.08 mm
⑥	Gear, 5th, Output	OD: 73.50 – 73.70 mm ID: 59.235 – 59.635 mm
⑦	External retaining ring	28 mm
⑧	Flat tooth washer	28 x 35 mm
⑨	Gear, 4th, Output	OD: 75.60 – 75.80 mm ID: 31.00 – 31.015 mm
⑩	Splined Bushing	OD: 56.55 – 56.95 mm ID: 31.00 – 31.015 mm
⑪	Gear, 3rd, Output	OD: 80.30 – 80.50 mm ID: 31.00 – 31.015 mm
⑫	Flat tooth washer	28 x 35 mm
⑬	External retaining ring	28 mm
⑭	Gear, 6th, Output	OD: 63.98 – 64.02 mm ID: 31.00 – 31.015 mm
⑮	External retaining ring	30 mm

NUMBER	MEASUREMENT LOCATION	SPECIFICATION
⑯	Flat tooth washer	30 x 38 mm
⑰	Plain Bushing	34 mm
⑱	Gear, 2nd, Output	OD: 87.30 – 87.50 mm ID: 34.000 – 34.025 mm
⑲	Shaft, Output	-

NOTICE

Refer to the Assembly View section in this chapter for component locations and exploded diagrams. See Transmission Assembly View page 6.12 .

Refer to the Service Specifications section in this chapter for complete transmission specifications. See Service Specifications - Transmission / Crankshaft page 6.4.

Shafts

1. Measure outside diameter of shafts and bearing areas for wear and concentricity. Look closely at splines for wear. Inspect ends of shafts for signs of wear:
   - Dull finish
   - Discoloration
   - Rough or uneven surface
   - Measurement outside of specification

Gears

2. Visually inspect:
   - Gear internal splines
   - Gear teeth
   - Gear dogs for rounding, cracks, chips
   - Gear dog slots for rounding
   - Bearing surfaces
   - Shift fork grooves

   Check each gear for damage, cracks, wear (rounding of dogs or surfaces), or discoloration.

Shift Forks, Shift Fork Rails

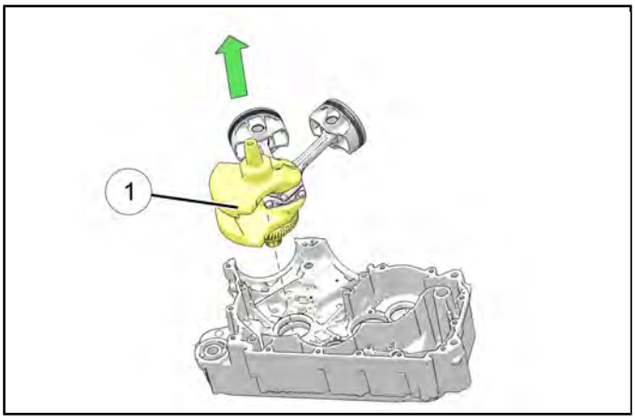
3. Inspect all contact surfaces of each shift fork. Replace a shift fork if any part is discolored (overheated), unusually scored, warped, or worn beyond service limit.
4. Inspect each shift fork pin for wear or damage and compare to specifications.
5. Inspect shift fork rails for wear, scoring, or runout.
6. Measure shift fork rail O.D. for wear in 3 or 4 places along the length. The rail O.D. should be consistent over the entire length.
7. Slide rails into crankcase holes and check for a good snug fit.
8. Visually inspect the shift drum bearing in the left crankcase for wear or damage. The bearing must be fully seated in the case and held in position by the retaining plate. Replace the bearing if it is loose in the bore, or if any side play is detected.
9. Temporarily install shift drum into bearing and rotate, checking for smooth bearing operation.

Shift Drum

10. Inspect shift drum grooves for wear. Pay close attention to corners of grooves where forks change direction.
11. Inspect surface of shift drum star for excessive wear or damage.
12. Inspect right side shift drum bearing.
13. Temporarily install shift drum in right hand case bearing and inspect fit. Spin drum to check for smooth bearing operation.

CRANKSHAFT REMOVAL

1. Separate Right-Hand crankcase from Left-Hand case. See **Crankcase Separation page 6.26**.
2. Lift crankshaft assembly ① straight up until clear of right side engine case.

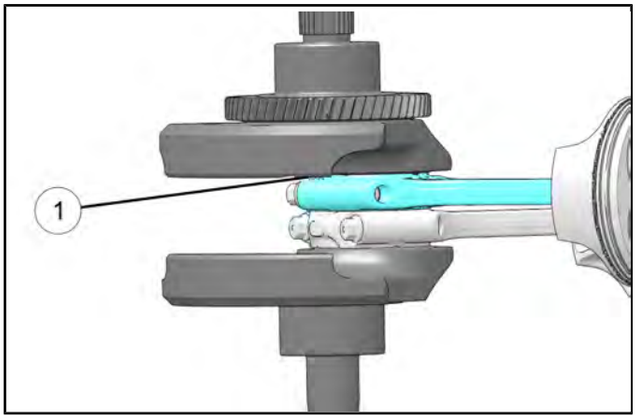


⚠ CAUTION

Connecting rod bearings and main bearings are easily damaged. Be careful not to cause damage to these parts when servicing items within the crankcase.

CONNECTING ROD SIDE CLEARANCE INSPECTION

1. Move connecting rods to one side of crankshaft. Insert a feeler gauge ① between one connecting rod and the crankshaft. Compare measurement to specification outlined in this chapter. See **Service Specifications - Transmission / Crankshaft page 6.4**.



2. If clearance recorded exceeds service limit, the crankshaft, connecting rod or both must be inspected and worn parts replaced. See **Crankshaft Inspection page 6.39**.

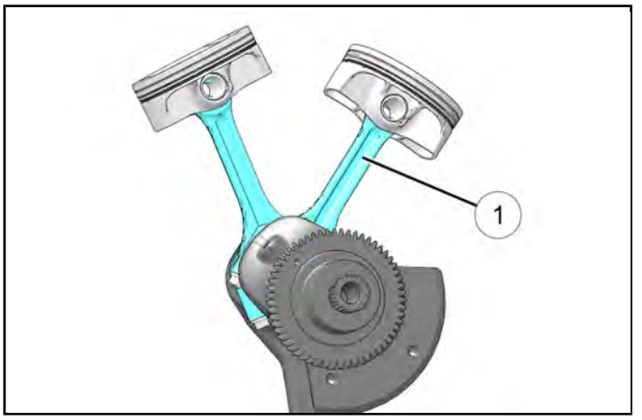
6

CONNECTING ROD REMOVAL / IDENTIFICATION

IMPORTANT

The connecting rod caps are marked with paint from the factory, however it is recommended that an additional reference mark be added for clarity. **Caps are matched to rods and MUST be installed with the proper orientation left to right and front to back.** DO NOT strike or stamp the connecting rod.

1. Use a permanent marker to mark orientation of connecting rods and rod bearing caps. **These parts MUST be installed in their original locations.** EXAMPLE: Right connecting rod must be assembled on the right side with the bearing cap that was removed from it. The bearing cap and connecting rod must be assembled in the same direction as it was removed using a **NEW bolt.**
2. Mark the outside of both connecting rods ① prior to removal so they can be assembled in the same direction in relation to the crankshaft.



3. Remove connecting rod bolts and connecting rod bearing caps.

IMPORTANT

It may be necessary to lightly tap the caps with a plastic mallet to loosen them.

⚠ CAUTION

The mating surface of connecting rod and cap is rough in appearance, which is a normal condition due to the manufacturing process. If rod caps are installed *incorrectly* and tightened, the precision mating surfaces will be damaged. Replace the connecting rod assembly if mating surfaces are damaged.

CONNECTING ROD INSPECTION (BIG END)

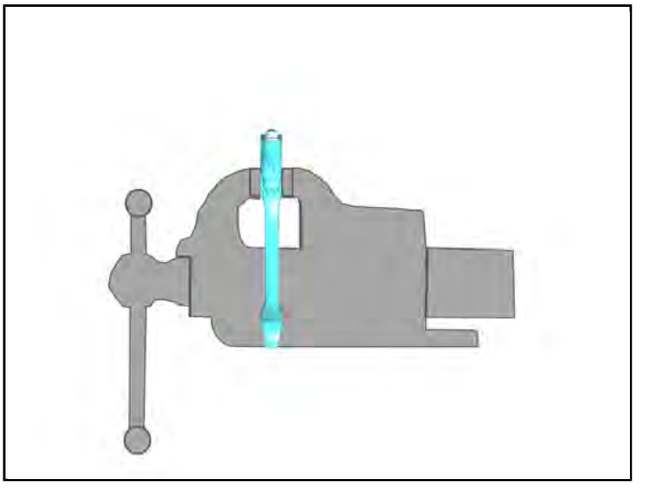
⚠ CAUTION

Connecting rod bolts are torque to yield fasteners and must be replaced if removed. Failure to replace can result in severe engine damage.

1. Refer to **Piston Pin / Pin Bore Inspection page 3.113** for connecting rod small end inspection.

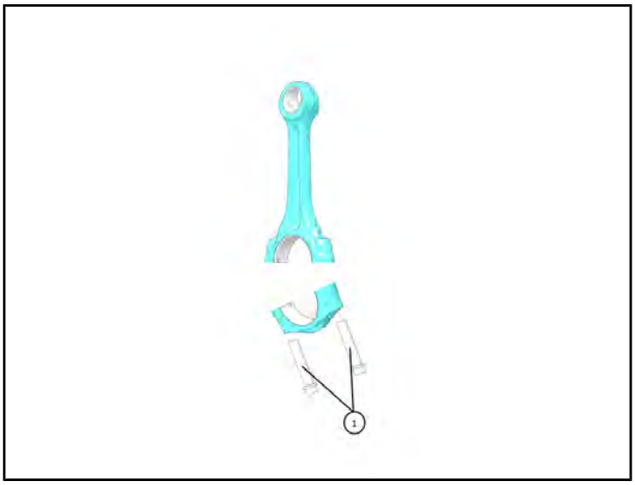
⚠ CAUTION

Be sure to match connecting rod caps with their respective rod and orient the cap properly before installing the cap. Secure the big end of rods in a vise equipped with soft, protective jaws before torquing rod bolts.



2. Remove bearings and install caps on connecting rods. Be sure mating surfaces ① of rod and cap are clean.

3. Apply engine oil to threads of rod bolts. Torque bolts to specification.

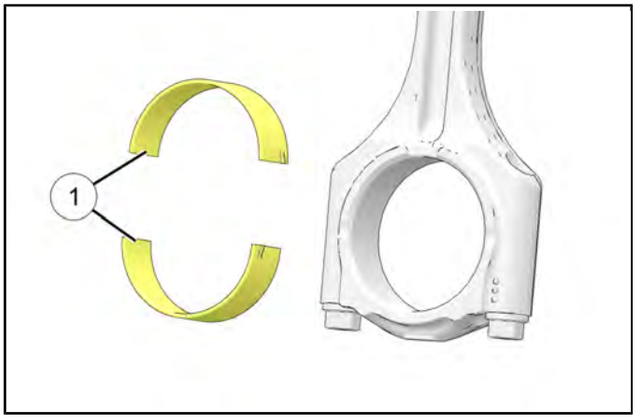


TORQUE
Connecting Rod Fasteners: **Step 1: Torque both fasteners to 22 ft-lbs (30 N·m)** **Step 2: Tighten both fasteners an additional 90°**

4. Measure I.D. of connecting rod big end for size and out of round and compare to specification. See **Service Specifications - Transmission / Crankshaft page 6.4**.
5. Visually inspect connecting rod upper and lower ends for scoring, damage, or excessive wear.

CONNECTING ROD BEARING INSPECTION

- Inspect bearing inserts ① for unusual wear, peeling, scoring, damage etc. Replace as a set if damage is noted. Inspect bearing clearance and refer to Bearing Selection Chart. See **Connecting Rod Bearing Selection page 6.37**.



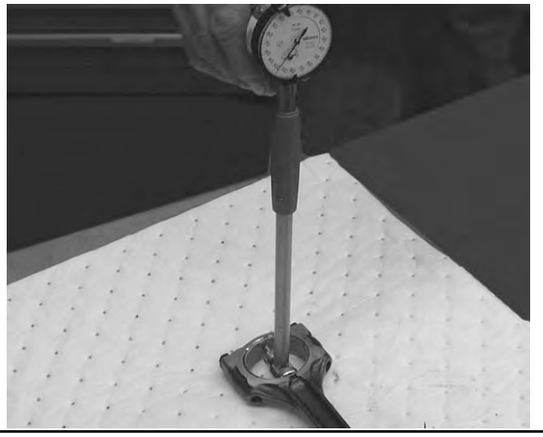
6

CONNECTING ROD BEARING CLEARANCE INSPECTION

1. Assemble the connecting rod cap with bearings and torque to specification.

TORQUE
Connecting Rod Fasteners: **Step 1: Torque both fasteners to 22 ft-lbs (30 N·m)** **Step 2: Tighten both fasteners an additional 90°**

2. Measure the connecting rod big end bearing I.D. with a dial bore gauge and record.



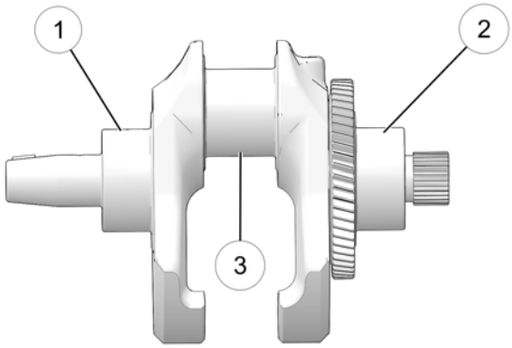
3. Measure the connecting rod journal on crankshaft and record.
4. Subtract the journal diameter from the connecting rod bearing diameter to calculate oil clearance and compare to specification. See **Service Specifications - Transmission / Crankshaft page 6.4**.
5. If service limits are exceeded, install new rod bearings and recheck oil clearance.
6. If service limits are still exceeded, determine if crankshaft or connecting rods need to be replaced.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

CONNECTING ROD BEARING SELECTION

1. Two different dimension crankshafts were used. Identify the crankshaft by part number and use the corresponding chart for bearing selection.

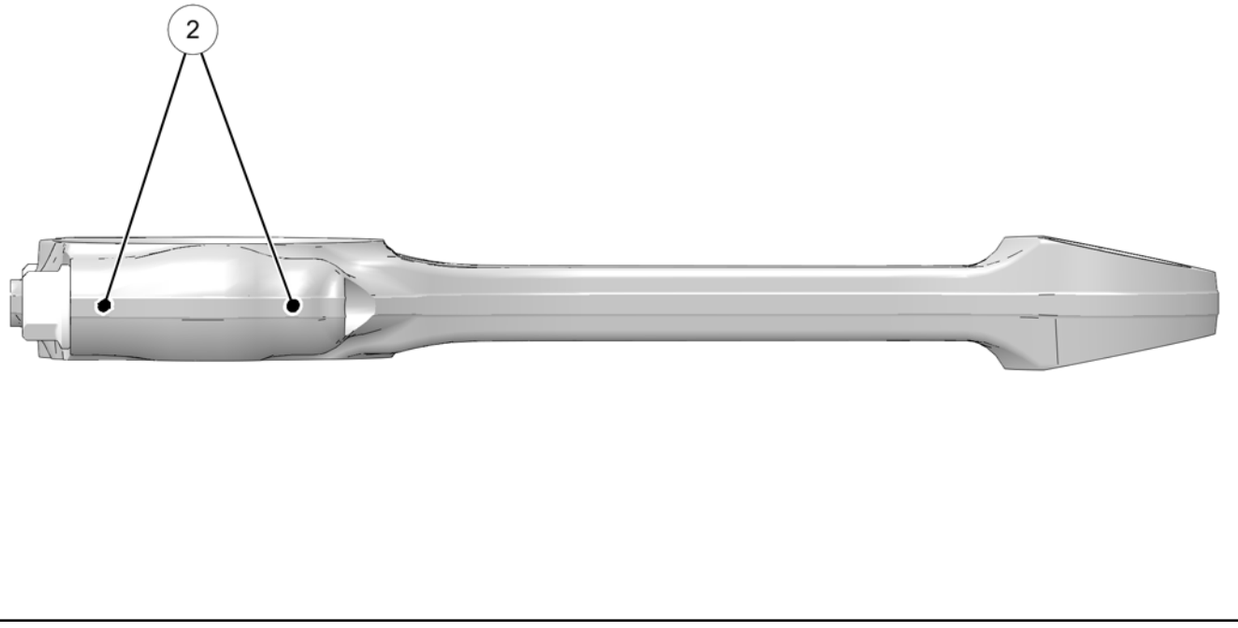
   Locate the label on the crankshaft counter weight. The top three letters designate the letter to its applicable bearing surface.



- The first digit ① designates the stator side main bearing color. (R in this example).
- The second digit ② designates the clutch side main bearing color. (W in this example).
- The third digit ③ designates the rod bearing color. (W in this example).

2. There are 3 sizes of connecting rod bearings available: Black, yellow and Blue (see chart below).
3. To determine which bearing to use, look at the color code on the left crankshaft counterweight “R” for Red or “W” for White. The letter will be etched onto the outer surface of the counterweight.

4. The color code on the connecting rod is laser etched onto the big end side of the connecting rod. There will be an “R” for Red or “W” for White.



② reads:
Last Digit
“W” = WHITE
“R” = RED
Example: 12345W

5. Refer to the chart below to select the proper bearing insert.

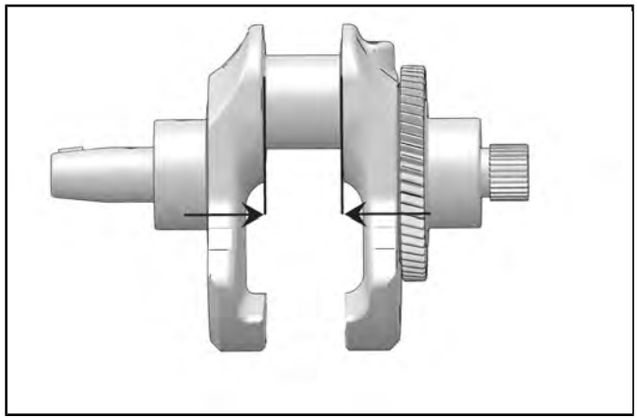
   FOR EXAMPLE: If the CONNECTING ROD grade is RED and the CRANKSHAFT stamp is W (white) , use BLACK bearing inserts.

CONNECTING ROD BEARING SELECTION CHART FOR CRANKSHAFT PN 3023328				
Connecting Rod Color	**Crankshaft Color**	**Bearing Color**	**Part Number**	**Reference Clearance**
White	Red	Blue	3515027–001	0.0015–0.0024 Inches 0.038–0.062 mm
White	White	Yellow	3515027–002	
Red	Red	Yellow	3515027–002	
Red	White	Black	3515027–003	

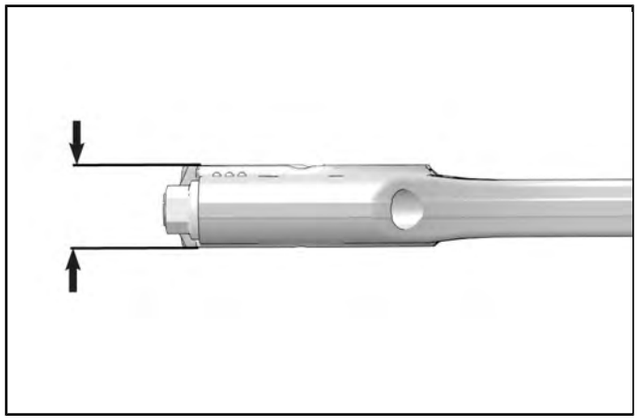
CRANKSHAFT INSPECTION

Record all measurements and compare to specifications. Replace crankshaft if any measurement is worn beyond the service limit. See **Service Specifications - Transmission / Crankshaft page 6.4**.

1. Measure the width of the rod bearing journal.



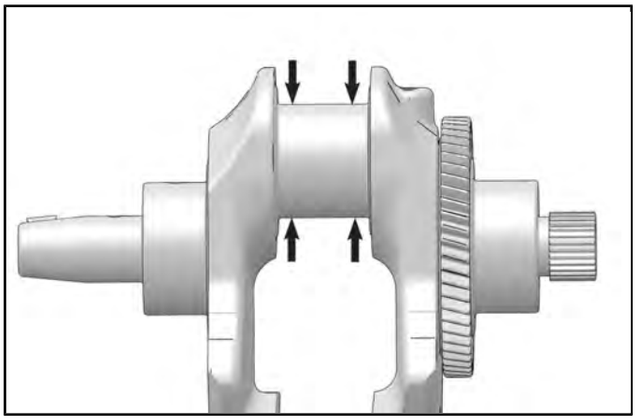
2. Measure width of connecting rods at big end.



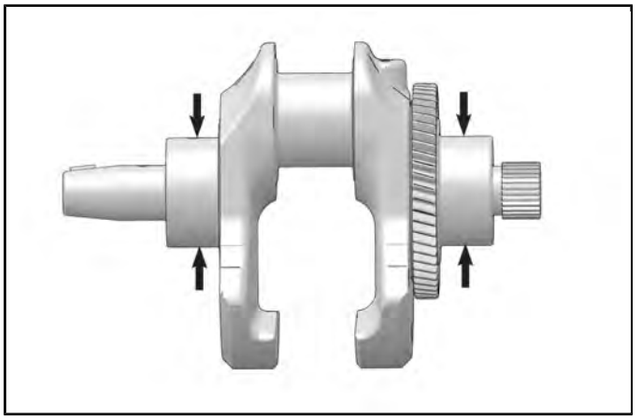
3. Visually inspect all bearing journals for scoring, damage or excessive wear.

4. Crankshaft and connecting rods are identified by color. Be sure to compare measurements to specifications for the proper color (or non-marked) connecting rod or crankshaft.

   Measure O.D. of crankshaft rod journal in four places and compare to specifications.



5. Measure O.D. of main bearing journals.

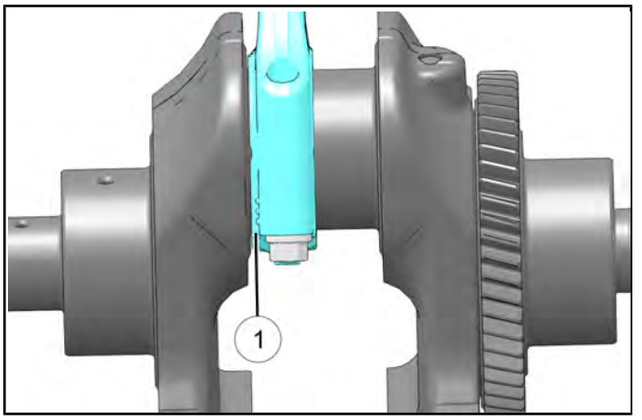


CONNECTING ROD INSTALLATION

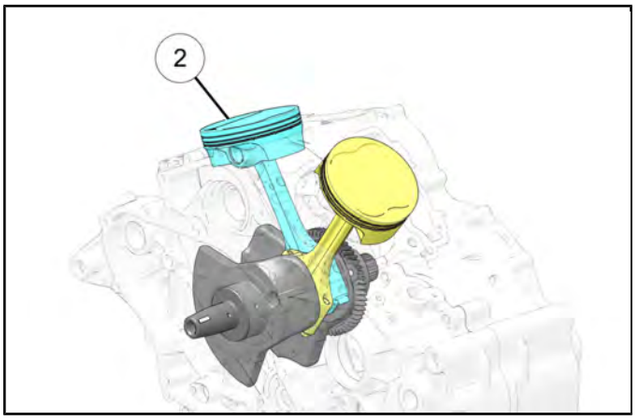
1. Make sure proper bearing clearance is achieved by using the correct colored bearing insert for a given color combination of connecting rod and crankshaft.
2. Clean all oil off connecting rod, connecting rod cap and bearing inserts with isopropyl alcohol.
3. Install bearing inserts into connecting rods and caps. First, install bearing tab into groove, then press the rest of the bearing into place.

IMPORTANT
Procedure during disassembly called for marking of connecting rods and caps. Ensure that each part is installed in original location including rod cap bolts.

4. Apply moly grease to connecting rod bearings and crank pin.
5. Install rods and caps onto the crankshaft. Ensure the chamfered side ① is facing outward.



6. Ensure the primary side connecting rod ② is angled toward front of the engine and the stator side connecting rod is angled toward the rear of the engine.



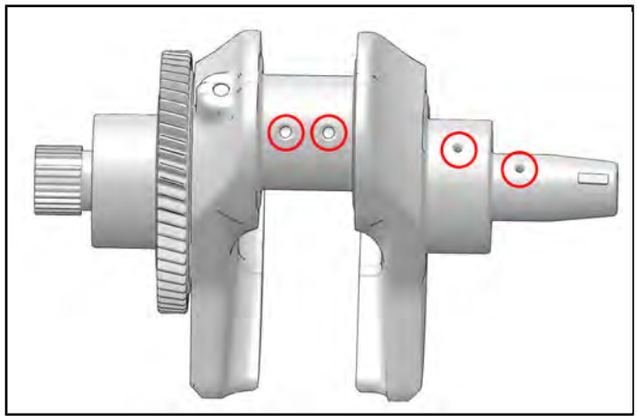
7. Tighten rod fasteners:

TORQUE
Connecting Rod Fasteners: **Step 1: Torque both fasteners to 22 ft-lbs (30 N·m)** **Step 2: Tighten both fasteners an additional 90°**

8. Check that the connecting rods rotate smoothly and freely on crankshaft journal.

CRANKSHAFT CLEANING

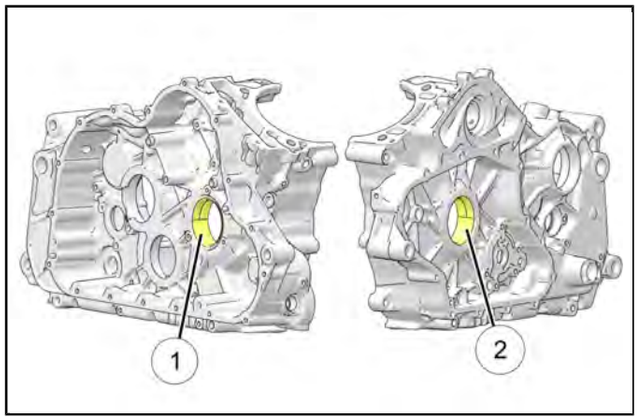
1. Pass cleaning solvent through the oil passages to ensure that passages are clear.



2. After cleaning passages, verify crankshaft journals and oil passage openings are free of debris.

MAIN BEARING INSPECTION

1. Inspect crankcase main bearing surfaces for wear, peeling, scoring, or damage.
2. Inspect alignment of bearing lubrication hole in right case half ① and left case half ②. Holes must be aligned with their respective oil passage in crankcase.

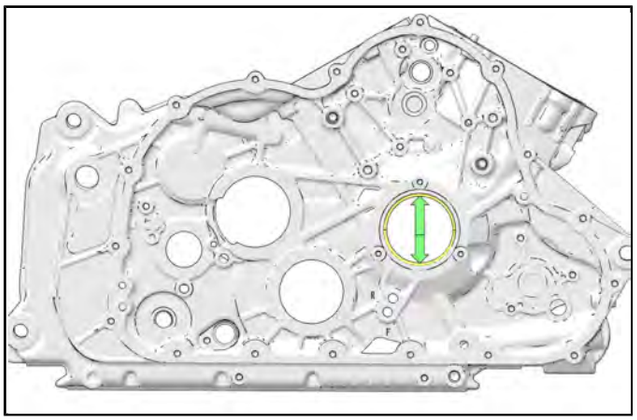


NOTICE

Check the location of the bearing split line and ensure the bearing depth is even.

MAIN BEARING OIL CLEARANCE INSPECTION

1. Measure main bearing I.D. with a dial bore gauge for right and left side. Compare to specification. Subtract crankshaft main journal diameter from main bearing diameter to calculate oil clearance. See **Service Specifications - Transmission / Crankshaft page 6.4**.



2. If crankshaft dimensions are within tolerances and oil clearances are incorrect, the bearing shells must be replaced.

IMPORTANT

Replace bearing shells as a set.

6

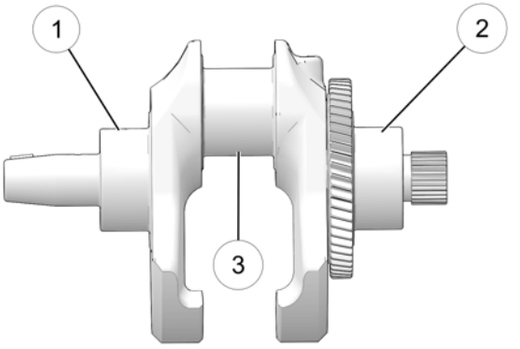
MAIN BEARING SELECTION

The FTR models utilize serviceable graded crankshaft main bearings. It is vital when replacing main bearings to select the correct bearing, and to install in the correct orientation.

⚠ CAUTION

Failure to properly install the correct bearings will result in blocked oil passages, restrict oil flow, and cause permanent engine damage.

Locate the label on the crankshaft counter weight. The top three letters designate the letter to its applicable bearing surface.



- The first digit ① designates the stator side main bearing color. (R in this example).
- The second digit ② designates the clutch side main bearing color. (W in this example).
- The third digit ③ designates the rod bearing color. (W in this example).

1. Locate the colored marking on the case half.
2. Identify the colored markings on each side of the crankshaft.

3. Record both marking colors reference the table.

Crankcase Marking	Crankshaft Marking	BEARING INSERT			Reference Clearance
		Size Color	PN Top	PN Bottom	
White (1)	Red (2)	Blue	3515065–001	3515066–001	0.00138 – 0.0027 Inches 0.035–0.068 mm
White (1)	White (1)	Yellow	3515065–002	3515066–002	
Red (2)	Red (2)	Yellow	3515065–002	3515066–002	
Red (2)	White (1)	Black	3515065–003	3515066–003	

MAIN BEARING REPLACEMENT

To watch a video of this procedure, scan the QR code or click **HERE**.

The use of a commercially available press is required for bearing replacement.

REMOVAL

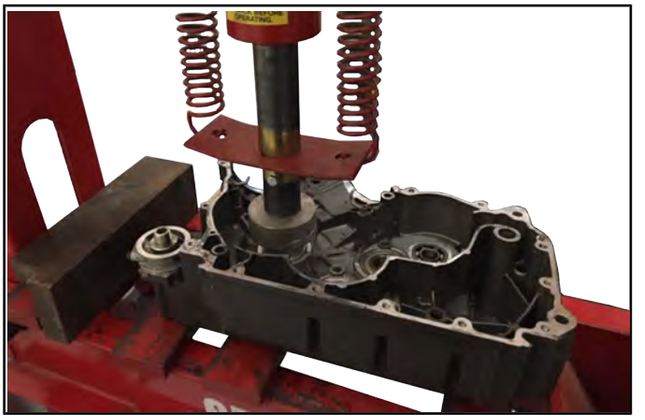
1. Support the case half with support bocks.

IMPORTANT
Ensure the case half is evenly supported and is resting in a level position.

2. Install bearing taper **PF-52726-2** between a support and the case half as shown.

IMPORTANT
Ensure the larger end of the tapered hole is against the case half.

3. Install bearing driver **PF-52726-1** into the bearing bore.



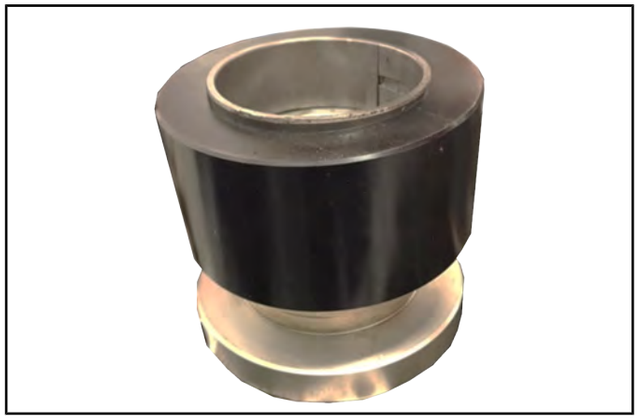
4. Press out the bearing into the bearing taper. Discard old bearings.

⚠ CAUTION
Ensure the bearing is being pressed out perpendicular to the case half. If the bearing is pressed out off center, damage can occur to the main bearing bore.

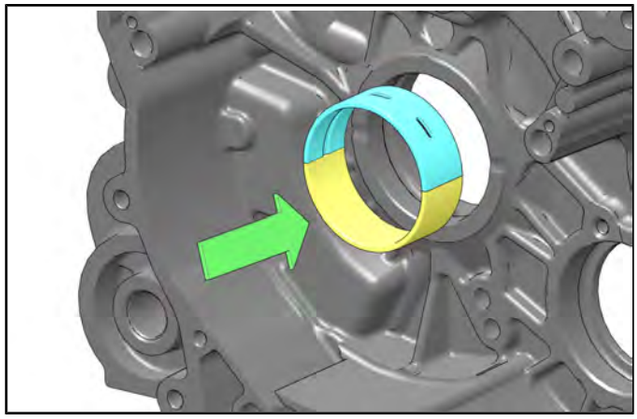
INSTALLATION

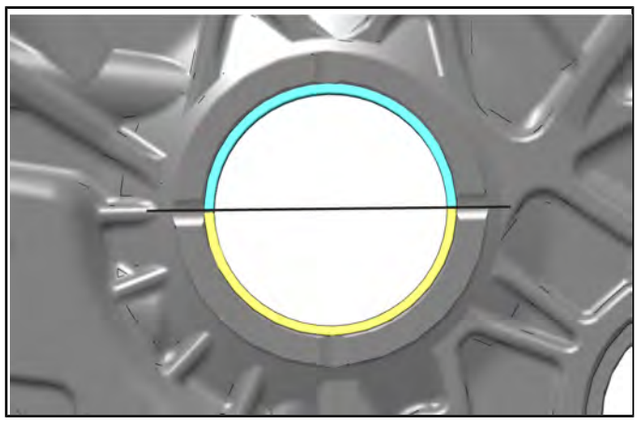
1. Reference Main Bearing Selection page 6.42 to find the correct bearings for installation.
2. Install the *new* bearings into the bearing taper.

3. Use the bearing driver to push the bearings out approximately 1/16" (1.6 mm).



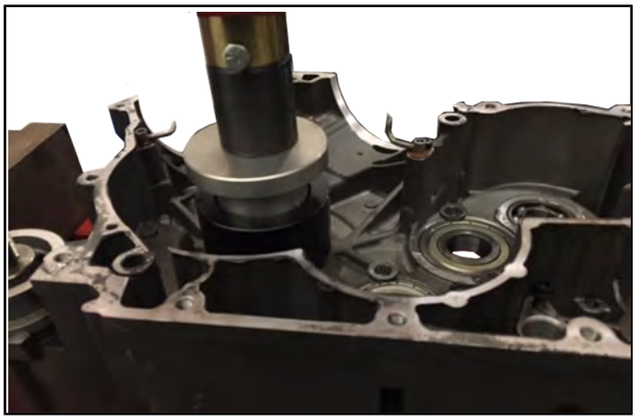
4. Ensure the main bearing bore is free of debris.
5. Orientate the bearings so they will be installed into the case half in regard to the split line as shown.





6. Use the bearing driver tool to start the bearing into the case.

7. Press the bearing into the casehalf.

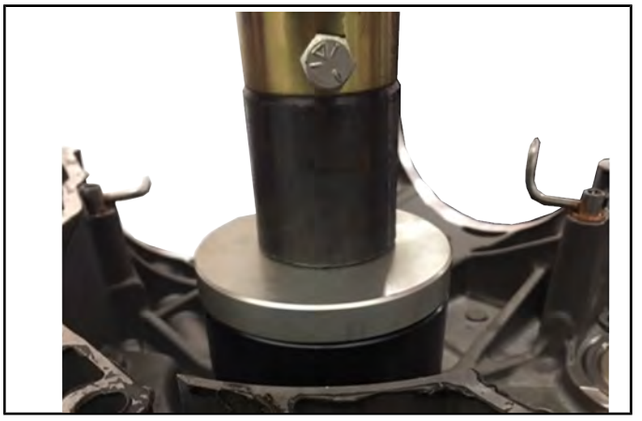


⚠ CAUTION

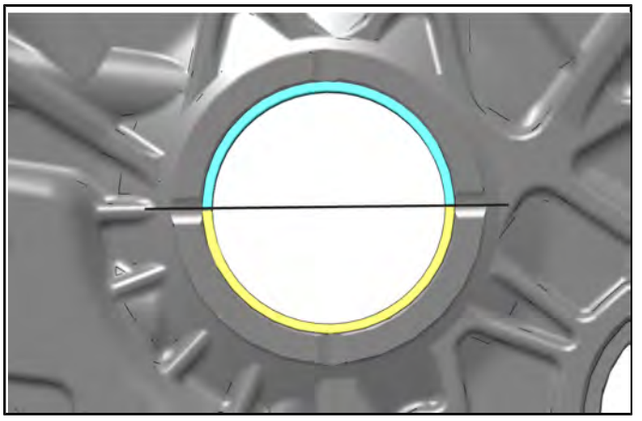
Ensure the bearing is being pressed in straight. If the bearing is pressed in off center, damage can occur to the casehalf.

6

8. Press the bearing once the driver touches the bearing taper.



9. Inspect the bearing to validate they are orientated correctly and are pressed in evenly. If the bearings aren't orientated correctly in regard to the split line, repeat procedure.



⚠ CAUTION

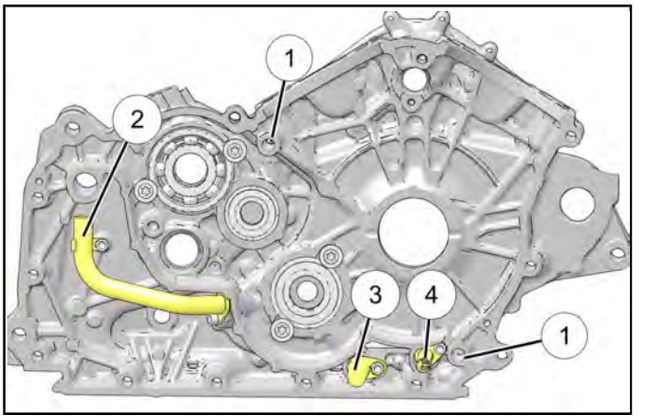
If the main bearing are orientated incorrectly they can block oil passages, restrict oil flow, and cause permanent engine damage.

LEFT CRANKCASE ASSEMBLY

Prepare LEFT crankcase for assembly:

Refer to crankcase assembly view for locations and torque values. See **Crankcase Assembly View page 6.7**.

1. Clean crankcase and oil passages ① thoroughly. Rinse and dry with compressed air.



2. Install new ball bearings in crankcase as required.
   - Apply a film of lithium grease to outer race of bearings to prevent galling upon installation
   - Press on outer race of bearings using an arbor press and a suitable arbor that is slightly smaller than bearing outside diameter
   - DO NOT press on inner race of ball bearings
3. Install *New* bearing retainers as required and torque to specification.
4. Install the scavenge return tube ② with a new o-ring. Lubricate with engine oil for installation.
5. Install rear scavenge oil inlet screen assembly ③ with a new o-ring. Lubricate with engine oil for installation. See **Lubrication System Assembly View page 3.33**.
6. Install front scavenge oil inlet screen assembly ④ with a new o-ring. Lubricate with engine oil for installation.

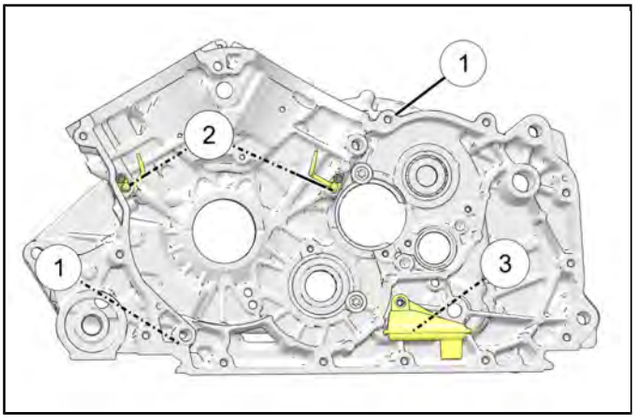
TORQUE
Scavenge Inlet Tube Fastener: **88 in-lbs (10 N·m)**

RIGHT CRANKCASE ASSEMBLY

Prepare RIGHT crankcase for assembly:

Refer to crankcase assembly view for locations and torque specification. See **Crankcase Assembly View page 6.7**.

1. Clean crankcase oil passages ① thoroughly. Rinse and dry with compressed air.



2. Install *new* bearings in crankcase as required.
   - Apply a film of lithium grease to outer race of bearings to prevent galling upon installation.
   - Press on outer race of bearings using an arbor press and a suitable arbor that is slightly smaller than bearing outside diameter.
   - DO NOT press on inner race of ball bearings.
3. Install *new* bearing retainers as required and torque to specification.

TORQUE
Bearing Retainer Plate Fastener: **88 in-lbs (10 N·m)**

4. Install piston cooling jets ② with a new o-ring and torque to specification. Lubricate O-rings with engine oil.

TORQUE
Piston Cooling Jet Fastener: **62 in-lbs (7)**

5. Install pressure lubrication pump oil pickup screen ③ with a new o-ring and torque fastener to specification. Lubricate O-rings with engine oil.

NOTICE
Inspect oil pick up screen prior to installation and clean as necessary.

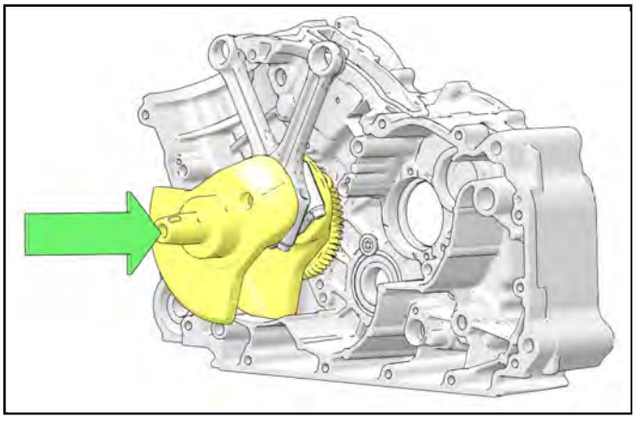
TORQUE
Oil Pump Pickup Screen Fastener: **88 in-lbs (10 N·m)**

6

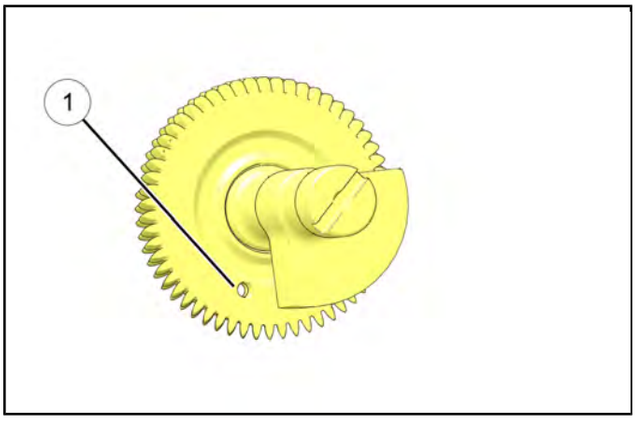
CRANKSHAFT INSTALLATION

NOTICE
Install left engine case onto an engine stand.

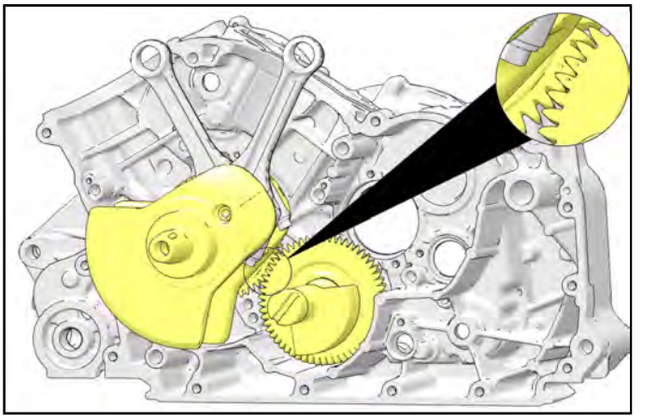
1. Apply assembly paste to main bearings.
2. Hold crankshaft over right crankcase and position rods so that left side rod is in cutout for rear cylinder and right side rod is in cutout for the front cylinder.
3. Install the crankshaft into the case.



4. Insert a punch or other suitable object into the opening ① to align the balance shaft split gear teeth.



5. Install the balance shaft and align the timing marks.



6. Remove the split alignment tool.

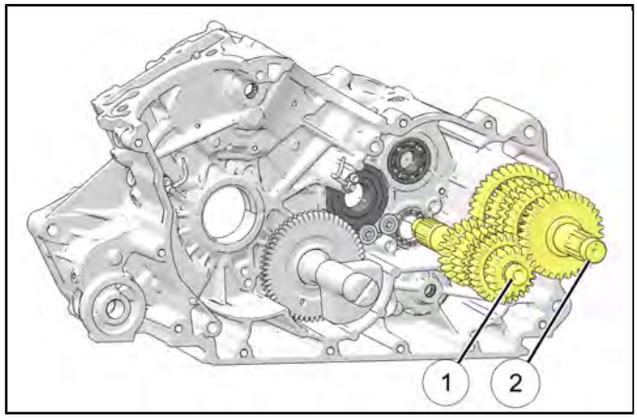
TRANSMISSION INSTALLATION

To watch a video of this procedure, scan the QR code or click **HERE**.

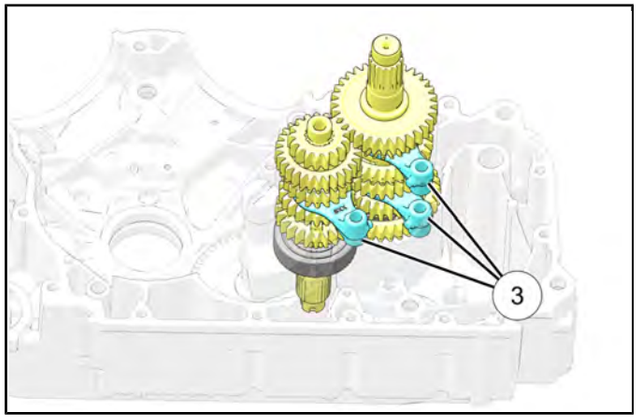
1. Install balance shaft if previously removed. See **Balance Shaft Installation page 6.21**.
2. If transmission shaft bearings were replaced, be sure all bearing retainer plate screws are installed and tightened to specification. See **Crankcase Assembly View page 6.7**.

IMPORTANT
Lubricate parts with engine oil. Apply assembly lube to ends of transmission shafts.

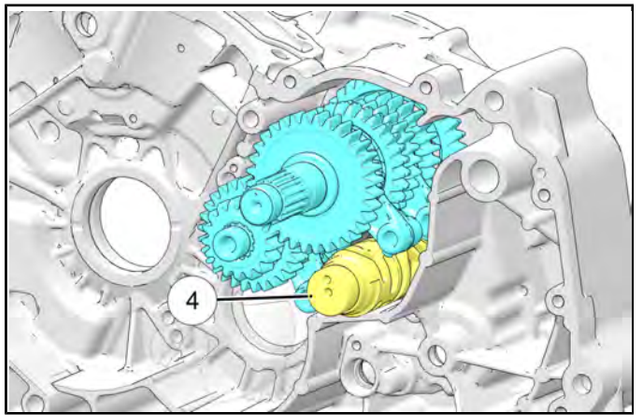
3. Assemble the input shaft ① and output shaft ② so the gears are properly meshed and insert them into the case half. Verify both shafts are fully seated and rotate freely.



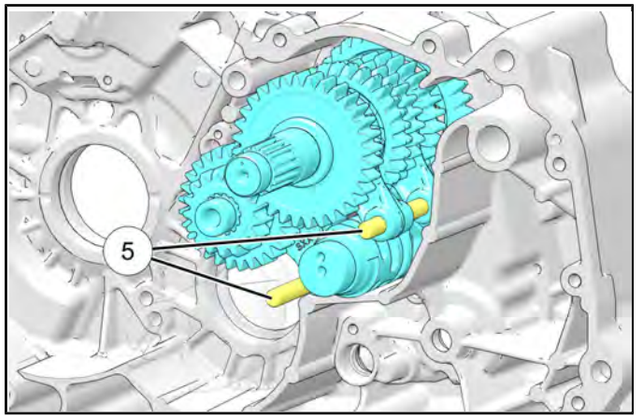
4. Install the shift forks ③.



5. Install the shift drum ④.



6. Rotate shift drum to align proper grooves with forks.
7. Move shift fork pins into drum grooves and seat rails.
8. Install the shift rails ⑤.

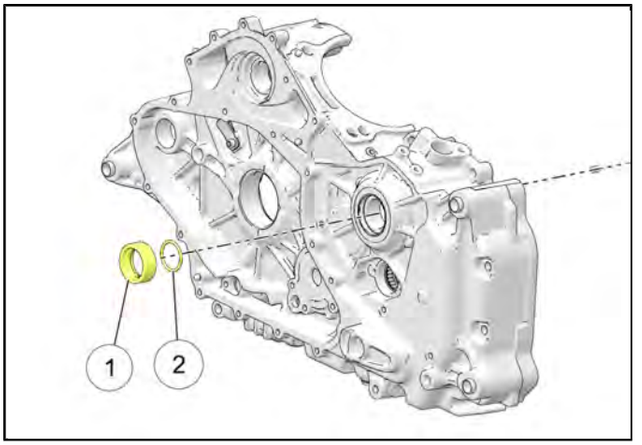


9. Install crankshaft. See **Crankshaft Installation page 6.48**.

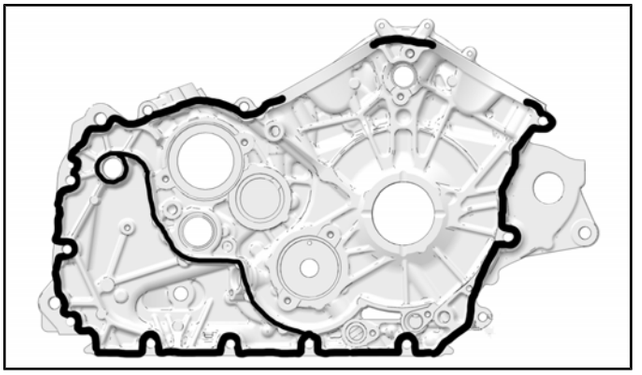
10. Assemble crankcase. See **Crankcase Assembly page 6.50**.

CRANKCASE ASSEMBLY

1. Clean crankcase mating surfaces to remove all grease, oil, and old sealant.
2. Check to be sure all shafts are seated properly (crankshaft, balance shaft, shift drum, shift forks, input shaft, output shaft).
3. Check to be sure that alignment dowel pins and oil pipes, etc. are in place.
4. Remove the drive sprocket spacer ① and o-ring ② from the left-hand crankcase prior to installation.



5. Apply a light even bead of Loctite™ Ultra Black 598 to entire case sealing surface.

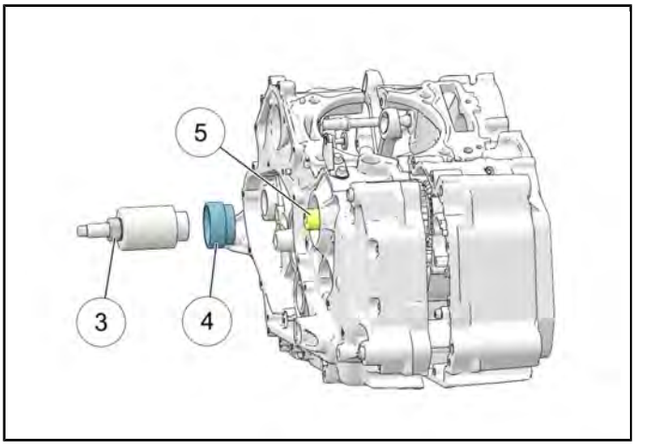


6. Spread sealant into a thin even layer on entire case mating surface. Be sure all areas are covered.

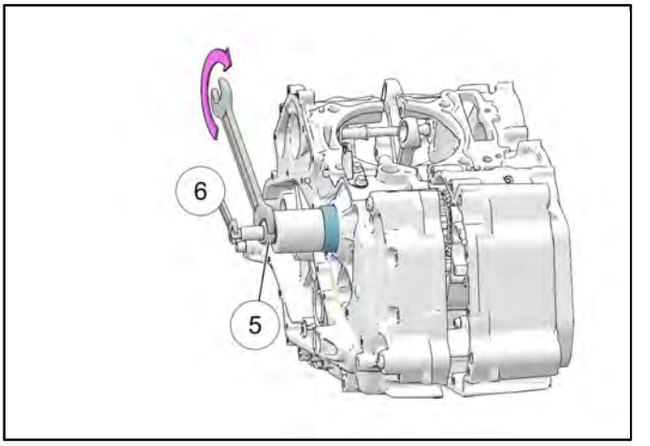
IMPORTANT

DO NOT ALLOW SEALANT TO DRY. CONTINUE ASSEMBLY UNTIL CASES ARE SEALED AND ALL BOLTS ARE TIGHT.

7. Lower the left-hand case onto the right-hand case and install mainshaft / crankcase installer PV-45030 ③ and engine case assembly cup PF-51663 ④ onto the transmission output shaft.



8. Pull crankcase together by tightening nut ⑤ and holding tool ⑥ tapping on crankcase with a soft mallet.



NOTICE

The cases will mate before the output shaft is drawn fully into bearing.

IMPORTANT

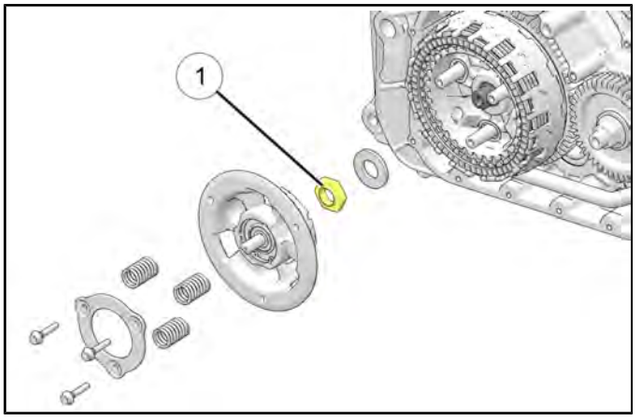
Continue to turn nut and tap case until sealant squeezes out along the entire perimeter and resistance is felt when turning nut.

9. Remove the tools from the output shaft.
10. Install crankcase bolts and torque to specification. See **Crankcase Assembly View page 6.7**.
11. Install a new output seal in left-hand crankcase using seal installer **PF-51243**.

12. Install the o-ring and drive sprocket spacer removed in STEP 4 with tapered edge toward the o-ring.
13. Install the gear position switch. See **Sensors - Powertrain Management Components page 4.11**.
14. Install the drive sprocket. See **Drive Sprocket Installation page 8.83**.
15. Install the scavenge oil pump. See **Scavenge Oil Pump Installation page 3.39**.
16. Install the pressure lubrication oil pump. See **Pressure Oil Pump Installation page 3.41**.
17. Install the starter drive. See **Starter Drive Installation page 6.24**.
18. Install the cam chains. See **Cam Chain Installation page 3.82**.
19. Install the flywheel. See **Flywheel Installation page 5.37**.
20. Install the clutch assembly. See **Clutch Installation page 5.29**.
21. Install cylinders. See **Cylinder Installation page 3.115**.
22. Install cylinder heads. See **Cylinder Head Installation page 3.99**.
23. Install the primary cover. See **Primary Drive / Clutch Cover Installation page 5.16**.
24. Install the stator cover. See **Stator Cover Installation page 5.35**.
25. Install engine in frame. See **Engine to Frame, Removal / Installation page 3.21**.

STAKE NUT INSTALLATION

- A stake nut is located on the clutch side of the transmission input shaft ①.



- It is important that they are torqued and staked correctly for proper function

IMPORTANT
Do not reuse or reinstall any previously used stake nut. A new stake nut needs to be installed every time the nut is removed or loosened.

Use the following procedure to install the stake nuts correctly:

1. Clean threads on shaft so there is no oil or contaminants.
2. Thread NEW stake nut onto shaft finger tight.
3. Torque stake nut to specification.

TORQUE
Stake Nut: **125 ft-lbs (170 N·m)**

4. Stake the stake nut as shown below using round side of punch. Do not crack or tear staking lip. Do not use a sharp chisel to stake the nut.

TROUBLESHOOTING TRANSMISSION / CRANKSHAFT

PROBLEM	POSSIBLE CAUSE	PART(S) AFFECTED	REPAIR RECOMMENDED
Transmission Will Not Shift	Broken Shift Cam	Shift Cam	Replace shift cam
	Bent Shift Forks	Shift Fork	Replace shift fork(s)
	Worn Gearshift Pawl	Shift Cam	Replace shift cam
	Broken Gears	Transmission Gears	Replace necessary parts
	Damaged/Broken Bearings	Transmission, Shift Cam Bearings	Replace necessary parts
	Worn Gear Shift Ratchet Mechanism	Shifter Ratchet	Refer to Clutch / Primary / Shift Chapter
	Broken or out-of-place spring on shift ratchet	Shift Ratchet Spring	Refer to Clutch / Primary / Shift Chapter
	Shift Detent Ratchet Stuck	Shift Ratchet	Repair as necessary
	Seized Pivot Point, Bent External Shift Linkage	External Shift Linkage	Repair as necessary
	Bent or Distorted Shift Fork Rails	Shift Fork Rails	Replace Shift Fork Rails
	Debris From Broken Parts Locking Transmission	Transmission Components	Repair as necessary
Excessive Noise Related to Bottom End of Engine	Worn Main Bearings	Crankshaft and/or Crankshaft Bearings	Repair as necessary
	Worn Connecting Rod Bearings	Connecting Rod Bearings and/or Connecting Rod and/or Rod Bearings	Repair as necessary
	Worn Connecting Rod Small End Bushing	Connecting Rod, Connecting Rod Bushing, Piston Pin, Piston	Repair as necessary
	Worn, seized, chipped or broken gear teeth	Transmission Gears	Repair as necessary
	Worn, seized, chipped or broken Transmission Bearings	Transmission Bearings	Repair as necessary
	Originates from Primary Cover	Clutch, Oil Pump Drive	Repair as necessary
	Oil Pump	Oil Pump, Oil Pump Drive	Refer to Engine / Cooling / Exhaust Chapter (Lubrication / Cooling)
	Cam Drive	Cam Chain, Cam Sprocket	Refer to Engine / Cooling / Exhaust Chapter (Cylinder Head / Valves)

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

PROBLEM	POSSIBLE CAUSE	PART(S) AFFECTED	REPAIR RECOMMENDED
Transmission Hard to Shift	Improper Clutch Operation	Clutch	Refer to Clutch / Primary / Shift Chapter
	Incorrect Oil Viscosity	Engine oil and filter	Refer to Maintenance Chapter
	Incorrect Clutch Adjustment	Clutch Adjustment	Refer to Clutch / Primary / Shift Chapter
	Bent, Rubbing, Sticky, Broken Shift Shaft	Shifter Ratchet Assembly	Refer to Clutch / Primary / Shift Chapter
	Sticking Pivot Point, Bent External Shift Linkage	External Shift Linkage	Repair or replace components as necessary
	Bent or Distorted Shift Forks	Shift Forks	Replace bent shift fork
	Damaged Shift Drum Grooves	Shift Drum	Replace damaged shift drum
	Shift Ratchet Bent / Stuck	Shift Ratchet	Repair as necessary
	Bent or Distorted Shift Fork Rails	Shift Fork Rails	Replace Shift Fork Rails
Transmission Jumps Out of Gear	Broken Shift Stop Pin	Shift Stop Pin	Replace stop pin
	Worn Shift Drum Pawls or Shifter Ratchet	Shift Drum or Shift Linkage	Replace damaged shift drum or shifter ratchet
	Broken Shift Ratchet Spring	Shift Ratchet Spring	Replace spring
	Damaged Shift Drum Grooves	Shift Drum	Replace shift drum
	Bent, Worn, Distorted Shift Forks	Shift Forks	Replace shift forks
	Bent or Distorted Shift Fork Rails	Shift Fork Rails	Replace shift fork rails
	Worn Engagement Dogs on Transmission Gears	Transmission Gears	Replace necessary parts

NOTES

CHAPTER 7
FRAME / BODY

GENERAL INFORMATION

SERVICE NOTES

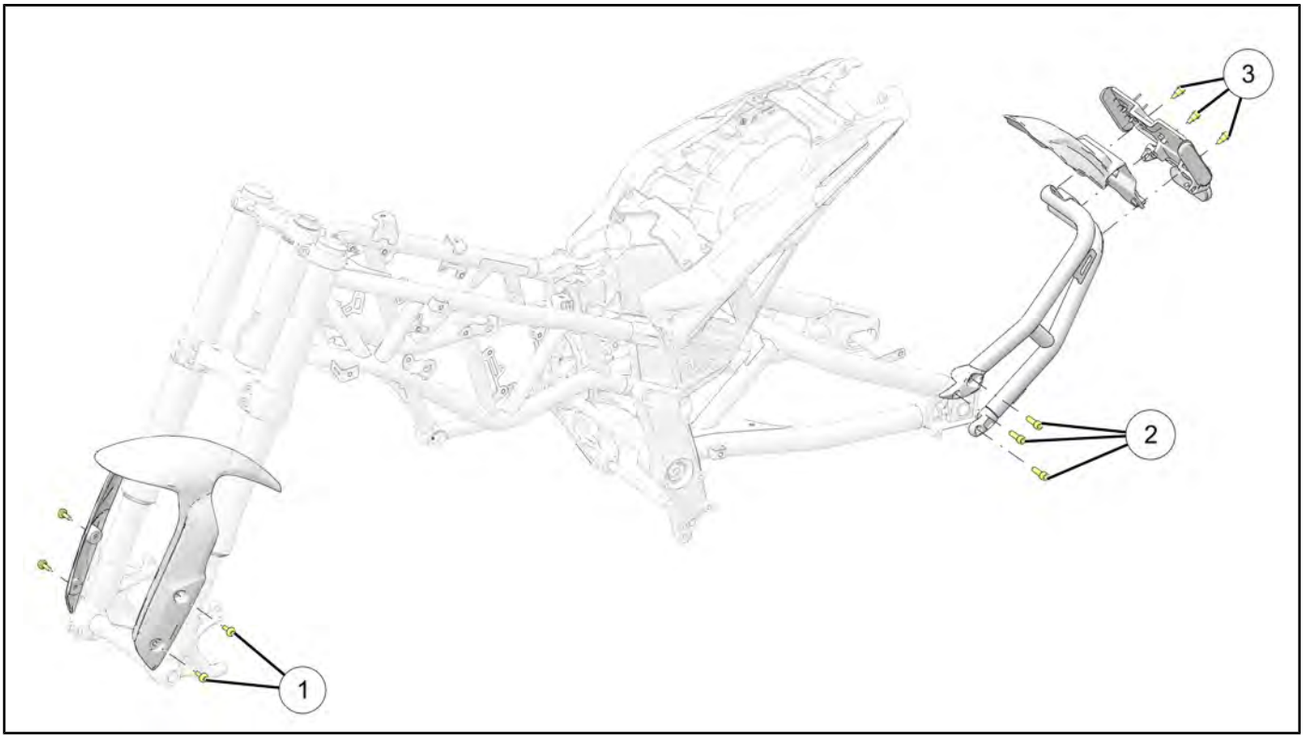
This section covers the removal and installation of frame and body components, assemblies and systems. Pay close attention to assembly procedures and torque specifications.

Cables, hoses and tie straps that have been removed during disassembly must be replaced per factory standards during assembly. Caution should be used when tightening body panels. Any deformation on the panel around the fastener is an indication that the fastener is too tight. Do not over tighten body components in order to avoid damage.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

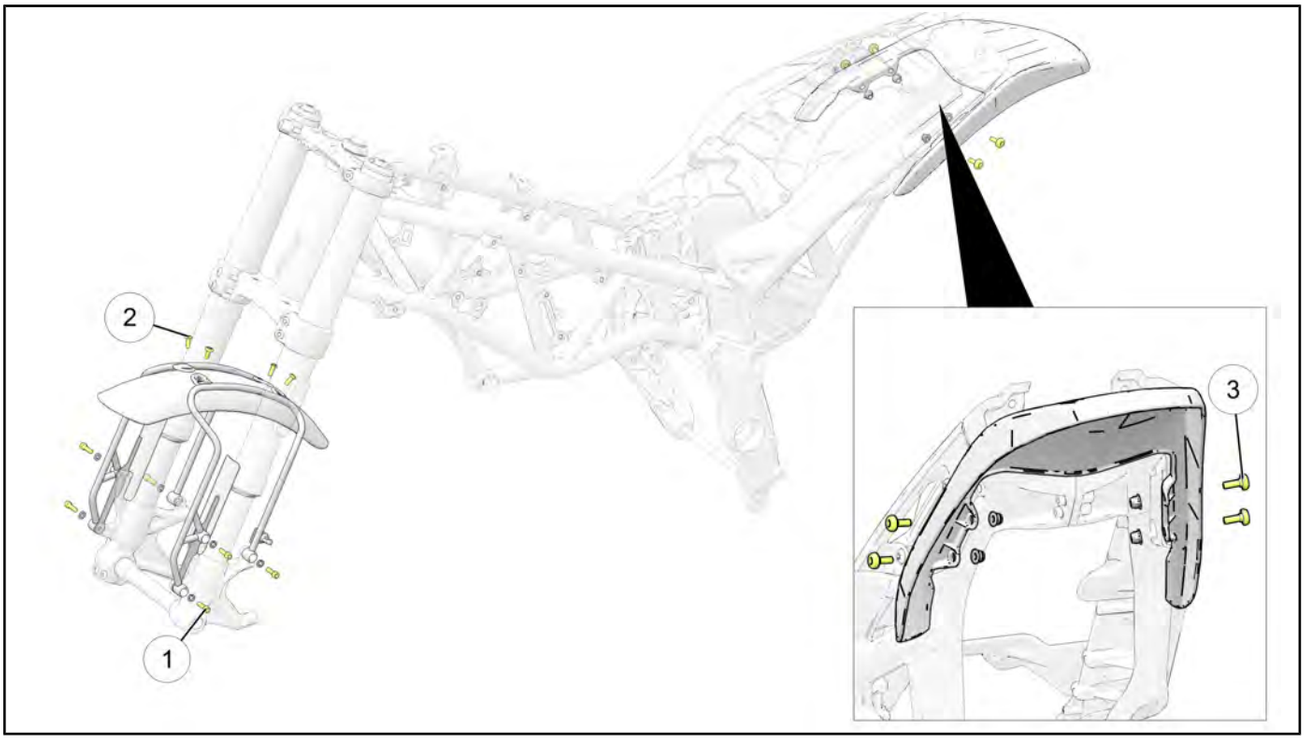
ASSEMBLY VIEWS

FENDERS ASSEMBLY VIEW



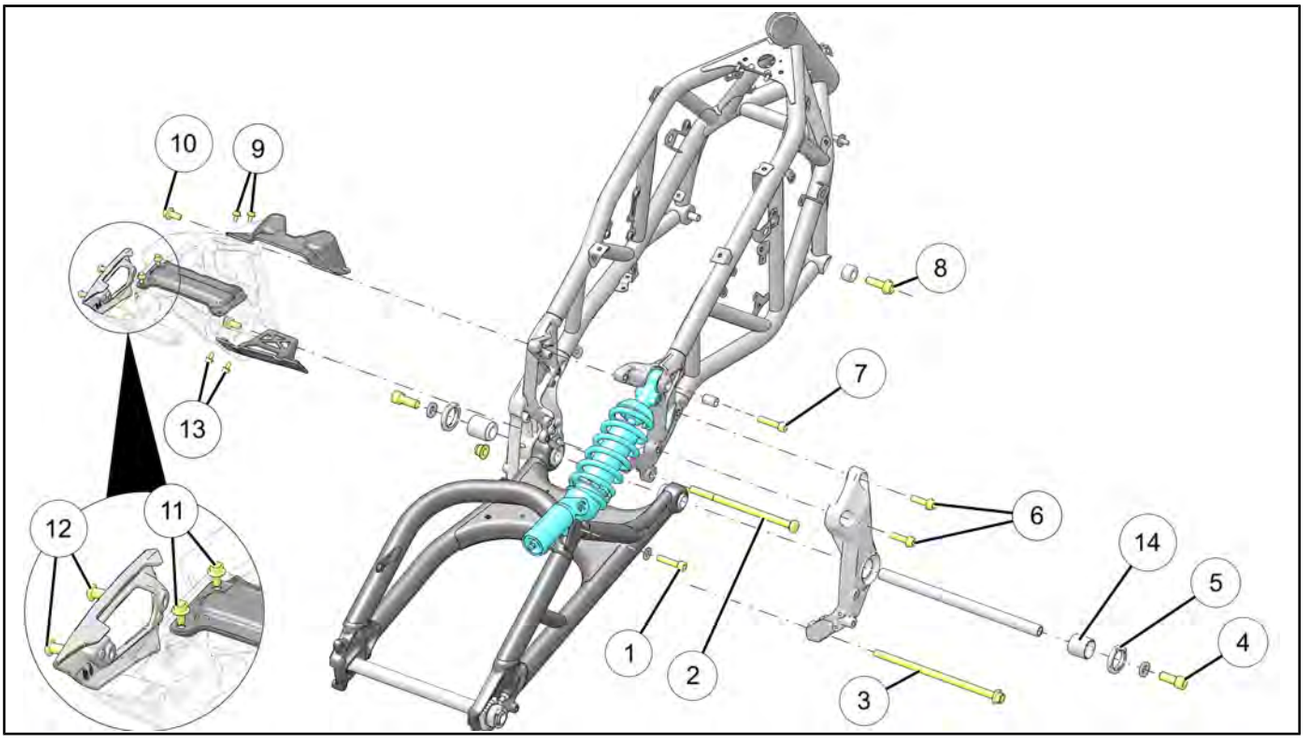
NUMBER	DESCRIPTION	TORQUE
①	Fender Fasteners (front)	**96 in-lbs (11 N·m)**
②	Rear Fender Arm Fasteners **Rear Fender Arm Fasteners are a single use fastener and NEW fasteners must be installed.**	**30 ft-lbs (41 N·m)**
③	Fender Fasteners (rear)	**96 in-lbs (11 N·m)**

MUD GUARD ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE
①	Mud Guard Mount Fasteners (front)	**96 in-lbs (11 N·m)**
②	Mud Guard to Bracket Fasteners	**96 in-lbs (11 N·m)**
③	Mud Guard Mount Fasteners (rear)	**96 in-lbs (11 N·m)**

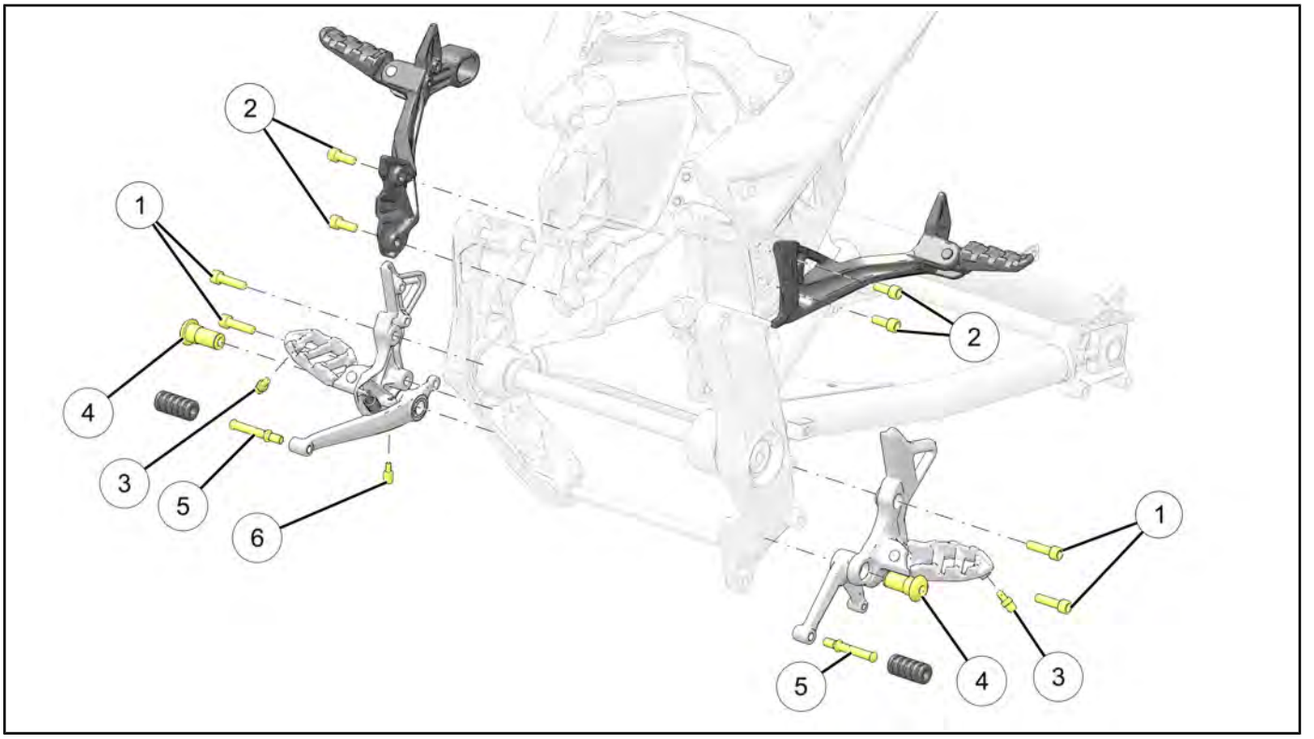
FRAME ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE
①	Shock Fastener (Lower)	**44 ft-lbs (60 N·m)**
②	Engine Mount Fastener (Rear Upper)	**51 ft-lbs (69 N·m)**
③	Engine Mount Fastener (Rear Lower)	**51 ft-lbs (69 N·m)**
④	Swingarm Pivot Bolt	Reference Steering/Suspension Chapter
⑤	Swingarm Lock Ring	Reference Steering/Suspension Chapter
⑥	Mid-Frame Fastener	**47 ft-lbs (64 N·m)**
⑦	Shock Fastener (Upper)	**44 ft-lbs (60 N·m)**
⑧	Headmount to Main Frame Fastener	**74 ft-lbs (100 N·m)**
⑨	Seat Support Bracket Fastener (front)	**96 in-lbs (11 N·m)**
⑩	Sub-Frame Fasteners (Rear)	**47 ft-lbs (64 N·m)**
⑪	Seat Support Bracket Fastener (rear)	**96 in-lbs (11 N·m)**
⑫	Passenger Grab Handle Fastener	**19 ft-lbs (26 N·m)**
⑬	Fuel Tank Support Fasteners (Bottom)	**96 in-lbs (11 N·m)**
⑭	Swingarm Pivot Adjuster	Reference Steering/Suspension Chapter

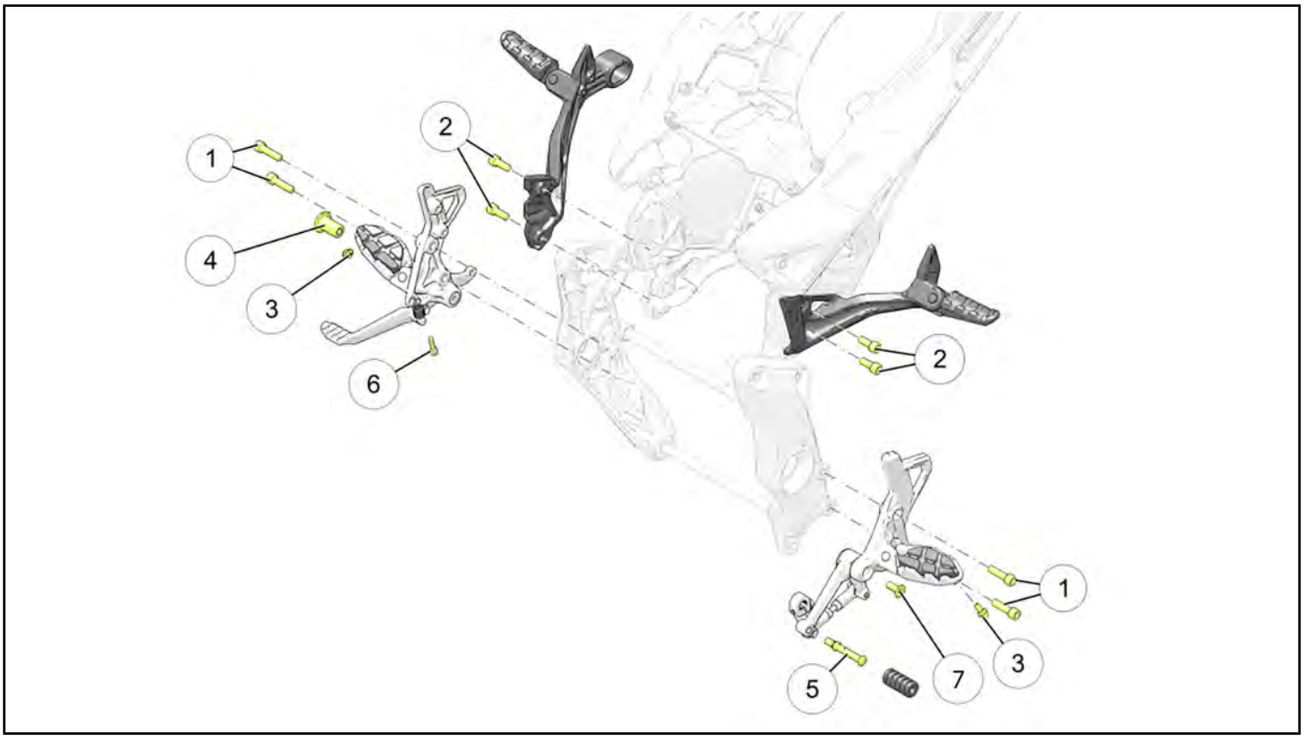
FOOT PEG ASSEMBLY VIEW

2019–2020 Models:



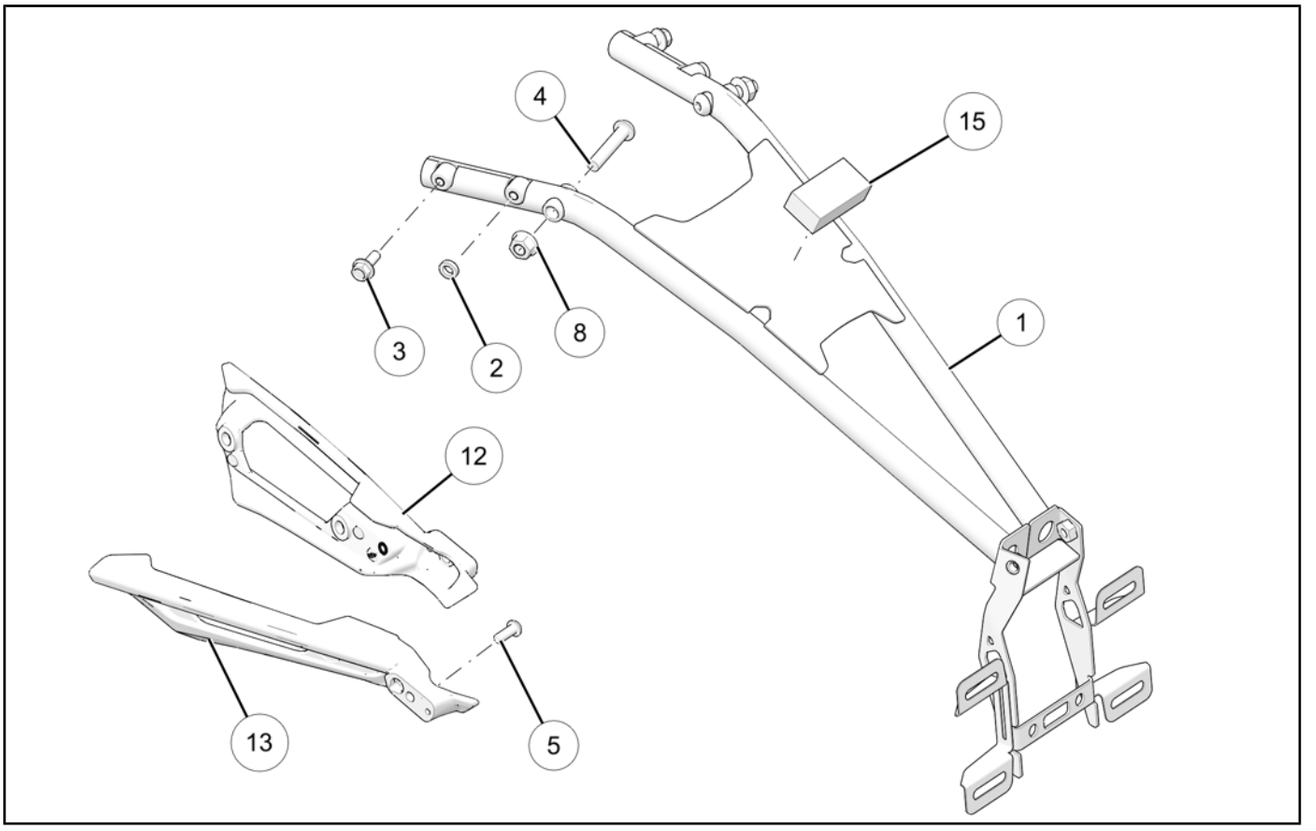
NUMBER	DESCRIPTION	TORQUE
①	Footpeg Fasteners (driver)	**17 ft-lbs (23 N·m)**
②	Footpeg Fasteners (passenger)	**17 ft-lbs (23 N·m)**
③	Feeler Peg	**96 in-lbs (11 N·m)**
④	Footpeg Shoulder Fasteners	**50 ft-lbs (68 N·m)** Apply grease to shaft portion
⑤	Shift / Brake Pedal Peg	**15 ft-lbs (20 N·m)** Apply **LOCTITE 263**
⑥	Adjuster Nut	**54 in-lbs (6 N·m)**

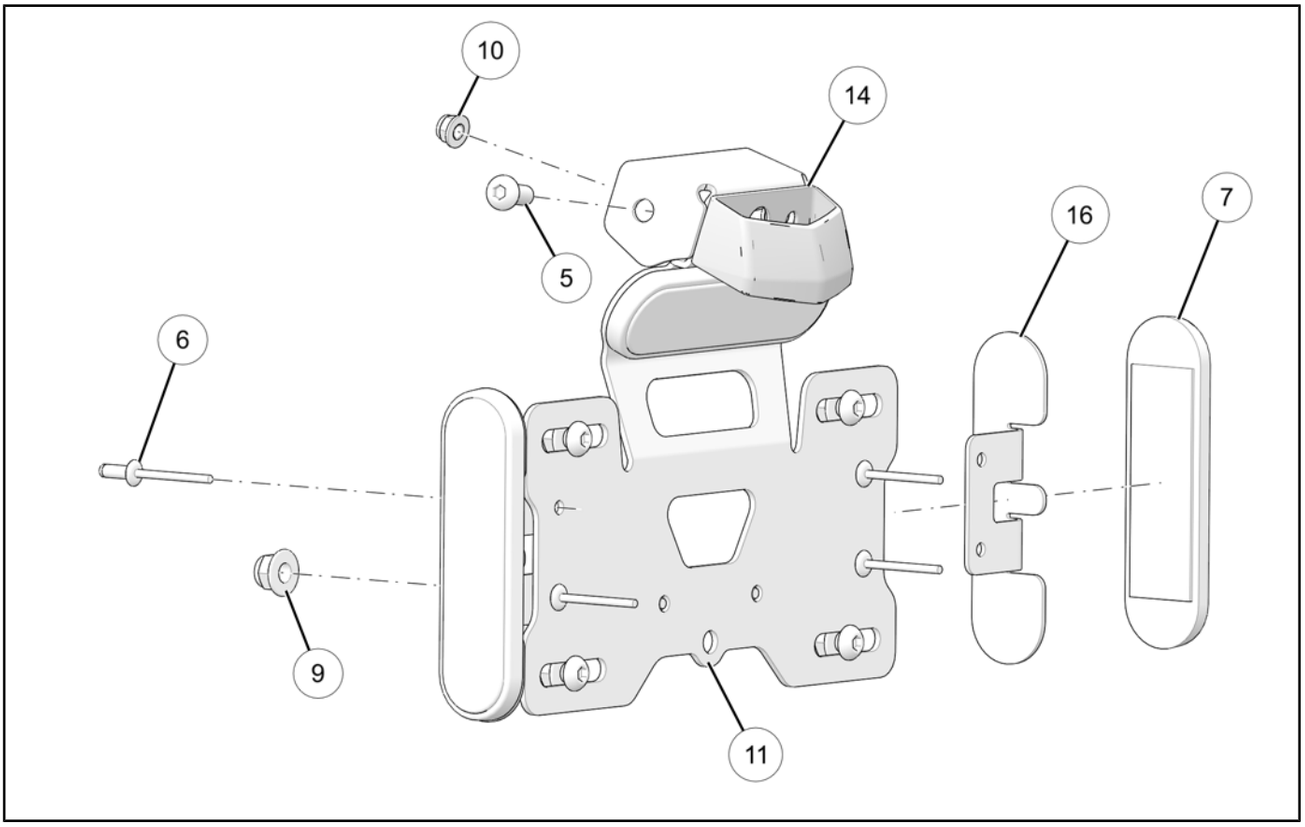
2022+ Models:



NUMBER	DESCRIPTION	TORQUE
①	Footpeg Fasteners (driver)	**17 ft-lbs (23 N·m)**
②	Footpeg Fasteners (passenger)	**17 ft-lbs (23 N·m)**
③	Feeler Peg	**96 in-lbs (11 N·m)**
④	Footpeg Shoulder Fasteners	**50 ft-lbs (68 N·m)** Apply grease to shaft portion
⑤	Shift / Brake Pedal Peg	**15 ft-lbs (20 N·m)** Apply **LOCTITE 263**
⑥	Adjuster Nut	**54 in-lbs (6 N·m)**
⑦	Footpeg Shoulder Fasteners	**18 ft-lbs (24 N·m)**

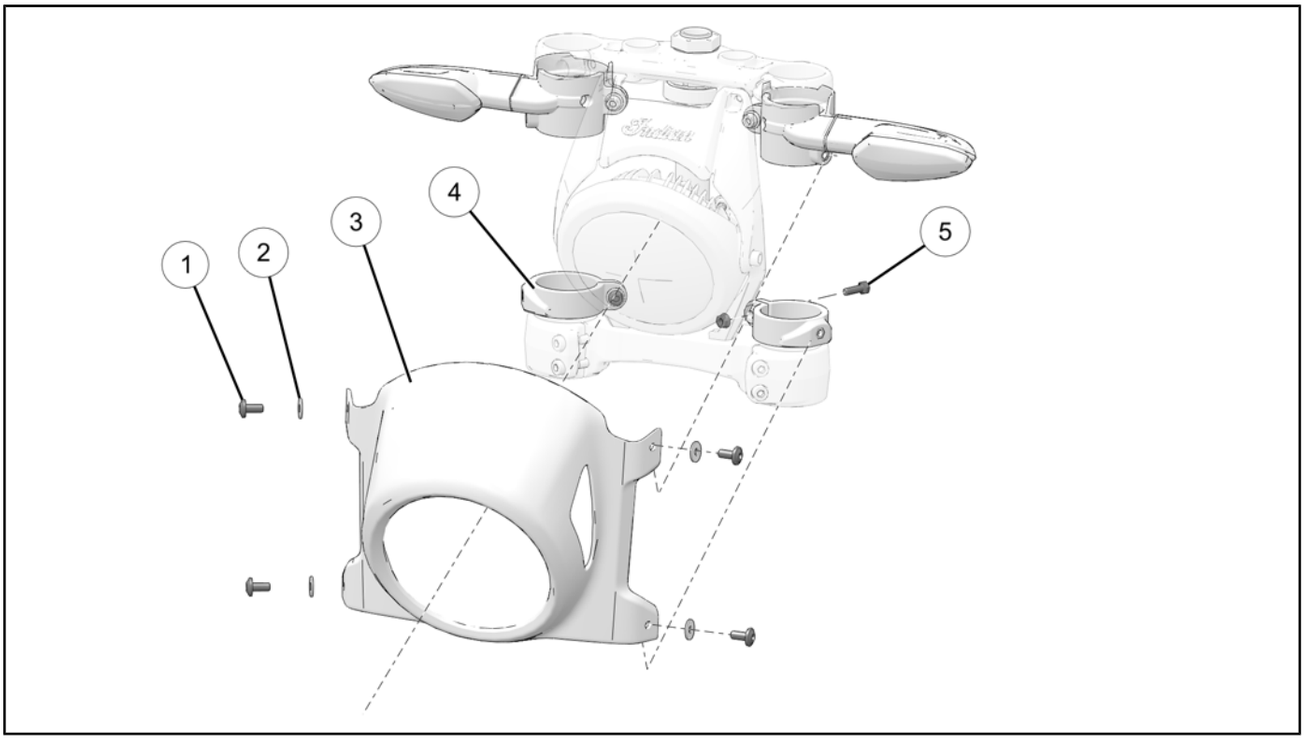
HIGH LICENSE PLATE MOUNT





ITEM	DESCRIPTION	TORQUE
①	Weld–Arm, License Plate, High	—
②	Spacer, Fender, Right Rear, High License Plate	—
③	Front License Plate Mount Fasteners	**72 in-lbs (8 N·m)**
④	Rear License Plate Mount Fasteners	**15 ft-lbs (20 N·m)**
⑤	Upper License Plate Bracket Fasteners	**72 in-lbs (8 N·m)**
⑥	Rivet	—
⑦	Reflector	—
⑧	Nut	—
⑨	Upper License Plate Bracket Nuts	**72 in-lbs (8 N·m)**
⑩	Light Curtain Nuts	**36 in-lbs (4 N·m)**
⑪	Holder, License Plate, High	—
⑫	Handle–Passenger, Tracker Seat, Right-Hand	—
⑬	Handle–Passenger, Tracker Seat, Left-Hand	—
⑭	Curtain–License Plate Light	—
⑮	Bumper–Tank, Foam	—
⑯	Bracket–Side Reflector	—

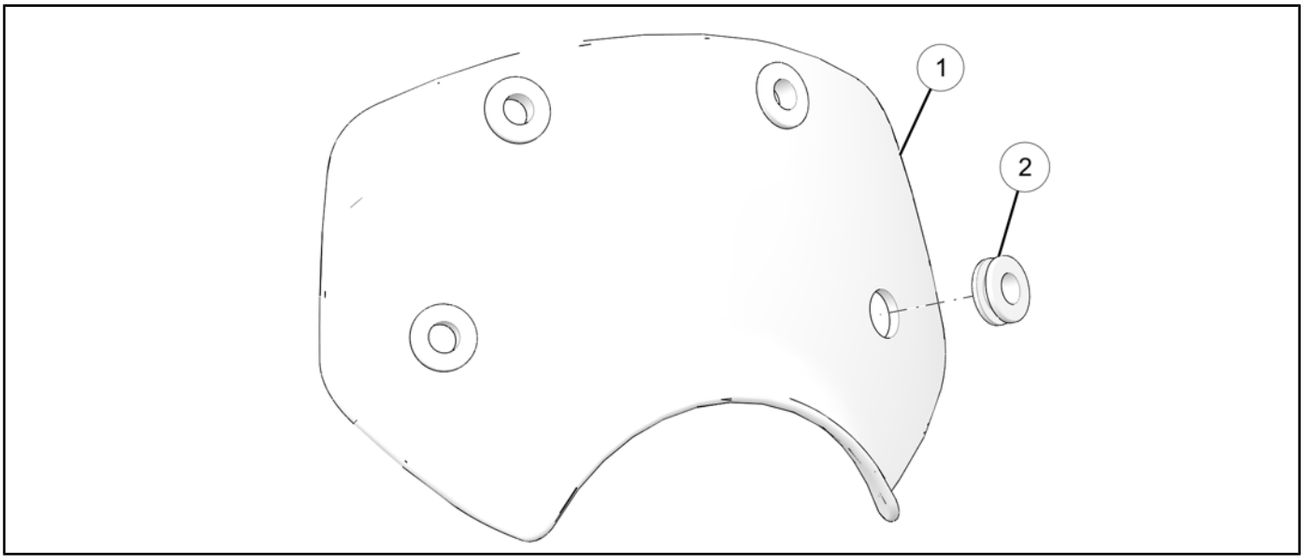
HEADLIGHT COVER ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Headlight Cover Fastener	**18 in-lbs (2 N·m)**
②	Washer	—
③	Headlight Cover	—
④	Headlight Cover Mount	—
⑤	Headlight Cover Mount Fastener	**36 in-lbs (4 N·m)**

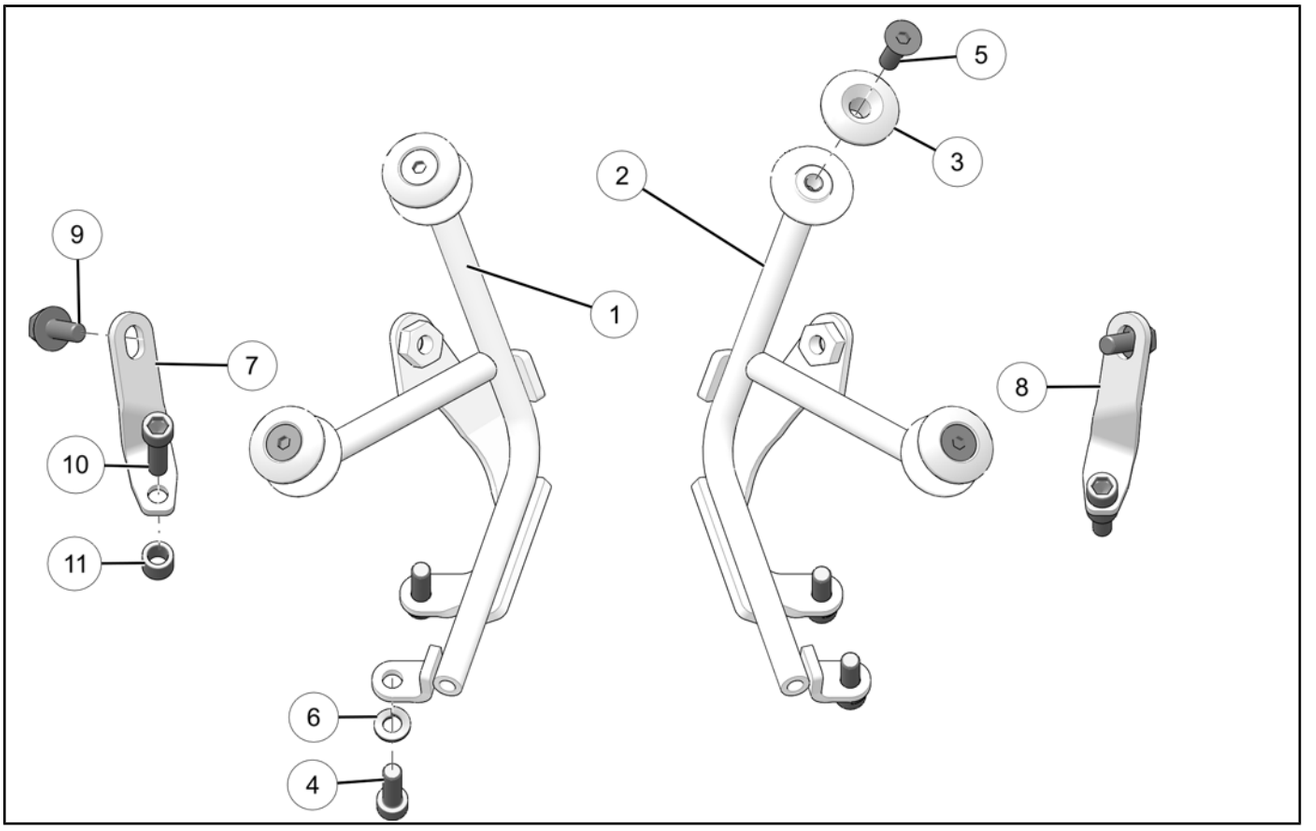
WINDSHIELD MOUNT ASSEMBLY VIEW

LOW WIND DEFLECTOR WITHOUT HEADLIGHT COWL



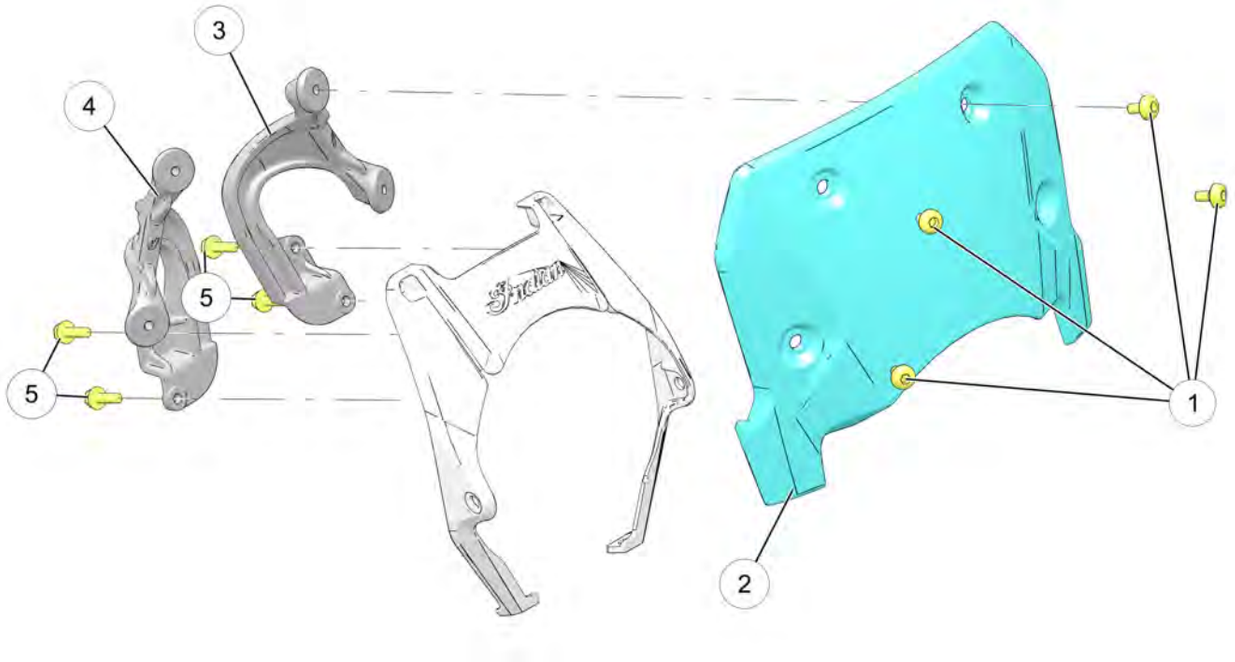
ITEM	DESCRIPTION
①	Windscreen–Small, Nacelle
②	Grommet–Windscreen

WINDSCREEN MOUNT



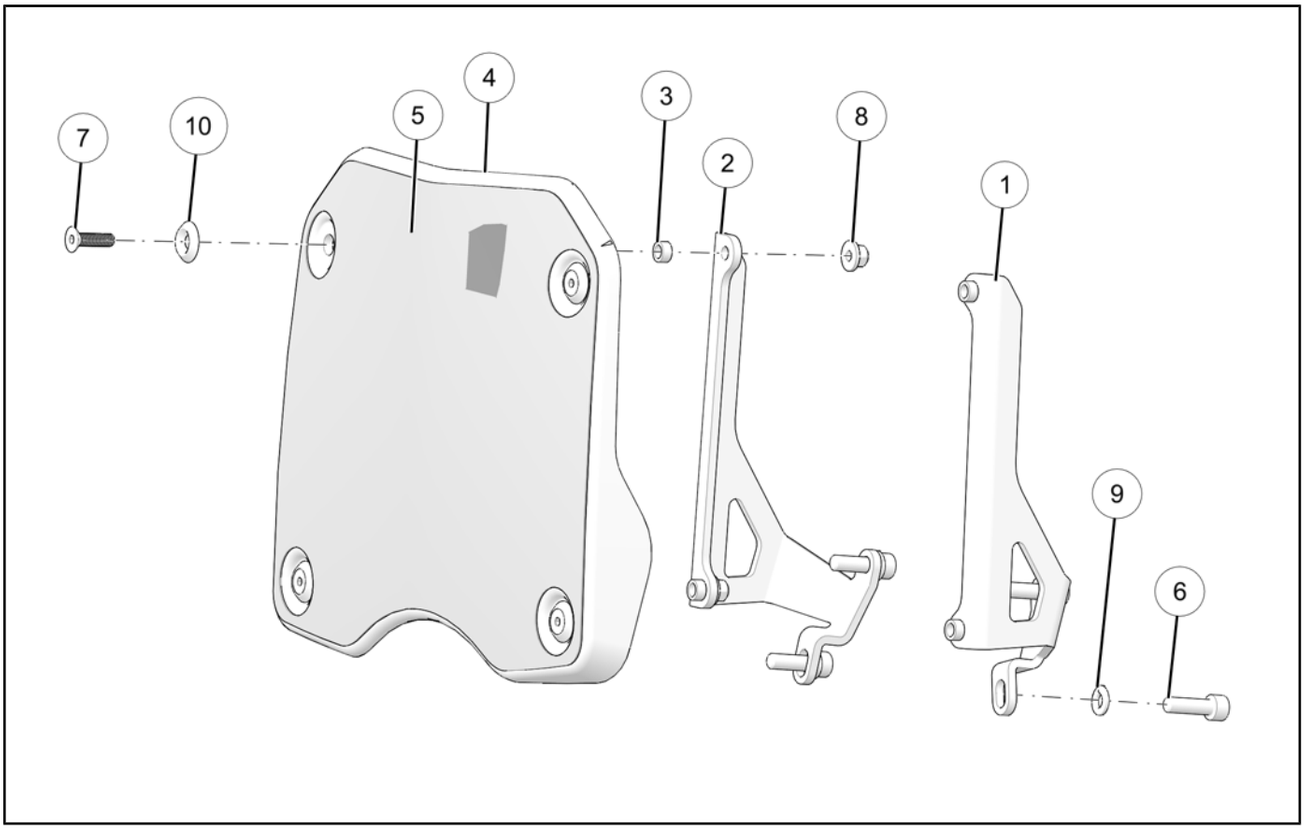
ITEM	DESCRIPTION	TORQUE
①	Weld–Windscreen Mount, FTR™, Right-Hand	—
②	Weld–Windscreen Mount, FTR™, Left-Hand	—
③	Cap–Windscreen	—
④	Windshield Mount Fasteners	**80 in-lbs (9 N·m)**
⑤	Wind Deflector Fasteners	**80 in-lbs (9 N·m)**
⑥	Washer–Lock, 6 mm	—
⑦	Bracket–Windshield, Mid, Left-Hand	—
⑧	Bracket–Windshield, Mid, Right-Hand	—
⑨	Windshield Mount Bracket Fasteners, Upper	**96 in-lbs (11 N·m)**
⑩	Windshield Mount Bracket Fasteners, Lower	**96 in-lbs (11 N·m)**
⑪	Spacer–Windscreen	—

NUMBER PLATE ASSEMBLY



ITEM	DESCRIPTION	TORQUE
①	Number Plate Fasteners	**80 in-lbs (9 N·m)**
②	Number Plate	—
③	Windscreen Bracket, Right	—
④	Windscreen Bracket, Left	—
⑤	Windscreen Bracket Fasteners	**96 in-lbs (11 N·m)**

WINDSCREEN ASSEMBLY

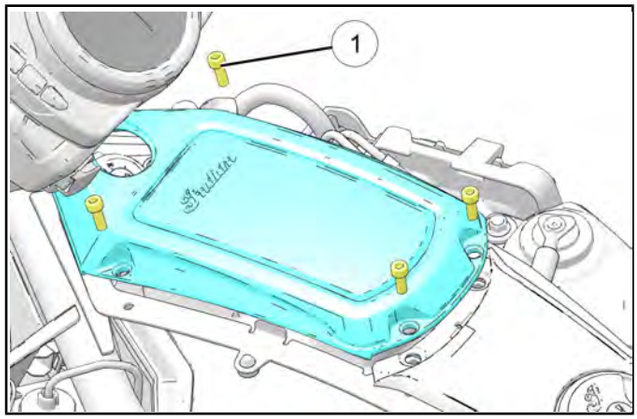


ITEM	DESCRIPTION	TORQUE
①	Weld–Bracket, Front Number Plate, LH	—
②	Weld–Bracket, Front Number plate, RH	—
③	Spacer	—
④	Number Plate, Front	—
⑤	Decal, Number, Plate, Front	—
⑥	Screw–Socket Head	**96 in-lbs (11 N·m)**
⑦	Screw–Flange Head	**60 in-lbs (7 N·m)**
⑧	Nut	—
⑨	Washer–Lock	—
⑩	Washer–Number plate	—

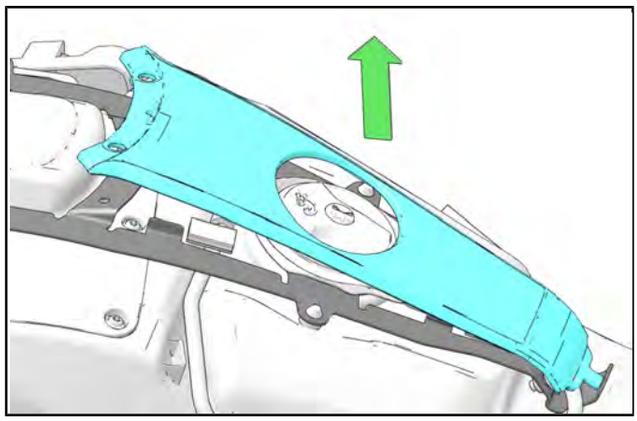
BODY / FRAME SERVICE

AIR BOX COVER REMOVAL

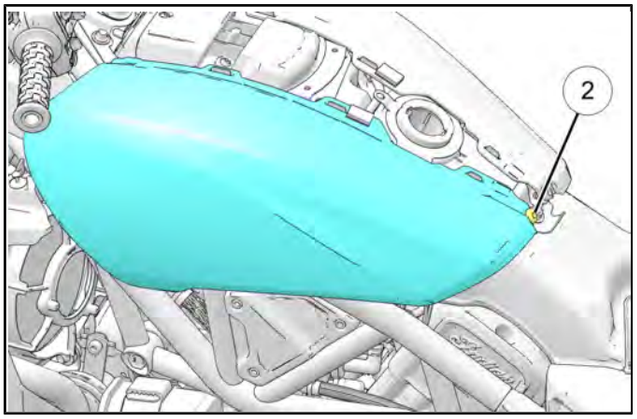
1. Remove the seat. See **Seat Removal / Installation page 7.19**.
2. Remove four fasteners ① securing air box bezel.



3. Remove the center console cover from the alignment bracket.



4. Remove the gas cap and relocate to safe location away.
5. Remove fastener securing the air box cover ②.



NOTICE
Pull air box cover up and out to remove.

6. **Installation is performed by reversing the removal procedure.**

TORQUE
Air Box Cover Fastener: **36 in-lbs (4 N·m)**

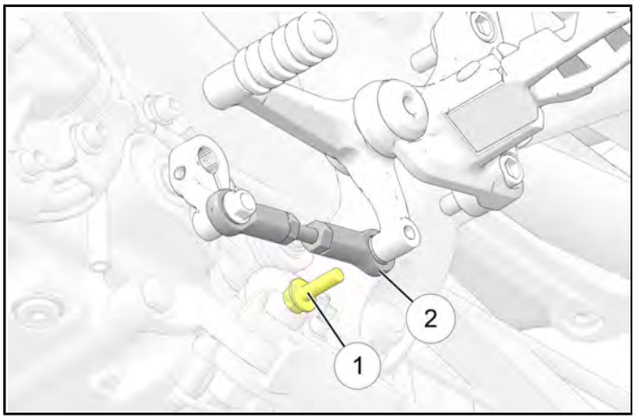
TORQUE
Air Box Bezel Fastener: **36 in-lbs (4 N·m)**

7

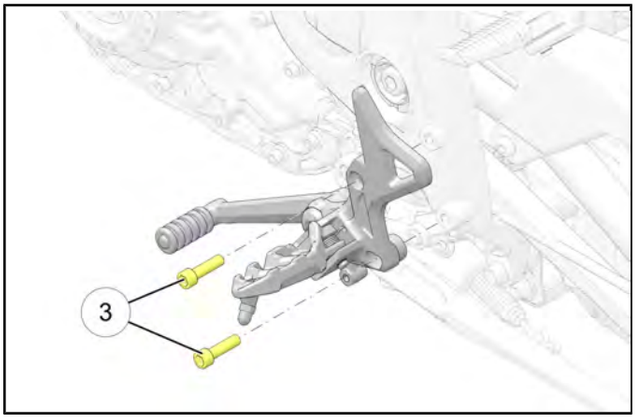
FOOT PEG (DRIVER) REMOVAL / INSTALLATION

Left Foot Peg

1. Remove Shift Rod Bolt ① from Shift Rod ②.



2. Remove two bolts ③ securing foot peg bracket to frame.



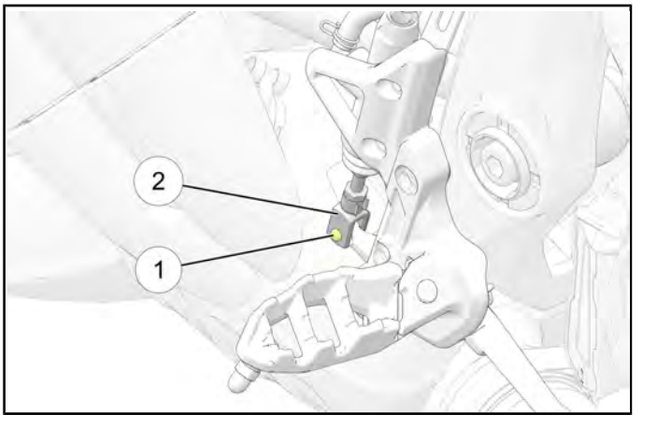
3. **INSTALLATION is performed by reversing the removal procedure.**
4. Torque driver foot peg bracket bolts to specification.

TORQUE
Footpeg Fasteners (driver): **17 ft-lbs (23 N·m)**

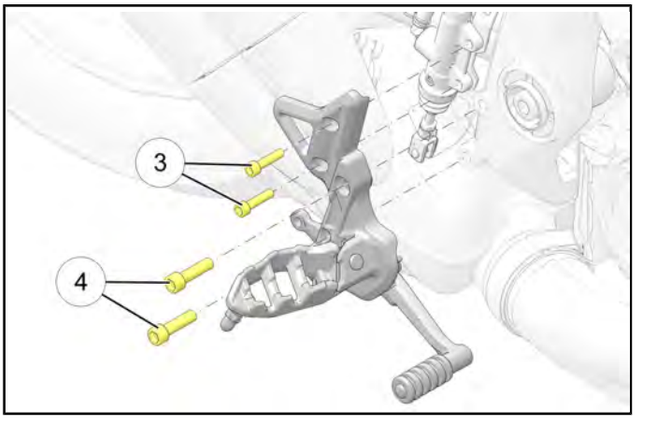
TORQUE
Shift Rod Fastener: **88 in-lbs (10 N·m)**

Right Foot Peg

1. Remove pin clip ① retaining the master cylinder clevis ② to pedal.



2. Remove two Master Cylinder Bolts ③.



3. Remove two bolts ④ securing foot peg bracket to frame.
4. **INSTALLATION is performed by reversing the removal procedure.**

5. Torque driver foot peg bolts to specification.

TORQUE
Footpeg Fasteners (driver): **17 ft-lbs (23 N·m)**

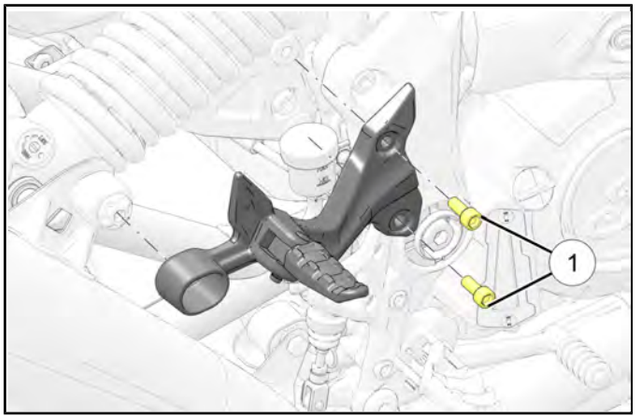
TORQUE
Master Cylinder Reservoir Mounting Fastener (rear) - 2019,2020: **84 in-lbs (9 N·m)**

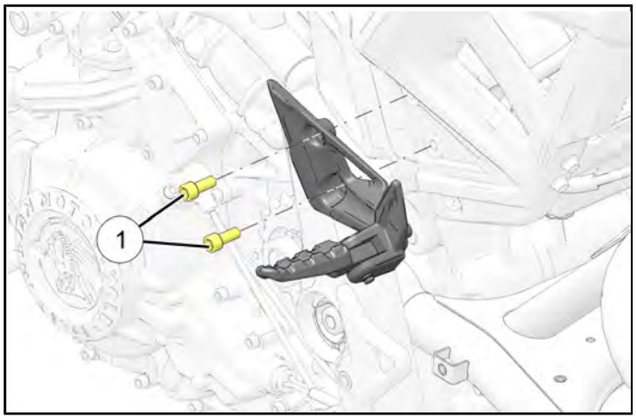
TORQUE
Master Cylinder Reservoir Mounting Fastener (rear) - 2022+ **62 in-lbs (7 N·m)**

FOOT PEG (PASSENGER) REMOVAL / INSTALLATION

NOTICE
Remove muffler to access right foot peg.

1. Remove bolts ① securing foot peg bracket to frame.
2. Remove foot peg / bracket as an assembly.





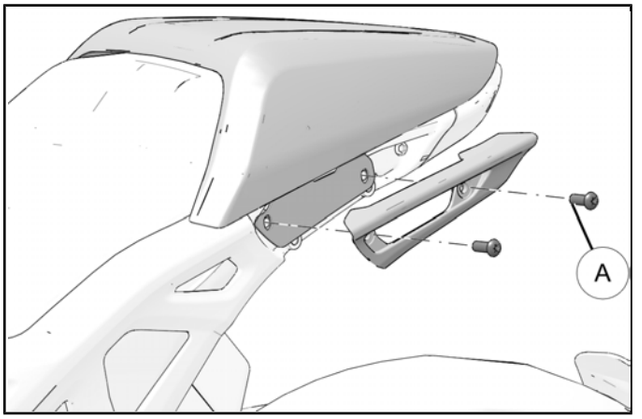
3. **INSTALLATION is performed by reversing the removal procedure.**
4. Torque passenger foot peg bracket bolts ① to specification.

TORQUE
Footpeg Bracket Fasteners (passenger) **17 ft-lbs (23 N·m)**

SEAT COWL REMOVAL / INSTALLATION

REMOVAL

1. Remove fasteners Ⓐ. remove passenger handles.

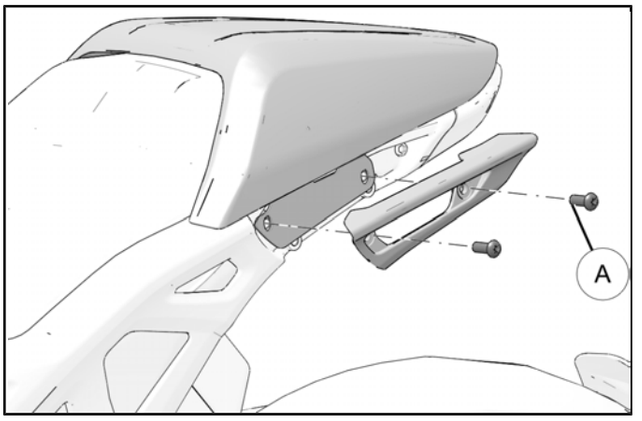


2. Repeat step 1 for the other side.
3. Remove the seat cowl.

INSTALLATION

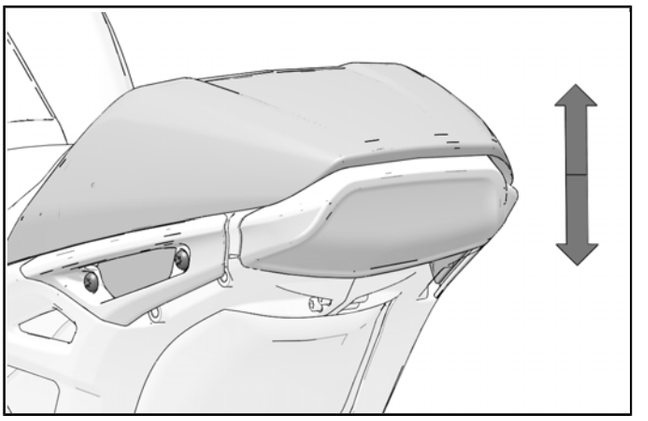
1. Place seat cowl assembly over rear portion of seat and pass retained fasteners Ⓐ through passenger handles and seat cowl brackets.

Hand tighten fasteners.



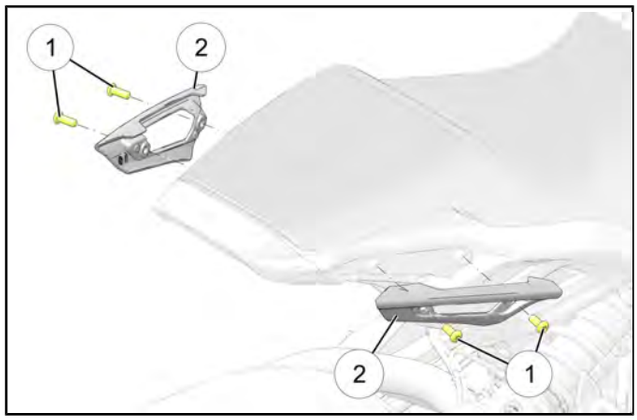
2. Adjust seat cowl height to ensure even spacing along sub-frame and rear light.

TORQUE
Passenger Handle Fasteners Ⓐ: **19 ft-lbs (26 N·m)**

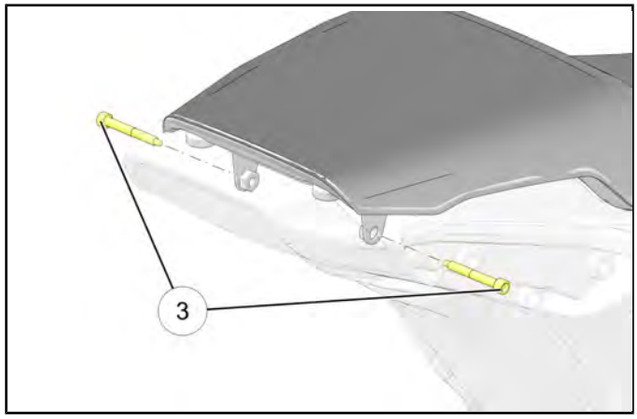


SEAT REMOVAL / INSTALLATION

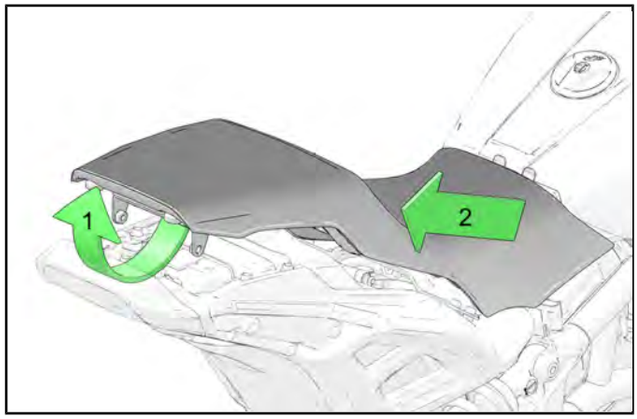
1. Remove both Passenger Grab Handle Fasteners ① and Grab Handles ②.



2. Remove Seat Fasteners ③.



3. Lift up on the rear of the seat and pull rearward to disengage the seat from the front of the seat to the frame.



4. **INSTALLATION is performed by reversing the removal procedure.**

TORQUE
Seat Fasteners: **88 in-lbs (10 N·m)**

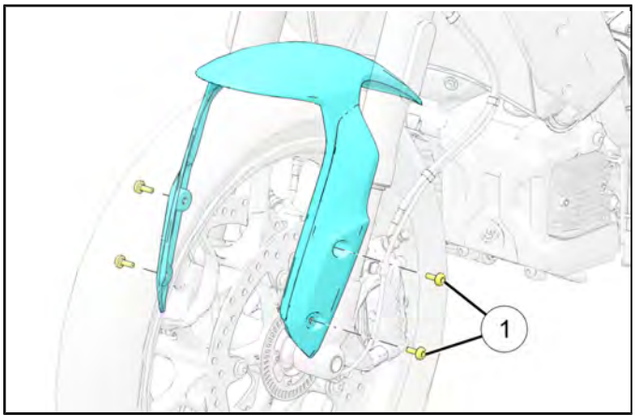
TORQUE
Passenger Grab Handle Fasteners: **19 ft-lbs (26 N·m)**

FRONT FENDER REMOVAL

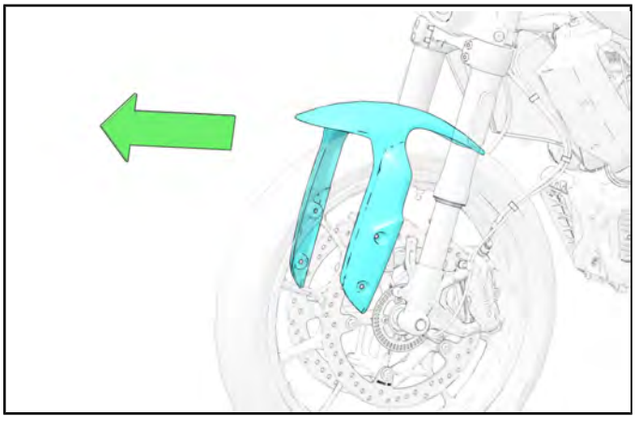
⚠ CAUTION

Use care not to scratch or damage painted surfaces during fender removal and / or installation.

1. Park Motorcycle on a flat level surface.
2. Remove two fasteners ① from each side of the fork slider leg.



3. Remove the fender from the unit.



IMPORTANT

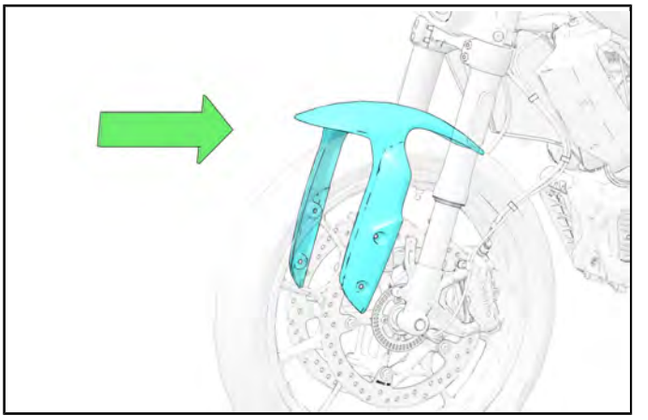
Once fender has been removed from the motorcycle, make sure the fender is stored safely until it is reinstalled.

FRONT FENDER INSTALLATION

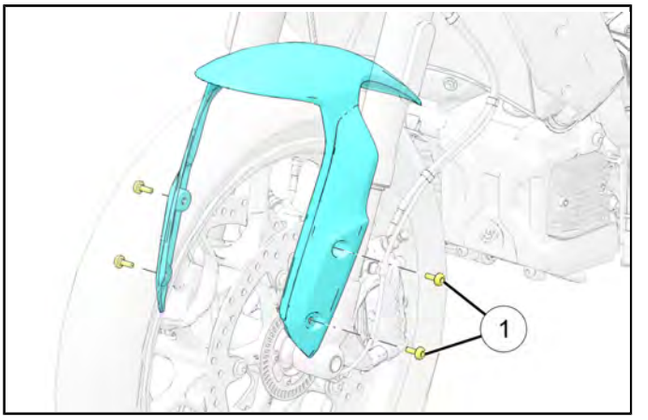
⚠ CAUTION

Use care not to scratch or damage painted surfaces during fender removal and / or installation.

1. Park motorcycle on a flat level surface.
2. Gently "roll" the fender into position between the fork legs so the bolt holes line up.



3. Install fender fasteners ① on each fork slider leg.



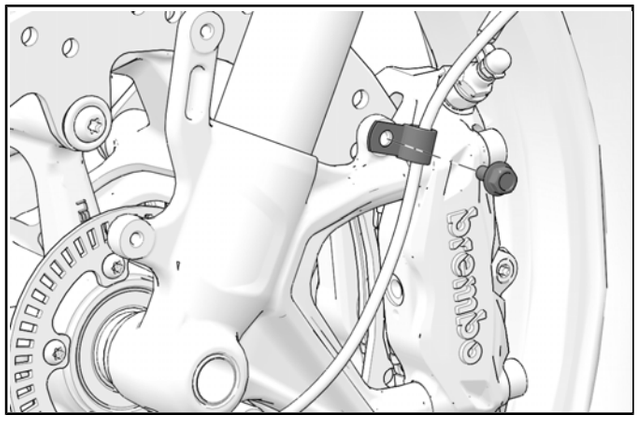
TORQUE

Fender Fasteners (front):
96 in-lbs (11 N·m)

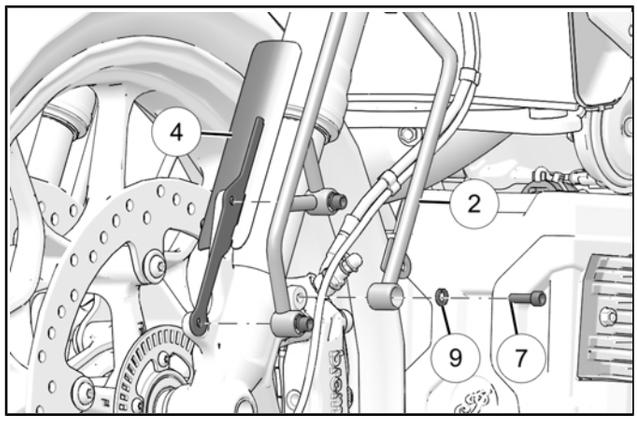
4. Turn the handlebar all the way to the left and right to verify proper operation and freedom of movement.

FRONT MUD GUARD INSTALLATION

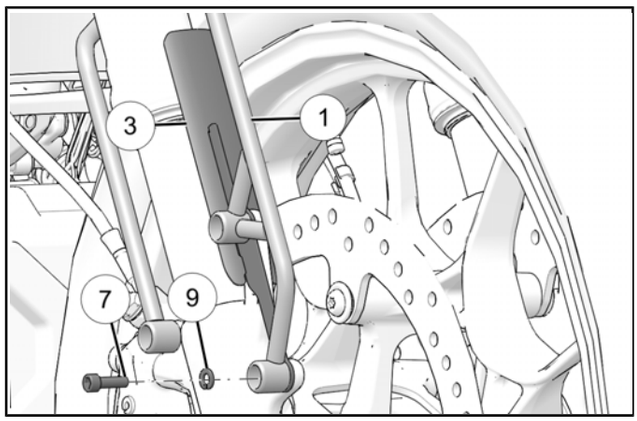
1. Remove and discard screw and clip, holding brake line.



2. Loosely install left-hand mudguard mount ② and left-hand fork guard ④ with three washers ⑨ and three fasteners ⑦.



3. Loosely install right-hand mudguard mount ① and right-hand fork guard ③ with three washers ⑨ and three fasteners ⑦.



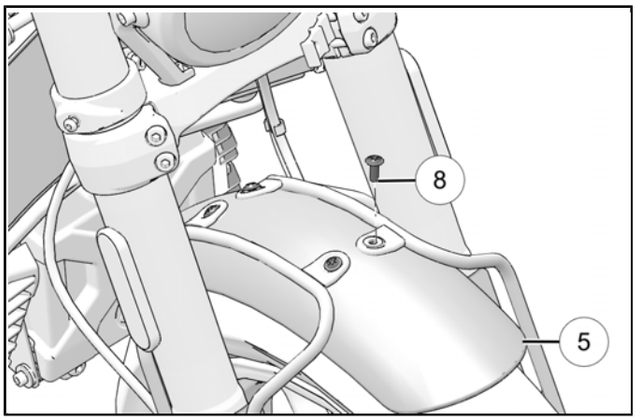
4. Place mudguard ⑤ beneath mudguard mounts and loosely install with four mud guard fasteners ⑧ prior to torquing.

⚠ CAUTION

Ensure mudguard finish is not damaged or scratched during installation.

TORQUE

Mud Guard to Bracket Fasteners ⑧:
96 in-lbs (11 N·m)

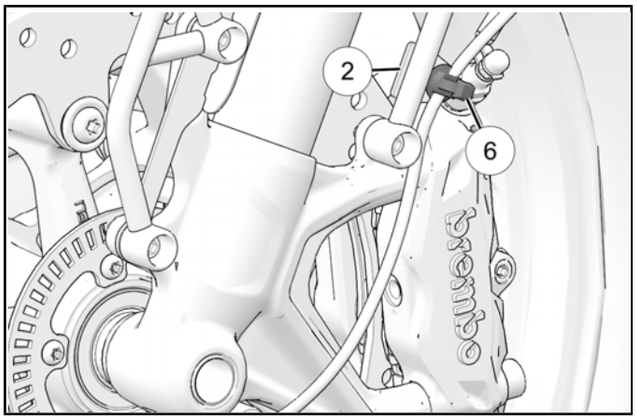


5. Torque mudguard mount hardware, loosely installed in steps 2 and 3 of this section.

TORQUE

Mud Guard Mount Fasteners (front) ⑦:
96 in-lbs (11 N·m)

6. Install routing clip ⑥ into left-hand mudguard mount ② and attach cable tie portion to brake line.

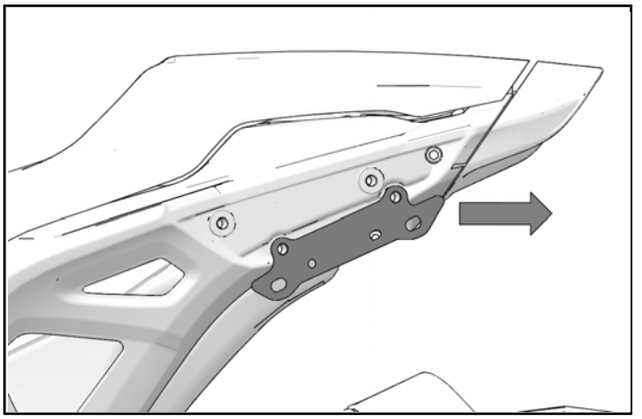


7

REAR BODY ACCESSORY MOUNT INSTALLATION

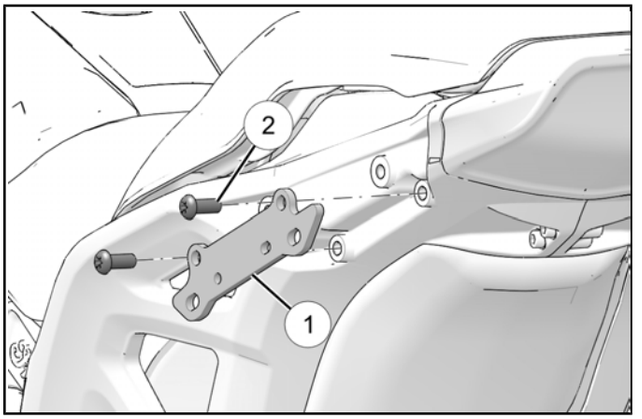
1. Ensure correct orientation. Longer end of bracket should be facing rearward.

IMPORTANT
Incorrect orientation will prevent correct fitment and installation of future accessories.



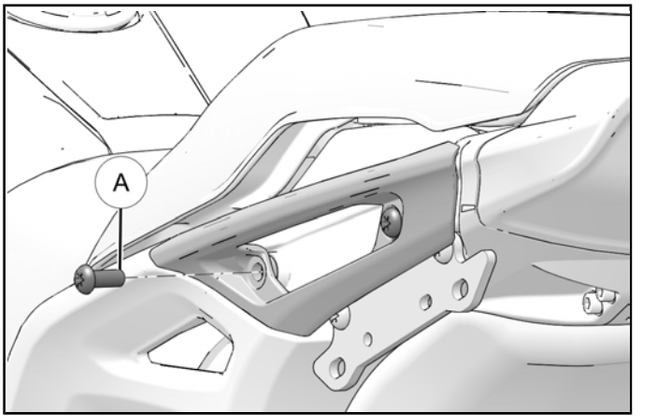
2. Install accessory mounting plate ① with two fasteners ②.

TORQUE
Mounting Plate Fasteners ②: **19 ft-lbs (26 N·m)**



3. Reinstall passenger handle with two fasteners Ⓐ.

TORQUE
Passenger Grab Handle Fasteners Ⓐ: **19 ft-lbs (26 N·m)**



4. Repeat this section for opposite side.

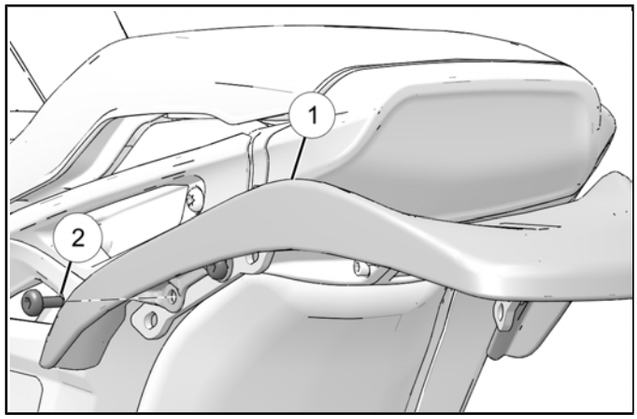
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

REAR MUD GUARD INSTALLATION

IMPORTANT

The rear body accessory mount needs to be installed before the procedure below can be performed. See Rear Body Accessory Mount Installation page 7.22

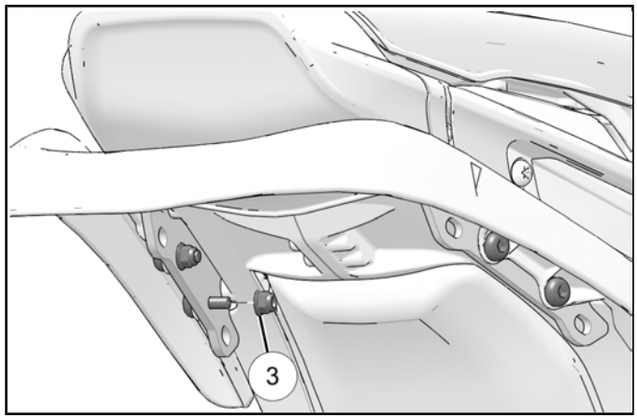
1. Align mudguard ① with middle holes of accessory mount and begin installation by passing four screws ② through mudguard and accessory mount.



2. Complete installation with four nuts ③. Counter-hold nuts ③ while torquing screws ②.

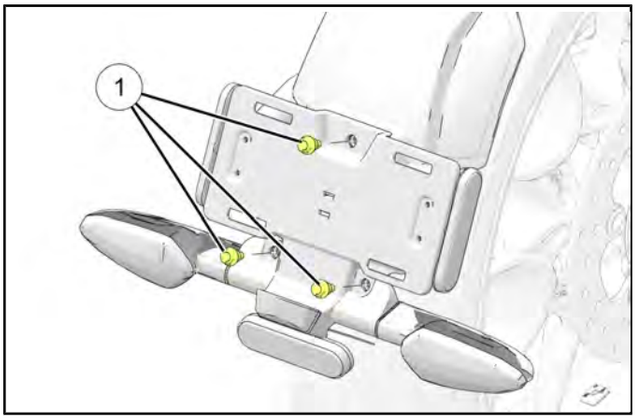
TORQUE

Rear Mudguard Fasteners ②:
96 in-lbs (11 N·m)

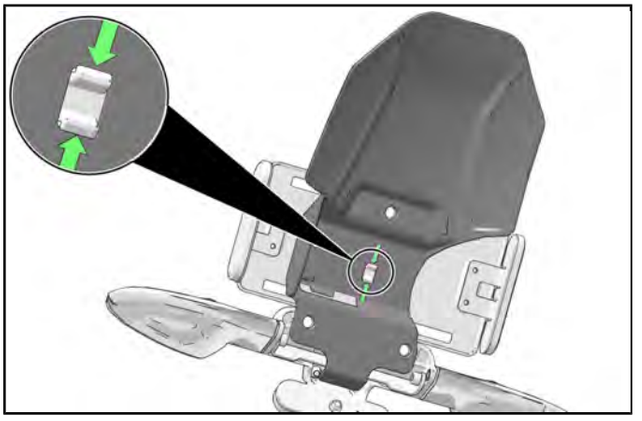


REAR FENDER REMOVAL

1. Remove three fasteners ① securing the license plate / fender assembly to the arm.

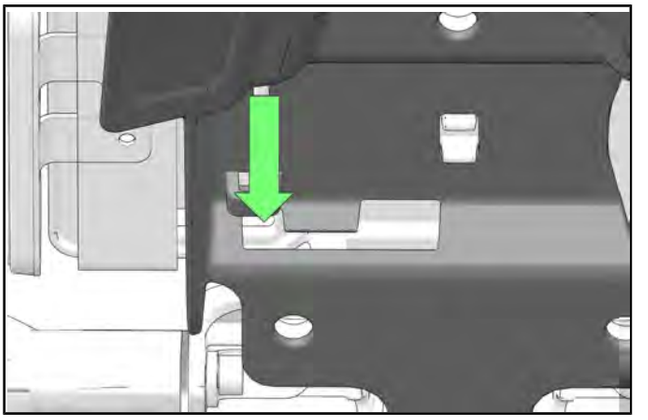


2. Disconnect the license plate light and turn signal electrical connector.
3. Push in two retaining tabs on the rear fender to remove.



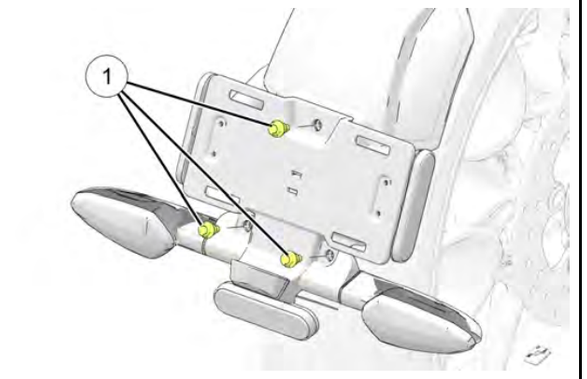
REAR FENDER INSTALLATION

1. Install rear fender.
2. Connect the license plate light and turn signal electrical connector.
3. Verify the license plate light wire is properly routed through the hole in the rear fender.

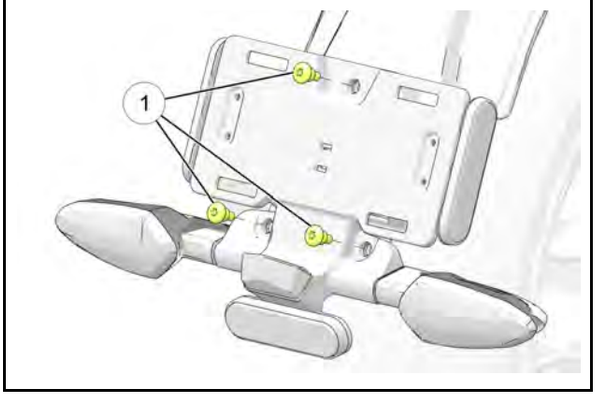


4. Place the rear fender and license plate holder assembly onto the motorcycle so the bolt holes line up and install fasteners ① to finger tightness.

2019–2020



2022

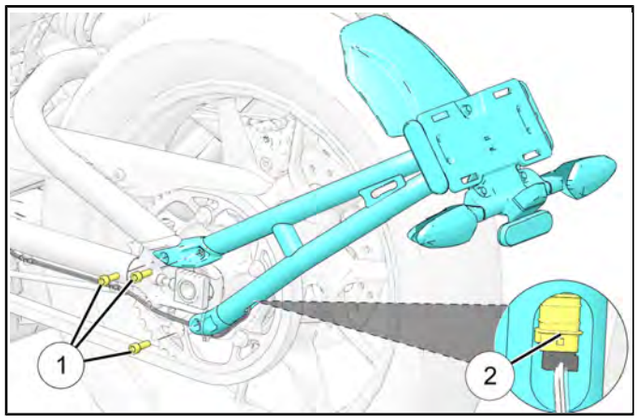


5. Torque fasteners to specification.

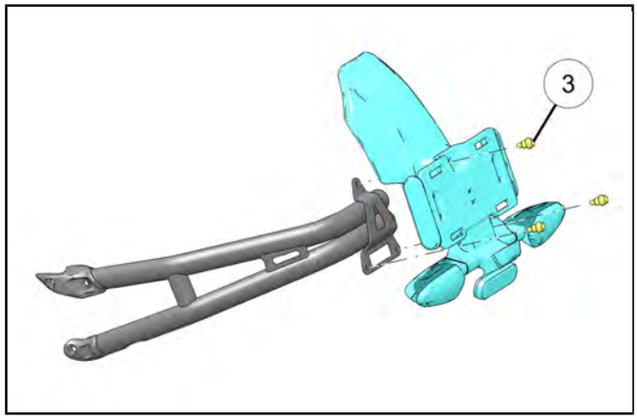
TORQUE
License Plate Mount Fasteners: **96 in-lbs (11 N·m)**

REAR FENDER ARM REPLACEMENT

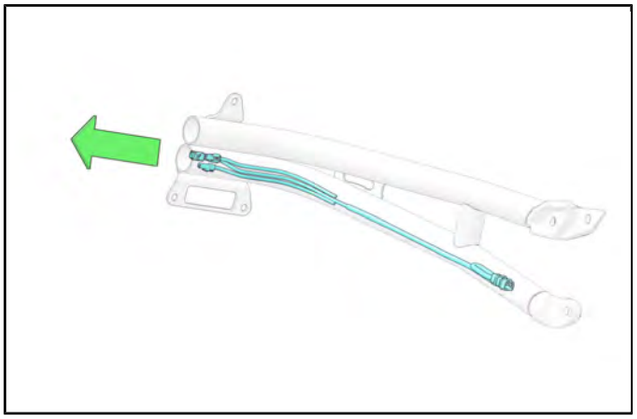
1. Remove three fasteners ① securing rear fender arm and DISCARD fasteners.



2. Disconnect license plate electrical connector ②.
3. Disconnect tail light electrical connectors.
4. Remove three fasteners ③ securing license plate frame and fender assembly.

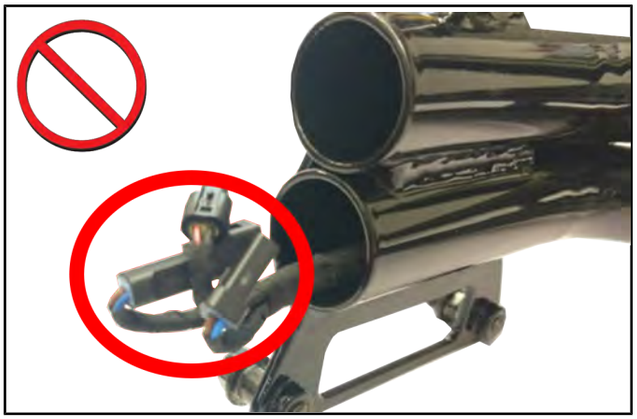


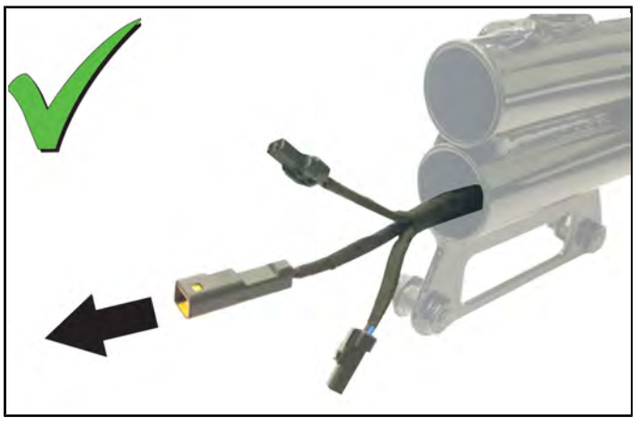
5. Remove the tail light jumper harness as shown.



⚠ CAUTION

Do not bend the connectors on removal or installation. Damage will occur to harness.





7

6. **Installation is performed by reversing the removal procedure.**

   Rear Fender Arm Fasteners are a single use fastener and NEW fasteners must be installed.

TORQUE
Rear Fender Arm Fasteners: **30 ft-lbs (41 N·m)**

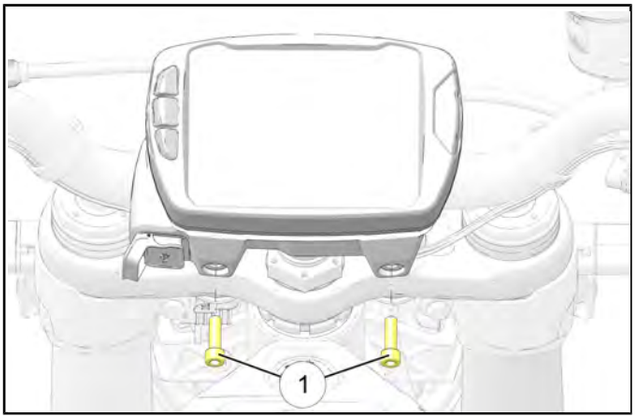
TORQUE
Fender Fasteners (Rear) **96 in-lbs (11 N·m)**

INSTRUMENT PANEL REMOVAL / INSTALLATION

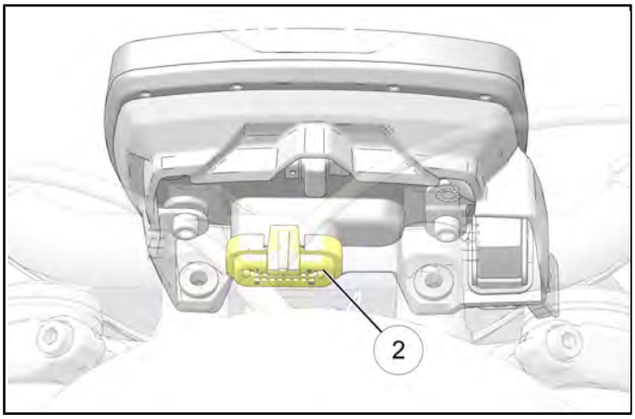
Reference Instrument Cluster Removal / Installation page 10.89

RIDE COMMAND™ DISPLAY REMOVAL / INSTALLATION

1. Remove two fasteners ① securing the instrument panel to the handle bars.



2. Lift instrument panel and disconnect the single multi-plug connector②.



3. Disconnect USB electrical connector.
4. **INSTALLATION is performed by reversing the removal procedure.**

TORQUE
Instrument Panel Fasteners: **84 in-lbs (9 N·m)**

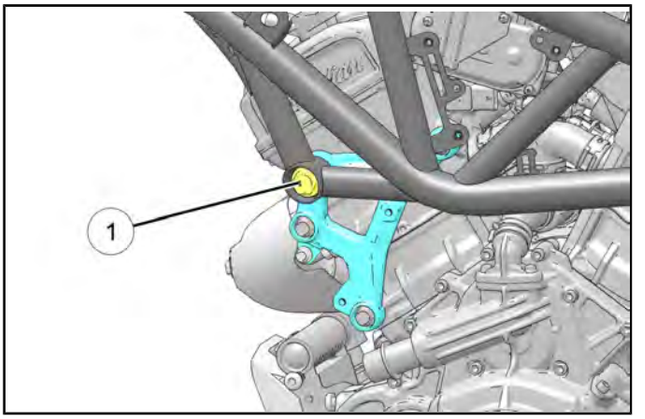
FRAME REMOVAL / INSTALLATION

⚠ WARNING

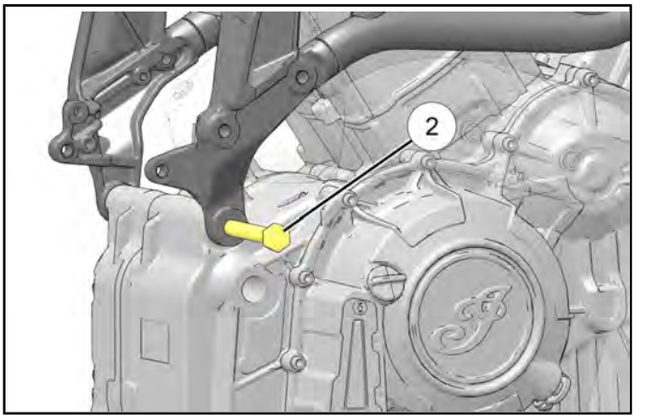
Care should be taken to be sure the motorcycle will not tip or fall while elevated. Severe personal injury or death could occur if the motorcycle tips or falls.

REMOVAL

1. Place the motorcycle in an upright position with the front wheel clamped in a wheel vise.\
2. Place a scissor jack underneath the engine.
3. Remove Seat. See **Seat Removal / Installation page 7.19**
4. Remove Muffler. See **Muffler Removal / Installation page 3.126**
5. Remove the driver foot controls. See **Foot Peg (Driver) Removal / Installation page 7.16**.
6. Remove passenger foot pegs (if equipped). See **Foot Peg (Passenger) Removal / Installation page 7.17**.
7. Remove the radiator. See **Radiator Removal / Installation page 3.57**
8. Remove the fuel tank. See **Fuel Tank Removal page 4.24**
9. Remove resonator. See **Resonator Removal / Installation page 3.127**
10. Remove swingarm. See **Swingarm Removal page 8.94**
11. Remove ABS module. See **ABS Module Replacement page 9.37**
12. Remove handlebars. See **Handlebar Removal / Installation page 8.23**
13. Remove headlight. See **Headlight Replacement page 10.74**
14. Remove triple clamp. See **Triple Clamp Removal page 8.52**
15. Disconnect wiring harness from frame.
16. Remove Headmount fastener ①. Repeat step for opposite side.



17. On the right side of the unit, remove the through bolt ②.



18. Remove the frame.

INSTALLATION

1. **Installation is performed by reversing the removal procedure.**

TORQUE
Headmount To Main Frame Fastener: **74 ft-lbs (100 N·m)**

TORQUE
Engine Mount Fastener (Rear Upper): **51 ft-lbs (69 N·m)**

TORQUE
Engine Mount Fastener (Rear Lower): **51 ft-lbs (69 N·m)**

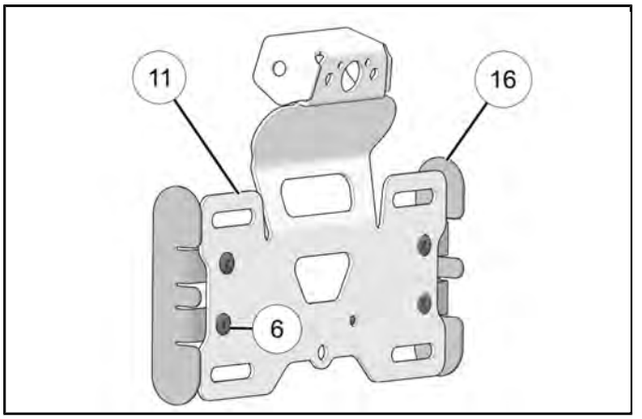
2. Install wiring harness to frame. Reference **Harness Routing page 10.65**
3. Install triple clamp. See **Triple Clamp Installation / Steering Head Bearing Adjustment page 8.54**
4. Install front forks. See **Front Fork Installation page 8.51**
5. Install headlight. See **Headlight Replacement page 10.74**
6. Install handlebars. See **Handlebar Removal / Installation page 8.23**
7. Install ABS module. See **ABS Module Replacement page 9.37**
8. Install swingarm. See **Swingarm Installation page 8.97**
9. Install resonator. See **Resonator Removal / Installation page 3.127**
10. Install Muffler. See **Muffler Removal / Installation page 3.126**
11. Install the fuel tank. See **Fuel Tank Installation page 4.30**
12. Install the radiator. See **Radiator Removal / Installation page 3.57**
13. Install passenger foot pegs (if equipped). See **Foot Peg (Passenger) Removal / Installation page 7.17**.
14. Install the driver foot controls. See **Foot Peg (Driver) Removal / Installation page 7.16**.
15. Install the battery box. See **Battery Tray Removal / Installation page 10.14**.
16. Remove Seat. See **Seat Removal / Installation page 7.19**

HIGH LICENSE PLATE INSTALLATION

LICENSE PLATE ASSEMBLY

1. **U.S. and Canada Models Only:**

   Install two reflector brackets ⑯ onto license plate holder ⑪ with four rivets ⑥.

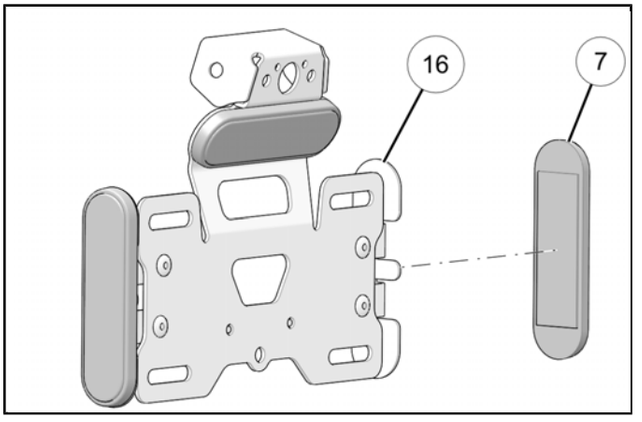


2. **U.S. and Canada Models Only:**

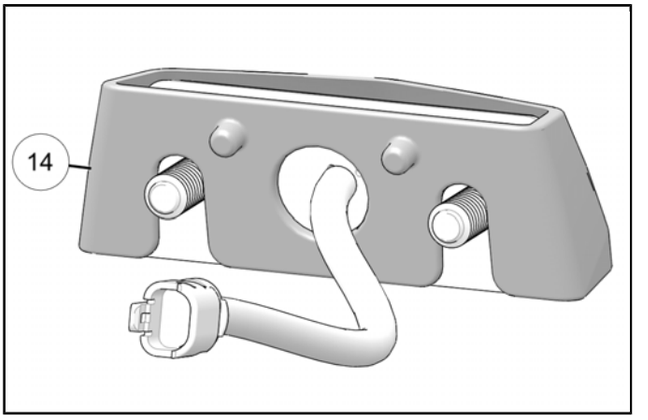
   Following all manufacturer warnings, use isopropyl alcohol to clean reflector brackets ⑯ prior to applying reflectors. Peel backing from three reflectors ⑦. Align and apply two reflectors ⑦ to reflector brackets ⑯. Apply third reflector ⑦ below license plate light mounting location, as shown.

⚠ WARNING

Isopropyl alcohol is hazardous to your health. See isopropyl alcohol packaging for proper handling instructions, including recommended personal protective equipment such as goggles and chemical resistant gloves.

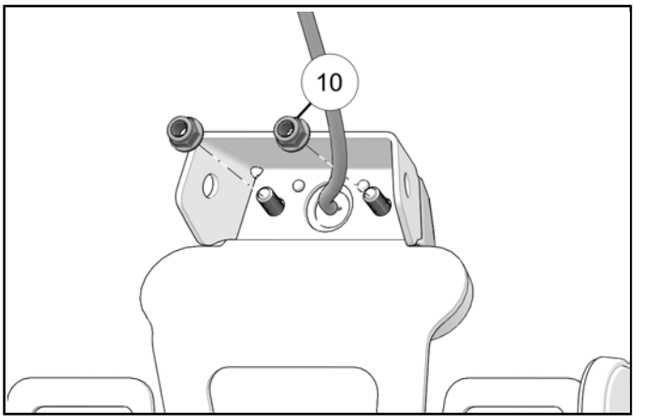


3. Route light cable through light curtain ⑭ and then slide retained license plate light into light curtain ⑭, as shown.



4. Install license plate light and curtain onto license plate bracket with two nuts ⑩.

TORQUE
Light Curtain Nuts ⑩: **36 in-lbs (4 N·m)**

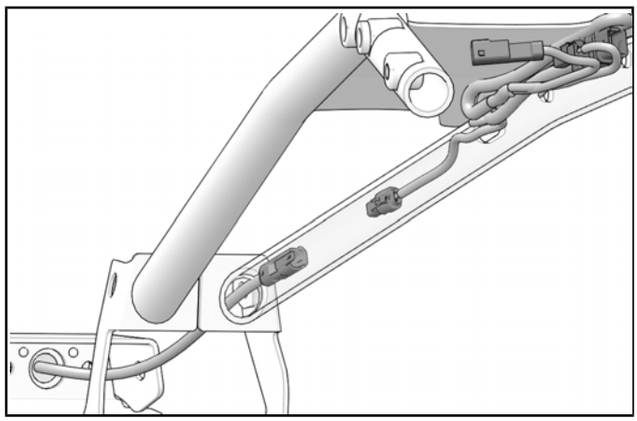


5. Pull tear-tape from license plate / turn signal harness to separate into three individual cables branching from a single connector.

Cable	Pin
Turn Signals	3 Pin
License Plate Light	2 Pin

6. Route license plate light cable through right-hand tube and connect to license plate light and pull slack from license plate light into tube so that connection is not exposed.

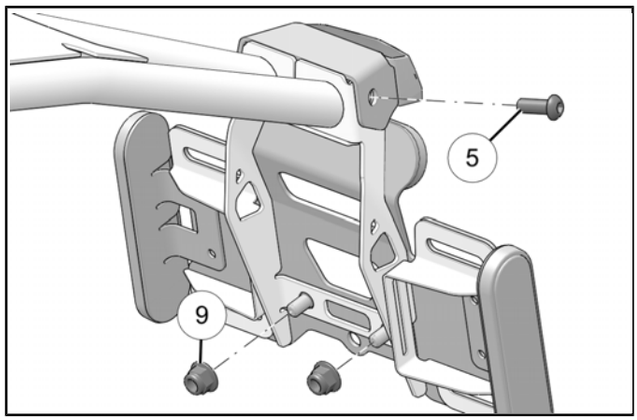
NOTE
Only license plate light cable (2 pin connector) is routed through high license plate mount.



7. Place threaded rods of license plate bracket through license plate mount. Install lower bracket with two nuts ⑨. Install upper bracket with two screws ⑤.

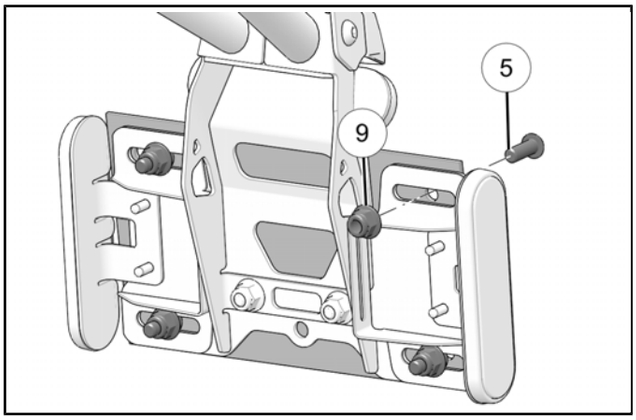
TORQUE
Upper License Plate Bracket Nuts ⑨: **72 in-lbs (8 N·m)**

TORQUE
Upper License Plate Bracket Fasteners ⑤: **72 in-lbs (8 N·m)**



8. Secure license plate to bracket with four fasteners ⑤ and four nuts ⑨.

TORQUE
License Plate Fasteners ⑤: **72 in-lbs (8 N·m)**



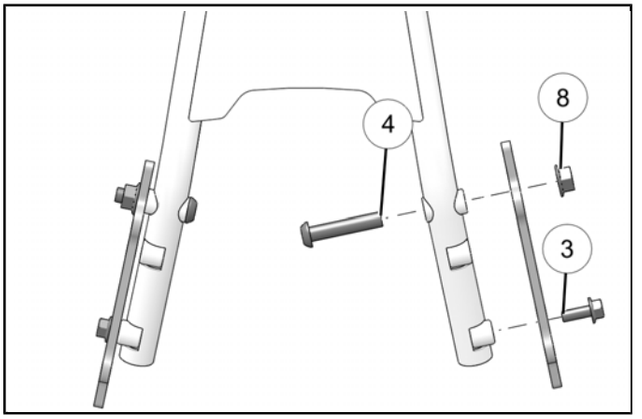
LICENSE PLATE MOUNT INSTALLATION

1. Loosely install two accessory mounting plates onto license plate assembly with two screws ③ at front-most location, and two screws ④ and two nuts ⑧ at rear-most location, as shown.

NOTE
If installing with additional accessory, see *Additional Accessory Installation* section below.

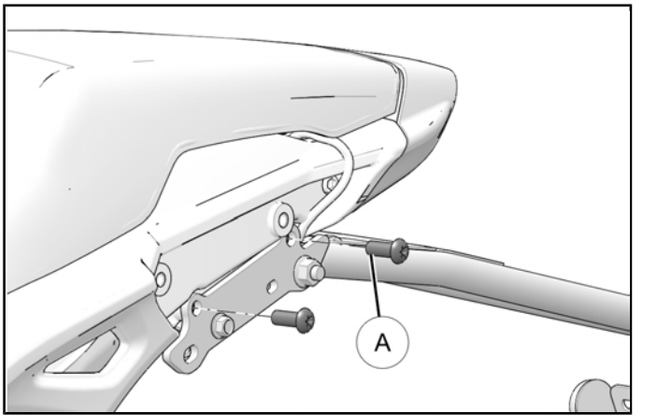
TORQUE
Front License Plate Mount Fasteners ③: **72 in-lbs (8 N·m)**

TORQUE
Rear License Plate Mount Fasteners ④: **15 ft-lbs (20 N·m)**



2. Install accessory mounting plate / license plate mount assembly onto sub-frame with two screws Ⓐ per side.

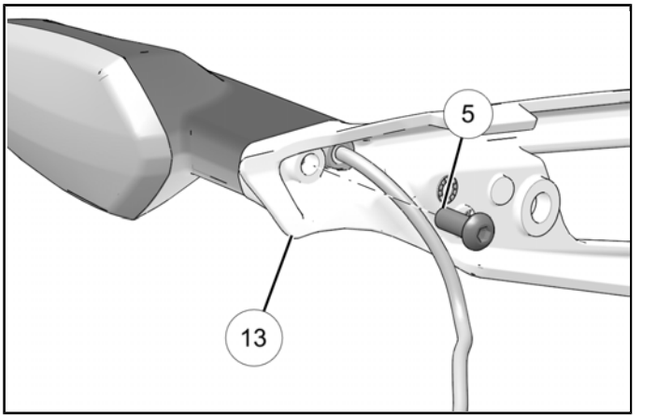
TORQUE
Accessory Mount Fasteners Ⓐ: **19 ft-lbs (26 N·m)**



3. Install retained turn signals onto new left-hand passenger handle ⑬ with one screw ⑤. Ensure turn signal cable passes through passenger handle before securing with fastener.

   Repeat this step for installing right-hand turn signal onto new right-hand passenger handle ⑫.

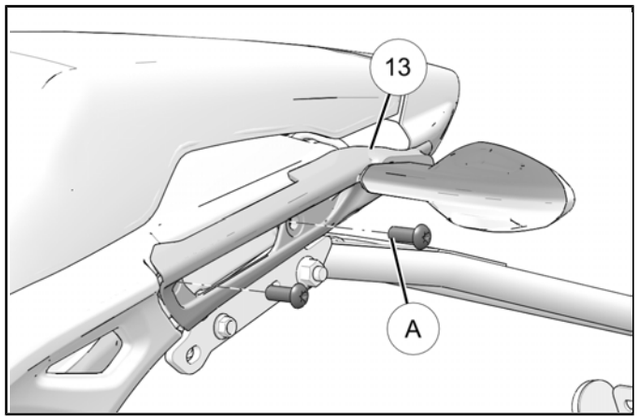
TORQUE
Turn Signal Fasteners ⑤: **36 in-lbs (4 N·m)**



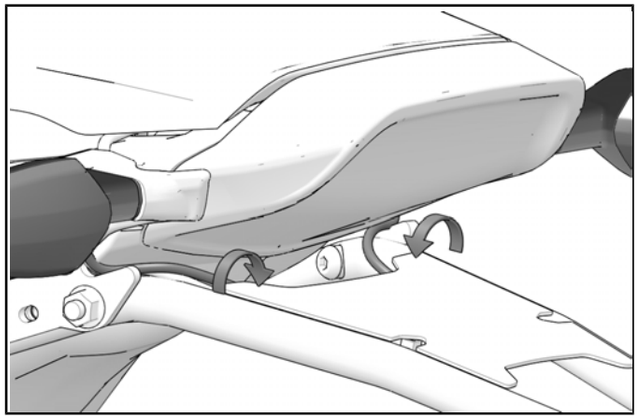
4. Install each passenger handle ⑫ ⑬ onto sub-frame with two retained screws Ⓐ per handle.

IMPORTANT
Ensure chassis harness is routed between passenger handle and sub frame, as shown.

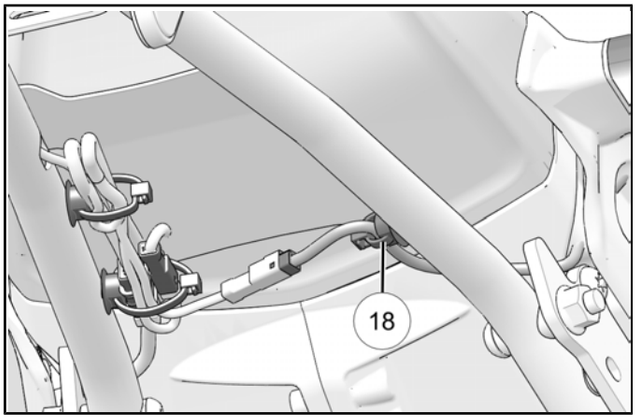
TORQUE
Passenger Handle Fasteners Ⓐ: **19 ft-lbs (26 N·m)**



5. Route turn signal cables over license plate mount tubes, as shown.



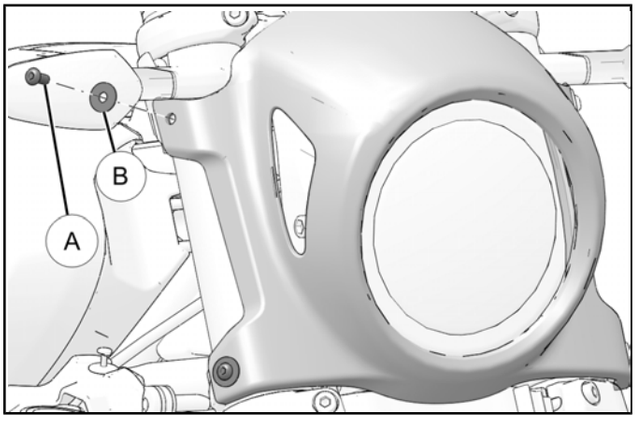
6. Join chassis harness connector to license plate light connector. Join turn signal connectors to license plate harness, installed in *License Plate Assembly* section. Secure excess cable to license plate mount with three push-pin cable ties ⑱.



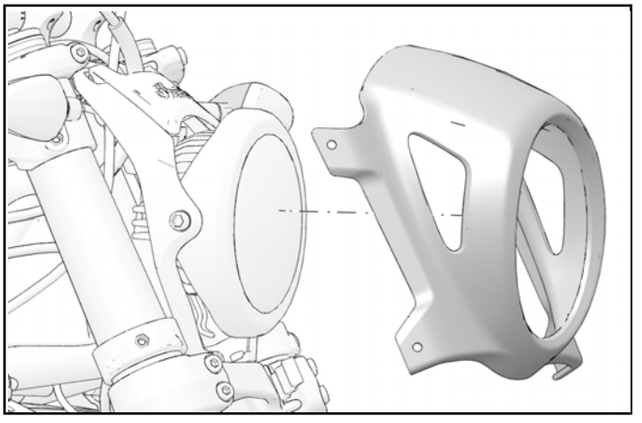
7

WINDSHIELD INSTALLATION

1. Turn key or ignition switch to OFF position and remove key.
2. Ensure motorcycle is parked on a flat surface, kickstand is fully extended, and vehicle is stable prior to installation.
3. If applicable, remove and retain four Head Light Cover Mount Fasteners Ⓐ and four washers Ⓑ from headlight cowl.

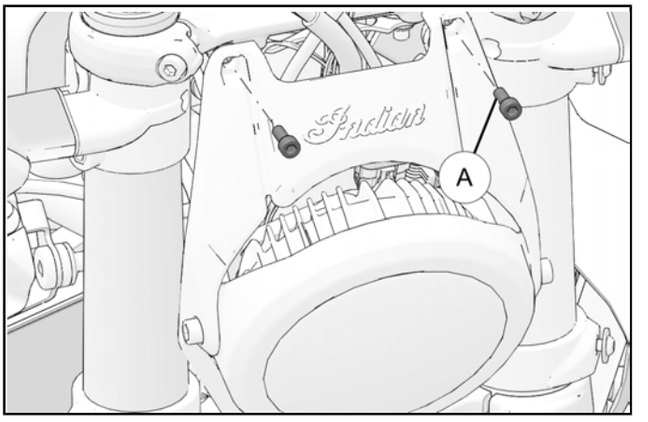


4. Remove headlight cowl and set aside for reinstallation.



HEADLIGHT REMOVAL

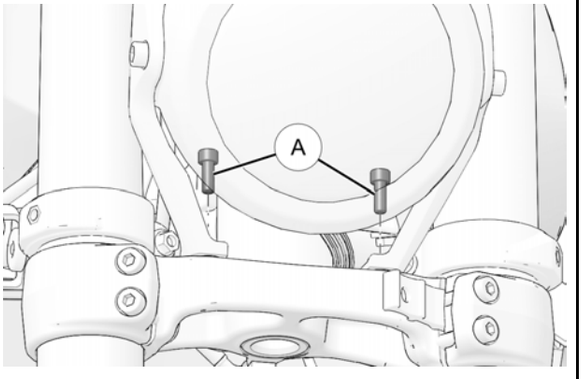
1. Remove and retain two fasteners Ⓐ from top of headlight bracket.



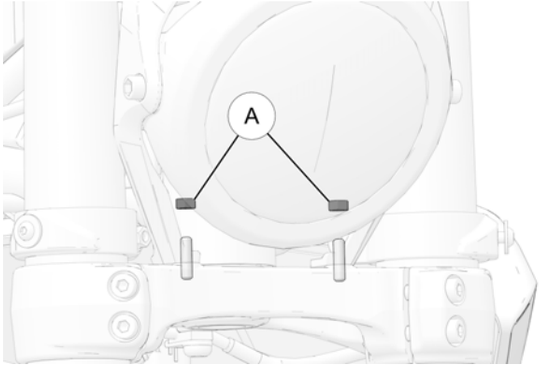
2. Remove and retain two fasteners Ⓐ from bottom of headlight bracket.

NOTICE
Turn handlebars lock-to-lock to access two fasteners Ⓐ from rear-side.

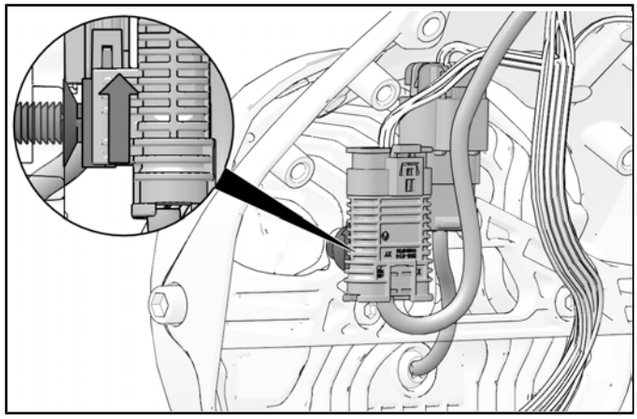
2019–2020



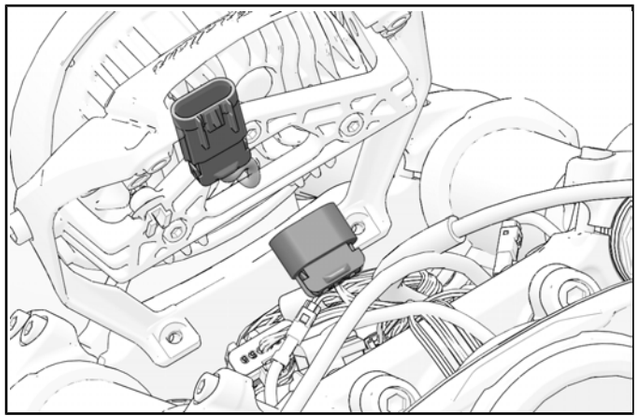
2022



3. With headlight assembly unmounted, tilt assembly forward and slide electronic throttle control (ETC) connection off push-pin clip. It is not necessary to disconnect harnesses.



4. Disconnect headlight from chassis harness. Headlight connector will remain installed onto push-pin clip.



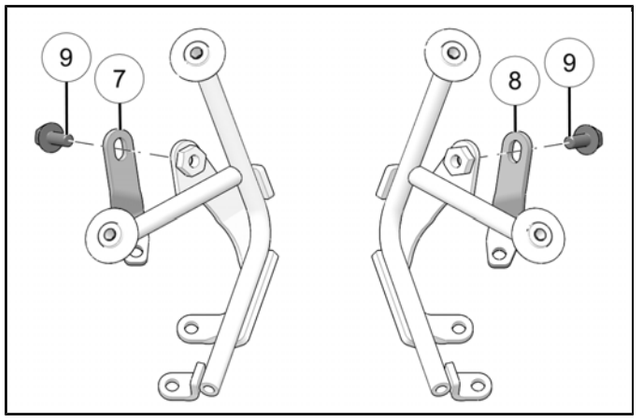
5. Carefully set headlight assembly aside on soft surface as to not scratch finished surfaces.

WINDSHIELD MOUNT INSTALLATION

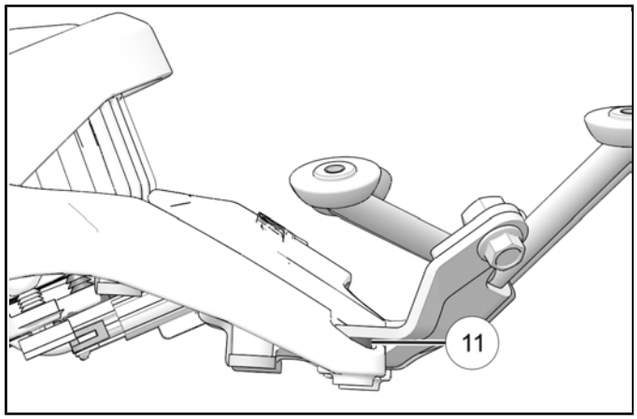
NOTE
All Indian Motorcycle® FTR™ models require *Windshield Mount* to be installed prior to windshield installation.

1. Protect face of headlight assembly with cloth or other soft surface before placing face down.
2. Loosely install brackets ⑦ ⑧ onto windscreen mounts with bracket fasteners ⑨.

Do not torque fasteners at this time.



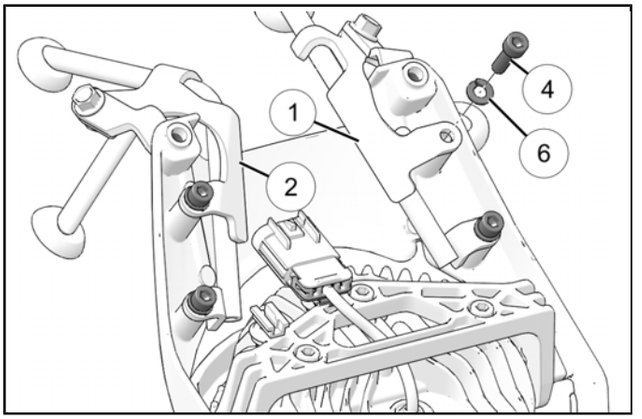
3. Slide windscreen mount assembly over headlight bracket and place one spacer ⑪ between windscreen bracket and headlight bracket in each top mounting hole.



7

4. Install right-hand mount ① and left-hand mount ② to back of headlight bracket with Windshield Mount Fasteners ④ and four washers ⑥.

TORQUE
Windshield Mount Fasteners ④: **96 in-lbs (11 N·m)**

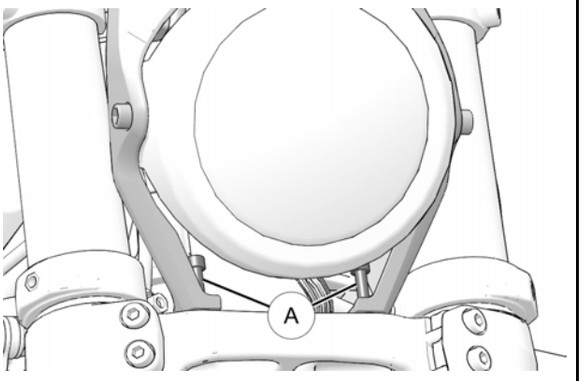


5. Re-join headlight connector to chassis harness connector. Re-mount ETC connection onto push-pin clip, on back of headlight mount.

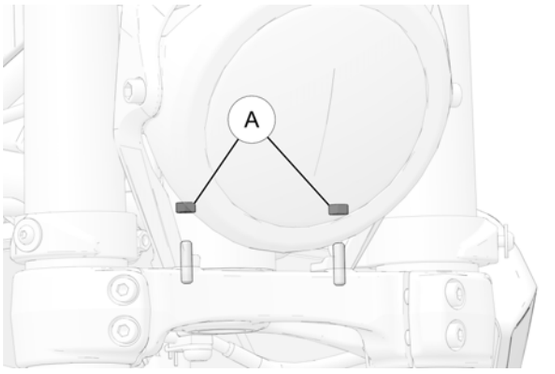
6. Reinstall bottom of headlight assembly with two fasteners Ⓐ.

NOTICE
Turn handlebars lock-to-lock to access two fasteners Ⓐ from rear-side.

2019–2020



2022

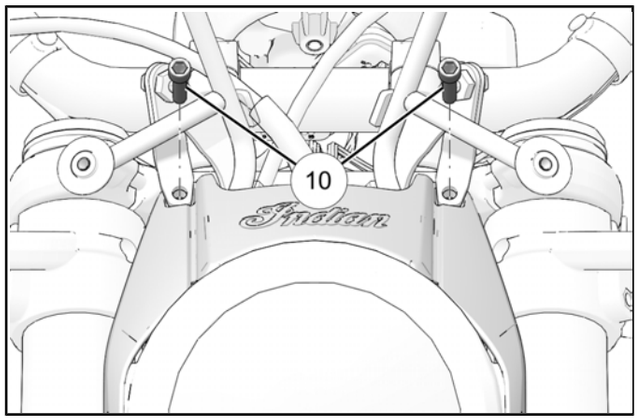


7. Ensure two Lower Windshield Mount Fasteners ⑩ pass through spacers and reinstall headlight bracket. Torque two fasteners ⑨ during this step.

TORQUE
Windshield Mount Bracket Fasteners, Lower ⑩: **96 in-lbs (11 N·m)**

TORQUE
Windshield Mount Bracket Fasteners, Upper ⑨: **96 in-lbs (11 N·m)**

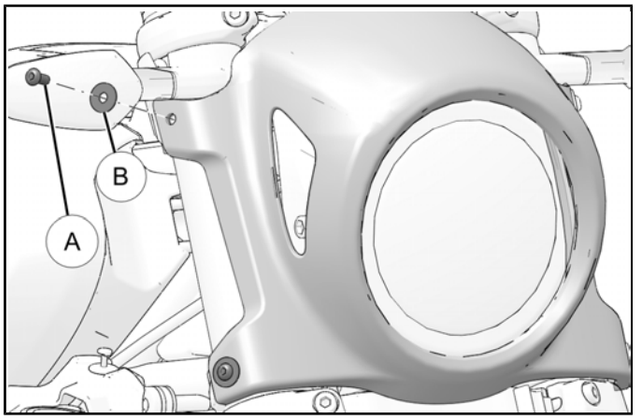
TORQUE
Headlight Mount Fasteners (lower) Ⓐ: **84 in-lbs (9 N·m)**



HEADLIGHT COWL INSTALLATION

1. Install headlight cowl onto turn signal mounts and headlight cowl mounts with four Head Light Cover Fasteners Ⓐ and four washers Ⓑ.

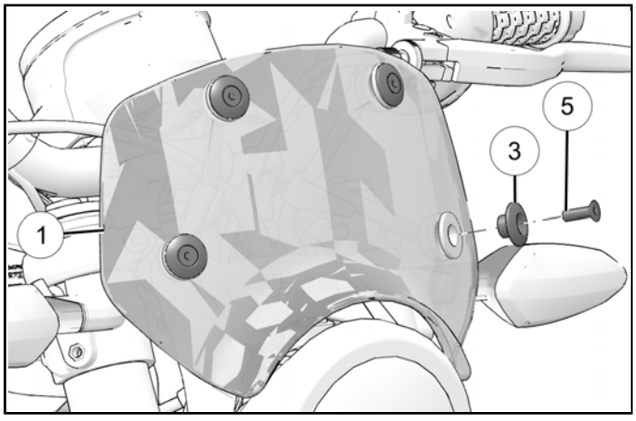
TORQUE
Headlight Cover Fasteners Ⓐ: **18 in-lbs (2 N·m)**



WINDSHIELD INSTALLATION

1. Align wind deflector ① with arms of windshield mount and loosely install with four Wind Deflector Fasteners ⑤ and four caps ③.

TORQUE
Wind Deflector Fasteners ⑤: **80 in-lbs (9 N·m)**



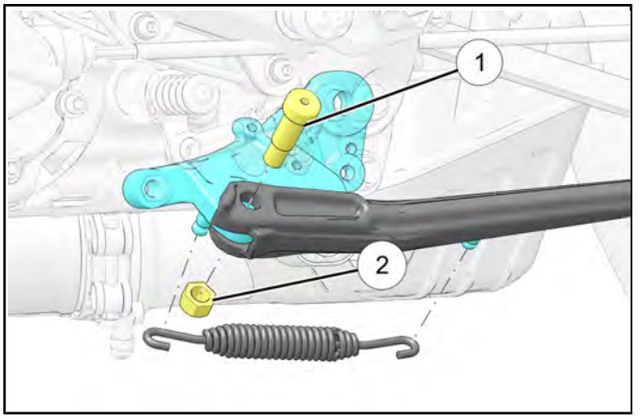
7

SIDE-STAND REMOVAL / INSTALLATION

⚠ WARNING

The side-stand spring is under tension. Wear eye and face protection when removing and installing the spring and side-stand. Be sure the vehicle is properly secured before you begin.

1. Side-stand will be moved between the UP (retracted) and DOWN (extended) position during removal and installation. Be sure vehicle is properly secured.
2. Remove side-stand pivot bolt ① using a 6 mm hex wrench while holding the nut ② with a 15 mm wrench.



3. Grasp side-stand firmly and move it to the UP position.
4. Pull side-stand rearward against spring tension until mounting flange on side-stand is clear of the mounting boss on the frame.
5. Relax tension and remove spring.

Installation:

6. Attach spring to side-stand.
7. Lightly grease side-stand mounting boss on frame and the shouldered portion of the pivot bolt.
8. Place loose end of spring through hole in frame rail.
9. With side-stand in the retracted position (up), pull stand rearward against spring tension until the mounting flange on the side-stand drops onto the mounting boss on the frame.
10. Swing side-stand to the extended position to align bolt hole and install bolt and nut.
11. Torque to specification and wipe off any excess grease.

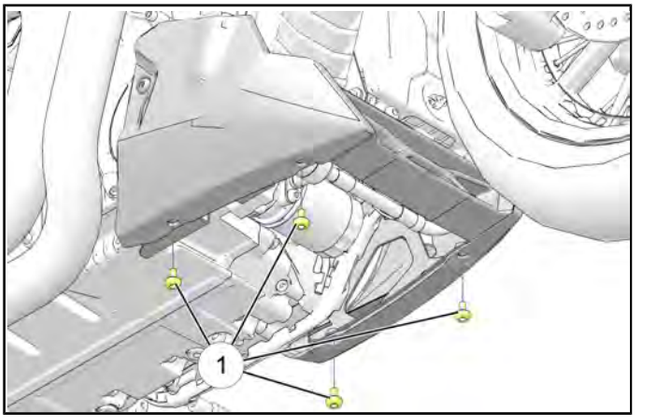
TORQUE
Side-stand Pivot Bolt: **35 ft-lbs (47 N·m)**

12. Cycle the side-stand to be sure it moves freely, and returns to the fully retracted position.

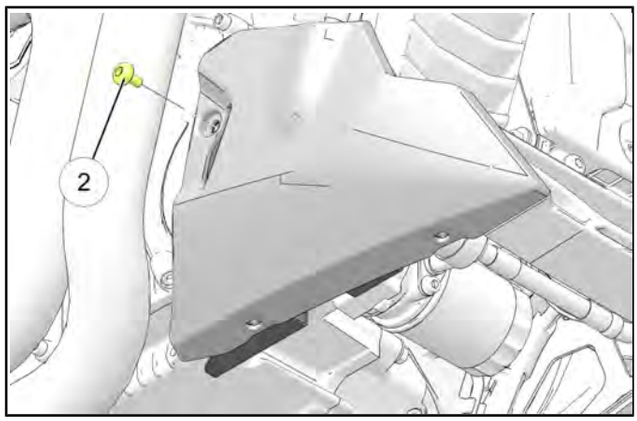
CHIN FAIRING REPLACEMENT

CHIN FAIRING REMOVAL

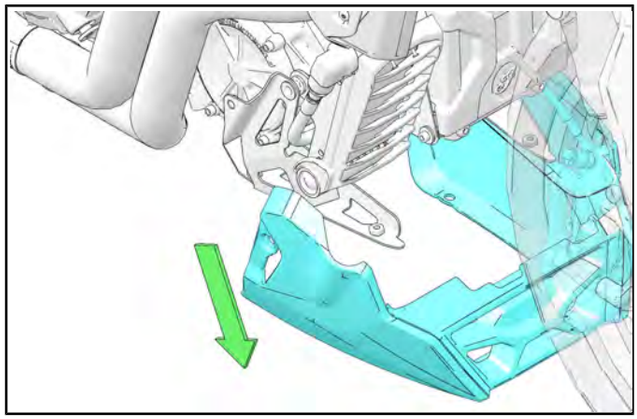
1. Remove four lower chin fairing bottom fasteners ①.



2. Remove two (one per side) lower chin fairing side fasteners ②.

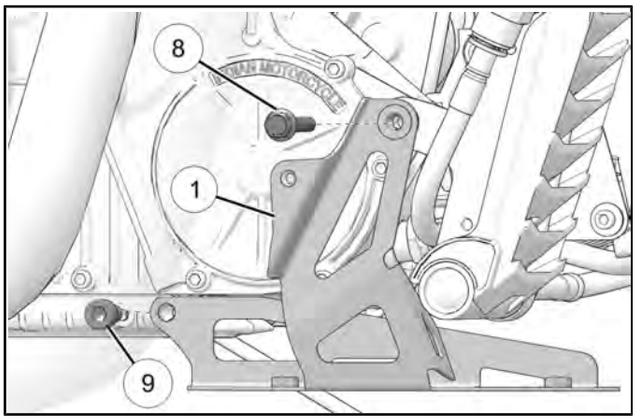


3. Remove the lower chin fairing from the mounting brackets.

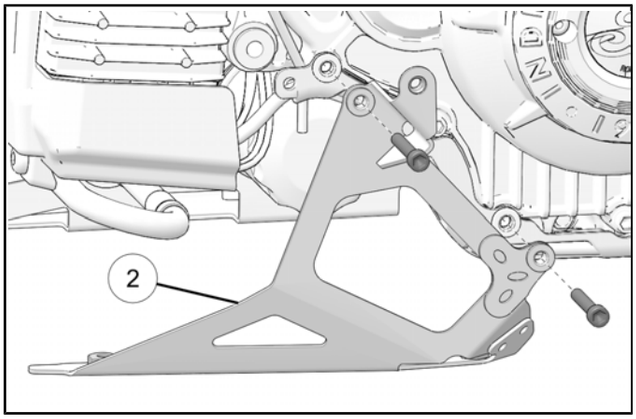


BRACKET REMOVAL

1. Remove right chin fairing bracket ① by removing M8 bolt ⑧ and M10 bolt ⑨



2. Removing two fasteners and the left chin fairing bracket ②.

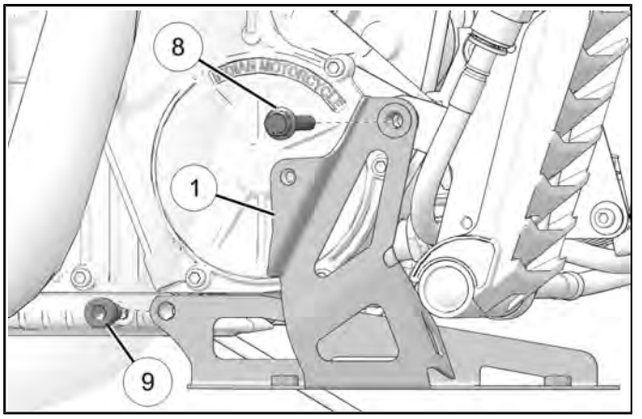


BRACKET INSTALLATION

1. Install right chin fairing bracket ① with M8 bolt ⑧ and M10 bolt ⑨. Torque to specification.

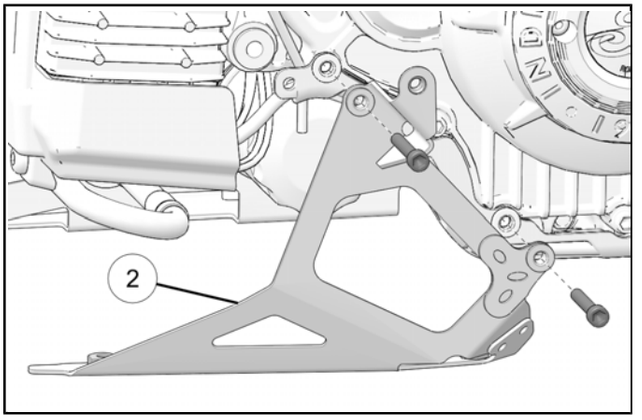
TORQUE
Screw ⑧: **71 in-lbs (8 N·m)**

TORQUE
Screw ⑨: **29 ft-lbs (40 N·m)**



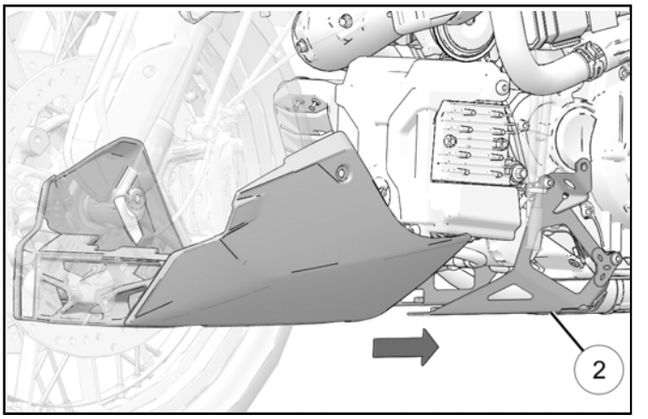
2. Install left chin fairing bracket ② with two fasteners. Torque to specification.

TORQUE
Fasteners: **106 in-lbs (12 N·m)**



CHIN FAIRING INSTALLATION

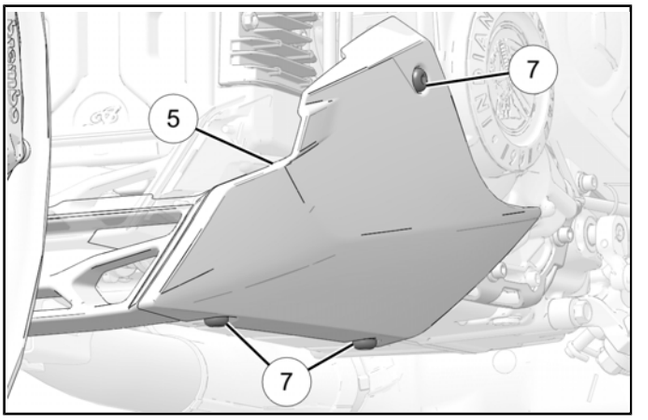
1. Install the chin fairing assembly to left chin fairing bracket ② and right chin fairing bracket by sliding it onto the bracket tabs.



2. Install two (one per side) lower chin fairing side fasteners ⑦. Torque to specification.

TORQUE
Chin Fairing Fasteners: **35 in-lbs (4 N·m)**

3. Install four lower chin fairing ⑤ bottom fasteners ⑦. Torque to specification.

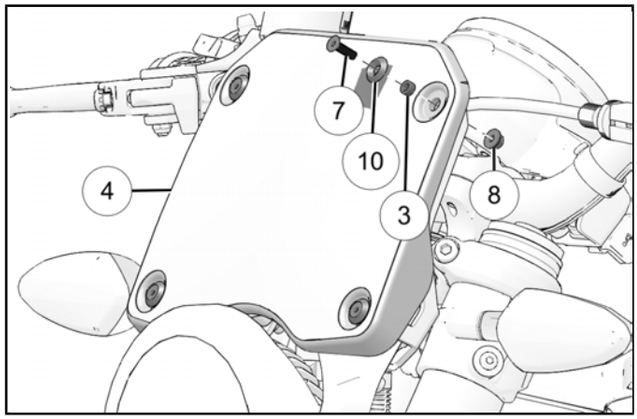


TORQUE
Chin Fairing Fasteners: **35 in-lbs (4 N·m)**

FRONT NUMBER PLATE REPLACEMENT

REMOVAL

1. Remove Bracket Fasteners ⑦ from Nuts ⑧ Along with the fasteners and nuts, remove and retain Four washers ⑩ and spacers ③.

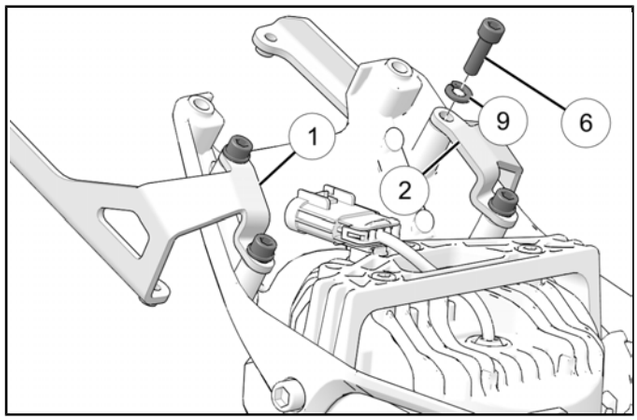


2. Re3move front number plate ④.

INSTALLATION

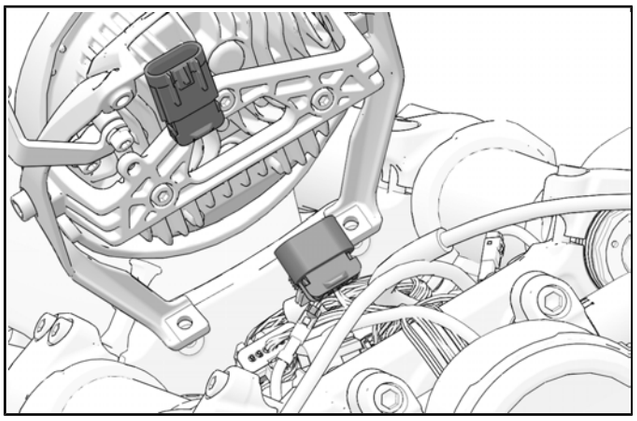
1. If removed, Install two number plate brackets ① ② onto back of headlight bracket with four bracket fasteners ⑥ and four lock washers ⑨.

TORQUE
Bracket Fasteners ⑥ (Number Plate Bracket to Headlight Bracket): **96 in-lbs (11 N·m)**



2. Verify alignment with number plate before proceeding. If bracket and number plate do not align, adjust bracket to proper alignment and torque fasteners again.

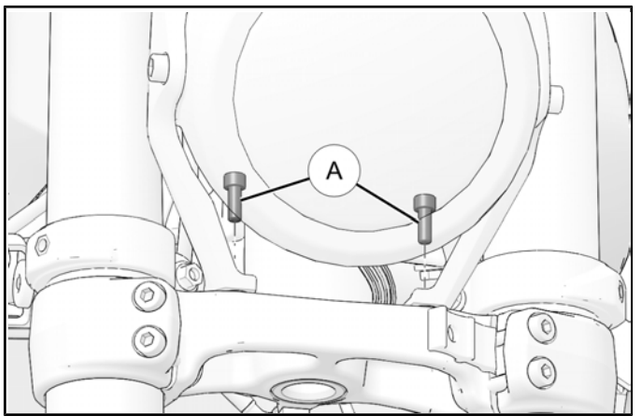
3. Re-join headlight connector to chassis harness connector.



4. Reinstall bottom of headlight assembly with two retained headlight bracket fasteners Ⓐ.

Do not torque headlight fasteners at this time.

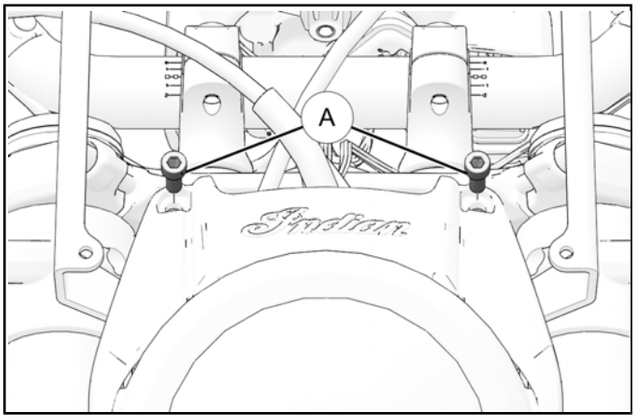
TIP
Turn handlebar lock-to-lock to access two fasteners from rear.



7

5. Reinstall top of headlight assembly with two retained headlight bracket fasteners Ⓐ.

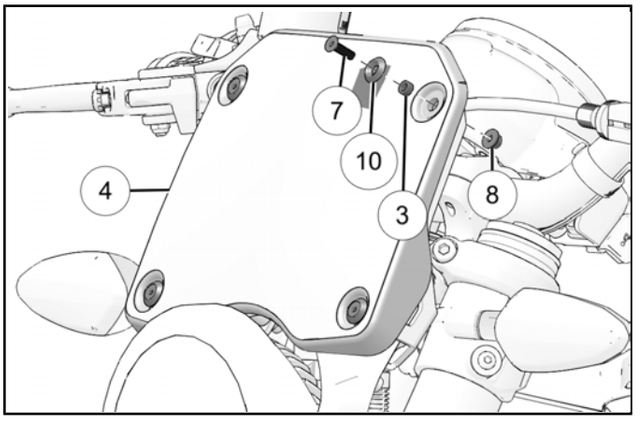
TORQUE
Headlight Bracket Fasteners Ⓐ: **84 in-lbs (9.5 N·m)**



6. Mount front number plate ④ onto two brackets with the following hardware:

- Four bracket fasteners ⑦
- Four washers ⑩
- Four spacers ③
- Four nuts ⑧

TORQUE
Bracket Fasteners ⑦ (Bracket to Number Plate): **60 in-lbs (7 N·m)**



CHAPTER 8
STEERING / SUSPENSION

FRONT WHEEL & SUSPENSION

GENERAL INFORMATION

SERVICE NOTES

⚠ WARNING

Indian Motorcycles are produced using the designated tires listed as original equipment. This includes field testing to ensure stability and superior handling. The use of tires other than original equipment may cause instability which could lead to a crash, resulting in serious injury or death. Use *only* the recommended tires inflated to the recommended tire pressures based on load conditions as listed on the tire information label.

Tubeless tires are used on certain Indian Motorcycle models. Operating the motorcycle with damaged rims creates a safety hazard including air pressure loss, steering imbalance and/or reduced steering control. Do not attempt to repair or straighten damaged rims.

⚠ CAUTION

Work performed to the front end of the motorcycle usually involves supporting the machine with the front end elevated. Take precautions so that the motorcycle is securely supported when the front tire is off the ground. This reduces the possibility of personal injury or damage to the motorcycle.

Leaking front fork seals are a safety hazard and should be replaced immediately if a leak is found. Fork oil could contaminate front brake components which could reduce stopping ability of the motorcycle. Contaminated brake discs or pads greatly reduce available stopping force & increase stopping distance. Brake discs can be cleaned using commercially available brake cleaner. NEVER attempt to clean contaminated brake pads. Replace pads as a set.

- Refer to Maintenance Chapter for **MAINTENANCE** of front end components.
- Refer to Steering / Suspension Chapter for **TIRE REMOVAL, REPAIR, & BALANCING**
- Refer to Brakes Chapter for **BRAKE SYSTEM** service and repairs.

SPECIAL TOOLS - FRONT WHEEL & SUSPENSION

TOOL DESCRIPTION	PART NUMBER
Fork Spring Compressor	PV-49463
Fork Seal Guide	PV-47037
Inverted Fork Seal Installer	PV-47035
Cartridge Holder	PF-52745
Damper Rod Holder	PF-52747
Fork Cap Wrench	PF-52744
Bearing Kit	PU-51324
Fork Spring Compressor Adapter	PV-49464
Fork Oil Seal Driver	PF-51610
Fork Pull-up Tool (Ohlins)	PF-53159
Fork Top Nut Tool (Ohlins)	PF-53158
Fork Spanner (Ohlins)	PF-53160
Steering head wrench	PV-43508
Shock Preload Spanner wrench	2884176
Front Axle Adapter -22 mm (commercially available)	NA
Drive Chain Tool (commercially available)	KM500R

SERVICE SPECIFICATIONS – FRONT WHEEL & SUSPENSION

ITEM		STANDARD	SERVICE
Axle Runout		-	.20 mm (.008 in.)
Front Wheel Runout (Cast and Spoked Type)	Axial	1.00 mm (.039 in.)	2.00 mm (.078 in.)
	Radial	.50 mm (.020 in.)	2.00 mm (.078 in.)
Inner Fork Tube Diameter		43 mm (1.69 in.)	Not Applicable
Inner and Outer Fork Tube Runout		-	.20 mm (.008 in.)
Fork Oil Type	FTR / FTR S / FTR Rally	Indian Motorcycle Fork Oil (PN: 2208093) OR Fuchs SAF 5113, Ohlins fork oil, or approved equivalent	
	FTR R Carbon	Indian Motorcycle Fork Oil (PN: 2208873) OR Fuchs SAF 5113, Ohlins fork oil, or approved equivalent	
Fork Spring Pre-Load	FTR Rally	5 mm (0.197 in)	Not Applicable
	FTR / FTR S	Adjustable, 0–10mm (0–0.394 in)	Not Applicable
	FTR R Carbon (Ohlins)	Adjustable, 9–24mm (0.354 –0.945 in)	Not Applicable
Fork Spring Rate	FTR Rally	6.25 N/mm / 8.34 N/mm / 9.81 N/mm (35.68 / 47.62 / 56.02 lb/in)	Not Applicable
	FTR / FTR S	7.5 N/mm	Not Applicable
	FTR R Carbon	7.5 N/mm	Not Applicable
Fork Spring Free Length	FTR Rally	385 mm (15.16 in.)	-
	FTR / FTR S	370 mm (14.57 in.)	-
	FTR R Carbon	320 mm (12.60 in.)	-
Fork Oil Capacity (per leg, dry) Oil height must be measured and adjusted to specification.	**FTR, FTR S, , FTR LIMITED, FTR CHAMPIONSHIP EDITION**		
	Height	104 mm (4.09 in)	-
	Volume	**17.2 ± .2 oz508 ± 6 cm³**	-
	FTR RALLY		
	Height	100 mm (3.94 in)	-
	Volume	**17.5 ± .2 oz519 ± 6 cm³**	-
	FTR R CARBON		
	Height	135 mm (5.31 in)	-
	Volume	**18.4 ± .2 oz544 ± 6 cm³**	-

8

FRONT FORK ADJUSTMENT GUIDE

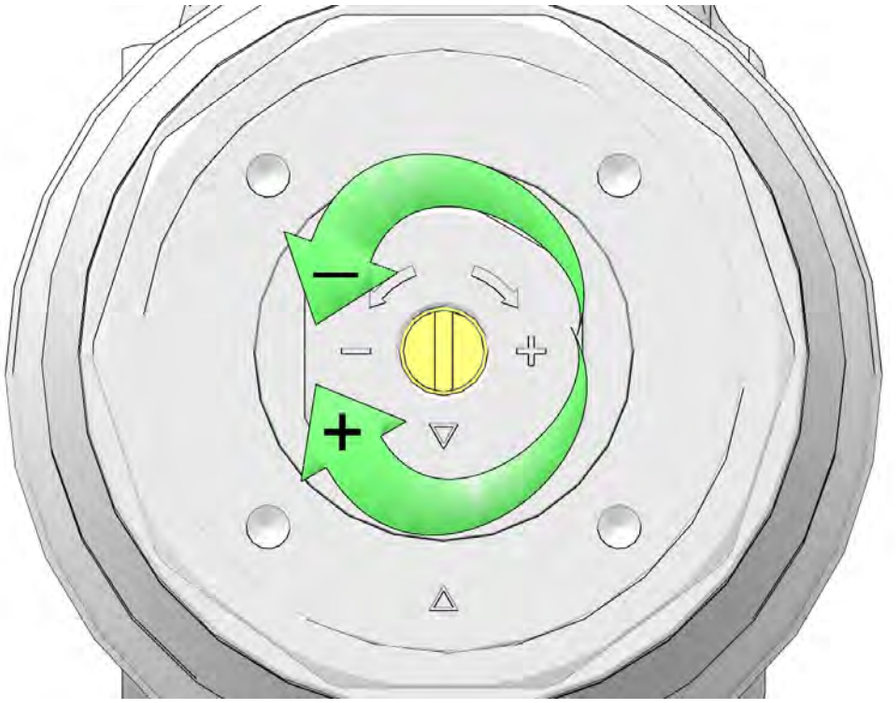
NOTICE
FTR Rally features a preload and rebound adjustments on the rear shock but no fork adjustments. ***FTR / FTR S*** features a fully adjustable fork and rear suspension components. ***FTR R Carbon*** features a fully adjustable fork and rear suspension components.

NOTICE
Turning adjusters fully clockwise (+) will result in a "full-in" position. While turning adjustments fully counter-clockwise (-) will result in a "full-out" position.

FRONT FORK FACTORY SETTINGS

	FTR RALLY	FTR FTR S	FTR R CARBON
Fork Rebound, right side screw slot	N/A	10 clicks *(out from full-in, 20 click range total)*	16 clicks *(out from full-in, 28 click range total)*
Fork Compression, left side screw lot	N/A	10 clicks *(out from full-in, 20 click range total)*	18 clicks *(out from full-in, 28 click range total)*
Fork Preload, 19 mm hex	N/A	3 turns *(in from full-out, 10 turn range total)*	9 turns *(in from full-out, 15 turn range total)*

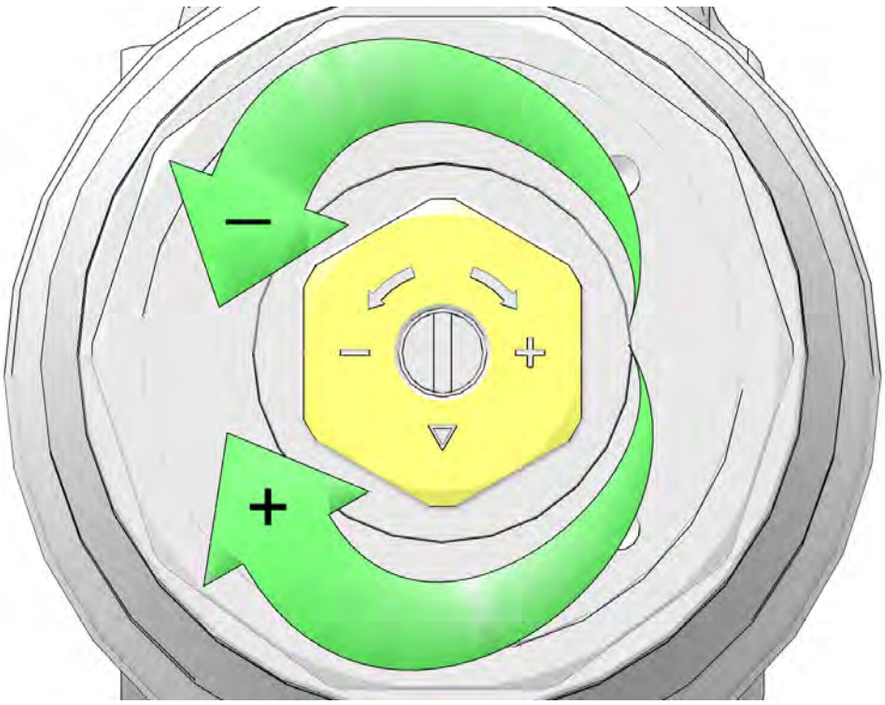
FTR / FTR S RECOMMENDED DAMPING SETTINGS



RIDING TYPE:	COMPRESSION (LEFT-HAND FORK)	REBOUND (RIGHT-HAND FORK)
Low Speed Riding (Urban)	17 clicks out	14 clicks out
General Riding (Town/Highway)	10 clicks out	7 clicks out

RIDING TYPE:	COMPRESSION (LEFT-HAND FORK)	REBOUND (RIGHT-HAND FORK)
General Riding (2-up)	10 clicks out	5 clicks out
Aggressive Riding (Track)	5 clicks out	4 clicks out

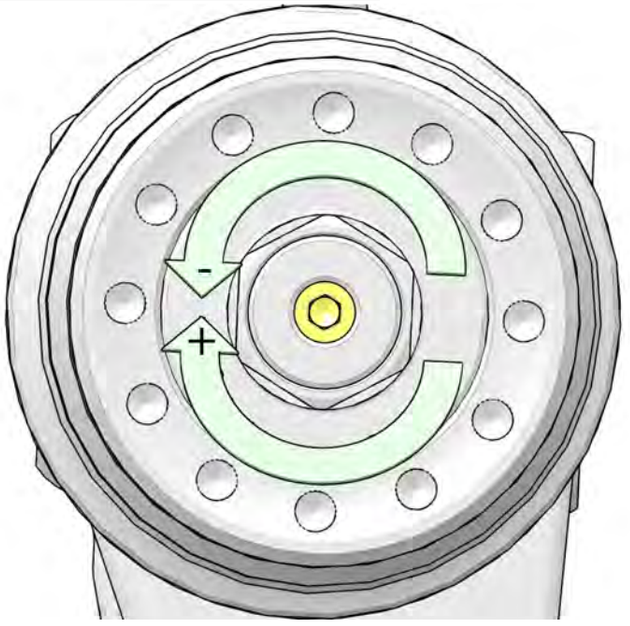
FTR / FTR S RECOMMENDED PRE-LOAD SETTINGS



Adjustments can be make to the fork to increase or decrease pre-load for a personal rider preference.

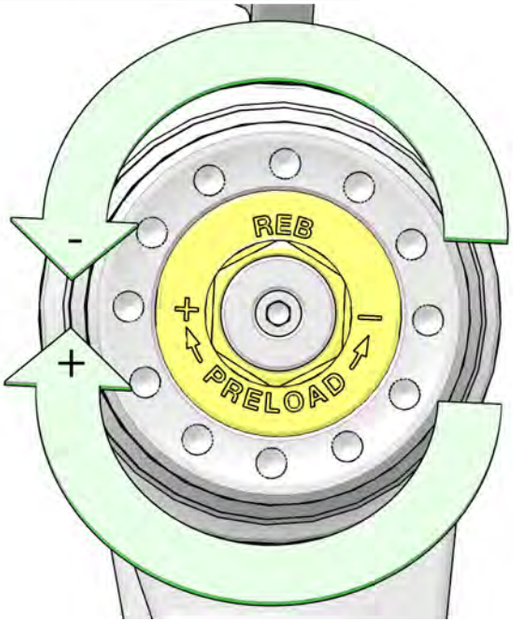
IMPORTANT
Make sure both forks are adjusted evenly.

FTR R CARBON RECOMMENDED DAMPING SETTINGS



RIDING TYPE:	COMPRESSION (LEFT-HAND FORK)	REBOUND (RIGHT-HAND FORK)
Low Speed Riding (Urban)	22 clicks out	18 clicks out
General Riding (Town/Highway)	18 clicks out	16 clicks out
General Riding (2-up)	15 clicks out	14 clicks out
Aggressive Riding (Track)	14 clicks out	19 clicks out

FTR R CARBON RECOMMENDED PRE-LOAD SETTINGS



Adjustments can be make to the fork to increase or decrease pre-load for a personal rider preference.

IMPORTANT
Make sure both forks are adjusted evenly.

DRIVE CHAIN TENSION - SPECIFICATIONS

SPECIFICATIONS: DRIVE CHAIN

CHAIN DEFLECTION	
MODEL	**DEFLECTION AT 10 LBS FORCE**
FTR / FTR S FTR Rally / FTR R Carbon	**35 mm – 40 mm**
DRIVE CHAIN STRETCH SPECIFICATION	
MODEL	**Value**
FTR / FTR S FTR Rally / FTR R Carbon	**319 mm or less**

DRIVE CHAIN TENSION

Special Tool Required: **Chain Tension Gauge PV-43532**

IMPORTANT
Do not adjust the chain when wet, or immediately after riding. Chain must be *dry* and the drive system must be at ambient temperature (60-80° F). This is extremely important for accuracy.

IMPORTANT
Perform this procedure to achieve proper chain tension *and* alignment. Chain tension should be set before performing the alignment procedure.

⚠ WARNING
A drive chain that is not properly tensioned can cause drive line noise and damage the drive chain, causing possible chain failure and loss of control of the motorcycle.

⚠ WARNING
Care should be taken to be sure the motorcycle will not tip or fall while checking drive chain tension. Severe personal injury or death may occur if the motorcycle tips or falls.

1. With the transmission in neutral, place the unit onto its side-stand.

2. Use special tool **PV-43532** and apply 10 lbs of force to the bottom of the drive chain.
3. Measure the distance between the top of the drive link to the bottom of the swingarm behind the chain slider.
4. Compare the measured value with the specification.

Drive Chain Deflection Specification: **35 mm – 40 mm**

5. If the measured value is out of specification, adjust the drive chain. Reference **Drive Chain Adjustment page 8.75**.

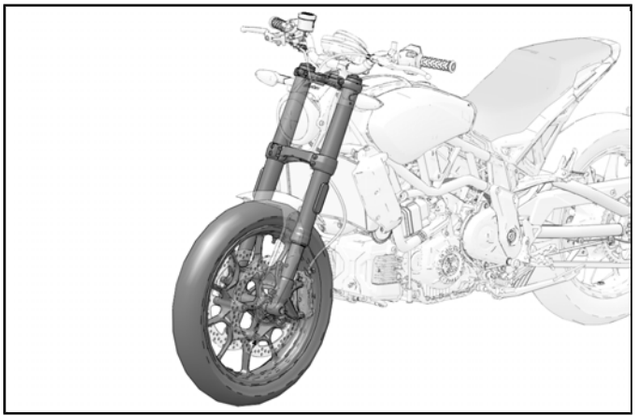
STEERING HEAD / FRONT WHEEL INSPECTION

⚠ WARNING
Care should be taken to be sure the motorcycle will not tip or fall while elevated. Severe personal injury or death may occur if the motorcycle tips or falls.

IMPORTANT
Be sure control cables, hoses and wiring are not interfering with handle bar rotation.

1. Secure motorcycle with front wheel off the floor.

2. Turn handlebars from full left to full right and inspect for smooth, free movement. Point front wheel straight ahead, grasp fork tubes and pull/push fork tubes back and forth. If steering binds, feels rough or uneven, or if movement is detected at steering stem, adjust or replace steering head bearings as necessary.

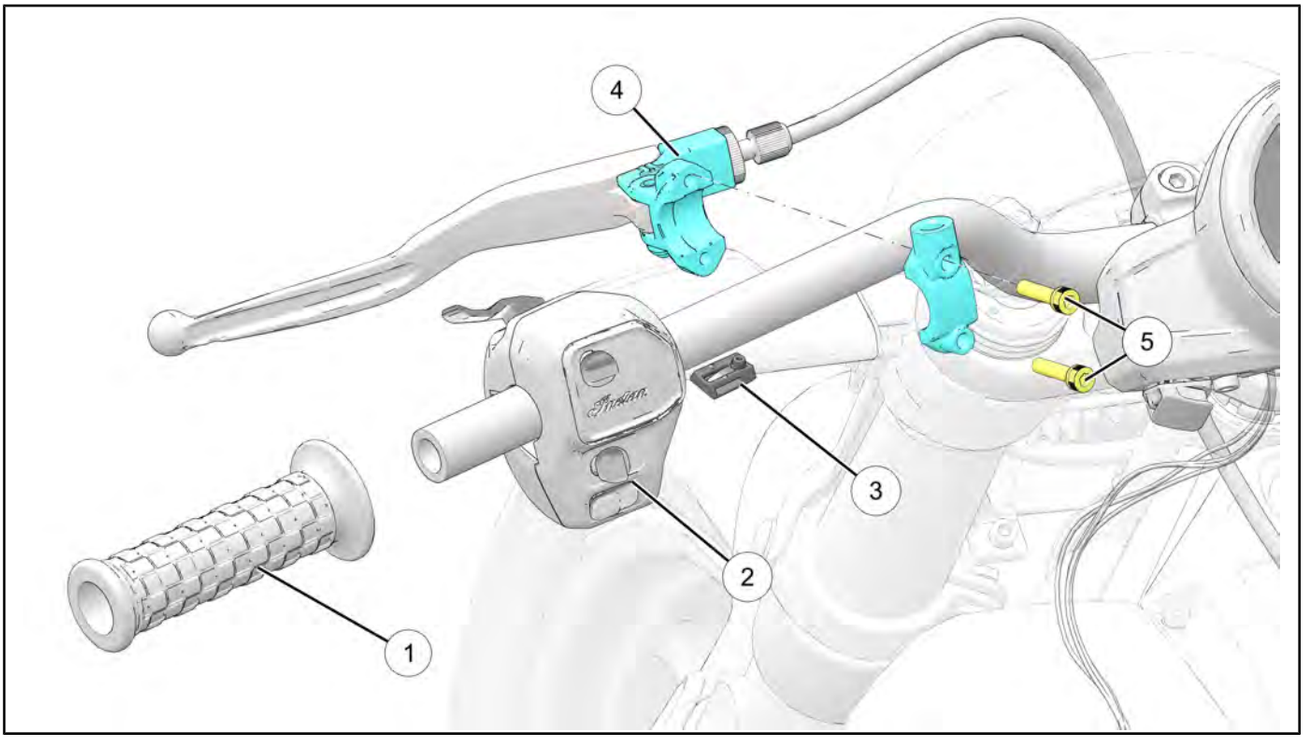


3. Rotate front wheel and inspect for smooth rotation of front wheel bearings. If roughness or unusual sounds are present, replace front wheel bearings. See Steering / Suspension Chapter.
4. Turn handle bars full right or left and hold against the fork stop. Attempt to move front wheel side-to-side. If movement is observed, inspect front axle, wheel, and bearings. See Steering / Suspension Chapter.

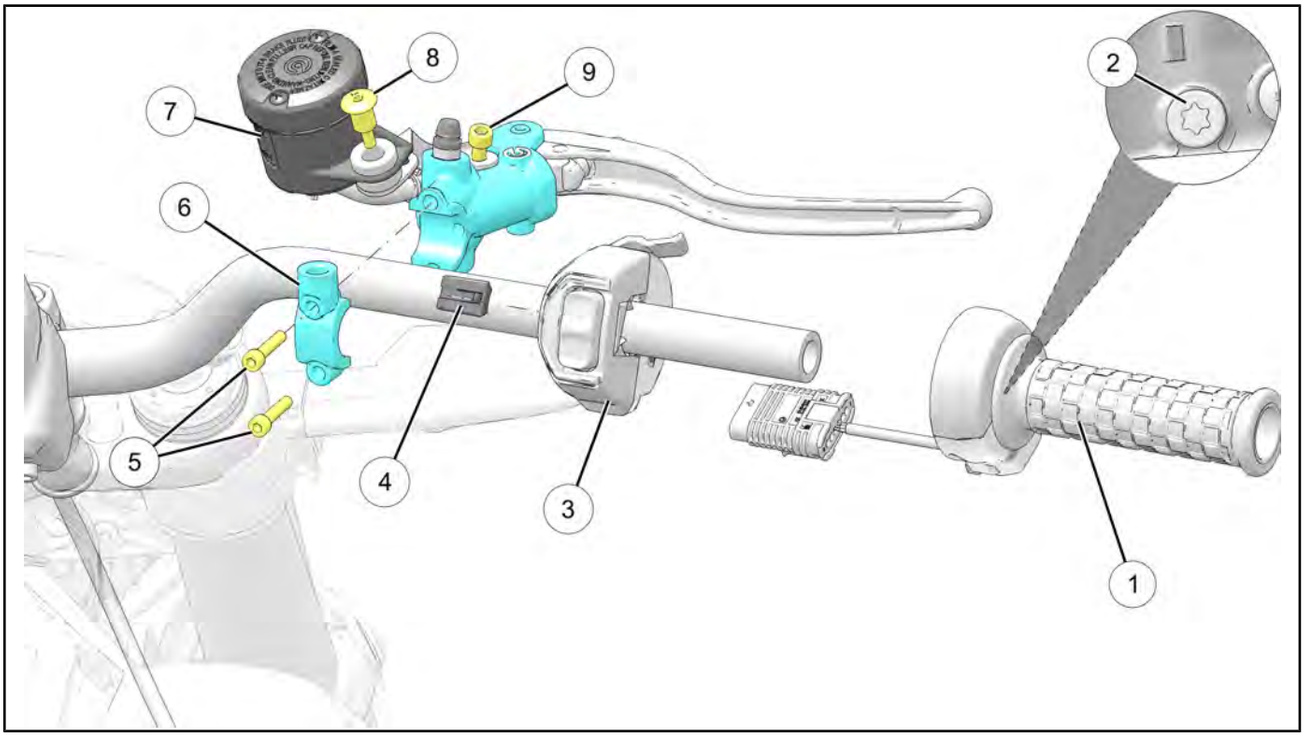
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

ASSEMBLY VIEWS

HAND CONTROLS - ASSEMBLY VIEW



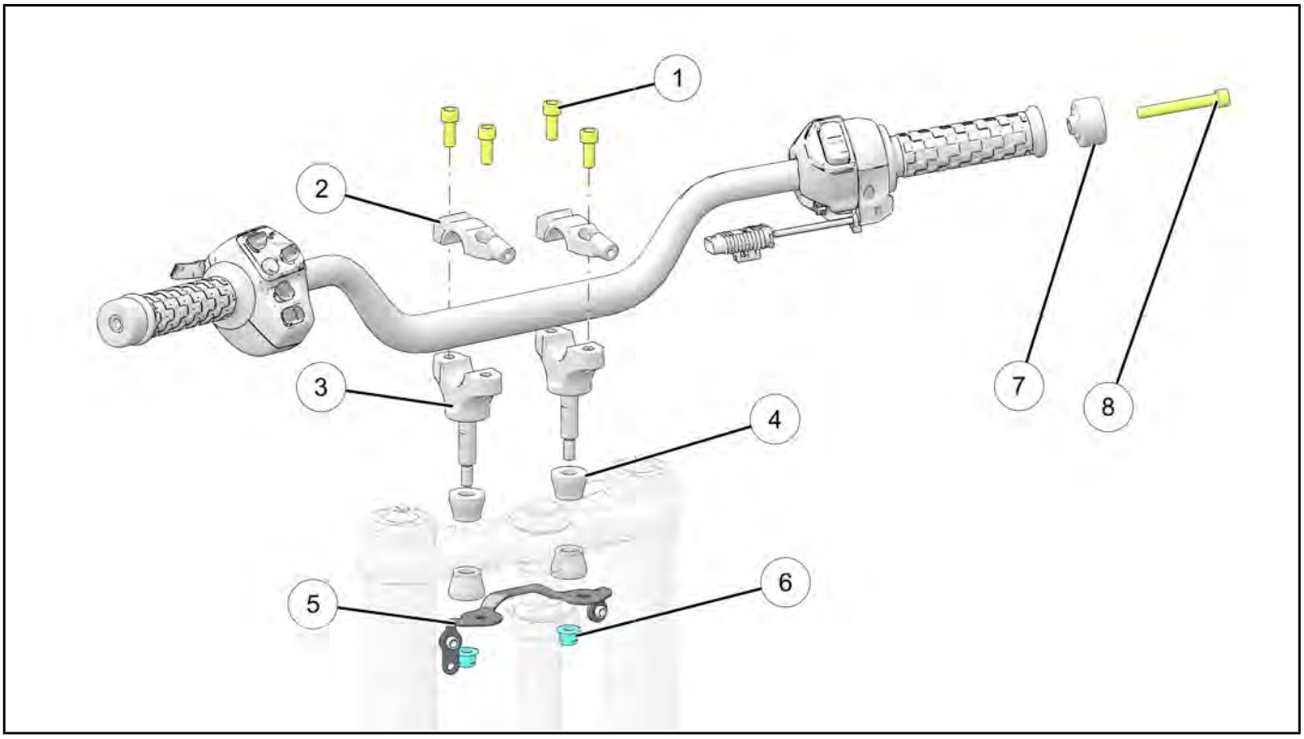
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Handlebar Grip	-
②	Left Hand Switch Cube	-
③	Retention Clip	-
④	Clutch Perch Clamp	-
⑤	Clutch Perch Clamp Fastener	**96 in-lbs (11 N·m)** **IMPORTANT** Torque the **Clutch Perch Clamp** upper fastener first and the bottom fastener second.



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Throttle Assembly	-
②	Throttle assembly Fastener	**27 in-lbs (3 N·m)**
③	Right Hand Switch Cube	-
④	Retention Clip	-
⑤	Master Cylinder Clamp Fastener (Front)	**88 in-lbs (10 N·m)** IMPORTANT Torque the **Master Cylinder Clamp** upper fastener first and the bottom fastener second.
⑥	Master Cylinder Clamp	-
⑦	Brake Fluid Reservoir	-
⑧	Brake Fluid Reservoir Mounting Fastener (front)	**44 in-lbs (5 N·m)**
⑨	Brake Fluid Reservoir Bracket Fastener (front)	**80 in-lbs (9 N·m)**

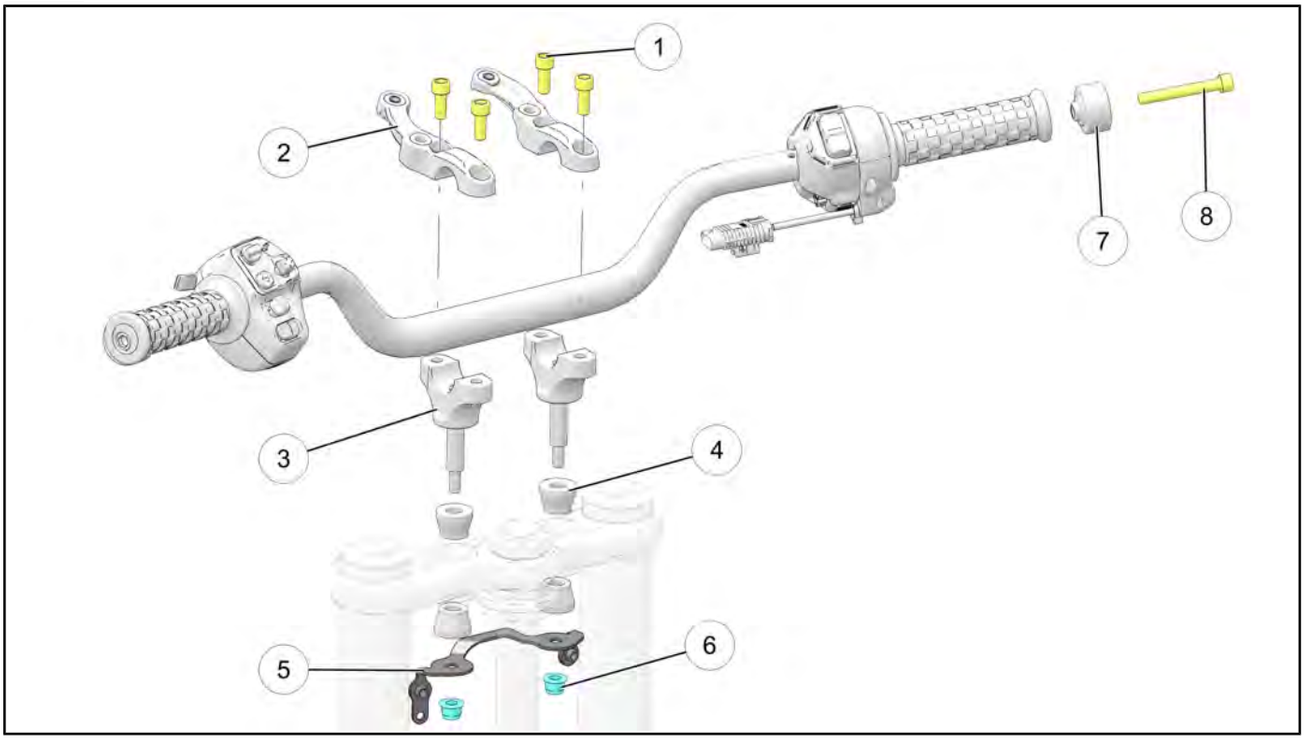
HANDLEBAR - ASSEMBLY VIEW

2019,2020,2022



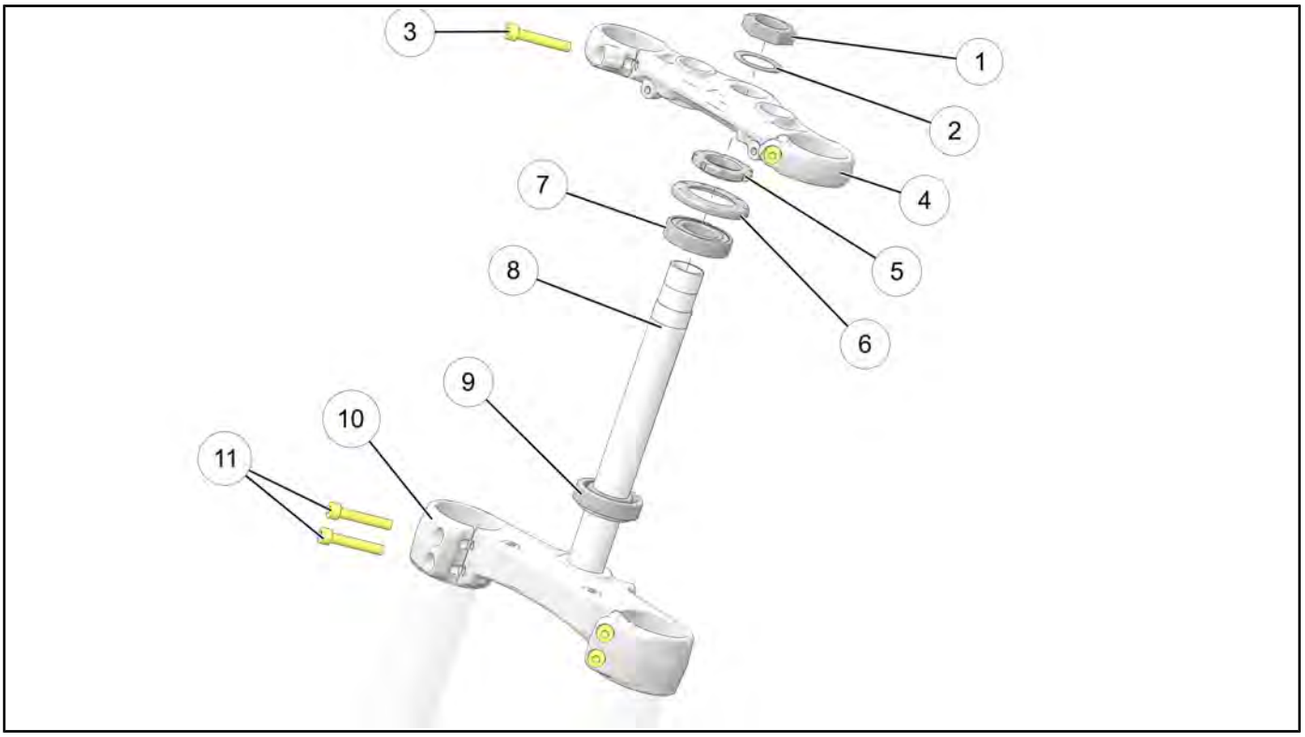
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Cap Riser Fasteners	**18 ft-lbs (24 N·m)** Tighten Front Bolts First, then Rear
②	Riser Caps	-
③	Handlebar Risers	-
④	Handlebar Isolator	-
⑤	Riser Bracket	-
⑥	Handlebar Riser Nut	**18 ft-lbs (24 N·m)**
⑦	Handlebar End Weight	-
⑧	Handlebar Cap Fastener	**18 ft-lbs (24 N·m)**

2023+



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Cap Riser Fasteners	**18 ft-lbs (24 N·m)** Tighten Front Bolts First, then Rear
②	Riser Caps	-
③	Handlebar Risers	-
④	Handlebar Isolator	-
⑤	Riser Bracket	-
⑥	Handlebar Riser Nut (2023)	**24 ft-lbs (33 N·m)**
⑦	Handlebar End Weight	-
⑧	Handlebar Cap Fastener	**18 ft-lbs (24 N·m)**

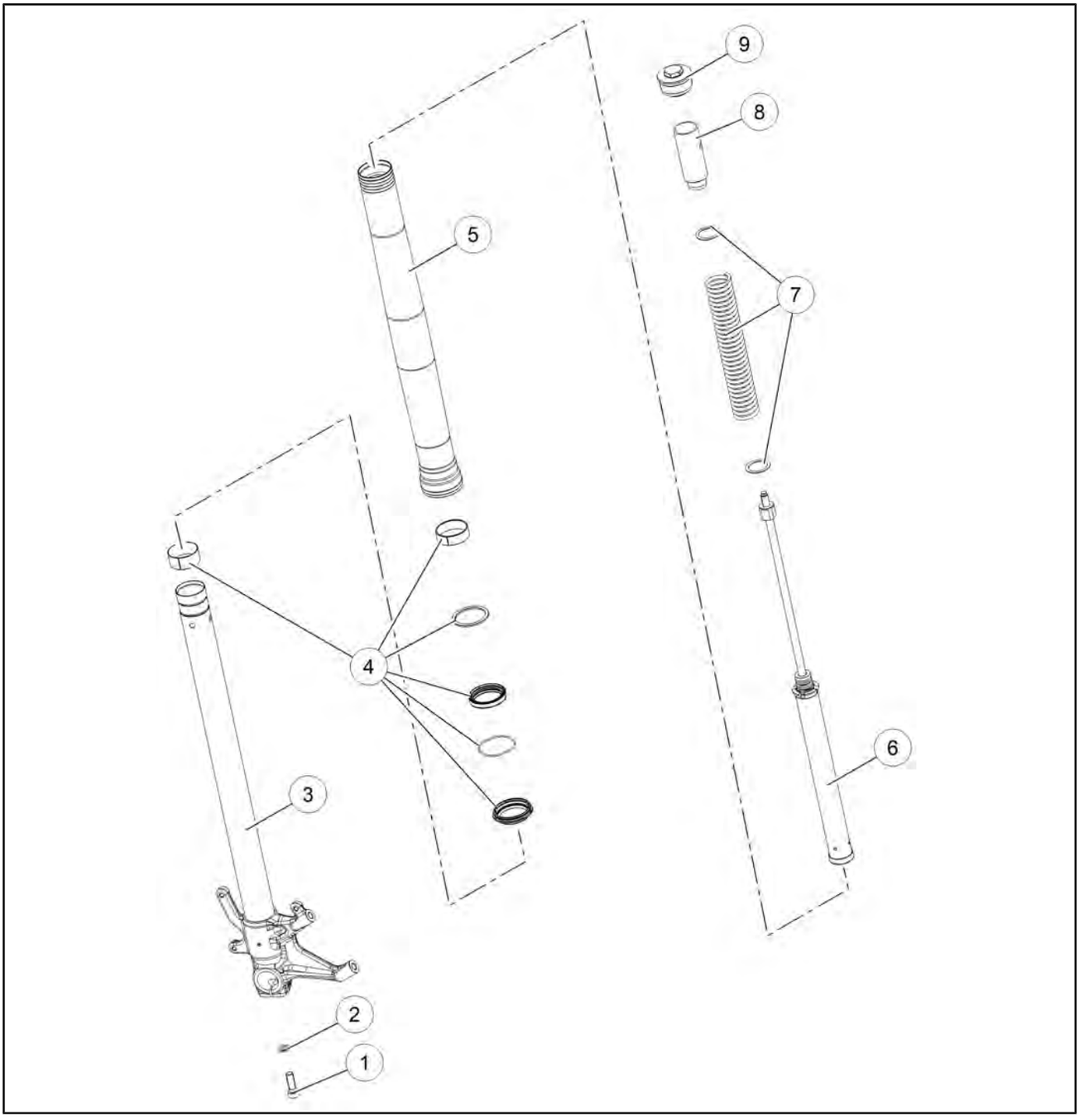
TRIPLE CLAMP - ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Steering Stem Nut (top)	See Tightening Procedure Outlined in this Chapter
②	Washer	-
③	Fork Triple Clamp Fasteners (Upper)	See Tightening Procedure Outlined in this Chapter
④	Upper Triple Clamp	-
⑤	Steering Head Nut	See Tightening Procedure Outlined in this Chapter
⑥	Steering Stem Cover	-
⑦	Ball Bearing	-
⑧	Steering Stem	-
⑨	Lower Bearing	-
⑩	Lower Triple Clamp	-
⑪	Fork Triple Clamp Fasteners (Lower)	See Tightening Procedure Outlined in this Chapter

FRONT FORK - ASSEMBLY VIEW

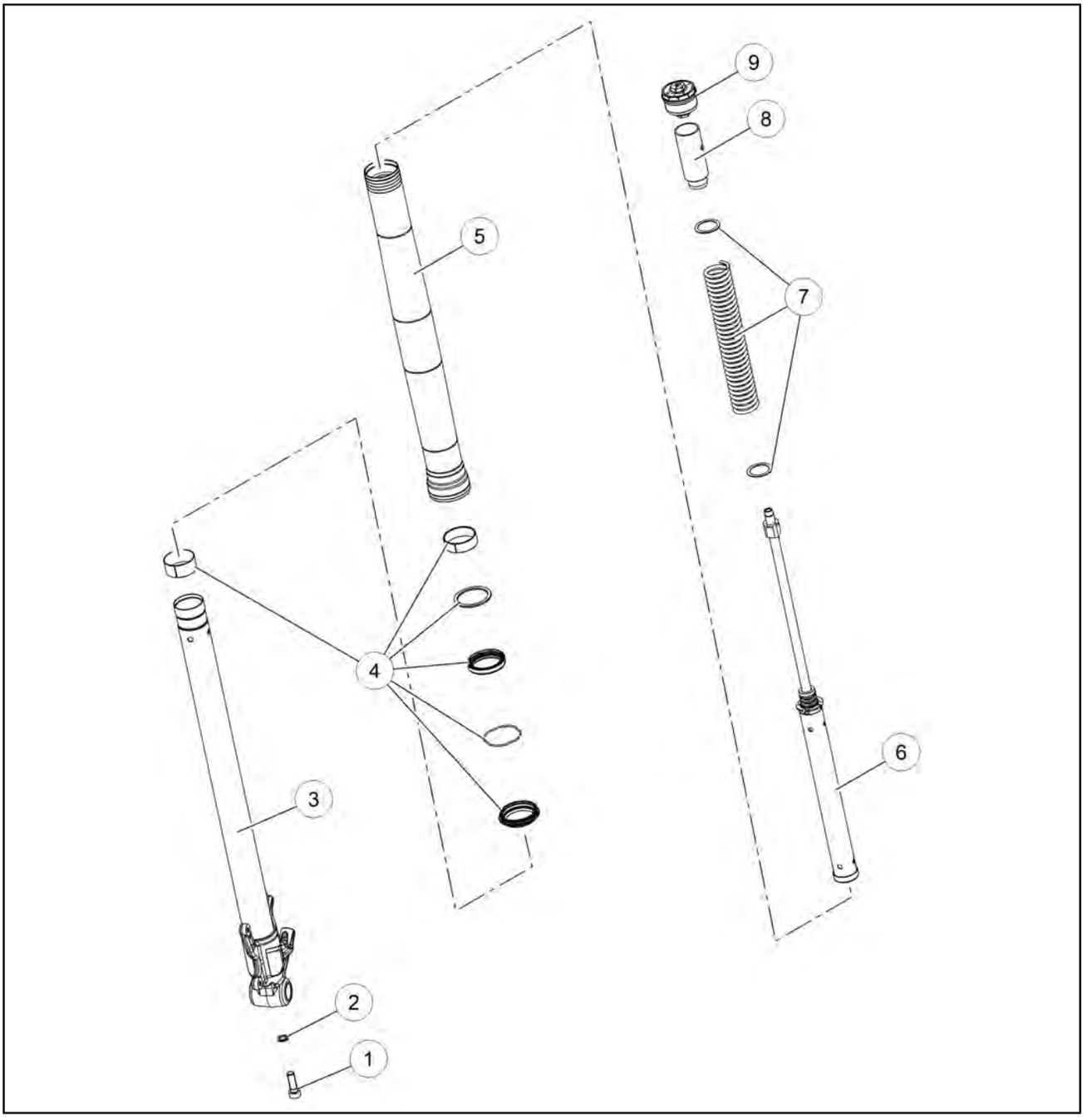
NON-ADJUSTABLE FORKS



IMPORTANT
The fork cartridges ⑥ are non-servicable and can not be rebuilt. In the event of replacement, a cartridge assembly must be installed.

NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Cartridge Fastener	**17 ft-lbs (23 N·m)**
②	Cartridge Washer	-
③	Inner Tube Assembly	-
④	Seal Kit	-
⑤	Outer Fork Tube	-
⑥	Cartridge, Non-Adjustable	-
⑦	Spring Assembly	-
⑧	Spring Spacer	-
⑨	Fork Cap, Non-Adjustable	**12 ft-lbs (16 N·m)**

ADJUSTABLE FORKS



IMPORTANT
The fork cartridges ⑥ are non-serviceable and can not be rebuilt. In the event of replacement, a cartridge assembly must be installed.

NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Cartridge Fastener	**17 ft-lbs (23 N·m)**
②	Cartridge Washer	-
③	Inner Tube Assembly	-
④	Seal Kit	-
⑤	Outer Fork Tube	-
⑥	Cartridge, Adjustable	-
⑦	Spring Assembly	-
⑧	Spring Spacer	-
⑨	Fork Cap, Adjustable	**11 ft-lbs (15 N·m)**

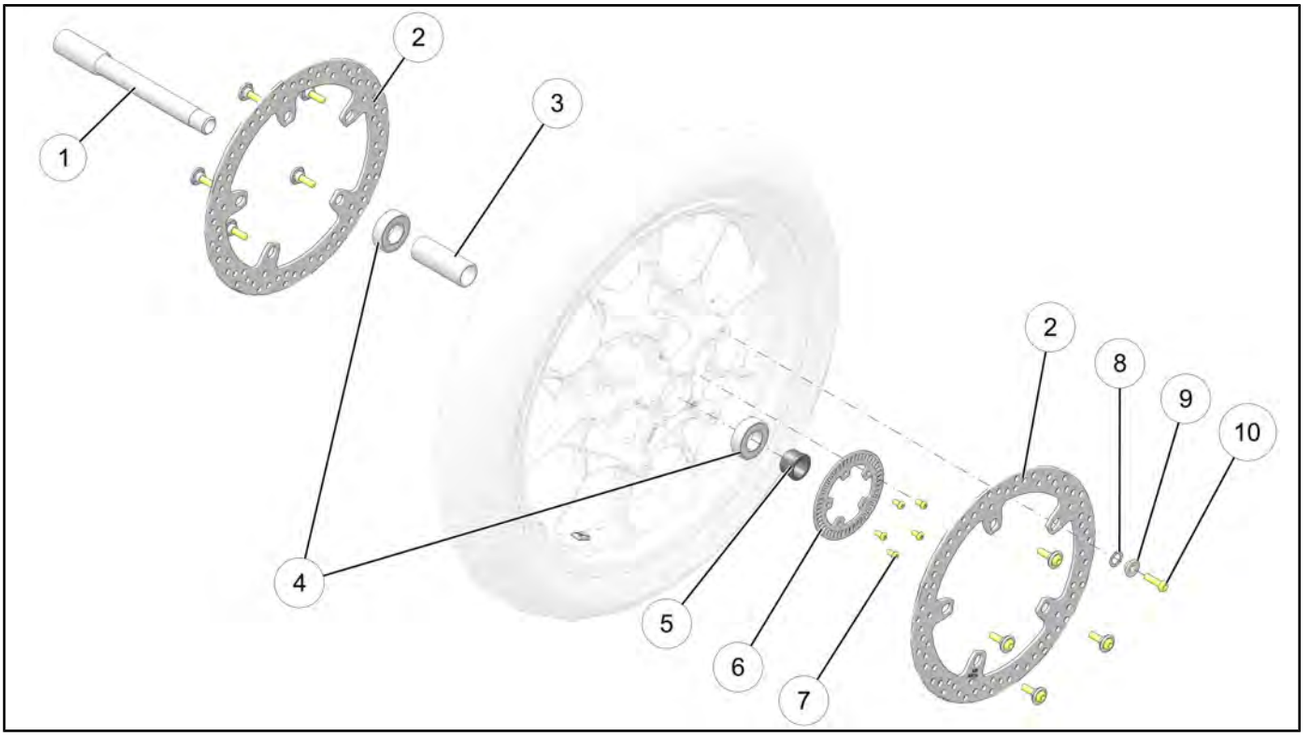
FRONT FORK - ASSEMBLY VIEW

2022+ FTR R Carbon adjustable Ohlins

NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Fork Cap, Adjustable	**11 ft-lbs (15 N·m)**
②	O-Ring	-
③	Spring	-
④	Washer	-
⑤	Outer Fork Tube	-
⑥	Oil Seal	-
⑦	Circlip	-
⑧	Dust Seal	-

FRONT WHEEL - ASSEMBLY VIEW

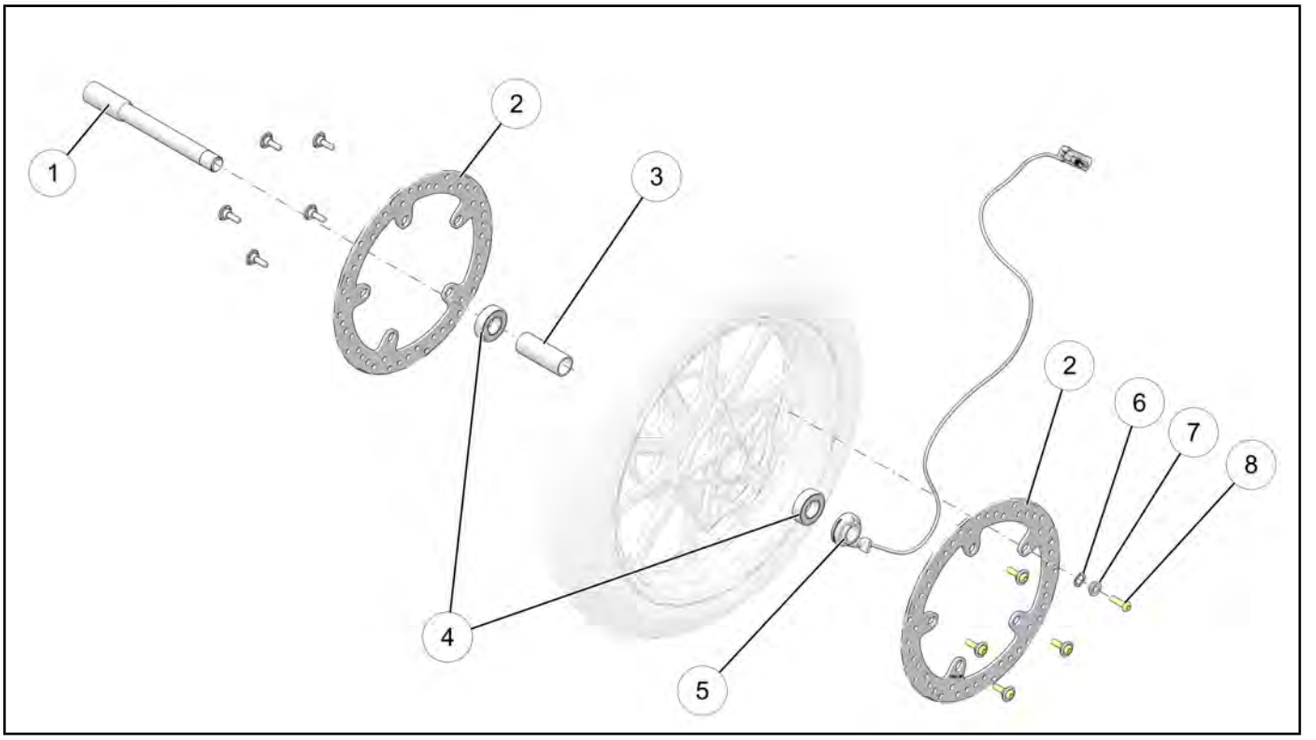
2019-2020 / 2023+ MODELS



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Axle (front)	**55 ft-lbs (75 N·m)**
②	Brake Disc (QTY 2)	-
③	Inner Bearing Spacer	-
④	Wheel Bearing	-
⑤	Wheel Spacer	-
⑥	ABS Tone Ring	-
⑦	Tone Ring Fasteners (QTY 5)	**84 in-lbs (9 N·m)**
⑧	Spring Washer (QTY.10)	-
⑨	Bushing (QTY.10)	-
⑩	Brake Disc Fasteners (QTY.10)	**22 ft-lbs (30 N·m)**

FRONT WHEEL - ASSEMBLY VIEW

2022 MODELS



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Axle (front)	**55 ft-lbs (75 N·m)**
②	Brake Disc (QTY 2)	-
③	Inner Bearing Spacer	-
④	Wheel Bearing	-
⑤	Wheel Speed Sensor	-
⑥	Spring Washer (QTY.10)	-
⑦	Bushing (QTY.10)	-
⑧	Brake Disc Fasteners (QTY.10)	**22 ft-lbs (30 N·m)**

SERVICE PROCEDURES

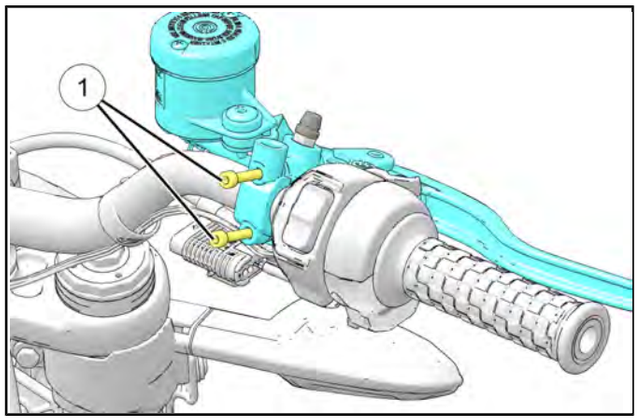
HANDLEBAR REMOVAL / INSTALLATION

Removal

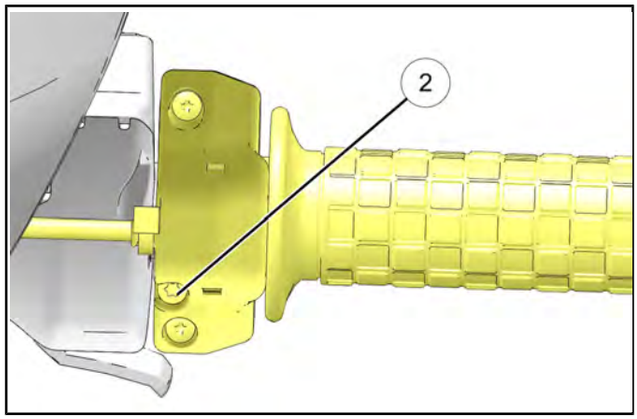
⚠ WARNING

Clutch cable must be routed, installed, and adjusted correctly to function properly. Note how cable is routed and secured before removing the cable. Permanent cable damage may result if the inner cable is bent or twisted during installation. If the cable is incorrectly routed, installed, or adjusted, serious injury or death may occur.

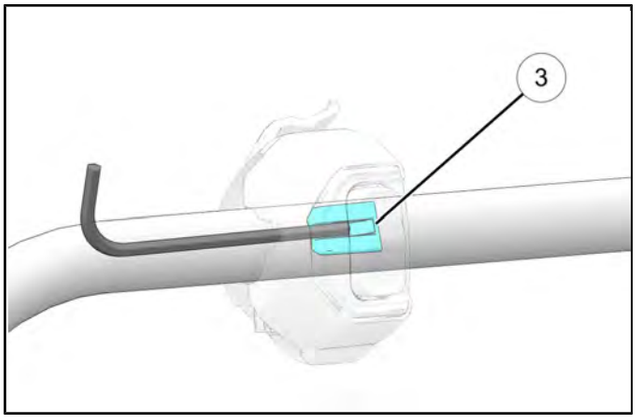
1. Place motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Remove master cylinder mounting fasteners ①. Secure master cylinder so the brake line is secured and not strained.



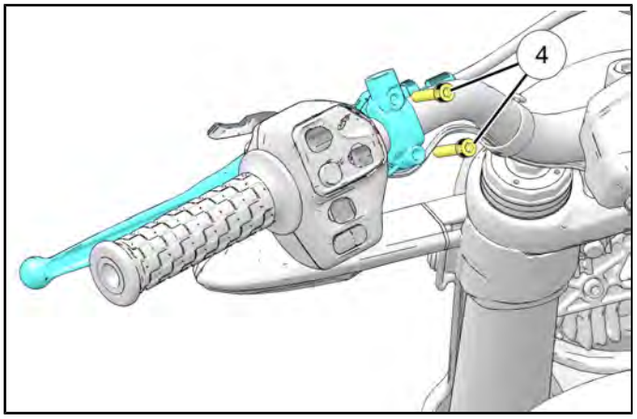
3. From the bottom of the throttle assembly, loosen its fastener ②.



4. Disconnect the throttle assembly and remove the throttle assembly.
5. Depress the locking mechanism of the electrical connectors by hand.
6. Carefully insert a 2mm allen wrench into the switchcube relief to release the retention feature ③.



7. Slide the switch cube inward.
8. Remove the retention feature.
9. Remove the switch cube from the handlebar.
10. Remove clutch perch by removing its fasteners ④.

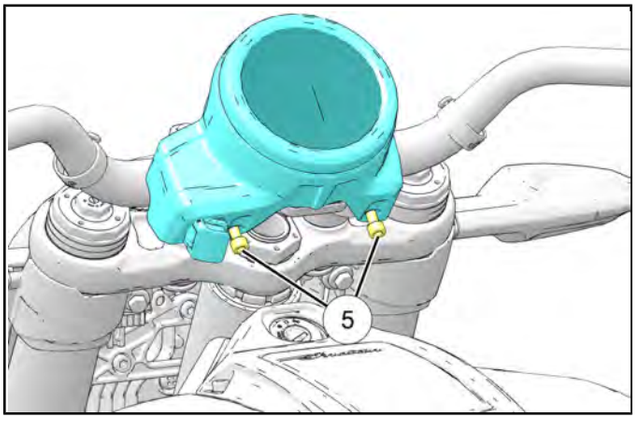


11. Carefully remove electrical connectors from switch cube.
12. Carefully insert a 2mm allen wrench into the switchcube relief to release the retention feature.
13. Remove handlebar weight.
14. Using compressed air, remove the left hand grip from the handlebar.
15. Remove the switch cube.

8

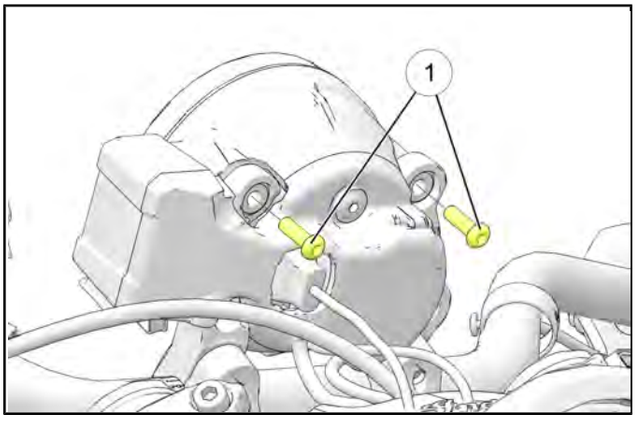
16.

- **2019-2022:** Remove the instrument by removing its fasteners ⑤.

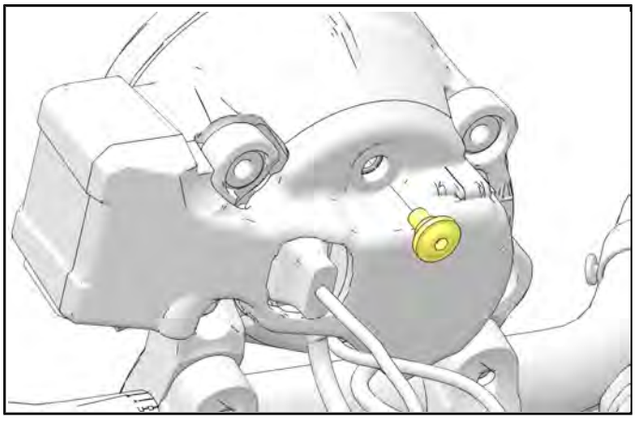


- **2023+:**

  Remove rear display fasteners ①.



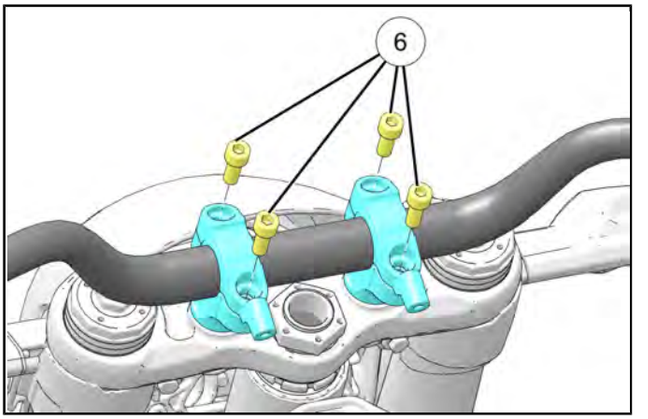
- Remove rear middle display fastener and cover.



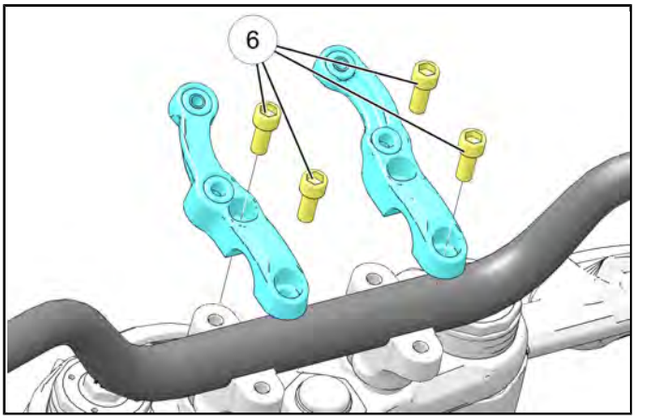
17. Disconnect the instrument cluster electrical connections.

18. Remove the four fasteners ⑥ securing the handlebars.

- **2019-2022:**



- **2023+:**



Installation

1. **Installation is performed by reversing the removal procedure.**

2. Line up the handlebar index mark and torque instrument cluster, starting with the front bolts, to specification.

TORQUE
Handlebar Riser Nut: **18 ft-lbs (24 N·m)**

TORQUE
Handlebar Riser Nut (2023) **24 ft-lbs (33 N·m)**

TORQUE
Instrument Cluster Fasteners: **84 in-lbs (9 N·m)**

TORQUE
Instrument Cluster Fasteners (2023) **9 in-lbs (1 N·m)**

TORQUE
Center Cluster Fastener: **53 in-lbs (6 N·m)**

TORQUE
Throttle Assembly Fastener: **27 in-lbs (3 N·m)**

TORQUE
Clutch Perch Clamp Fasteners: **96 in-lbs (11 N·m)**

IMPORTANT
Torque the **Clutch Perch Clamp** upper fastener first and the bottom fastener second.

TORQUE
Master Cylinder Clamp Fastener (Front): **88 in-lbs (10 N·m)**

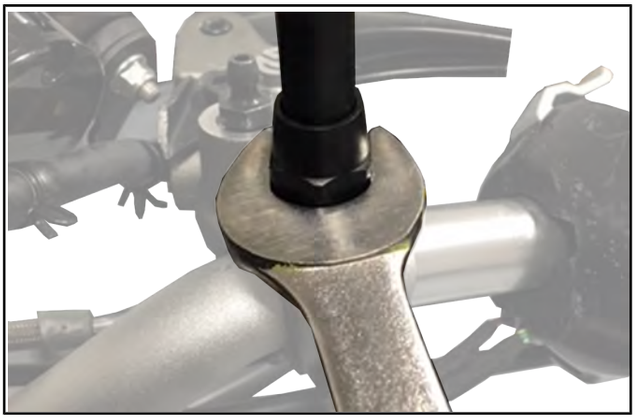
IMPORTANT
Torque the **Master Cylinder Clamp** upper fastener first and the bottom fastener second.

TORQUE
Handlebar Cap Fastener: **18 ft-lbs (24 N·m)**

MIRROR REMOVAL / INSTALLATION

REMOVAL

1. Loosen the 17 mm jam nut.



2. When the jam nut is loosened completely, Spin the mirror off its mount.

INSTALLATION

1. Thread the mirror on until it bottoms out.
2. Adjust the mirror accordingly.
3. Torque the jam nut to specification.

TORQUE
Mirror Jam Nut: **12 ft-lbs (16 N·m)**

CLUTCH CABLE REMOVAL / INSTALLATION

1. Place motorcycle in an upright position with the front wheel clamped in a wheel vise.

Clutch Cable Removal

2. Loosen the bottom clutch cable jam nut ①.

3. Protect the clutch pinion arm ② with a shop towel. Using an adjustable wrench, rotate the pinion arm inward. Disconnect clutch cable from pinion arm.
4. Withdraw the clutch cable from the mounting boss located on the primary cover.
5. At the handlebar, remove the clutch cable casing from the lever perch and rotate cable outward to align inner cable wire with slot in lever.
6. Pull lever slightly until slotted opening in lever is clear of perch and slide cable barrel end down and out of lever.
7. Note routing of clutch cable through frame.
8. Remove the clutch cable.

Clutch Cable Installation

⚠ CAUTION
Do not kink, bend, or twist the inner cable or outer cable casing during installation

1. Route clutch cable in the same manner as removed.
2. Apply multi-purpose grease to the lever end of the cable and install it in the clutch lever at the handlebar.
3. Install the casing in the lever perch at the handlebar.
4. Install cable in the mounting boss located on the primary cover.
5. At the pinion arm end of the cable, pull the inner cable until fully extended. Be sure the upper end of the cable casing is seated in the lever perch at handlebar end.
6. Apply multi-purpose grease to the lower barrel end of the cable.
7. Rotate the pinion arm inward (as in STEP 3) until cable can be installed in pinion arm.
8. Adjust clutch cable free play. See **Clutch Lever Free Play page 5.6**.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

FRONT WHEEL REMOVAL / INSTALLATION

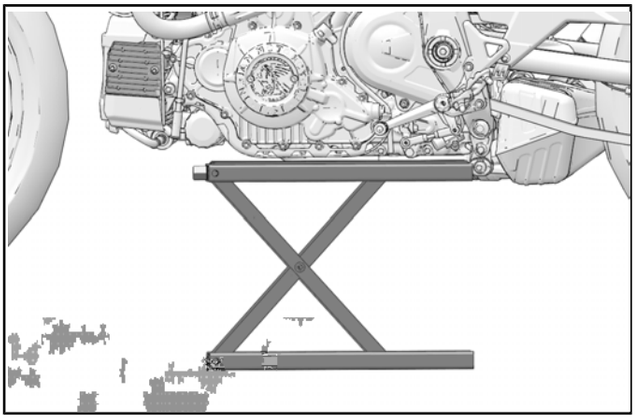
⚠ WARNING

This procedure requires raising and supporting the motorcycle so that the front wheel is off the ground. Precautions should be taken to ensure the motorcycle is properly stabilized at all times. Failure to properly support motorcycle may result in personal injury or damage to the motorcycle.

⚠ CAUTION

Do not twist the brake hose or brake line. Do not allow calipers to hang from the brake hose. Secure calipers in such a way to avoid hose damage.

1. Secure the motorcycle in an upright position with tie-down straps and a platform jack positioned beneath the engine cases.

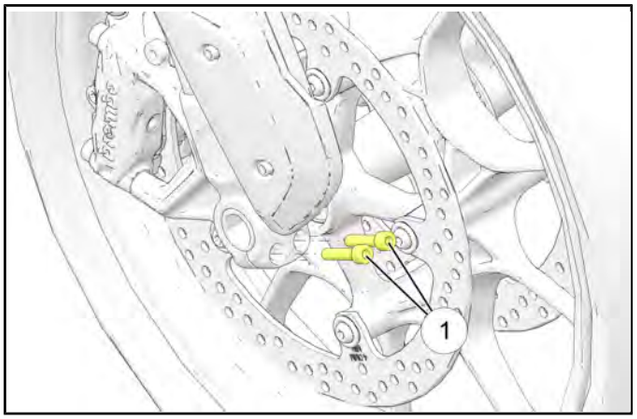


IMPORTANT

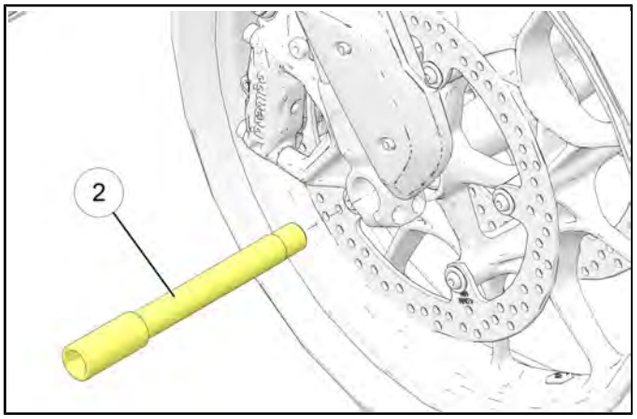
Do not operate the front brake lever with the calipers or wheel removed.

REMOVAL

2. Remove front brake calipers. See **Front Caliper Removal page 9.54**.
3. Loosen axle pinch bolts ① on lower right fork leg.



4. Support wheel and remove axle ② with a commercially available 22 mm Allen. Spacers are loosely retained by the dust seals, but may fall out after wheel has been removed.



INSTALLATION

5. Install front wheel and spacers into fork.
6. Install the axle and torque to specification.

TORQUE
Axle (front fork): **55 ft-lbs (75 N·m)**

7. Cycle the front suspension. Tighten axle pinch bolts to specification.

TORQUE
Axle Pinch Fasteners: **14 ft-lbs (19 N·m)** **Tighten each screw once after initial torque**

8. Reinstall front brake calipers. See **Front Caliper Installation page 9.55**.

FRONT AXLE INSPECTION

1. Place axle in V-blocks and inspect runout. Compare to specifications in this chapter. See **Service Specifications - Front Wheel & Suspension page 8.5**.

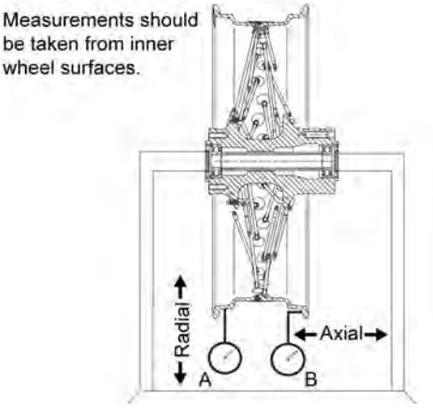
2. Replace axle if it fails inspection. Do not attempt to straighten a bent axle.

FRONT WHEEL INSPECTION

1. Install front wheel in truing stand.

IMPORTANT
Bearings must be in good condition to accurately measure runout.

2. Set up a dial indicator to measure radial runout (up and down) (A) and compare to specifications. See **Service Specifications - Front Wheel & Suspension page 8.5**.
3. Position dial indicator to measure axial runout (side to side) (B) and compare to specifications. See **Service Specifications - Front Wheel & Suspension page 8.5**.

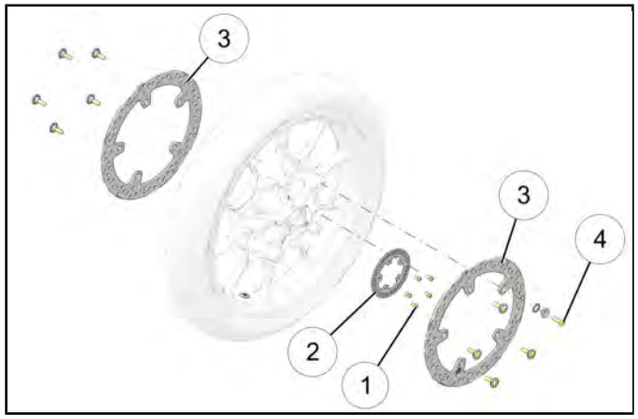


4. Visually inspect wheel for cracks.
5. Replace wheel if it fails visual or measured inspection. Do not attempt to straighten cast wheels.

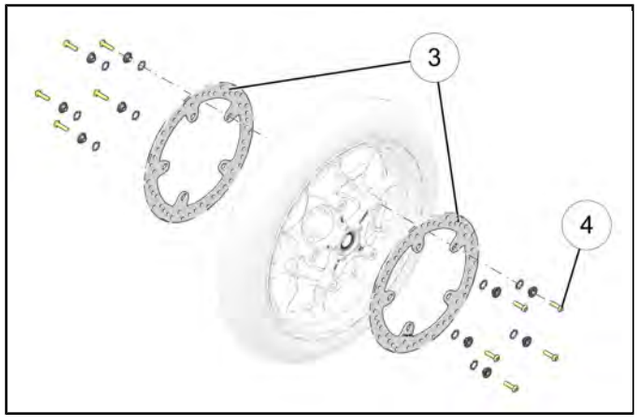
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

BRAKE DISC REMOVAL / INSTALLATION

1. Remove front wheel. See **Front Wheel Removal / Installation page 8.29**.
2. Position wheel with brake disc facing up.
3. Remove and discard brake disc fasteners ④ .
4. Remove tone ring fasteners ①, tone ring ②, and brake discs ③ from wheel.
   - **2019, 2020, 2023 models**

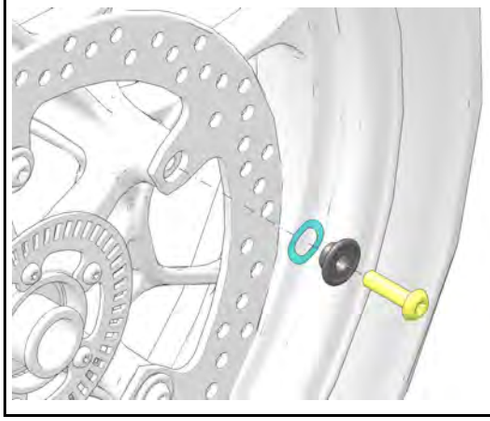


   - **2022 models**



5. **Installation is performed by reversing the removal procedure. Use new brake disc fasteners for installation**

IMPORTANT
Make sure the fastener, bushing, and wave spring are installed in the order shown.



6. Torque *new* brake disc fasteners to specification in a star pattern.

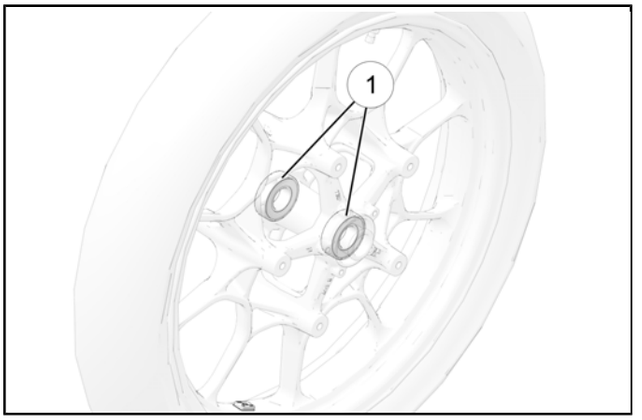
TORQUE
Tone Ring Fasteners (2019–2020, 2023+ models): **84 in-lbs (9 N·m)**

TORQUE
Brake Disc Fasteners: **22 ft-lbs (30 N·m)**

FRONT WHEEL BEARING INSPECTION

IMPORTANT
Inspect bearings installed in the wheel. Do not remove to inspect. Bearings cannot be repacked. Replace both wheel bearings if one or both fail inspection, or if either bearing was removed.

1. Visually inspect bearing seals ① on each side for wear or damage.



2. Check bearings by turning inner race by hand.
   - Look for signs of discoloration, scoring, galling, or contamination from moisture or dirt. Replace bearings if any of the above are present.
   - Turn the inner race of the bearings. The bearings should turn smoothly and quietly. The inner race should be firm with minimal side to side movement and no detectable up and down movement.
3. Discard bearings that fail any of the above inspections.

⚠ CAUTION

Do not reuse bearings after removing them from the wheel. Removal damages the bearings internally.

4. Inspect bearing fit into wheel hub. The outer race of the bearing must fit tightly into the bore. You should not be able to move it (or remove it) by hand. Replace the wheel if outer race of a new bearing does not fit tightly in the bore.

FRONT WHEEL BEARING REPLACEMENT

⚠ CAUTION

Do not reuse bearings that have been removed.

NOTICE

This procedure requires the Wheel Bearing Removal / Installation Kit **(PF-51324)**. Refer to special tool manufacturer instructions for proper use of tool.

REMOVE

1. Remove front wheel. See **Front Wheel Removal / Installation page 8.29**.
2. Remove brake discs. See **Brake Disc Removal / Installation page 8.91**.
3. Carefully remove both seals using a suitable seal removal tool and discard.

⚠ CAUTION

Be careful not to scratch the seal bore.

4. Refer to special tool manufacturer instructions to remove bearing from Left-Hand side of hub.
5. Remove bearing.
6. Remove spacer.
7. Extract or drive bearing from Right-Hand side of hub.

INSTALLATION

1. **Installation:** Use the Wheel Bearing Removal / Installation Kit **(PF-51324)** to install new wheel bearings. Refer to special tool manufacturer instructions for proper use of tool.
2. Install *new* wheel bearing into the Right-Hand side of hub followed by the inner bearing spacer.
3. Install *new* wheel bearing into the Left-Hand side of hub.
4. Install *new* seals and existing outer bearing spacers into each side of the wheel hub.
5. Install the brake discs. See **Brake Disc Removal / Installation page 8.91**.
6. Install the front wheel. See **Front Wheel Removal / Installation page 8.29**.

FRONT FORK REMOVAL

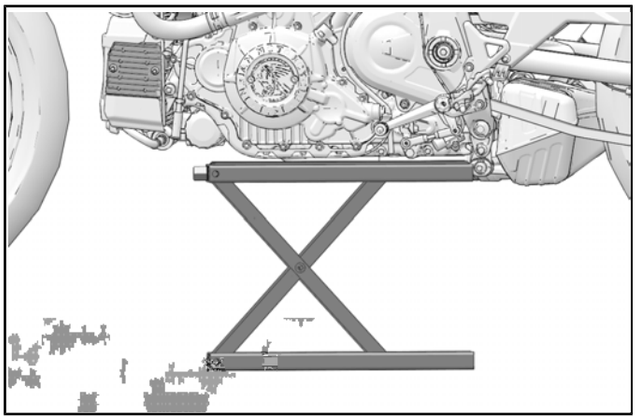
⚠ WARNING

This procedure requires raising and supporting the motorcycle so that the front wheel is off the ground. Precautions should be taken to ensure the motorcycle is properly stabilized at all times. Failure to properly support motorcycle may result in personal injury or damage to the motorcycle.

⚠ CAUTION

Do not twist the brake hose or brake line. Do not allow calipers to hang from the brake hose. Secure calipers in such a way to avoid hose damage.

1. Remove front fender. See **Front Fender Removal page 7.20**.
2. Secure the motorcycle in an upright position with tie-down straps and a platform jack positioned beneath the engine cases.

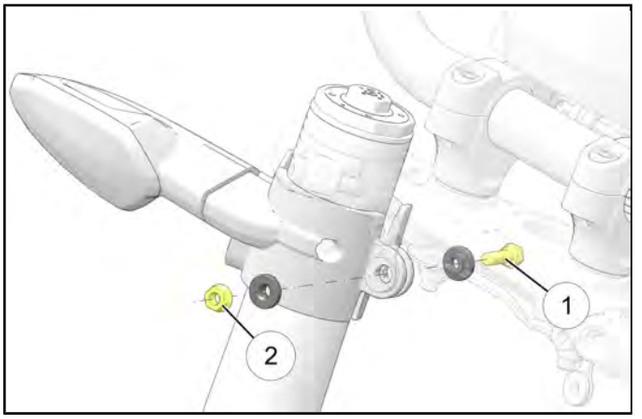


NOTICE

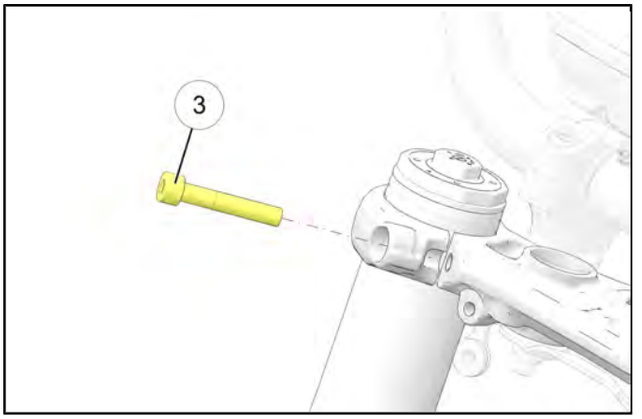
Do not operate the front brake lever with the calipers or wheel removed.

3. Remove front brake calipers and support them so they do not hang by brake hoses. See **Front Caliper Removal page 9.54**.
4. Remove front wheel. See **Front Wheel Removal / Installation page 8.29**.

5. Remove turn signal assembly by removing bolt ① and nut ②.

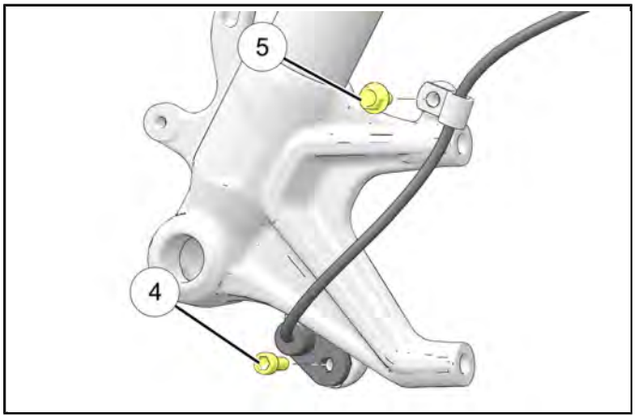


6. Loosen top triple clamp pinch bolt ③.



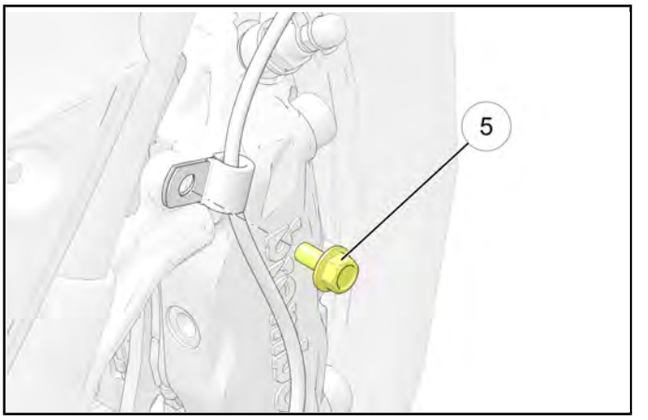
7. For the left-hand fork:
   - **2019–2020, 2023+ models**

     Remove wheel speed sensor fastener ④ and line retainer fastener ⑤.

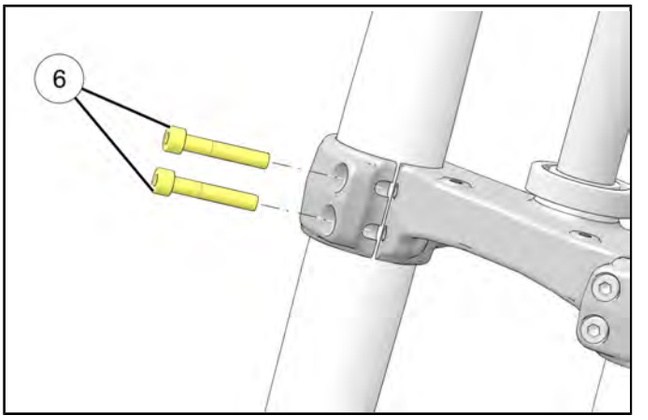


   - **2022+ models**

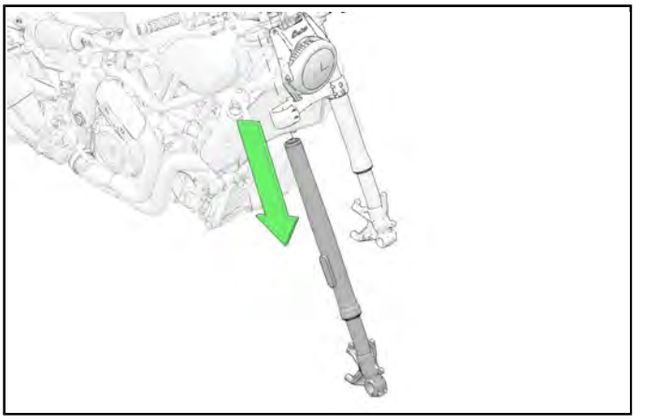
     Remove wheel speed sensor line retainer fastener ⑤.



8. Loosen lower triple clamp pinch bolts ⑥.



9. Slide fork leg down and remove.



⚠ CAUTION

Take cation while removing to avoid damage to upper fork tube

FRONT FORK DISASSEMBLY

NOTICE

For fork parts information, see Front Fork - Assembly View page 8.16Clean fork tubes before disassembly.

NOTICE

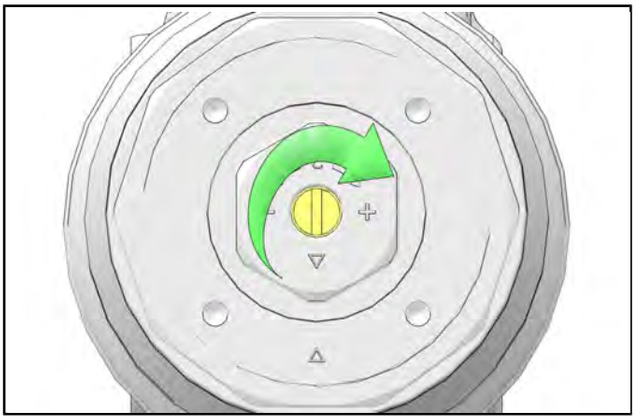
The following procedure requires the use of special tools:.

- Fork Spring Compressor (PV-49463)
- Fork Cap Wrench (PF-52744)
- Damper Rod Holder (PF-52747)
- Cartridge Holder (PF-52745)

NOTICE

FTR S shown.

1. Using a small flat bladed screwdriver, turn clicker all the way in a clockwise (+) direction.



IMPORTANT

Note how many clicks for reassembly.

NOTICE

FTR S models only

2. Secure the fork body in a soft jaw vice. Use care not to damage the fork body.

3. Loosen cap with special tool **(PF-52744)**.

4. Secure Fork Spring Compressor **(PV-49463)** vertically in a vise with drive bolt UP.

NOTICE

Remove the rear thumb screw as it will not be needed.

8

5. Insert the base of the fork into the tool.

⚠ CAUTION

Ensure the two axle pinch bolts are removed from the Right-Hand fork leg to avoid damage on the post.

6. Unscrew the fork cap completely and slide the fork body down to expose the adapter.

7. Adjust the tool until it aligns with the holes in the adapter and secure with the two side thumb screws.

8. Using a 19 mm socket and special tool **(PF-52744)**, turn counter-clockwise to remove the preload.

NOTICE

FTR S models only

9. Tighten the special tool drive bolt to compress the fork.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

10. Using a 19 mm socket and a 19 mm wrench, loosen cap from the cartridge.

IMPORTANT

During cap removal, make sure the inner clicker stays in place.

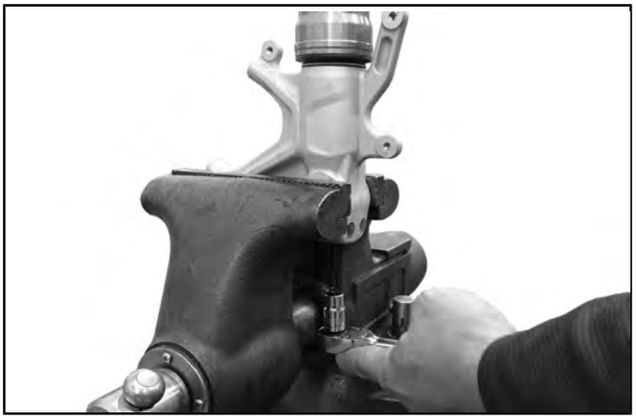
11. Remove cap, adapter, washer, spring, washer.

NOTICE

Note parts sequence during removal and orientation of spring for assembly.

12. Drain fluid into a suitable container. Stroke the fork to aid in draining.

13. Place the bottom of the fork into a vice as shown. Use 8 mm allen socket into bottom of fork leg and loosen fastener.



NOTICE

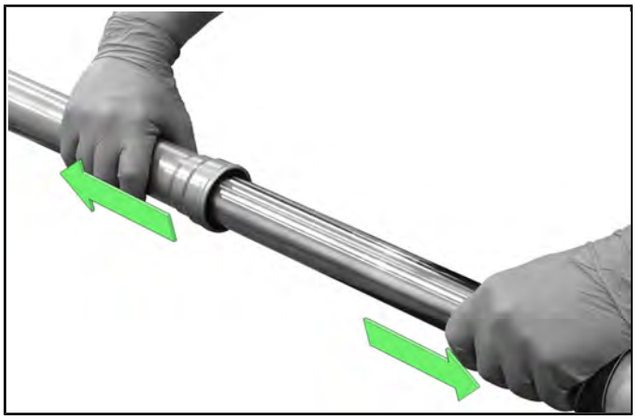
Use special tool (PF-52745) to prevent cartridge from spinning during disassembly.

14. Remove cartridge assembly.

15. Carefully lift dust seal out of outer fork tube with a small flat screwdriver.

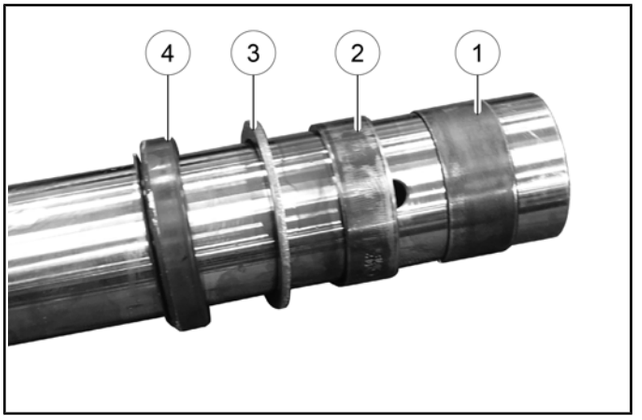
16. Use a pick to remove seal retaining ring. Use care not to scratch the surface of the inner fork tube

17. Push inner and outer tube together, then pull apart quickly to produce a slide hammer motion to remove the inner tube.

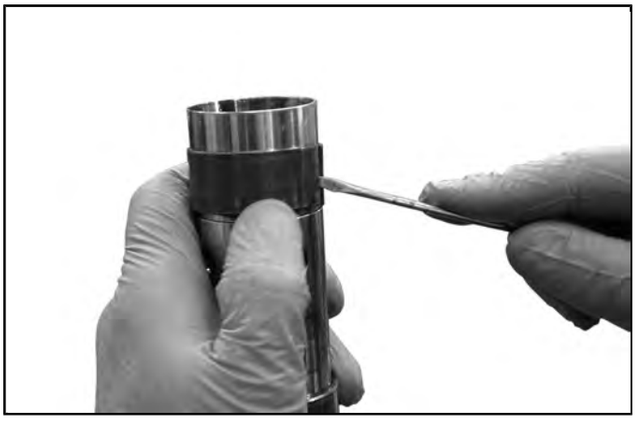


8

18. Remove bushing ①, slide ②, washer ③ and oil seal ④.



19. Gently pry the bushing apart using a small flat blade screwdriver to remove.



FRONT FORK DISASSEMBLY (OHLINS)

2022+ FTR R CARBON ADJUSTABLE OHLINS®

NOTICE

For fork parts information, see Front Fork - Assembly View page 8.20.
Clean fork tubes before disassembly.

NOTICE

The following procedure requires the following items
Special Tools:

- Top Nut Tool (PF-53158)
- Pull-Up Tool (PF-53159)
- Spanner (PF-53160)

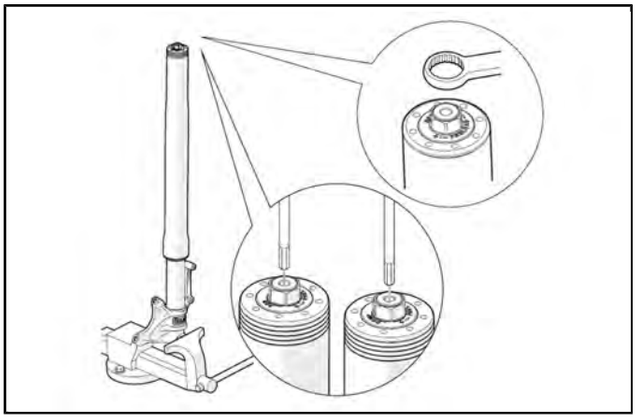
Standard Tools:

- 3mm Allen Key Screwdriver
- Soft Jaw Vice
- 14mm, 17mm Spanner
- Wire with a hook
- 17mm Socket
- Pick tool
- Flat tire lever or similar

IMPORTANT

Only disassemble one fork at a time to not mix up any parts during service.

1. Secure the fork body in a soft jaw vice. Use care not to damage the fork body.
2. Using a 17mm socket, turn the adjuster nut counter clockwise to fully release the preload.



IMPORTANT

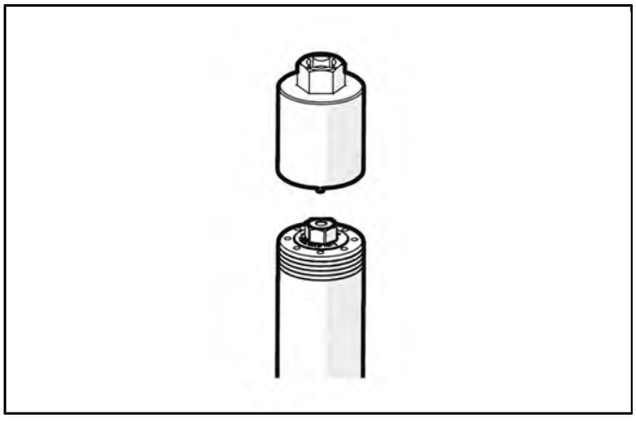
Note how full revolutions for reassembly.

3. Using a 3mm Allen Key Screwdriver, turn the clicker clockwise to the bottom and count the clicks for notice. Then turn the clicker counter-clockwise all the way out to open the bleed adjuster.

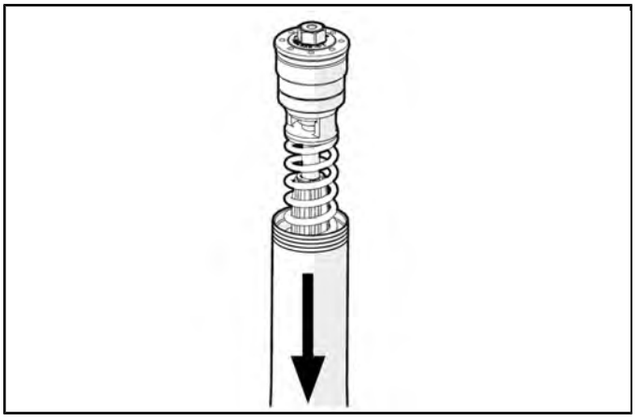
IMPORTANT

Note how many clicks for reassembly.

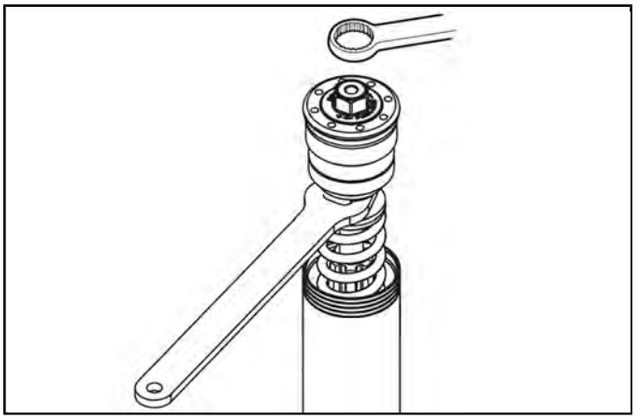
4. Use the Top Nut Tool (PF-53158) and loosen the top cap from the outer tube.



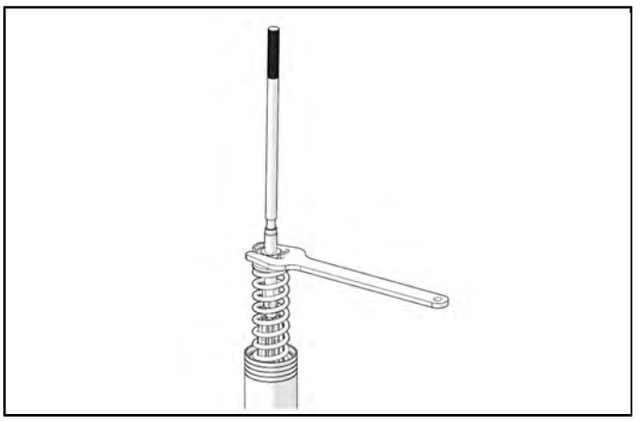
5. Carefully slide the outer tube all the way down.



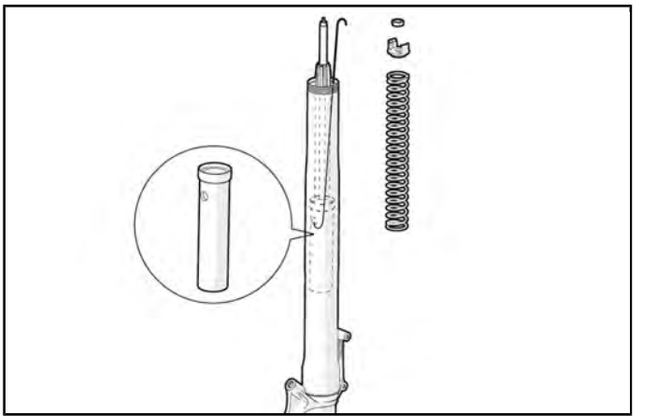
6. Install the Spanner (PF-53160) on the top cap lock nut. Use a 17mm socket to loosen and remove the top cap from the shaft.



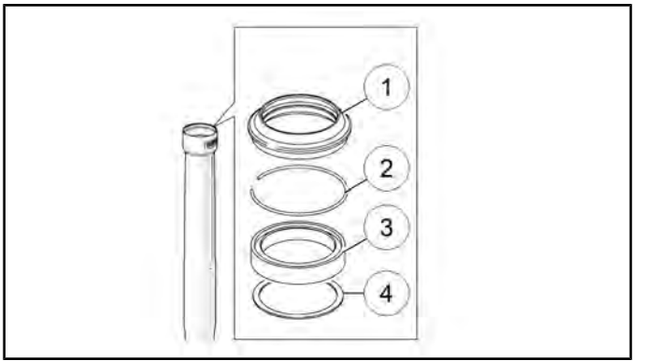
7. Remove the adjustment rod and install Pull-Up Tool (PF-53159). Use Spanner (PF-53160) to remove the lock nut at the same time as you top out the piston shaft.



8. Remove the spring seat, main spring and preload tube. Use a wire with a hook to remove the preload tube.



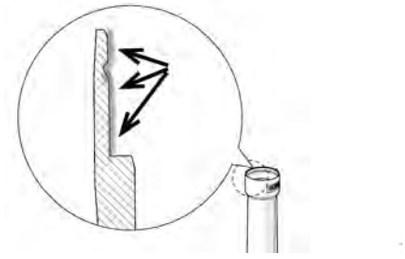
9. Cover the piston shaft to prevent the needle and spring from falling into the fluid container.
10. Drain fluid into a suitable container. Stroke the fork to aid in draining.
11. Carefully remove the outer tube.
12. Place the outer tube on the workbench with the seal side up.
13. Carefully lift dust seal ① out of outer fork tube.



NOTICE
Place a rag on the edge of the outer tube. Pry the dust seal using a flat tire lever or similar tool.

14. Use a pick to remove seal retaining ring ②.

IMPORTANT
Use care not to scratch the surface of the inner fork tube.

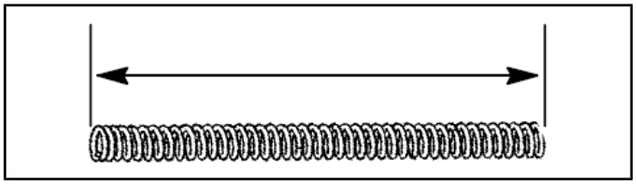


15. Remove the oil seal ③ and washer ④ from the outer tube.

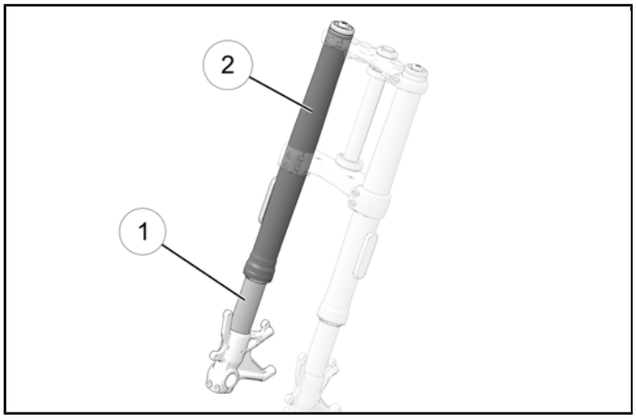
NOTICE
Place a rag on the edge of the outer tube. Pry the oil seal using a flat tire lever or similar tool.

FRONT FORK INSPECTION

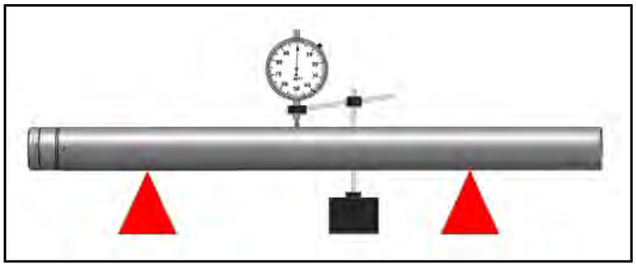
1. Measure fork spring free length and compare to specifications on **Service Specifications - Front Wheel & Suspension page 8.5**.



2. Inspect inner fork tube ① for scoring, heavy scratches, dents due to rocks or other road debris, or excessive wear. Replace tube(s) if deep scratches, pitting, or dents are found.
3. Inspect upper fork tube ② for dents or other indentations due to rocks or other road debris or damage. If damage is found on exterior of slider, insert inner fork tube into upper fork tube and move the tube through the complete travel range. Check for resistance or binding in the damaged area. If binding or resistance is evident, replace damaged tube.



4. Place fork tubes in V-blocks and measure runout. Replace the tube if runout exceeds service limit listed at **Service Specifications - Front Wheel & Suspension page 8.5**.



8

FRONT FORK ASSEMBLY

NOTICE

Clean all parts prior to assembly.

NOTICE

Refer to Indian Motorcycle Service Products and Lubricants page 2.3 for fork oil type and pn info.

IMPORTANT

New parts stackup should be ordered on the inner tube as shown.

NOTICE

The following procedure requires the use of special tools:.

- Fork Spring Compressor (PV-49463)
- Fork Seal Guide (PV-47037)
- Fork Sealer Installer (PV-47035)
- Fork Cap Wrench (PF-52744)
- Damper Rod Holder(PF-52747)
- Cartridge Holder (PF-52745)

NOTICE

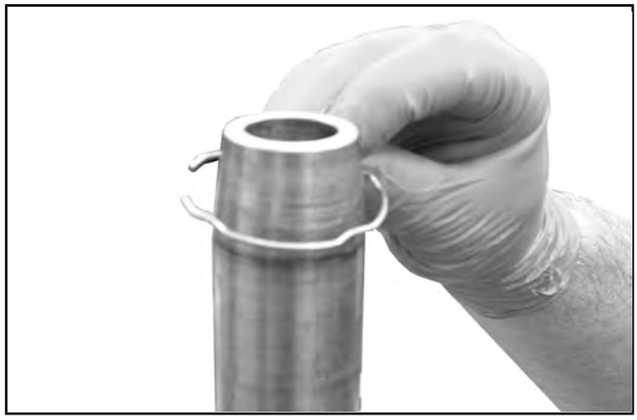
FTR S shown.

Seal Stackup Installation

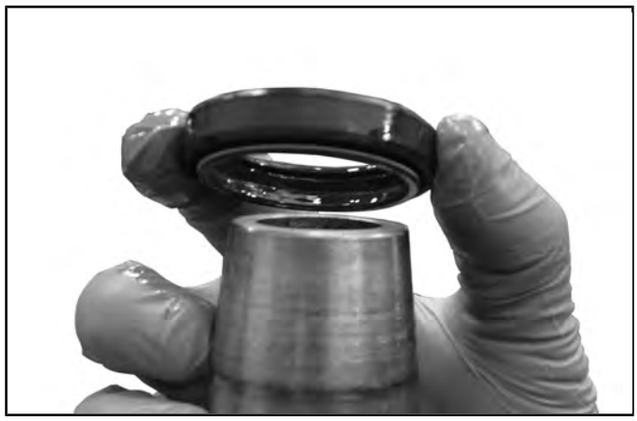
1. Install Fork Seal Installation Tool **(PV-47037)** on fork tube.

2. Apply a light film of fork oil to outside edge and inside seal lips of new dust seal and install by hand.

3. Install the seal locking clip.



4. Apply a light film of fork oil to outside edge and inside seal lips of new oil seal and install by hand.



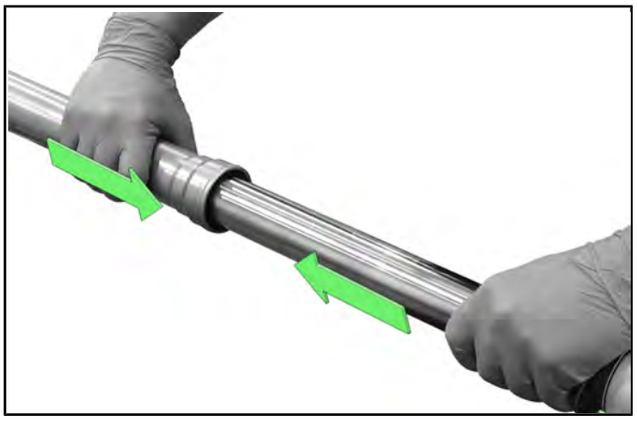
5. Install the washer.

6. Install the lower bushing.

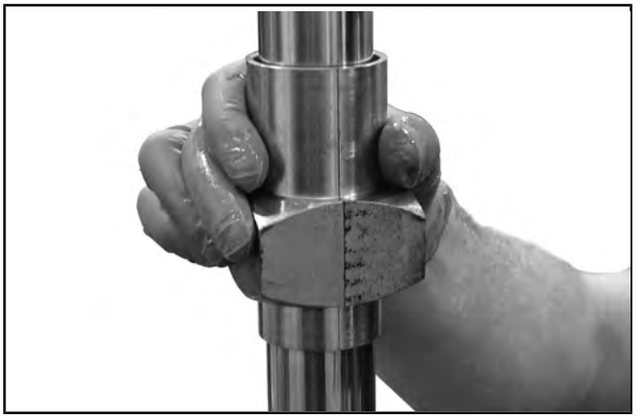
7. Lubricate and install a new upper bushing on inner fork tube.

Seal / Bushing install into outer fork tube

1. Install leg into fork body.



2. To properly seat the bushing and washer, use Fork Sealer Installer **(PV-47035)** with the short end of the seal installer positioned down toward the bushing as shown.



IMPORTANT
Fork Seal Installer must be positioned with the short end facing the bushing as shown. Seal damage will result if not positioned correctly.

3. To properly seat the oil seal, position the Fork Sealer Installer **(PV-47035)** as shown.

NOTICE
Both halves of PV-47035 should be used at all time to install seals. The image is for reference only to show the inner groves of the tool.

4. Seat the seal locking clip into groove.

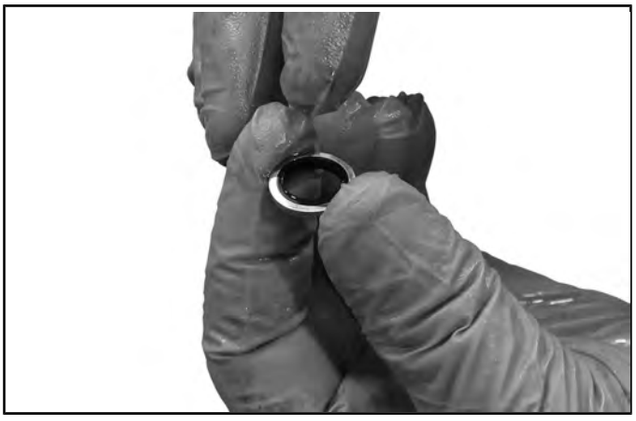
IMPORTANT
Make sure the clip is fully seated.

5. Seat the Dust Seal by hand.

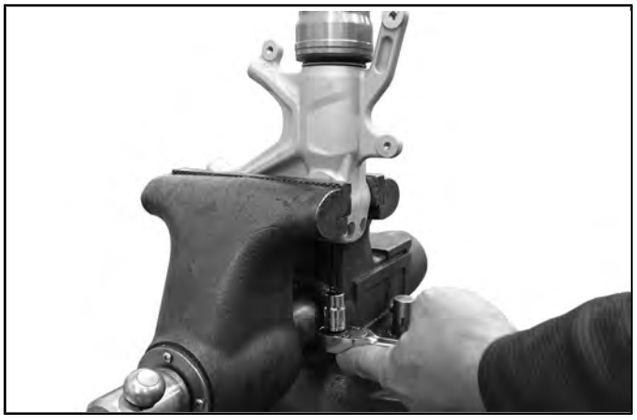
Cartridge Installation

1. Install new cartridge.

2. Apply a light film of fork oil to new cartridge washer and install with cartridge fastener.



3. Install Cartridge Holder **(PF-52745)** into the top of the fork body to prevent cartridge from turning while torquing the cartridge fastener. Using a 8 mm allen, torque cartridge fastener to specification.



TORQUE
Cartridge Fastener: **17 ft-lbs (23 N·m)**

4. Install damper rod bleed tool (PF-52747) to the threaded end of the damper rod.
5. Slowly add fork oil. Stop periodically to cycle the damper though several strokes using special tool PF-52747. This action bleeds air from the cartridge.

	Height	Volume
FTR Rally	104 mm	519 ± 6 cc
FTR / FTR S	100 mm	508 ± 6 cc

6. You can use digital micrometer as a measuring tool to determine the height of fluid in the fork body.

8

- Push the dampening rod down into the fork body.
- Set the micrometer to specification height and insert the tail end of the micrometer into the fork body as shown.
- Measure between the top of the tube to the fluid. Refer to the measurement table to identify how much fluid is required.

IMPORTANT

Make sure dampening rod is pushed all the way down into the fork body during measurement.

7. Install washer and make sure it's centered as shown.

8. Install new spring and washer.

NOTICE

Note the orientation of the spring. The closed end of the spring should be installed down first.

9. Install spacer and cap. Install fork into Fork Compressor **(PV-49463)**

10. Using a 19 mm socket and a 19 mm wrench, tighten cap to the cartridge until the cap bottoms out.

11. Compress fork and install the fork cap onto the cartridge body handtight.

12. Place the fork body into a soft jawed vice. Tighten cap with special tool **(PF-52744)**. Torque to specification.

TORQUE
Fork Cap: **12 ft-lbs (16 N·m)**

NOTICE
To use the special tool **(PF-52744)** with a torque wrench, install the torque wrench at 90 degrees to the fork cap tool square cutout.

13. Reset clickers and preload to previous settings noted before disassembly.

NOTICE
If you want to return the fork settings back to factory, see Front Fork Adjustment Guide page 8.6

FRONT FORK ASSEMBLY (OHLINS)

NOTICE

The following procedure requires the following items

Special Tools:

- Top Nut Tool (PF-53158)
- Pull-Up Tool (PF-53159)
- Spanner (PF-53160)

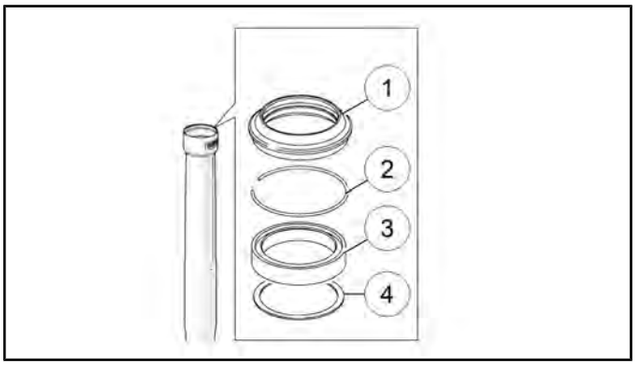
Standard Tools:

- 3mm Allen Key Screwdriver
- Soft Jaw Vice
- 14mm, 17mm Spanner
- 17mm Socket
- Torque Wrench
- Fluid Measuring Syringe

NOTICE

Refer to Indian Motorcycle Service Products and Lubricants page 2.3 for fork oil type and pn info.

1. Apply a light film of fork oil on the sealing surface inside the outer tube.
2. Install the washer ④ and oil seal ③.

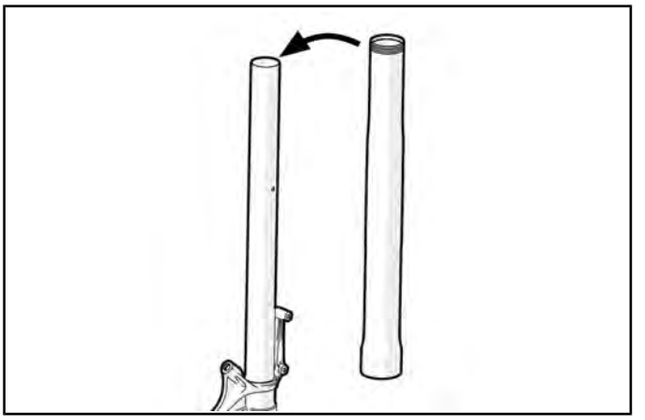


3. Seat the circlip ② into groove.

IMPORTANT

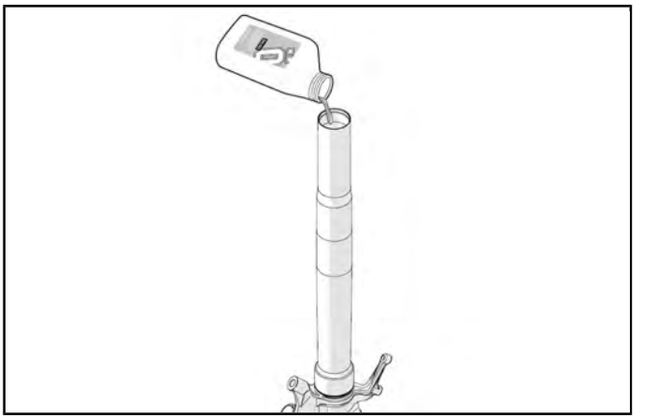
Make sure the clip is fully seated.

4. Seat the Dust Seal ① by hand.
5. Apply a thin layer of fork fluid on the outer surface of the inner tube and on the seal and scraper in the outer tube. Carefully install the outer tube and slide it all the way down.



6. Slowly add fork oil. Stop periodically to cycle the piston rod though several strokes as this action bleeds air. To get all air out also lift the outer tube 80-120 mm (max 130 mm). Cover the outer tube with a hand to create a vacuum. Push down the outer tube while covering the tube until you cant push harder, then release the hand.

   Repeat several times.

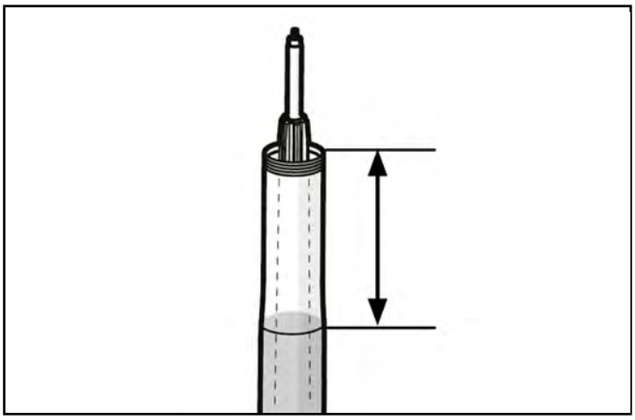


IMPORTANT

Add fork oil until it covers the cylinder tube.

7. Push the piston shaft down into the fork body.

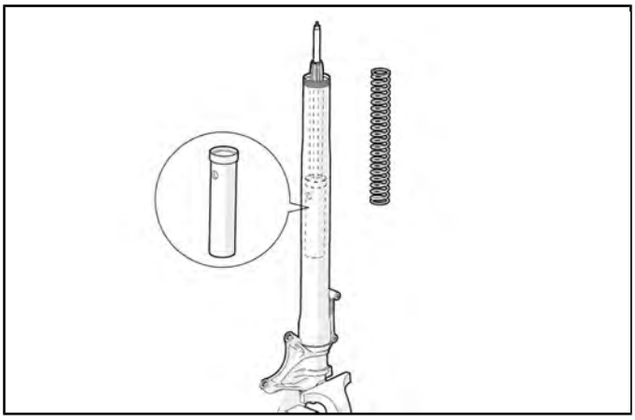
8. Using a fluid measuring syringe, set the depth to 135 mm. Install the syringe into the outer fork tube to determine the height of fluid in the fork body.



IMPORTANT
Make sure the outer tube and piston shaft are pushed all the way down into the fork body during measurement.

MEASUREMENT
Fork Fluid Level: 135 mm

9. Install the tube preload tube into the fork leg.

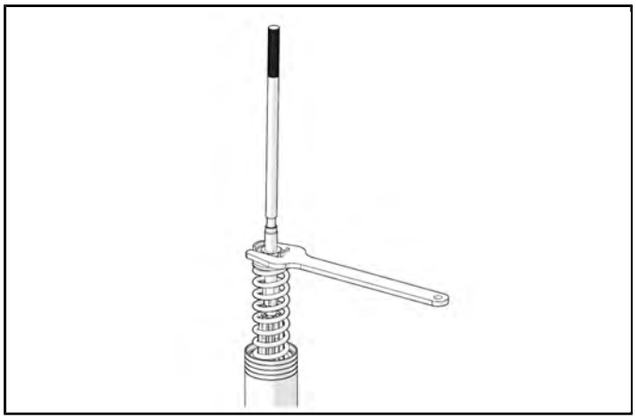


10. Install the spring into the fork leg.

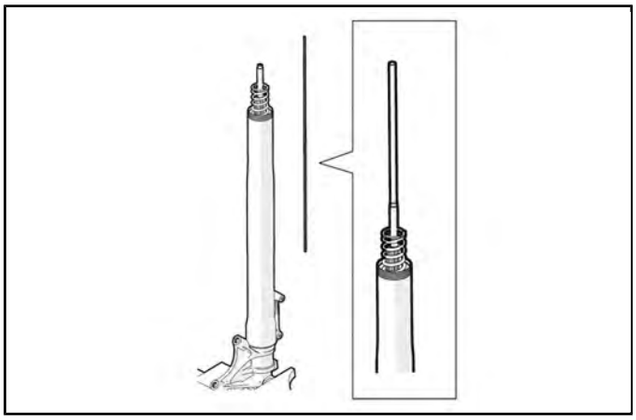
NOTICE
If their is a mark on one end of the spring, make sure that end faces up.

11. Install the spring seat and the top cap lock nut.

12. Install the Pull-Up Tool (PF-53159) to the piston shaft. Top out the piston shaft at the same time as you wind the nut all the way down.



13. Remove the pull up tool and install the adjustment rod in the shaft.

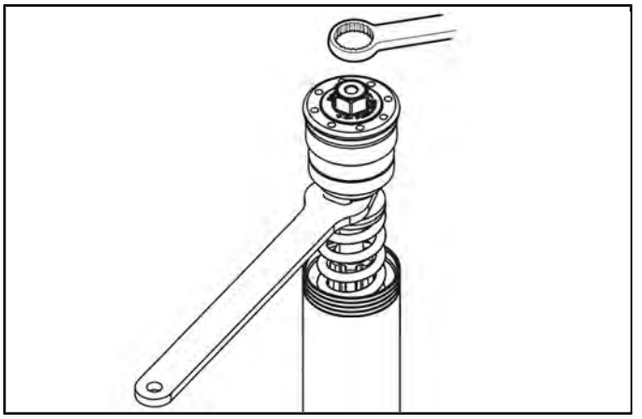


14. Install the fork cap on the shaft.

NOTICE
Before you tighten the lock nut , make sure that the shaft bottoms in the top cap.

8

15. Use the Spanner (PF-53160) and tighten the fork cap lock nut to specification.

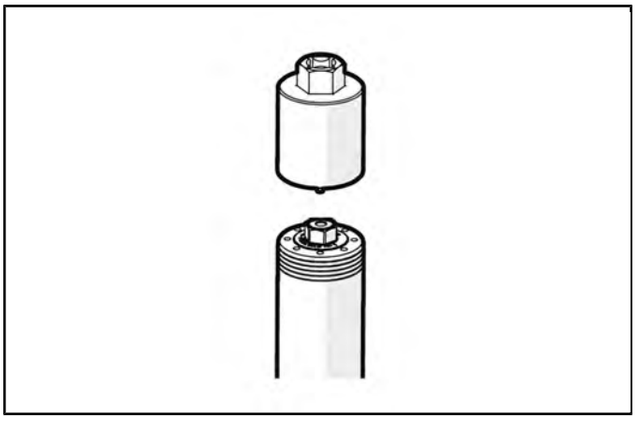


NOTICE

The nut will be loosen when the top cap is in the bottom of its thread. Use the spanner and 17 mm socket to tighten the top cap. the nut will be tighten against the top cap.

TORQUE
Fork Cap Lock Nut: **15 ft-lbs (20 N·m)**

16. Apply grease on the fork cap O-ring and the thread.
17. Make sure that the fork leg is fully extended and topped out. Use the Top Nut Tool (PF-53158) and tighten the fork cap on the outer fork leg to specification.



TORQUE
Fork Cap: **11 ft-lbs (15 N·m)**

18. Reset clickers and preload to previous settings noted before disassembly.

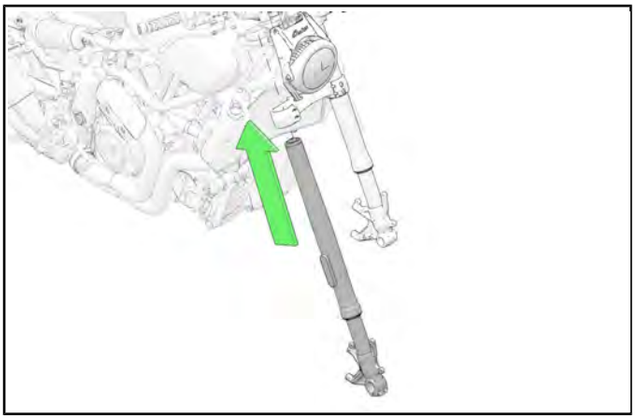
NOTICE

If you want to return the fork settings back to factory, see Front Fork Adjustment Guide page 8.6

FRONT FORK INSTALLATION

NOTICE
Clean the fork tubes and the clamping surfaces of the triple clamps to remove any oil or grease prior to installation.

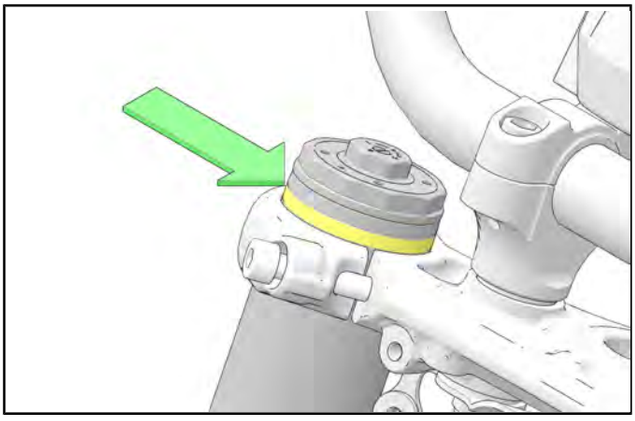
1. Install one fork tube assembly into lower triple clamp.



2. Continue to slide tube through lower triple clamp and into upper triple clamp.

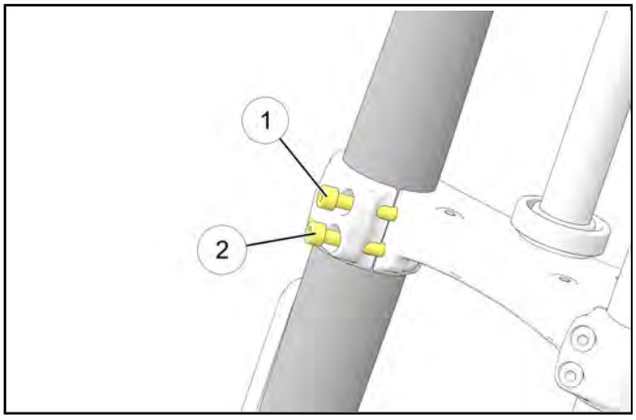
IMPORTANT
Spread the lower triple clamp to prevent scratching the fork outer tube.

- **FTR / FTR S Models:** Stop when the 2nd ring aligns with the upper triple clamp.

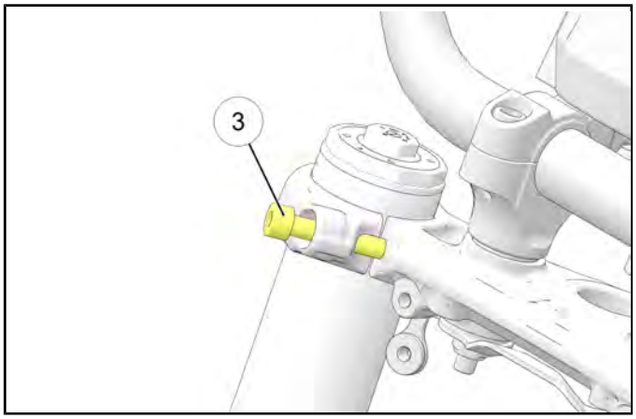


- **FTR R Carbon Model:** Stop when 11mm of outer tube (gold) reaches above the upper triple clamp.

3. Torque the bottom bolt on the lower triple clamp ②.
4. Torque the top bolt on the lower triple clamp ①.



5. REPEAT steps 3 – 4.
6. Torque the upper triple clamp bolt ③.



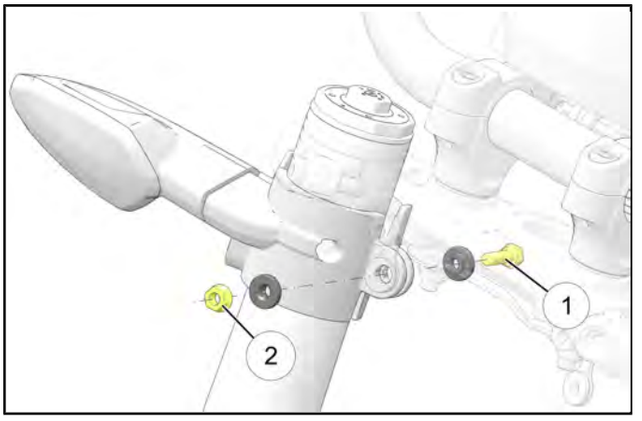
TORQUE
Fork Triple Clamp Fasteners (Lower): **18 ft-lbs (24 N·m)**

TORQUE
Fork Triple Clamp Fasteners (Upper): **18 ft-lbs (24 N·m)**

7. Repeat steps 1 through 6 for the other fork tube.
8. Install brake line guides (if removed).

8

9. Install turn signal assembly. Torque bolt ① to specification.



TORQUE
Turn Signal Mount Fastener (Front): **36 in-lbs (4 N·m)**

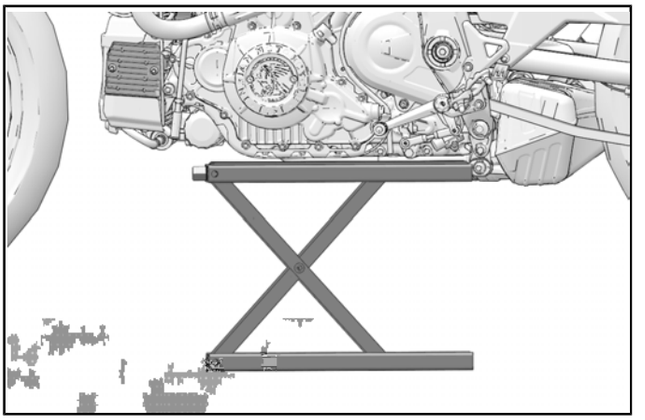
10. Install front wheel. See **Front Wheel Removal / Installation page 8.29**.
11. Install brake caliper. See **Front Caliper Removal page 9.54**.
12. Install front fender. See **Front Fender Installation page 7.20**.
13. Inspect all bolts for proper torque. Inspect hoses and wiring for proper routing.
14. Lower front end of motorcycle to the ground and test front suspension / fork operation.

TRIPLE CLAMP REMOVAL

⚠ WARNING
This procedure requires raising and supporting the motorcycle so that the front wheel is off the ground. Precautions should be taken to ensure the motorcycle is properly stabilized at all times. Failure to properly support motorcycle may result in personal injury or damage to the motorcycle.

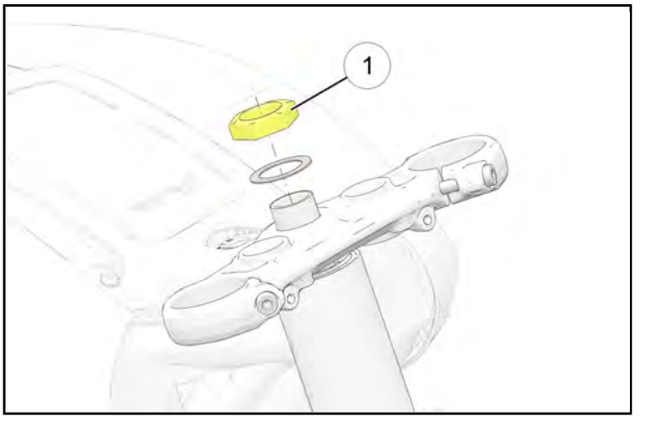
⚠ CAUTION
Do not twist the brake hose or brake line. Do not allow calipers to hang from the brake hose. Secure calipers in such a way to avoid hose damage.

1. Secure the motorcycle in an upright position with tie-down straps and a platform jack positioned beneath the engine cases.

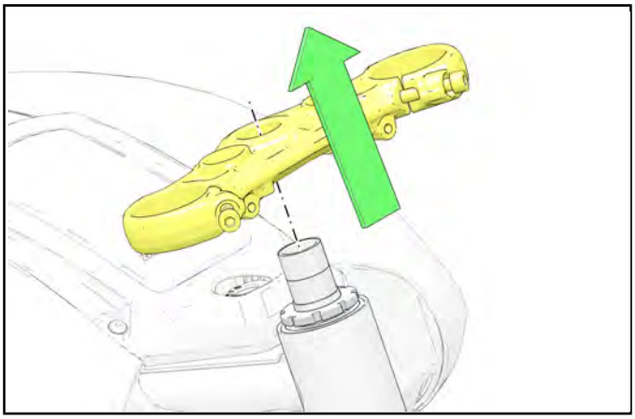


IMPORTANT
Do not operate the front brake lever with the calipers or wheel removed.

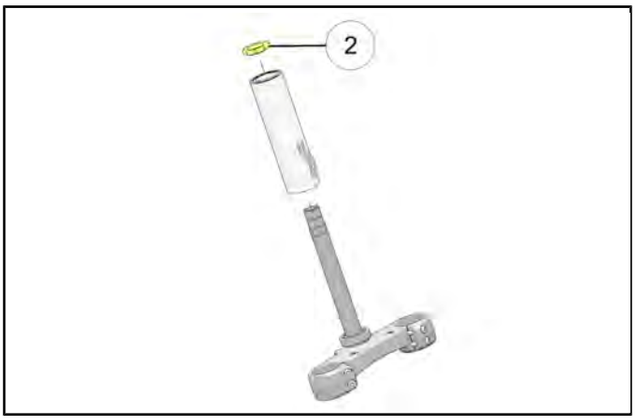
2. Remove the front fender. See **Front Fender Removal page 7.20**.
3. Remove front wheel. See **Front Wheel Removal / Installation page 8.29**.
4. Remove Speedometer assembly.
5. Remove Headlight assembly.
6. Remove the handlebar / riser assembly. See **Handlebar Removal / Installation page 8.23**.
7. Remove fork tubes. See **Front Fork Removal page 8.33**.
8. Remove brake line guides from lower triple clamp.
9. Remove center nut ① and washer on upper triple clamp.



10. Slide upper triple clamp off steering stem.



11. Remove stem adjuster nut ② with a spanner socket **PV-43508**.

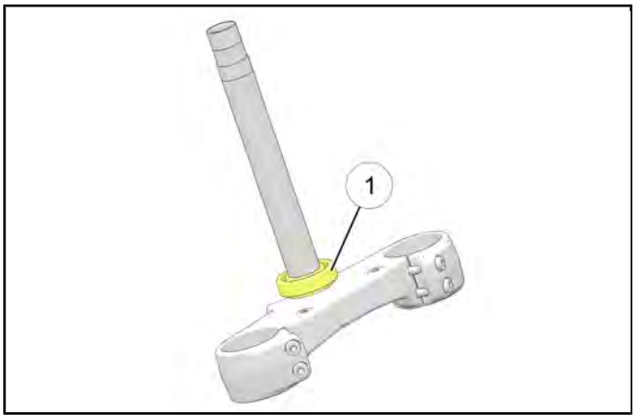


IMPORTANT
Support lower triple clamp while removing the adjuster nut.

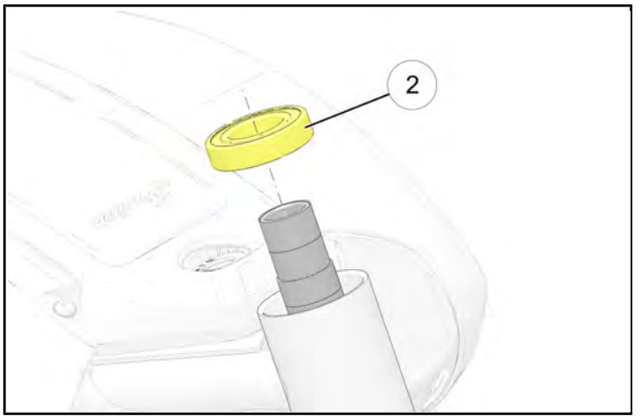
12. Remove lower triple clamp, with steering stem, and lower bearing (outer race will remain in head tube).
13. Inspect bearings and bearing races.

TRIPLE CLAMP INSTALLATION / STEERING HEAD BEARING ADJUSTMENT

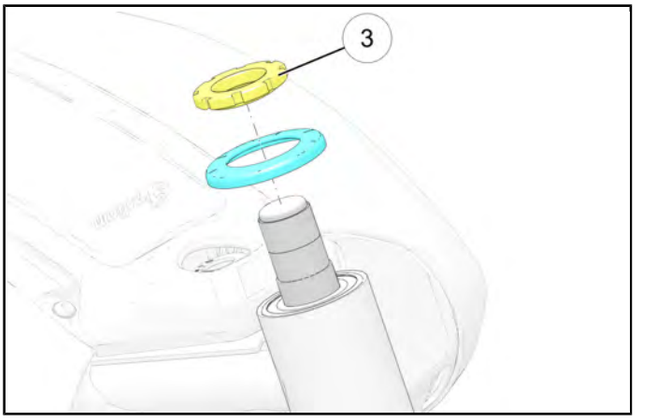
1. Inspect both top and bottom bearing races for pitting, dents, or worn surface. Replace bearings and races as a set if they are worn or damaged.
2. Be sure lower stem bearing ① is seated against step on lower triple clamp. Apply all purpose grease to bearing and install lower triple clamp / stem to frame.



3. Install upper bearing ② into steering head tube. Ensure it is fully seated.



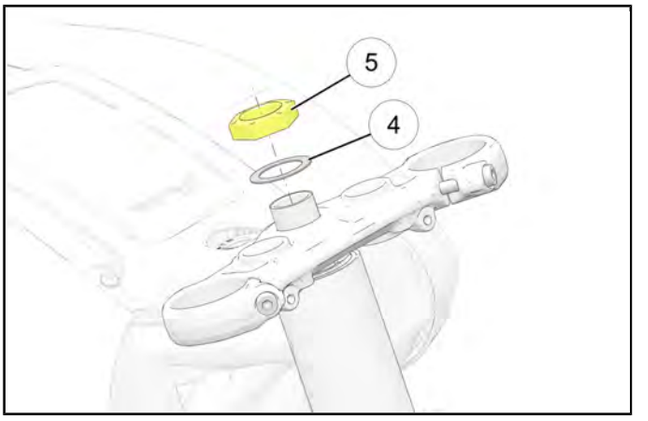
4. Install steering stem cover as shown. Screw steering head nut ③ (shoulder side down) onto the steering stem cover until it is finger tight.



5. Turn triple clamp assembly fully to the right.
6. Torque steering head nut to specification using suitable spanner wrench.

TORQUE
Steering Head Nut: **STEP 1: Torque to 29 ft-lbs (40 N·m)STEP 2: Turn lower triple clamp from lock to lock five times and *return to full right* position.STEP 3: Loosen adjuster nut 90 degrees (1/4 turn).**

7. Set upper triple clamp in place on stem. Install washer ④ and nut ⑤ and tighten top nut until it is finger tight.



NOTICE
Nut will be torqued after fork tubes are installed.

8. Continue to slide tube through lower triple clamp and into upper triple clamp. Stop when the 2nd ring aligns with the upper triple clamp.

9. Tighten top triple clamp pinch bolt enough to hold tubes in place. Leave lower triple clamp pinch bolts *loose*.
10. Torque the top steering stem nut to specification.

TORQUE
Steering Stem Nut (top): **92 ft-lbs (125 N·m)**

NOTICE
CHECK STEERING STEM BEARINGS at this time. Pull firmly on fork tubes with a front-to-rear motion. If movement can be felt in steering bearings, disassemble and go back to STEP 10. Tighten steering stem adjuster nut an additional 5 degrees, and reassemble following STEPS 10–15. Repeat this procedure until no play can be felt.

11. Torque the upper triple clamp pinch fasteners (both sides) to specification.

⚠ CAUTION
DO NOT over-torque fasteners.

TORQUE
Fork Triple Clamp Fasteners (Upper): **18 ft-lbs (24 N·m)**

12. Torque bottom fasteners on lower triple clamp to specification.
13. Torque top fasteners on lower triple clamp to specification.

⚠ CAUTION
DO NOT over-torque fasteners.

TORQUE
Fork Triple Clamp Fasteners (Lower): **18 ft-lbs (24 N·m)**

14. Repeat STEPS 15–17.
15. Install handlebar assembly. See **Handlebar Removal / Installation page 8.23**.
16. Install front wheel. See **Front Wheel Removal / Installation page 8.29**.
17. Verify all fasteners are installed and properly torqued.

TROUBLESHOOTING FRONT WHEEL / SUSPENSION

PROBLEM	POSSIBLE CAUSE	REPAIR RECOMMENDED
Heavy Steering	Steering Stem Nut Over Tightened	Torque to specification
	Damaged Steering Stem Bearings or Races	Replace
	Bent Steering Stem	Replace
	Front Tire Damaged or Worn	Replace
	Low Tire Pressure	Inflate to specification
Pulls to One Side or Wanders	Damaged Steering Stem Bearings or Races	Replace
	Steering Stem Nut Over Tightened or Under Tightened	Torque to specification
	Low Tire Pressure	Inflate to specification
	Rear Wheel Not Aligned Correctly	Align
	Bent Front Axle	Replace
	Damaged or Excessively Worn Front Tire / Incorrect Tire	Replace
	Damaged Wheel Bearings	Replace
	Damaged Swingarm Bearings	Replace
	Loose Swingarm Pivot Nut	Torque to specification
	Bent Frame or Swingarm	Replace
Handlebars Oscillate (Wobble)	Bent Front Axle	Replace
	Wheel Has Excessive Runout	True (Spoked) / Replace (Cast)
	Tire Mounted Incorrectly	Check Mounting and Balance
	Damaged Tire / Worn Tire	Replace
	Loose Steering Stem Nut	Torque to specification
	Incorrect Tire	Replace
	Incorrect Tire Pressure	Correct
Noise Coming From Front Suspension	Worn Fork Bushings	Rebuild Forks
	Low Fork Fluid	Determine Cause / Replace Fork Oil
	Loose Fasteners	Torque to specification
	Loose Steering Stem Bearings	Determine Cause / Correct
Front Wheel Oscillates (Wobbles)	Bent Front Rim	Replace
	Damaged Front Wheel Bearings	Replace
	Damaged or Incorrect Tire	Replace
Front Wheel Oscillates (Wobbles)	Loose Axle	Torque to specification

PROBLEM	POSSIBLE CAUSE	REPAIR RECOMMENDED
	Fork Tube Height Unequal	Install Correctly
	Fork Oil Level Unequal	Set Correctly
	Fork Spring Free Length Different Between Right & Left	Replace
	Wheel Assembly Out-of-Balance	Balance
	Low Tire Pressure	Inflate to specification
Front Suspension Too Soft	Weak Fork Springs	Replace
	Low Fork Oil Level	Determine Cause/Replace Fork Oil
	Wrong Weight Fork Oil	Replace
	Contaminated and/or Deteriorated Fork Oil	Replace
	Low Tire Pressure	Set Correctly
Front Suspension Too Hard	Tire Pressure Too High	Set Correctly
	Bent Fork Tubes	Replace
	Wrong Weight Fork Oil	Replace
	Too Much Fork Oil	Set Correctly
	Plugged Oil Passages	Rebuild Front Forks
	Damaged Sliders	Replace
	Forks Binding	Correct
Wheel Turns Hard	Damaged Wheel Bearings	Replace
	Front Axle Bent	Replace
	Brake Dragging (Hydraulic or Mechanical Problem)	Repair as Necessary
	Brake Dragging (Bent Disc)	Replace
	Improper Assembly After Repairs	Correct as Necessary

REAR WHEEL & SUSPENSION

GENERAL INFORMATION

SERVICE NOTES

⚠ WARNING

This motorcycle was produced with the designated tires as original equipment. The testing to ensure stability and superior handling was done using the OEM tires. Using non-OEM tires could result in poor motorcycle stability and handling, which can lead to a crash resulting in serious injury or death. Use only the recommended tires inflated to the recommended tire pressures.

Tubeless tires are used on certain Indian Motorcycle models. Operating the motorcycle with damaged rims creates a safety hazard including air pressure loss, steering imbalance and/or reduced steering control. Do not attempt to repair or straighten damaged cast or spoked rims. Always use genuine Indian Motorcycle parts or equivalent so that quality is not compromised. The use of tire valves and valve cores other than original equipment replacement Indian Motorcycle parts could cause tire deflation which may lead to loss of control, resulting in injury or death. Do not allow any motorcycle to leave your service area without tire valve caps securely installed.

- **FTR, FTR S, and FTR Rally models:** The rear shock absorber is not serviceable.
- **FTR R Carbon models:** rear shock must be serviced by an authorized Ohlins® Service Center.
- Refer to Maintenance Chapter for maintenance of rear wheel & suspension components, and suspension ride height adjustment.

SPECIAL TOOLS - REAR WHEEL & SUSPENSION

SPECIAL TOOL	PART NUMBER
Swingarm Bushing Tool	PF-51237
Shock Spanner Wrench	2884176
Output Shaft Seal Tool	PF-51243
Bearing Removal / Installation Kit	PU-51324
Swingarm Adjuster Tool	PF-52738
Swingarm Lock Ring Tool	PF-52737
Spring Compressor	Commercially Available
Platform Jack	Commercially Available
Drive Chain Tool	KM500R

SERVICE SPECIFICATIONS - REAR WHEEL & SUSPENSION

ITEM		STANDARD	SERVICE LIMIT
Axle Runout		-	.20 mm (.008")
Rear Wheel Runout	Axial / Radial	0.5 mm Radial 1.0 mm Axial	2.0 mm (.080")
Rear Wheel Size / Type	FTR / FTR S / FTR R Carbon	17 in x 5.50 in. Cast	–
	FTR Rally	18 in. x 4.25 in. Cast	
Rear Wheel Travel	FTR / FTR S / FTR R Carbon	5.1" (130 mm)	–
	FTR Rally	5.9" (150 mm)	–
Shock Free Length	FTR / FTR S / FTR R Carbon	327 mm (+/- 2.0 mm)	–
	FTR Rally	332 mm (+/- 1.5 mm)	–
Shock Spring Installed Length (Standard)	All Models	Perform Ride Height Adjustment	–
Suspension Ride Height	All Models	Refer to Maintenance Chapter for Ride Height Measurement procedure	–
Spring Rate	FTR / FTR S / FTR R Carbon	628 lbs / in (110 Nmm)	–
	FTR Rally	651 lbs / in (114 Nmm)	–
Swingarm Pivot Shaft Runout		Not Applicable	.30 mm (.012")
Swingarm Pivot Shaft O.D.		24.790 mm - 24.990 mm	–
Swingarm Needle Bearing Bore O.D. (right-hand)		32 mm	–
Swingarm Ball Bearing Bore O.D. (left-hand)		47 mm	–
Wheel bearing O.D. (approx)		51.987–52.000 mm	–
Wheel bearing I.D. (approx)		24.988–25.000 mm	–

REAR SHOCK ADJUSTMENT GUIDE

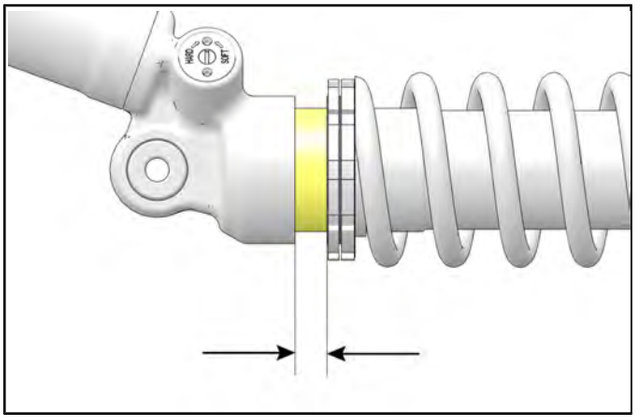
Refer to Suspension Adjustment Guide page 2.33

REAR SHOCK PRELOAD INSPECTION

Periodically inspect rear shock preload. For the most comfortable ride and proper ground clearance, adjust preload according to following table.

1. Identify the combined weight of rider, passenger, and cargo.

2. Determine shock preload by measuring the amount of exposed thread on the shock body behind the jam nut. See the table below for measurement based on weight.

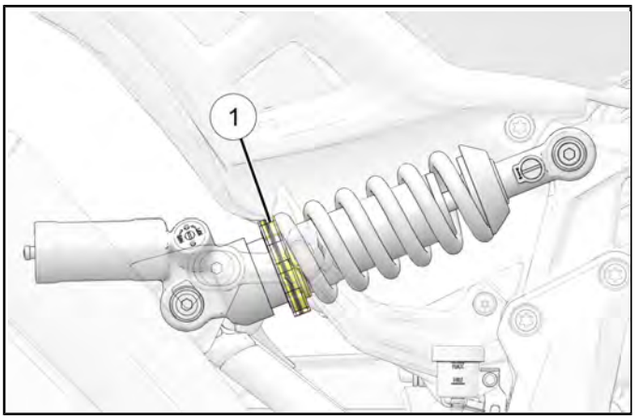


3. Adjust preload as needed to achieve dimension specified in the table below. To adjust, See **Rear Shock Preload Adjustment page 8.61**.

COMBINED WEIGHT OF RIDER, PASSENGER, AND CARGO	DIMENSION		
	FTR RALLY	FTR / FTR S	FTR R CARBON
125 lb (57 kg)	0 mm	0 mm	19 mm
150 lb (68 kg)	2 mm	2 mm	21 mm
175 lb (79 kg)	5 mm	5 mm	23.5 mm
200 lb (91 kg)	8 mm	8 mm	26 mm
225 lb (102 kg)	10 mm	10 mm	28 mm
250 lb (113 kg)	13 mm	13 mm	31 mm
275 lb (125 kg)	15 mm	16 mm	32 mm
300 lb (136 kg)	17 mm	18 mm	34 mm
325 lb (147 kg)	20 mm	21 mm	37 mm
350 lb (159 kg)	22 mm	23 mm	39 mm
375 lb (170 kg)	25 mm	26 mm	39.5 mm
400 lb (181 kg)	27 mm	28 mm	39.5 mm
425 lb (196 kg)	30 mm	30 mm	39.5 mm

REAR SHOCK PRELOAD ADJUSTMENT

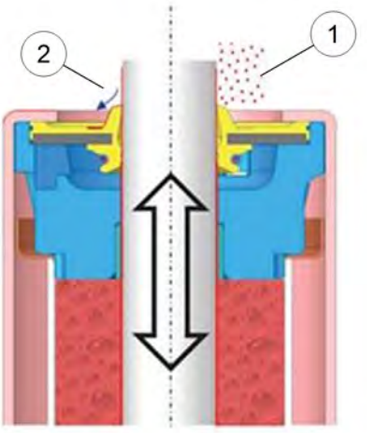
1. Place the motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Using shock spanner wrench **(2884176)** loosen the lock nut ① by turning it counter-clockwise (as viewed from the top of the shock).
3. Spray a light lubricant on the adjuster nut where it contacts the spring.
4. Adjust shock preload by rotating the adjuster nut clockwise (as viewed from the top of the shock) to **INCREASE** preload (firm) or counter-clockwise to **DECREASE** preload (softer).



5. Recheck the preload measurement after adjusting.
6. Tighten the lock nut securely against the adjuster nut.

SHOCK ANALYSIS

Shock "misting" ① or "weepage" ② is common and should be present during normal vehicle operation. All Shock Absorber Seals are designed to allow a thin film of oil to pass into and out of the shock. This thin film of oil lubricates the Seal to ensure low friction and reduces the corrosion rate of the Piston Rod.



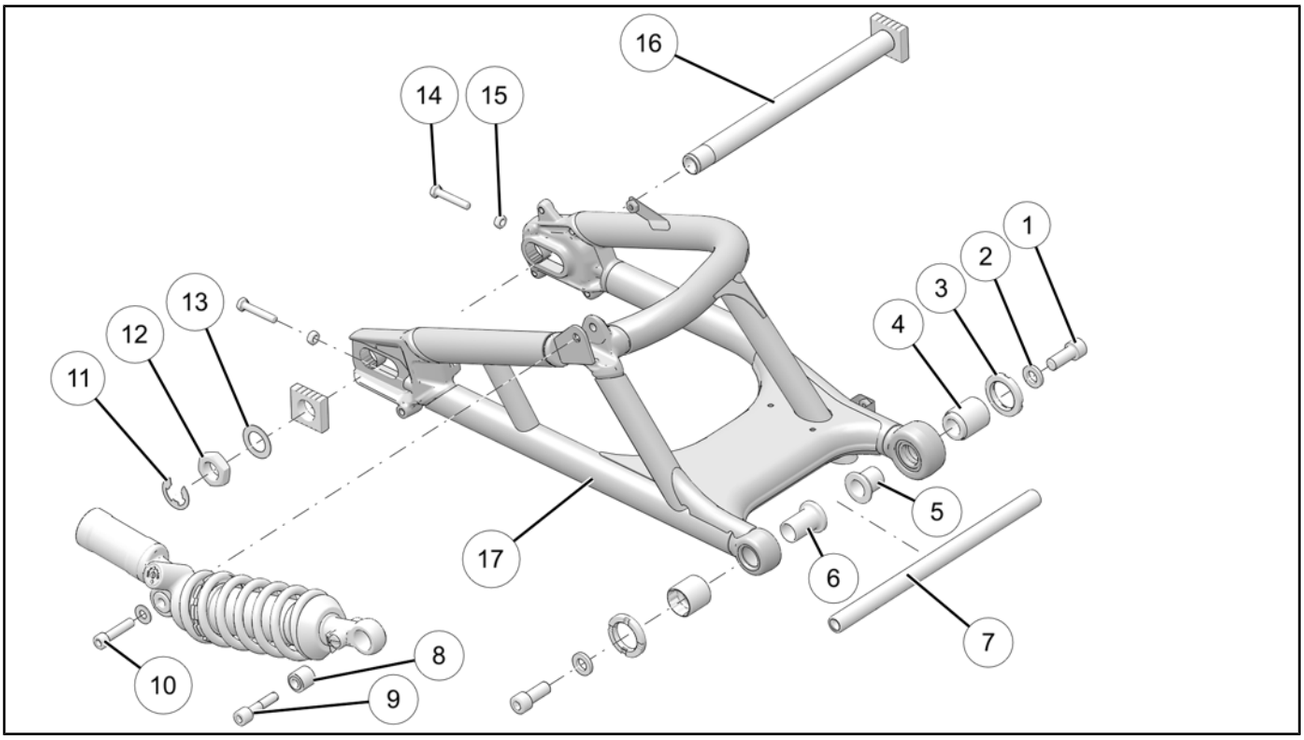
Vehicle operating conditions have a high impact on how much shock oil might be present on the seal and shock body (i.e. road conditions and operating temperature). It is important to properly identify the difference between normal operation (weepage or misting) and a shock that has a leak. Below are some images to help determine what is normal and what could be identified as a bad shock.

MISTING OR WEEPAGE	LEAKAGE
	

ASSEMBLY VIEWS

REAR SUSPENSION ASSEMBLY VIEW

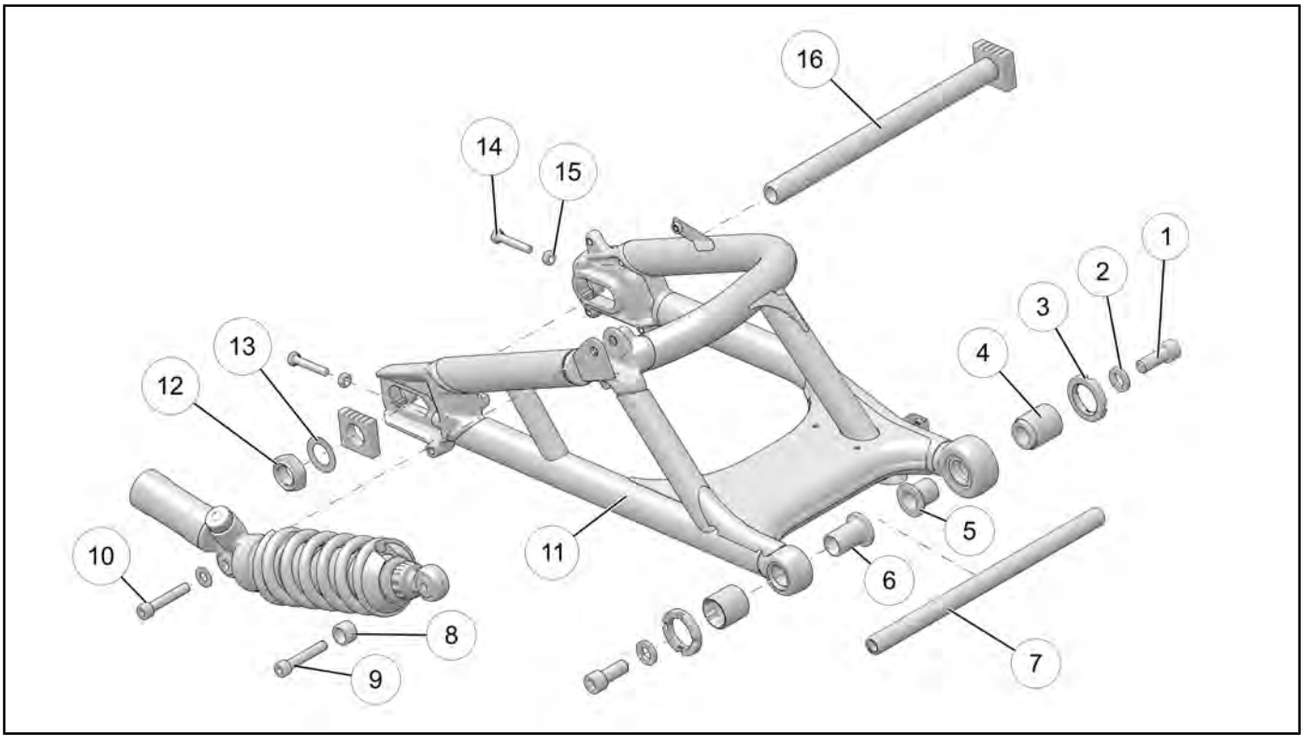
2019–2020 Models



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Swingarm Pivot Bolt	**52 ft-lbs (70 N·m)**
②	Washer	-
③	Swingarm Lock Ring	**44 ft-lbs (60 N·m)** See Tightening Procedure Outlined in this Chapter
④	Swingarm Pivot Adjuster	**11 (15 N·m)** See Tightening Procedure Outlined in this Chapter
⑤	Swingarm Bushing (Left-Hand)	-
⑥	Swingarm Bushing (Right-Hand)	-
⑦	Pivot Shaft	-
⑧	Shock Fastener Bushing	-
⑨	Shock Fastener (upper)	**44 ft-lbs (60 N·m)**
⑩	Shock Fastener (lower)	**44 ft-lbs (60 N·m)**
⑪	E-Clip	-
⑫	Axle Nut (rear)	**92 ft-lbs (125 N·m)**
⑬	Washer	-
⑭	Swingarm Adjustment Screw	-
⑮	Swingarm Jam Nut	**12 ft-lbs (16 N·m)**

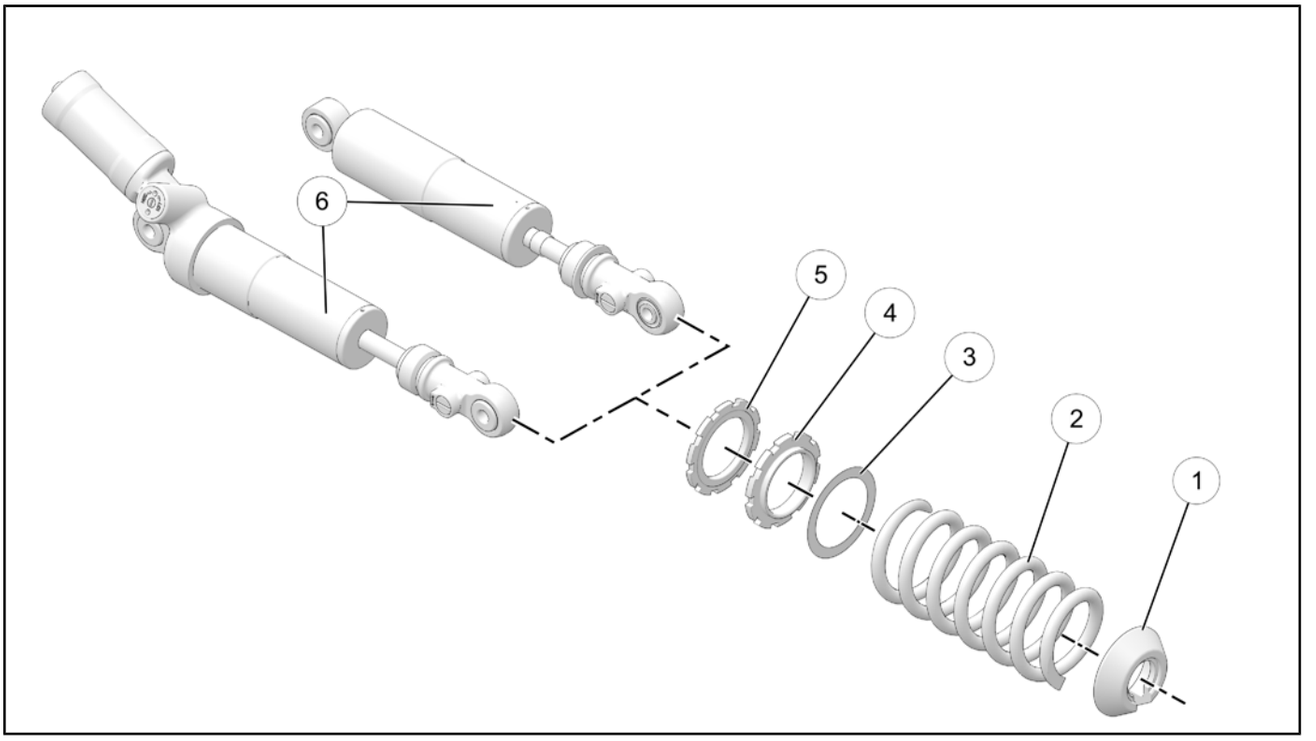
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
⑯	Rear Axle	-
⑰	Swingarm	-

2022+ Models



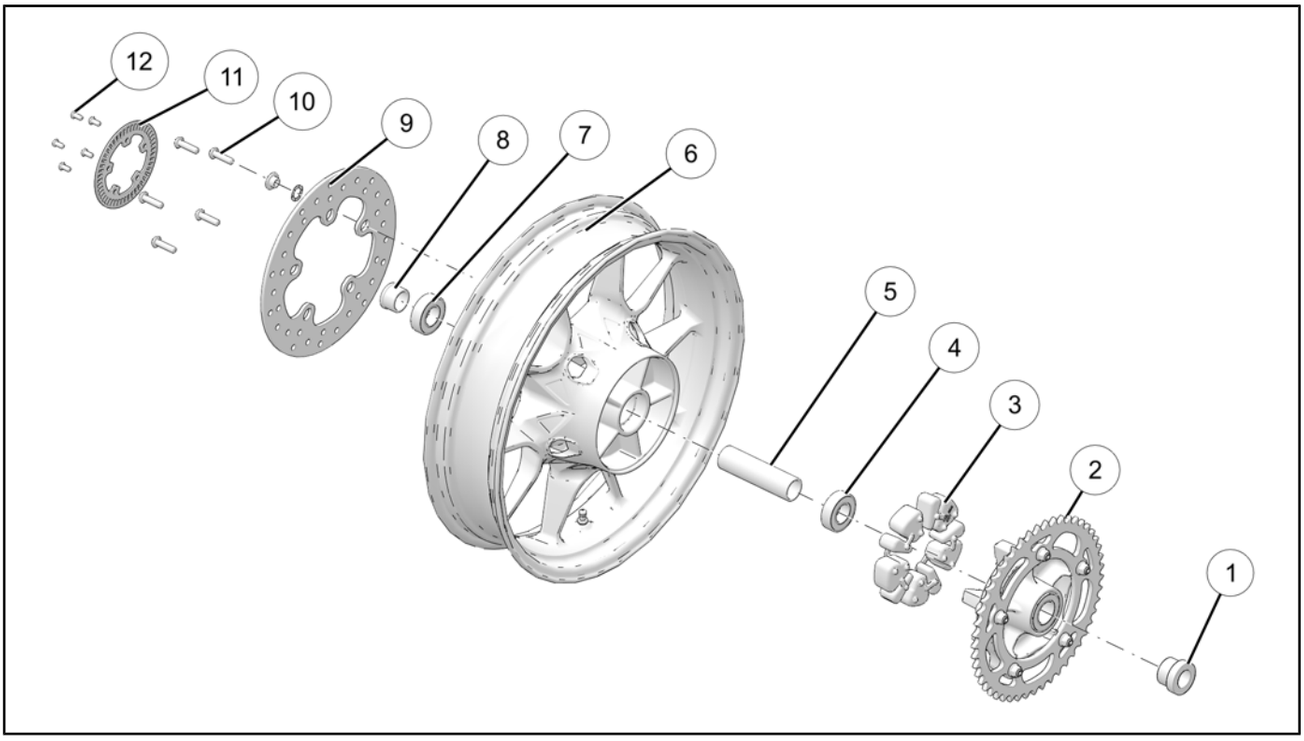
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Swingarm Pivot Bolt	**52 ft-lbs (70 N·m)**
②	Washer	-
③	Swingarm Lock Ring	**44 ft-lbs (60 N·m)** See Tightening Procedure Outlined in this Chapter
④	Swingarm Pivot Adjuster	**11 (15 N·m)** See Tightening Procedure Outlined in this Chapter
⑤	Swingarm Bushing (Left-Hand)	-
⑥	Swingarm Bushing (Right-Hand)	-
⑦	Pivot Shaft	-
⑧	Shock Fastener Bushing	-
⑨	Shock Fastener (upper)	**44 ft-lbs (60 N·m)**
⑩	Shock Fastener (lower)	**44 ft-lbs (60 N·m)**
⑪	Swingarm	-
⑫	Axle Nut, Locking (rear)	**92 ft-lbs (125 N·m)**
⑬	Washer	-
⑭	Swingarm Adjustment Screw	-
⑮	Swingarm Jam Nut	**12 ft-lbs (16 N·m)**
⑯	Rear Axle	-

REAR SHOCK ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Cap	-
②	Spring	-
③	Washer	-
④	Adjuster	-
⑤	Locking Ring	-
⑥	Shock Body (Adjustable)	-
	Shock Body (Non-Adjustable)	

REAR WHEEL ASSEMBLY VIEW

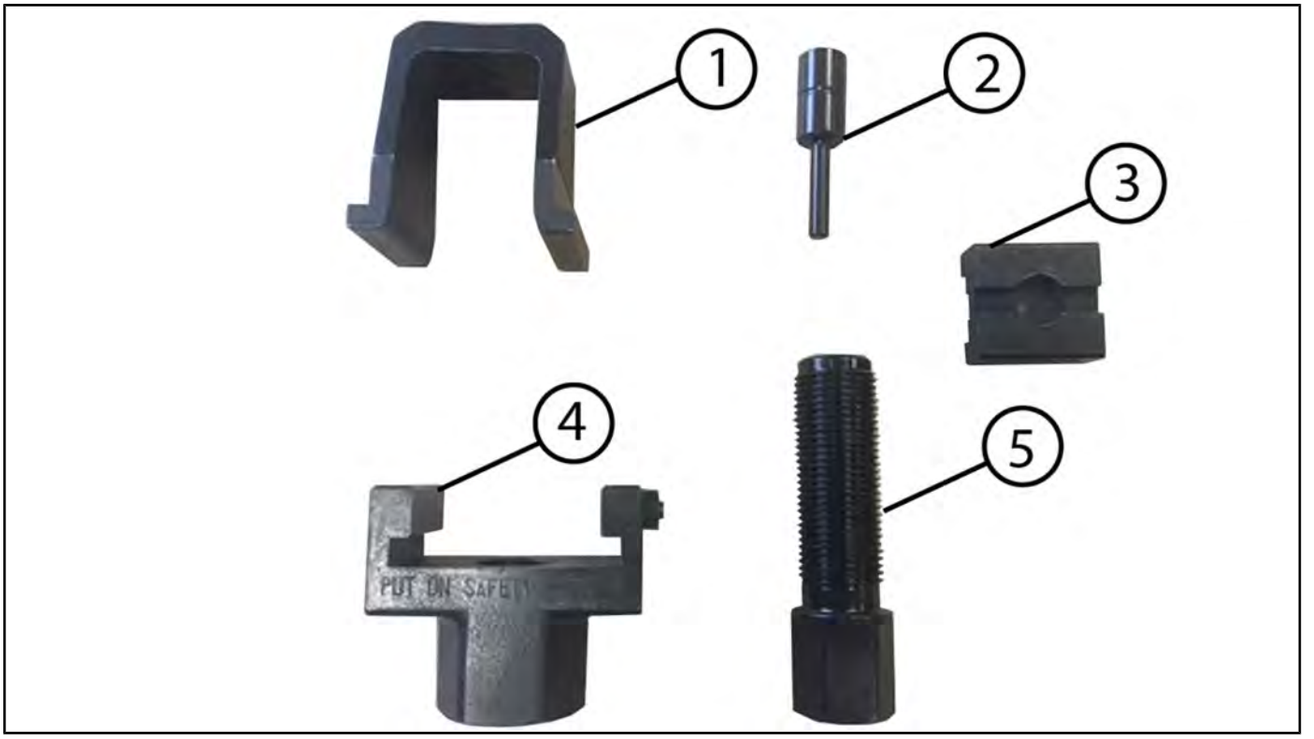


NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Outer Bearing Spacer	-
②	Sprocket Assembly	-
③	Damper	-
④	Wheel Bearing	-
⑤	Bearing Spacer	-
⑥	Rear Wheel	-
⑦	Wheel Bearing	-
⑧	Axle Spacer	-
⑨	Brake Rotor	-
⑩	Brake Disc Fasteners (QTY.5)	**22 ft-lbs (30 N·m)**
—	Spring Washer (QTY.10)	-
—	Bushing (QTY.10)	-
⑪	ABS Tone Ring	-
⑫	Tone Ring Fasteners (QTY.5)	**84 in-lbs (9 N·m)**

DRIVE CHAIN SERVICE

DRIVE CHAIN TOOL

KM500R

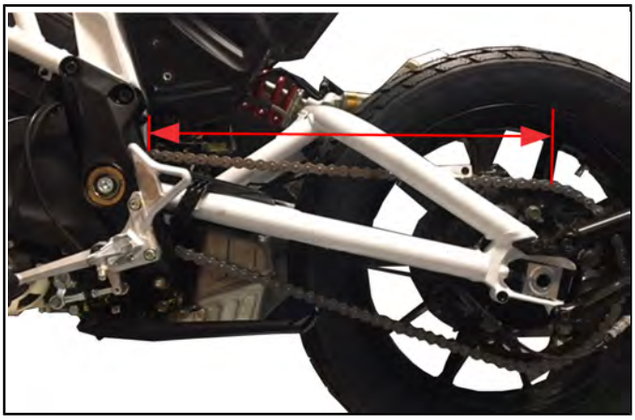


NUMBER	DESCRIPTION
①	U-Shaped Holder
②	Cutting / Riveting Pin
③	Plate Holder
④	Tool Body
⑤	Bolt

DRIVE CHAIN STRETCH INSPECTION

1. Apply a 20–25 lbs weight to the bottom of the drive chain.

2. Measure the length of 20 pitches from pin center to pin center, and compare to the specification.



length of 20 pitches: 317.5–319 mm

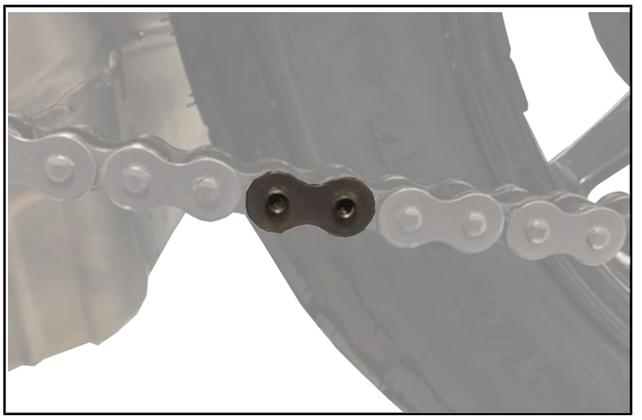
3. Replace the drive chain if the length exceeds specification. See DRIVE CHAIN SERVICE in the Steering / Suspension chapter.

DRIVE CHAIN MASTER LINK REMOVAL

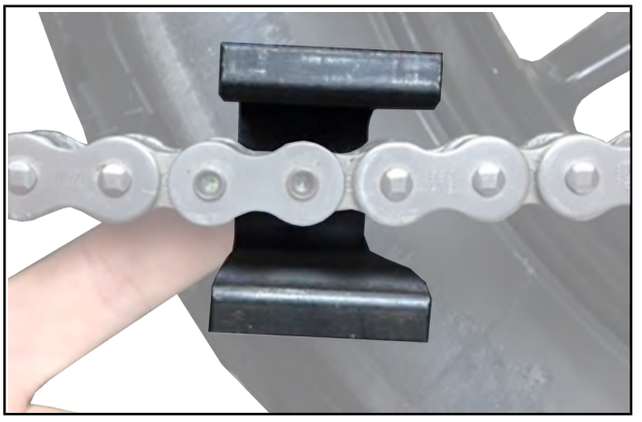
To watch a video of this procedure, scan the QR code or click **HERE**.

Special Tool Required: KM500R

1. Locate the master link and rotate the chain until it is on the bottom of the chain as shown.



2. Place the U-shape holder so that the right hand pin is lined up with the hole on the tool.



NOTE
The U-shape holder should be positioned so the letters are facing up.

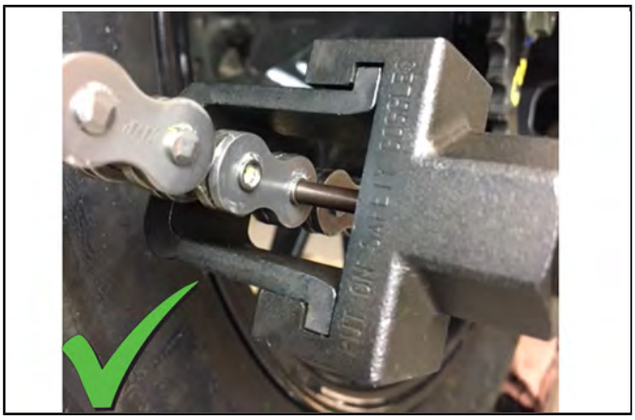
3. Install the cutting pin into the tool body.

4. Install the tool body onto the U-shaped holder and place into **Position A**.

5. Thread the tool until the cutting pin contacts the pin head.

⚠ CAUTION

Ensure the cutting pin is lined up with the center of the pin and not angled.



6. Use a 27mm wrench to hold the tool body in place.
7. Use a 19mm wrench to turn the bolt.

⚠ CAUTION

Turn the bolt slowly to avoid damage to the cutting pin.

8. Turn the bolt until the pin has been pressed out of the link.
9. Remove the tool from the chain.
10. Repeat procedure for remaining pin.

8

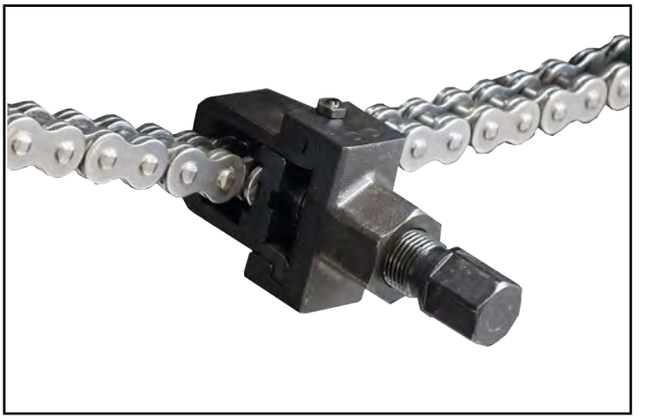
DRIVE CHAIN MASTER LINK INSTALLATION

To watch a video of this procedure, scan the QR code or click **HERE**

1. With the supplied lubricant, lubricate the X-rings as well as the pins on the *NEW* Master link
2. Install two X-rings onto the new master link.
3. Line up the chain and install the master link.
4. Install the two remaining X-rings.
5. Install the outer plate.
6. Install the U-shaped holder so the pin heads on the master link align with the dimples.
7. Install the riveting pin into the tool body.

8. Install the tool body onto the U-shaped holder and place into **Position "A"**.

9. Install the plate holder between the tool body and the outer plate.



10. Use a 27 mm wrench to hold the tool body.
11. Use a 19 mm wrench to press the outer plate onto the master link
12. Turn the bolt until it stops.
13. Loosen and remove tool and the plate holder.

14. Ensure the outer plate is straight by placing the plate holder onto the new master link and a link to the left and right

IMPORTANT
Ensure the new link is not stiff and can move freely.

Pin Head Flaring

1. Install the U-shaped holder so the pin heads on the master link align with the dimples.
2. Install the tool body onto the U-shaped holder and place into **Position "B"**.

3. Turn the bolt until the riveting pin contacts the pin head.

⚠ CAUTION

Ensure the riveting pin is lined up with the center of the pin head and not angled.

4. Use a 27 mm wrench to hold the tool body.
5. Use a 19 mm wrench to press the riveting pin into the pin head.
6. Turn the bolt until it stops.
7. Loosen and remove tool.
8. Check the flare of the pin head by placing the riveting pin onto the pin head. If the riveting pin can make contact with the surface of the outer plate, then the riveting is complete.

9. Repeat the for the remaining pin head.

IMPORTANT

Ensure the new link is not stiff and can move freely.

DRIVE CHAIN INSPECTION

NOTICE

Inspect drive chain in accordance with Periodic Maintenance Interval Chart and replace at specified intervals regardless of chain condition. See **Maintenance Intervals page 2.4**.

1. Periodically inspect drive chain for excessive wear, foreign substance (oil, grit), or any other damage.
2. If any damage is found, chain should be replaced.

NOTICE

Adjust drive chain tension at intervals in accordance with the Periodic Maintenance Interval Chart. See **Maintenance Intervals page 2.4**.

3. If the drive chain or sprocket is being replaced due to damage, replace chain and both sprockets as a set if drive system has more than 5000 miles (8000 Km) of use.

DRIVE CHAIN REPLACEMENT

1. Remove master link. See **Drive Chain Master Link Removal page 8.70**.
2. Use a zip tie to connect the old chain to the new chain.
3. With the unit in neutral, pull the drive chain from the bottom until the new chain is through.
4. Cut the zip tie and discard the old chain.
5. Trim any extra links with the drive chain tool in the same manner as step 1.
6. Install a new master link. See **Drive Chain Master Link Installation page 8.72**.
7. Adjust the drive chain. See **Drive Chain Adjustment page 8.75**.

DRIVE CHAIN ADJUSTMENT

Lubricate the drive chain with Indian Motorcycle chain spray lube or an approved chain lube at the interval specified in the Periodic Maintenance Chart. Lubricate more often under severe use, such as dirty or wet conditions.

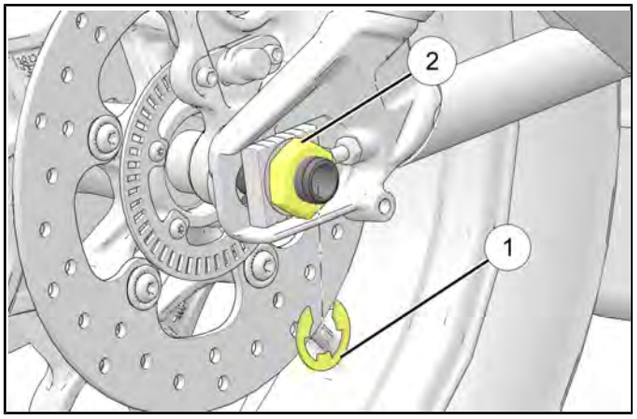
IMPORTANT

Washing the drive chain with a high pressure washer or solvents can cause premature wear and chain failure. Do not use a high pressure washer or gasoline to clean the drive chain. Operating the motorcycle with improper rear drive chain deflection can result in severe damage to the transmission and drive components. Always make sure the chain adjusted within the stated specifications.

⚠ WARNING

A rear axle not in alignment can cause drive line noise and damage the drive chain, causing possible chain failure and loss of control of the motorcycle.

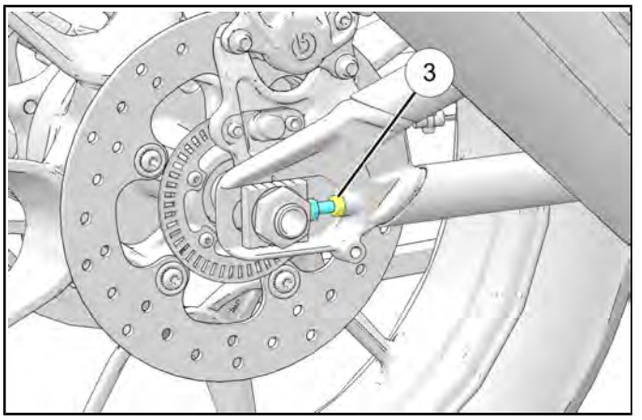
1. Remove e-clip ① and loosen the axle nut ②.



NOTICE

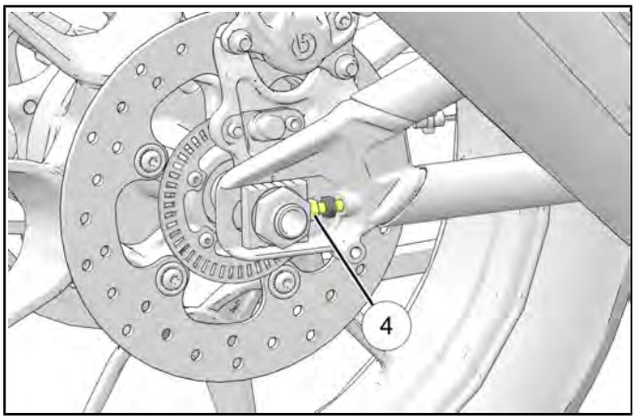
e-clip only applies to 2019–20 models. Newer models have a different design and do not use the e-clip.

2. Loosen both tension bolt jam nuts ③.

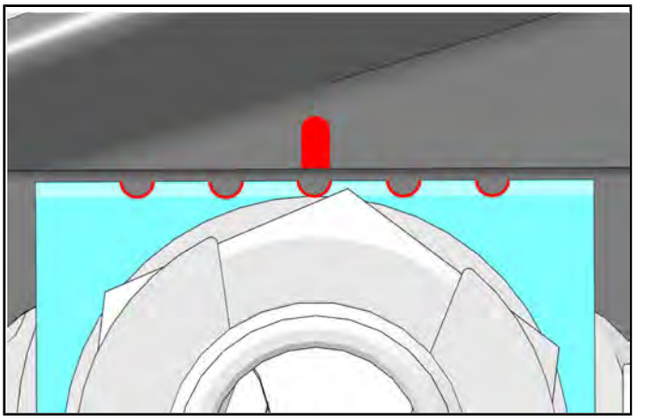


3. Adjust the tension bolts ④ evenly until correct tension is achieved. Reference **Drive Chain Tension page 8.9**.

IMPORTANT
To minimize change in chain tension, use RIGHT SIDE adjuster only to make final adjustments to chain alignment. Be sure to keep axle seated forward against axle adjusters during this procedure.



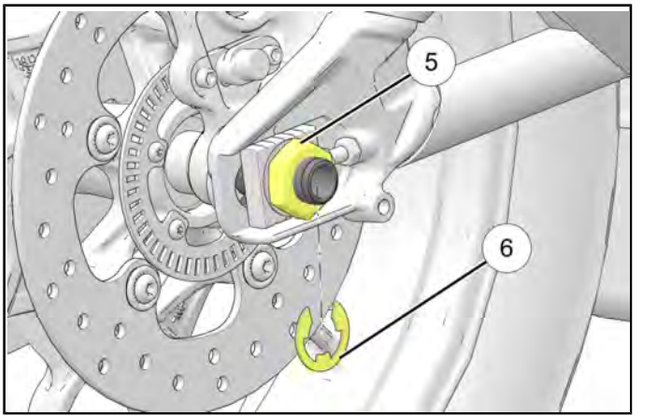
4. Use the adjuster marks to ensure even axle alignment.



5. Without moving the tension bolts, Tighten jam nuts. Ensure the axle is pushed forward against the adjuster bolts.

TORQUE
Swingarm Jam Nut: **12 ft-lbs (16 N·m)**

6. Recheck chain tension and adjust accordingly.
7. Install axle nut ⑤.



NOTICE
e-clip only applies to 2019–20 models. Newer models have a different design and do not use the e-clip.

TORQUE
Axle Nut (Rear): **92 ft-lbs (125 N·m)**

8. Install e-clip ⑥.

SPROCKET INSPECTION

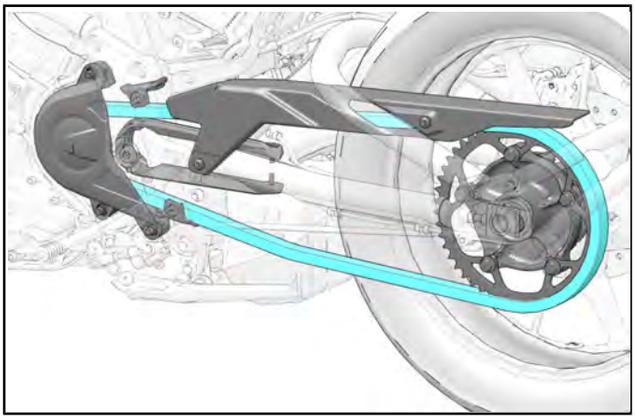
NOTICE
Drive chain and sprocket service life are maximized and drive line noise minimized by proper cleaning. Cleaning interval is approximately every tire change, or more often if operated in dirty, dusty, or high debris environments.

Clean the chain using a chain brush or clean rag to remove any dirt or grit. The chain must be lubricated using Indian Motorcycle chain lube (2884172). See **Maintenance Intervals page 2.4**

⚠ CAUTION
Always have the motorcycle off and the transmission in neutral when performing this procedure.

⚠ CAUTION
Do not use a de-greaser to clean the chain. De-greaser may damage the chain o-rings and cause premature wear.

1. Inspect front and rear sprocket teeth for wear or damage from foreign material.



2. Closely inspect drive chain condition.

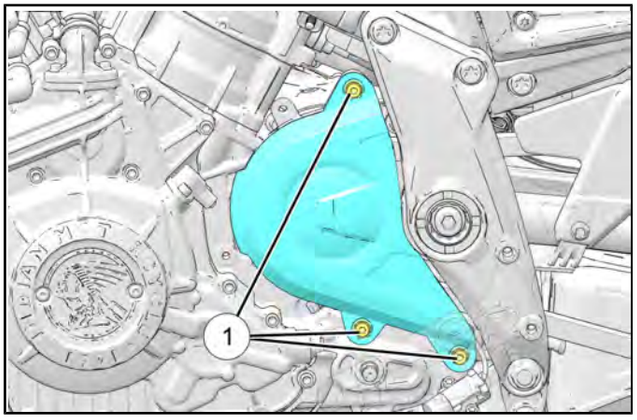
Things to look for:

- wear pattern - ensure even wear throughout sprocket
- cracks
- missing teeth
- uniform teeth size

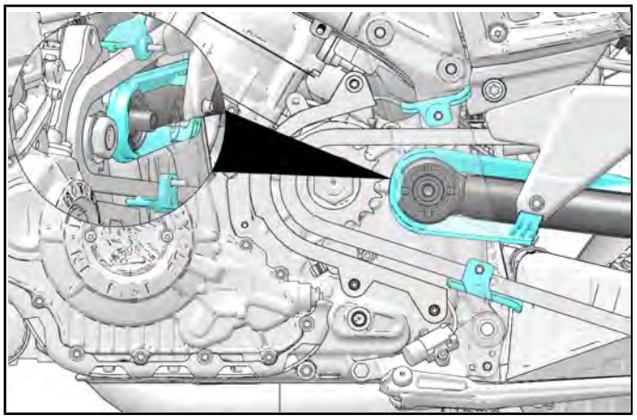
DRIVE CHAIN SLIDER INSPECTION

Drive chain sliders need to be inspected roughly every 5000 miles.

1. Remove three fasteners ① securing sprocket cover.



2. Using a flashlight and inspection mirror, ensure each slider is intact and secured to the vehicle. Verify that there is no excessive wear or damage. If damage or excessive wear is identified, replace the chain sliders as a set. See **Drive Chain Slider Replacement page 8.78**.



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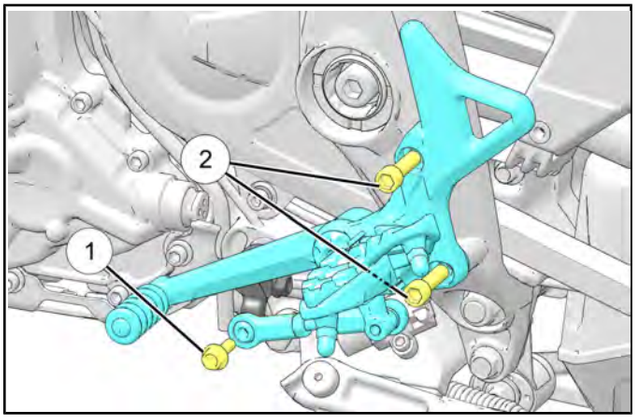
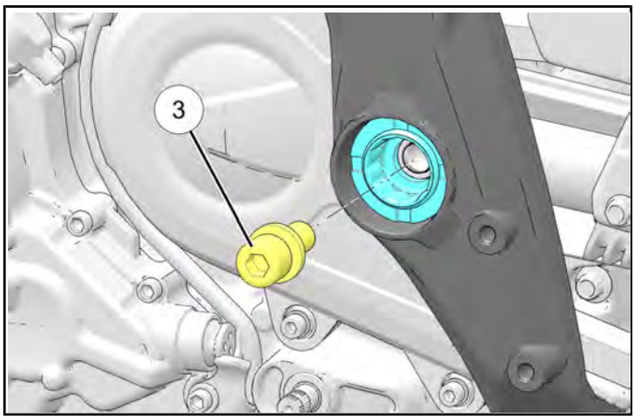
DRIVE CHAIN SLIDER REPLACEMENT

Mid Frame Chain Slider(s)

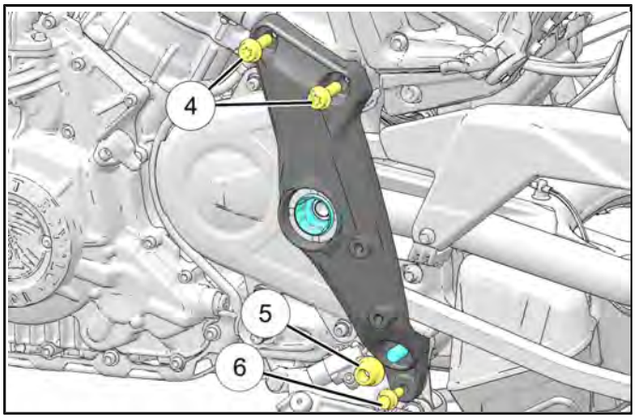
1. Place the front wheel of the unit into a wheel chock.
2. Remove shift linkage fastener ①.



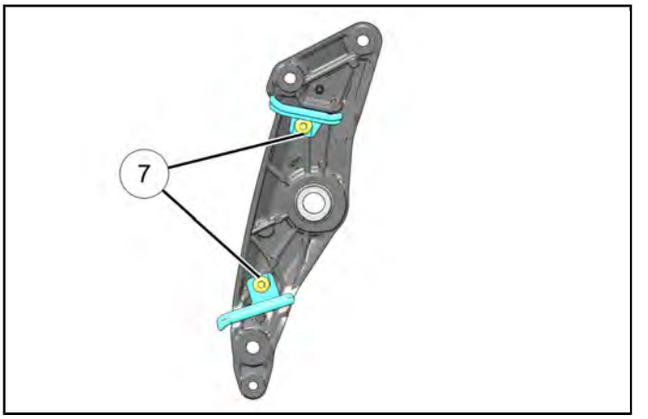
3. Remove two foot control fasteners ②.
4. Remove swingarm pivot bolt ③ and washer.



5. Remove mid frame fasteners ④.



6. Remove mid frame through bolt nut ⑤.
7. Remove resonator fastener ⑥.
8. Remove mid frame.
9. Remove chain slider fasteners ⑦ on the backside of the mid frame.



10. **Installation is performed by reversing the removal procedure.**

TORQUE
Chain Slider Fastener: **88 in-lbs (10 N·m)**

TORQUE
Engine Mount Fastener (Rear Lower): **51 ft-lbs (69 N·m)**

TORQUE
Resonator Fastener: **16 ft-lbs (21 N·m)**

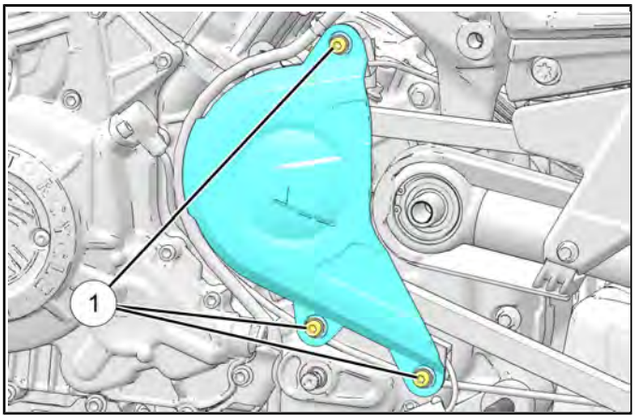
TORQUE
Swingarm Pivot Bolt: **52 ft-lbs (70 N·m)**

TORQUE
Footpeg Bracket Fasteners (driver): **17 ft-lbs (23 N·m)**

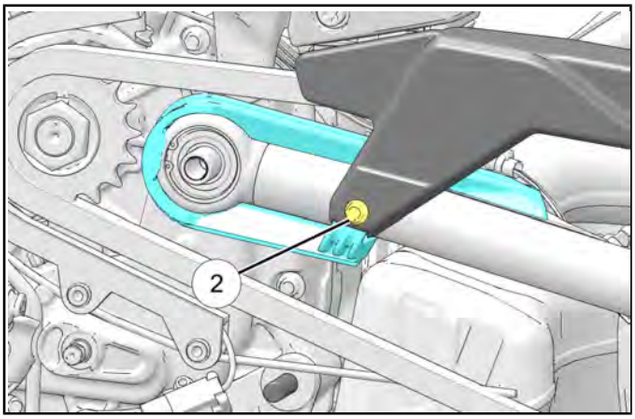
TORQUE
Shift Linkage Fastener: **88 in-lbs (10 N·m)**

Swingarm chain slider replacement

1. Remove three fasteners ① securing sprocket cover.



2. Remove chain guard ②



3. The swingarm chain slider is formed around the swing arm and requires some force to remove. To watch a video of this step, scan the QR code or click **HERE**.

4. **Installation is performed by reversing the removal procedure.**

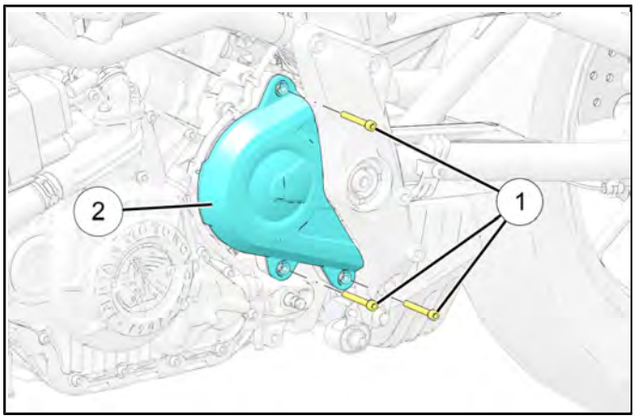
TORQUE
Chain Guard Fastener: **88 in-lbs (10 N·m)**

TORQUE
Drive Sprocket Cover Fasteners: **88 in-lbs (10 N·m)**

DRIVE SPROCKET SERVICE

DRIVE SPROCKET COVER REMOVAL / INSTALLATION

1. Remove bolts ① and drive sprocket cover ②.

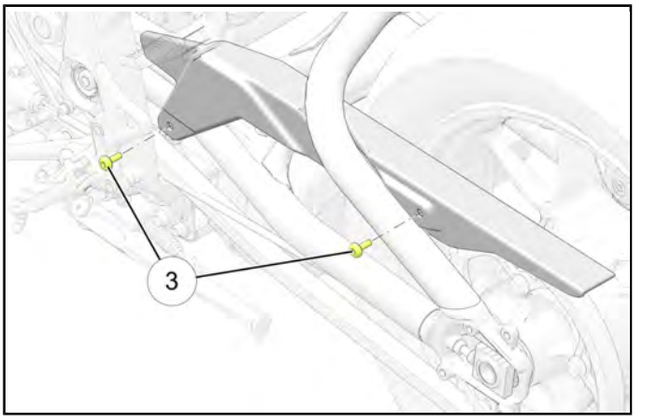


2. To install the drive sprocket cover, reverse the removal procedure.
3. Torque drive sprocket cover fasteners to specification.

TORQUE
Drive Sprocket Cover Fasteners: **88 in-lbs (10 N·m)**

CHAIN GUARD REMOVAL / INSTALLATION

1. Remove fasteners ③ chain guard.



2. To install the chain guard, reverse the removal procedure.
3. Torque chain guard fasteners to specification.

TORQUE
Chain Guard Fasteners: **88 in-lbs (10 N·m)**

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

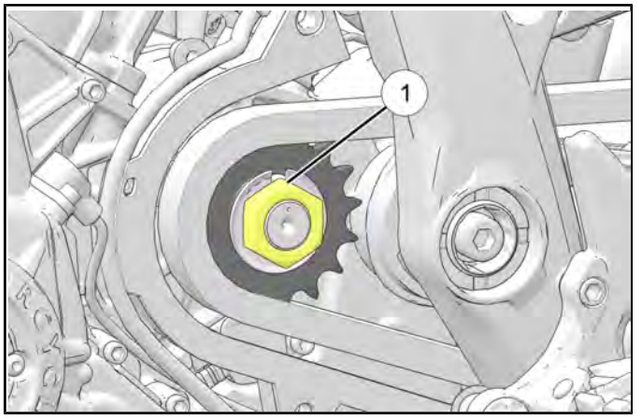
DRIVE SPROCKET REMOVAL

1. Place motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Remove the drive sprocket cover. See **Drive Sprocket Cover Removal / Installation page 8.80**.
3. Remove chain guard. See **Chain Guard Removal / Installation page 8.80**.
4. Use a punch to flatten out the folded end of the drive sprocket locking washer.

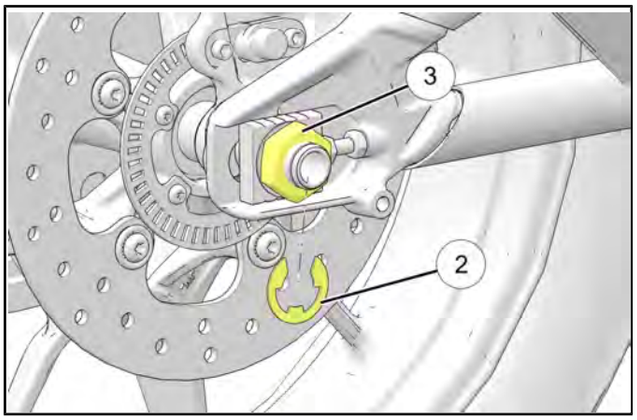
⚠ CAUTION

Use caution while flattening locking washer to prevent damage to sprocket nut.

5. With the motorcycle in gear, loosen the drive sprocket nut ①.



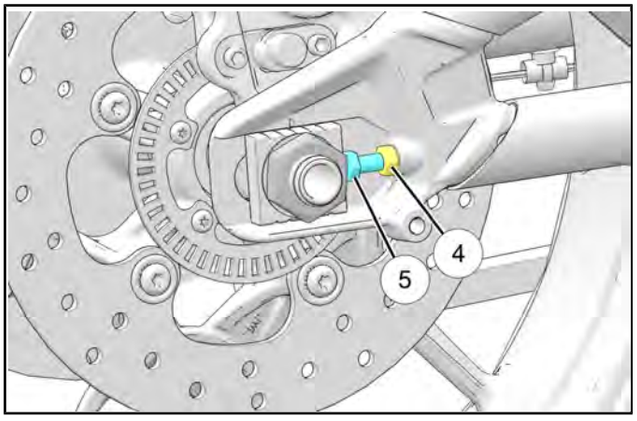
6. Remove E-Clip ② and loosen rear axle nut ③ so the wheel assembly can be moved forward.



NOTICE

e-clip only applies to 2019–20 models. Newer models have a different design and do not use the e-clip.

7. Loosen both axle adjuster lock nuts ④.



8

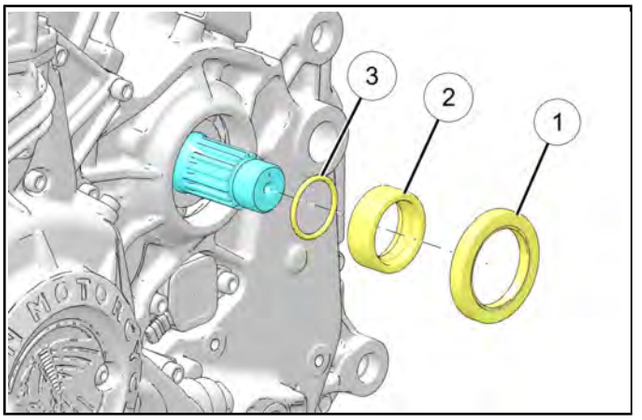
8. Tighten both axle adjusters ⑤ evenly until chain is loose.
9. Remove chain off drive sprocket.
10. Remove Sprocket and lock washer.

OUTPUT SHAFT SEAL REPLACEMENT

REMOVAL

IMPORTANT
If replacing the output shaft seal, it will be necessary to use the Output Shaft Seal Tool **(PF-51243)** for proper installation.

1. Remove the drive sprocket. See Drive Sprocket Removal page 8.81
2. Remove Seal ①, spacer ②, and O-ring ③ from the output shaft.

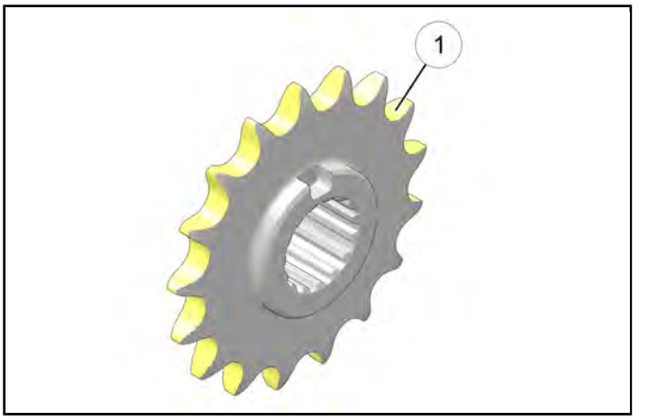


INSTALLATION

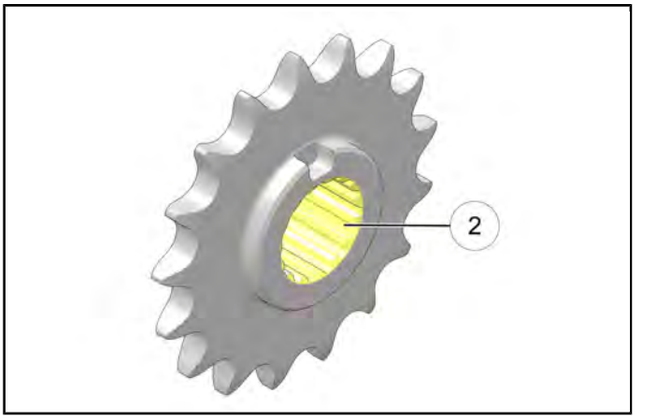
1. **Installation is performed by reversing the removal procedure.**
2. **Drive Sprocket Installation page 8.83**

DRIVE SPROCKET INSPECTION

1. Visually inspect sprocket teeth ① for excessive wear and damage.



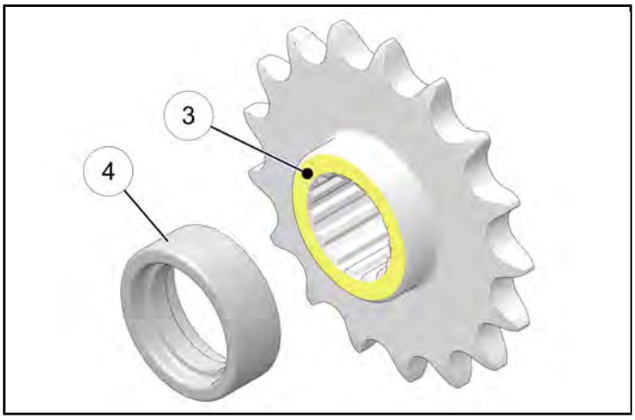
2. Inspect splines ② for a tight fit on output shaft splines.



3. Inspect the back surface of sprocket hub ③ where it contacts the seal sleeve. Replace if worn or if surface is rough.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

4. Inspect the machined sealing surface of the spacer sleeve ④. Replace the spacer sleeve if it is grooved or otherwise damaged.



5. Sprockets and chain normally exhibit a polished appearance due to normal operation. Chain replacement is not required unless uncharacteristic damage is noted, or if the mileage service interval is reached. Chain or sprocket damage is usually due to debris trapped between chain and sprocket, or from improper maintenance and adjustment.

DRIVE SPROCKET INSTALLATION

1. Install the drive sprocket and a *new* lock washer.
2. Hand tighten the sprocket nut.
3. Install the chain over the drive sprocket.
4. Adjust drive chain. See **Drive Chain Adjustment page 8.75**
5. Tighten the sprocket nut.

TORQUE
Drive Sprocket Nut: **133 ft-lbs (180 N·m)**

6. Install the drive sprocket cover.

TORQUE
Drive Sprocket Cover Fasteners: **88 in-lbs (10 N·m)**

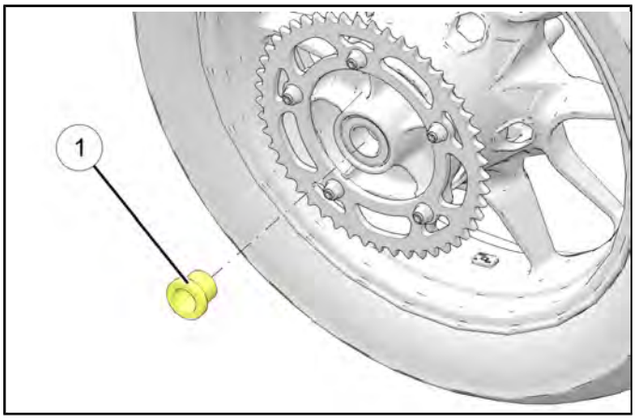
DRIVEN SPROCKET SERVICE

DRIVEN SPROCKET REMOVAL

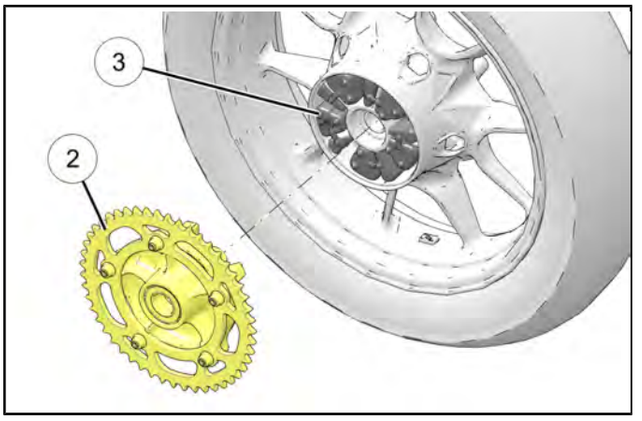
⚠ CAUTION

Protect brake disc surface while working on wheel.

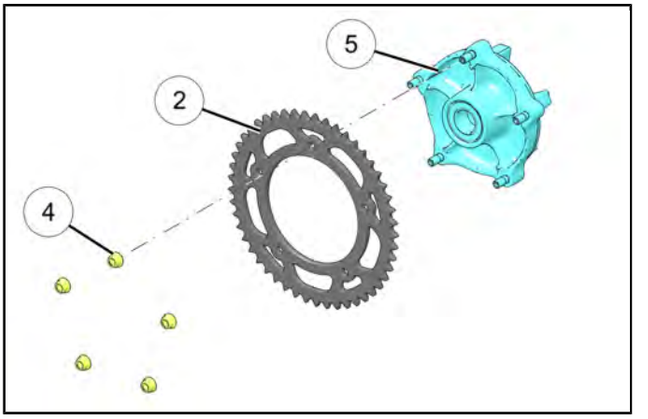
1. Remove rear wheel. See **Rear Wheel Removal / Installation page 8.87**.
2. Remove the Left-Hand wheel spacer ① from the driven sprocket roller bearing.



3. Lift the driven sprocket assembly ② off of the drive damper ③.



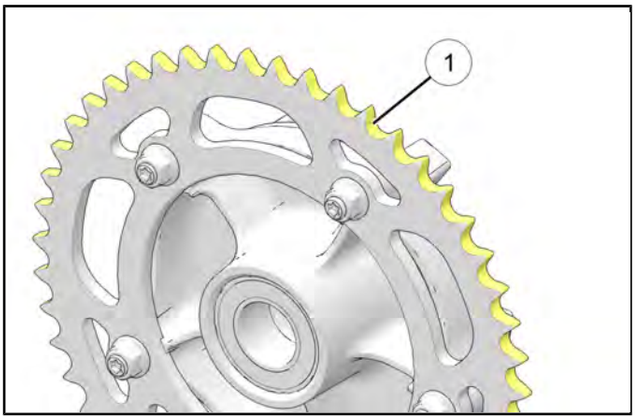
4. Remove sprocket fasteners ④ securing the driven sprocket ② to the sprocket carrier ⑤.



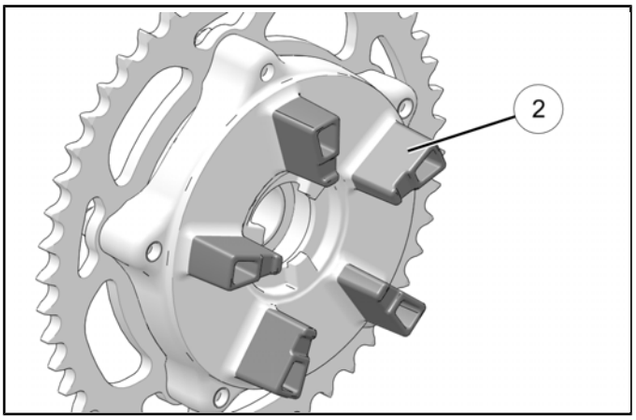
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

DRIVEN SPROCKET INSPECTION

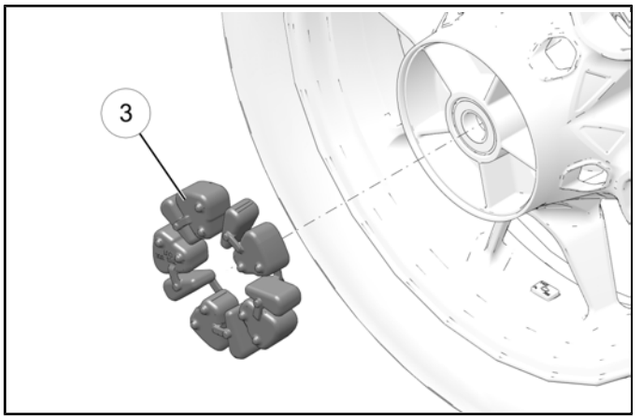
1. Visually inspect sprocket teeth ① for excessive wear and damage from foreign material or road debris.



2. Inspect the back side of the sprocket where it engages the damper ② for wear, galling or roughness. Surface must be smooth, with no burrs or surface irregularities.



3. Visually inspect the cushion drive damper ③ for cracks or deformation. Replace damper if damage is found.

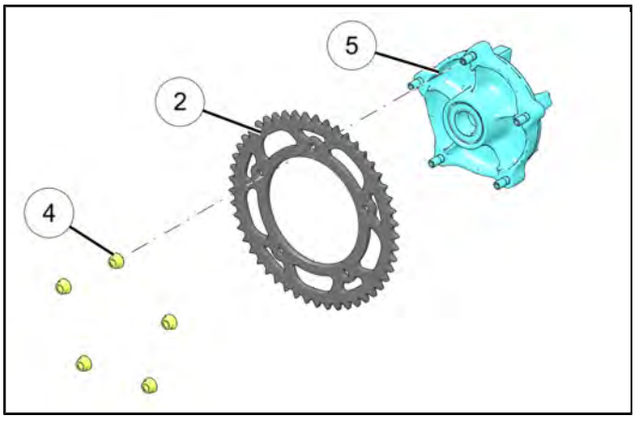


IMPORTANT

If the drive system has been in service for 5000 miles or more, replace both front and rear sprockets along with the chain if any one item is damaged or worn beyond a normal polished appearance.

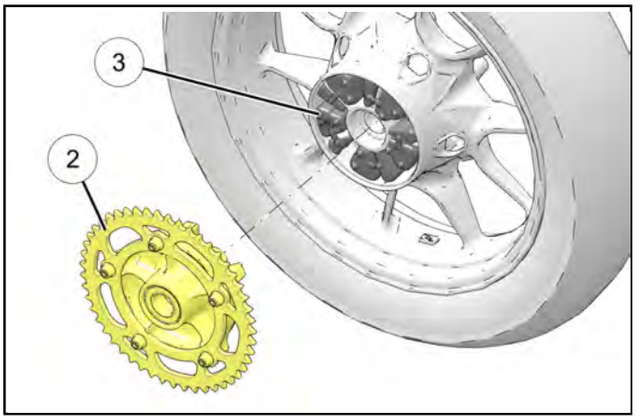
DRIVEN SPROCKET INSTALLATION

1. Install the sprocket ② onto the sprocket carrier ⑤ and secure with fasteners ④.

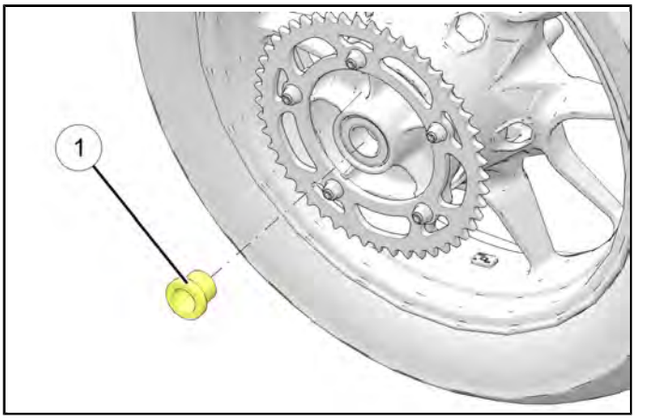


TORQUE
Driven Sprocket Fasteners: **59 ft-lbs (80 N·m)**

2. Install cushion damper ③ into wheel hub.
3. Install sprocket assembly ② onto wheel hub making sure the cushion damper is properly engaged.



4. Install the Left-Hand wheel spacer ① into the sprocket roller bearing.



REAR WHEEL SERVICE

REAR WHEEL REMOVAL / INSTALLATION

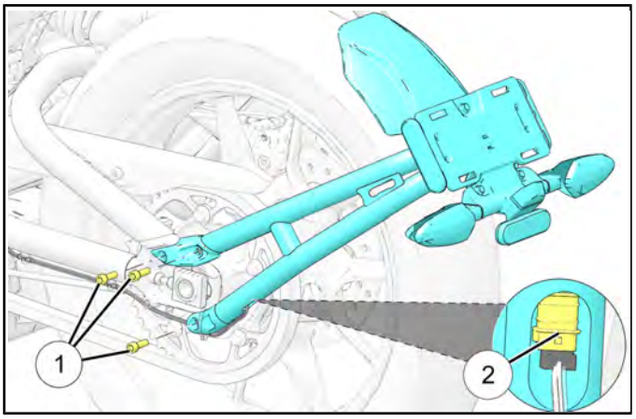
⚠ WARNING

Rear wheel removal involves supporting the machine with the rear end elevated. Take precautions so that the motorcycle is securely supported when the rear tire is off the ground. Severe personal injury or death can occur if the motorcycle tips or falls.

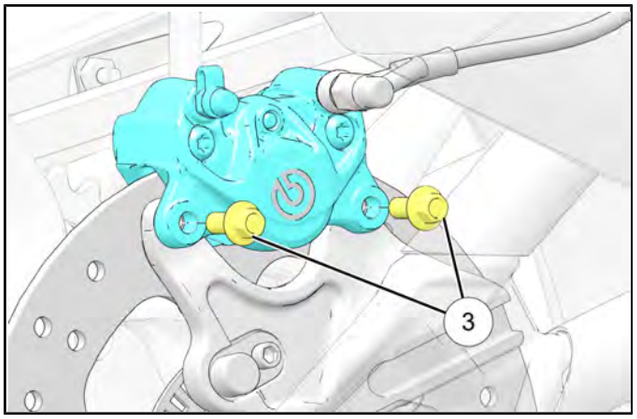
⚠ WARNING

Make sure the motorcycle has cooled to room temperature before attempting procedure.

1. Place the motorcycle in an upright position on a lift table with the front wheel clamped in a wheel vise.
2. Position a platform jack beneath the engine cases and raise until the rear tire is barely in contact with the ground.
3. Remove three fasteners ① securing rear fender arm.



4. Disconnect license plate electrical connector ②
5. Remove two caliper mounting bolts ③ and remove caliper.



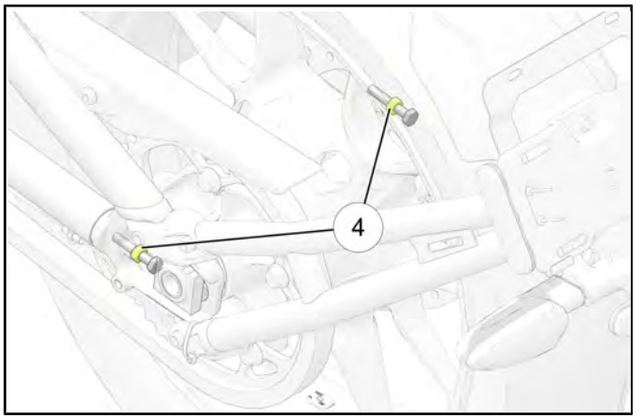
⚠ CAUTION

Do not hang rear brake caliper from the brake line. Do not twist the brake line or damage may result.

IMPORTANT

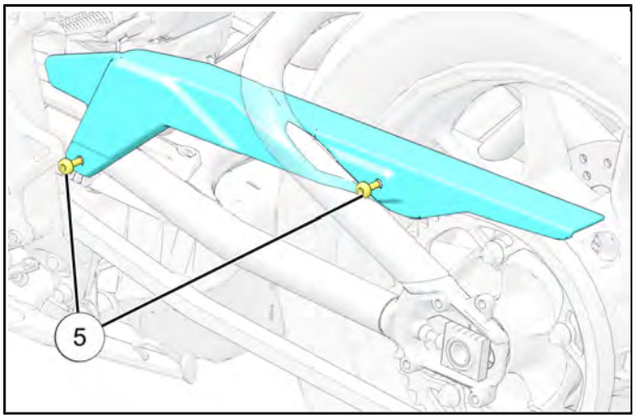
Do not apply rear brake pedal after the brake caliper has been removed.

6. Loosen right and left adjuster lock nuts ④ and adjusters.

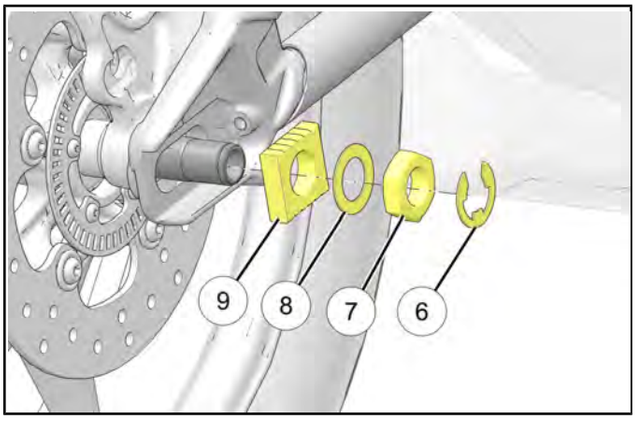


8

7. Remove chain guard by removing its fasteners ⑤.



8. Remove E-clip ⑥, rear axle nut ⑦ , washer ⑧ and axle plate adjuster ⑨ from side of swingarm.



NOTICE

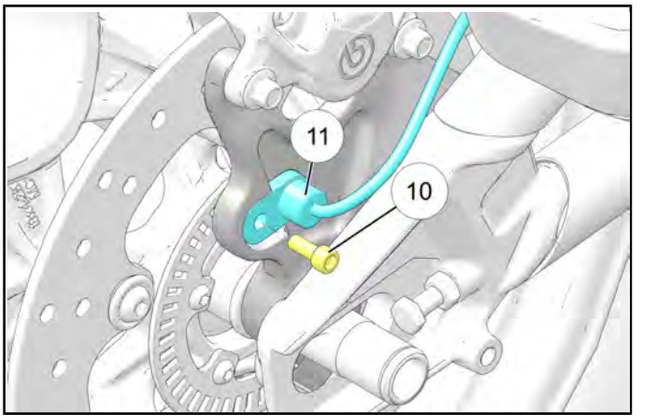
Make note of alignment marks of the swingarm with the axle plate adjuster ⑨.

9. Push wheel forward and slide drive chain to the LEFT side off of the rear sprocket.

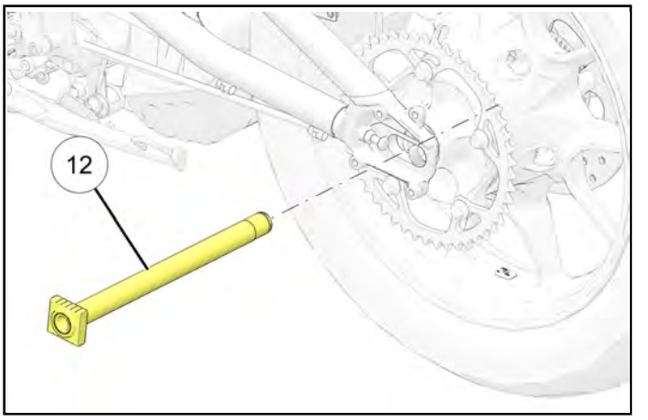
10. Move wheel rearward to gain access to remove wheel speed sensor mounting bolt ⑩ and sensor ⑪.

NOTICE

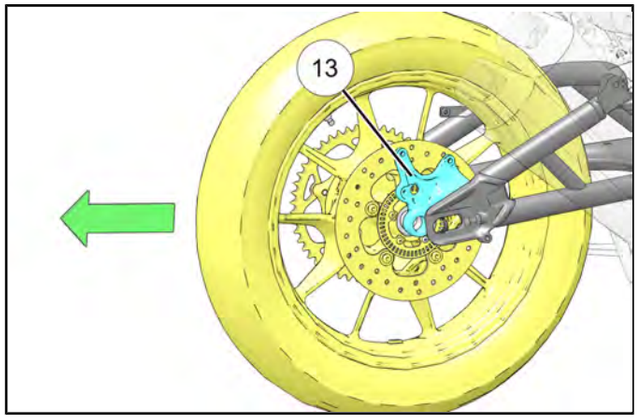
Pay attention to the number of washers between the sensor and the bracket for reinstallation.



11. Loosely install nut ⑥ onto axle and tap nut to start pushing axle out other side. Remove nut, slightly lift wheel and remove axle ⑨ from swingarm.



12. Remove rear wheel assembly by sliding it to the rear of the motorcycle.



13. Upon rear wheel removal, remove torque bracket ⑬ from the notch in the swingarm.
14. **Installation is performed by reversing the removal procedure.**
15. Install the torque bracket on to swingarm notch.
16. Torque fasteners to specification.

TORQUE
Axle Nut (rear): **92 ft-lbs (125 N·m)**

TORQUE
Wheel Speed Sensor Fastener: **88 in-lbs (10 N·m)**

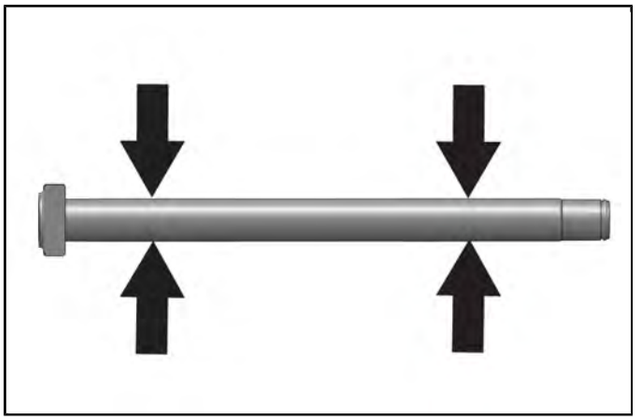
TORQUE
Caliper Mounting Fasteners (rear): **18 ft-lbs (24 N·m)**

TORQUE
Rear Fender Arm Fasteners: **30 ft-lbs (41 N·m)**

Set drive chain tension and alignment. See **Drive Chain Tension page 8.9** and **Drive Chain Adjustment page 8.75**.

REAR AXLE INSPECTION

1. Install rear axle in V-blocks and measure runout and compare to service limit. See **Service Specifications - Rear Wheel & Suspension page 8.59**.
2. Axle diameter should be measured on bearing surfaces.



Axle Diameter : 0.983–0.984 inches (24.965–24.991 mm)

REAR WHEEL INSPECTION

IMPORTANT
Wheel bearings must be in good condition.

1. Set up a dial indicator to measure axial and radial runout of the wheel and compare to service limit. See **Visual Inspection / Runout page 8.109**.
2. Visually inspect wheel for cracks or other damage.
3. Replace wheel if it fails visual or measured inspection.

REAR WHEEL BEARING INSPECTION

IMPORTANT

If possible, also inspect wheel bearings before removing the wheel from the vehicle. Do not remove bearings from wheel to inspect. Bearings cannot be repacked. Replace both bearings if one or both fail inspection, or if either bearing was removed.

1. Visually inspect integral bearing seal for damage.
2. Inspect bearing fit in wheel hub. The outer race of the bearing must fit tightly into the bore. You should not be able to move outer race by hand.
3. Slide axle into wheel and check for smooth rotation and tight fit.

IMPORTANT

Due to extremely close tolerances, the bearings must be inspected visually, and by feel. Look for signs of discoloration, scoring, galling, or contamination from moisture or dirt. Replace bearings if any of the above are present. Turn the inner race of the bearings. The bearings should turn smoothly and quietly. The inner race should be firm with minimal side to side movement and no detectable up and down movement.

WHEEL BEARING REPLACEMENT

⚠ CAUTION

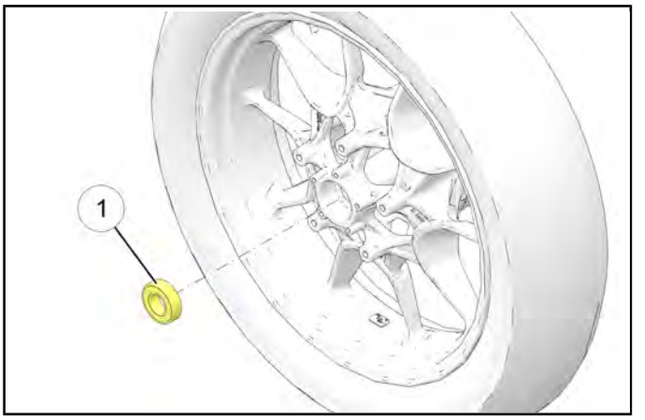
Do not reuse bearings that have been removed.

IMPORTANT

This procedure requires the Wheel Bearing Removal / Installation Kit **(PF-51324)**. Refer to special tool manufacturer instructions for proper use of tool.

REMOVAL

1. Remove rear wheel. See **Rear Wheel Removal / Installation page 8.87**.
2. Remove driven sprocket. See **Driven Sprocket Removal page 8.84**.
3. Remove brake disc. See **Brake Disc Removal / Installation page 8.31**.
4. Carefully pry seal ① out of right-hand side of hub.



5. Refer to special tool manufacturer instructions to remove bearing from brake disc side of hub.
6. Remove bearing.
7. Remove spacer.
8. Extract or drive bearing from sprocket side.

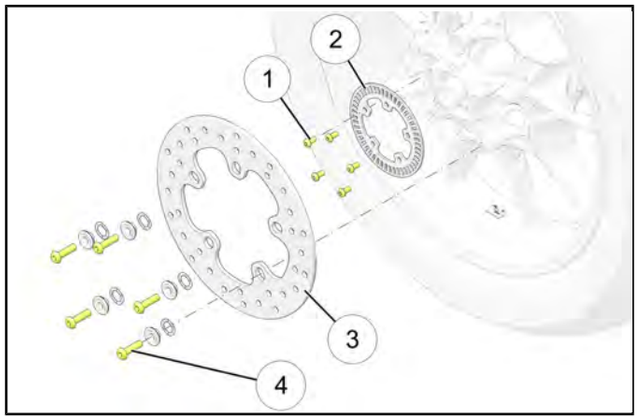
INSTALLATION

1. Use the Wheel Bearing Removal / Installation Kit **PF-51324)** to install new wheel bearings. Refer to special tool manufacturer instructions for proper use of tool.
2. Install new seal into the right-hand side of hub.
3. Install the brake disc. See **Brake Disc Removal / Installation page 8.31**.
4. Install driven sprocket. See **Driven Sprocket Installation page 8.86**.

5. Install the rear wheel. See **Rear Wheel Removal / Installation page 8.87**.

BRAKE DISC REMOVAL / INSTALLATION

1. Remove the rear wheel. See **Rear Wheel Removal / Installation page 8.87**.
2. Remove the driven sprocket and cushion damper. See **Driven Sprocket Removal page 8.84**.
3. Position wheel with brake disc facing up.
4. Remove and discard ABS tone ring fasteners ① and brake disc fasteners ④.
5. Remove the ABS tone ring ② and brake disc ③.



6. **Installation is performed by reversing the removal procedure.**
7. Torque brake disc bolts to specification in a star pattern. Ensure text on the rotor is facing outwards.

TORQUE
Brake Disc Fasteners: **22 ft-lbs (30 N·m)**

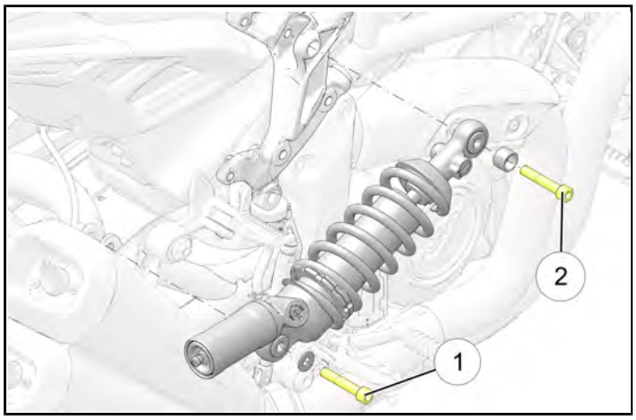
TORQUE
Tone Ring Fasteners: **84 in-lbs (9 N·m)**

SHOCK ABSORBER REMOVAL

⚠ WARNING

Shock absorber removal involves supporting the machine with the rear end elevated. Take precautions so that the motorcycle is securely supported when the rear tire is off the ground. Severe personal injury or death can occur if the motorcycle tips or falls.

- With the rear wheel properly supported, remove the lower shock fastener ① and upper shock fastener ② and remove shock absorber.



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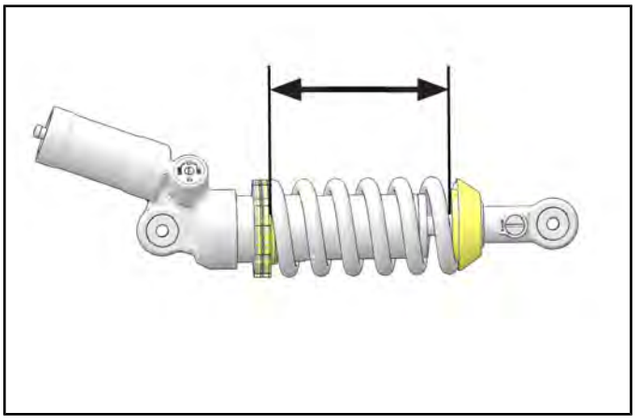
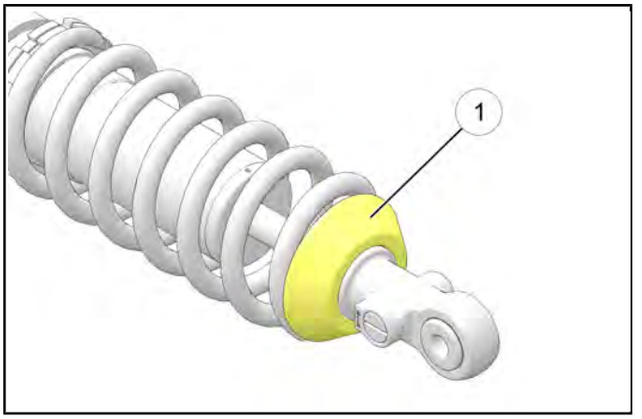
SHOCK ABSORBER INSPECTION

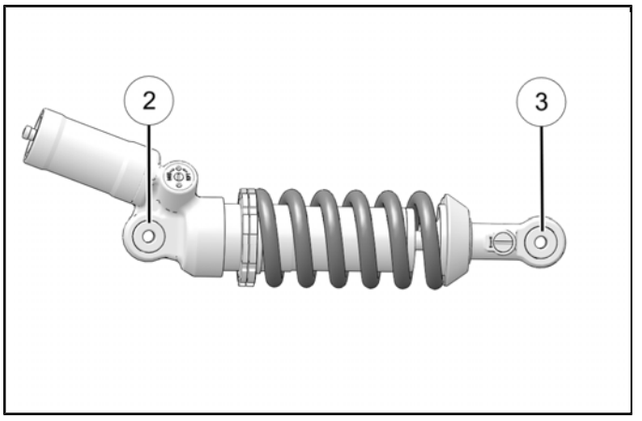
1. Measure spring installed height and record so ride height adjustment can be returned to rider's preference.



2. Using a commercially available spring compressor, compress shock enough to remove cap ① .



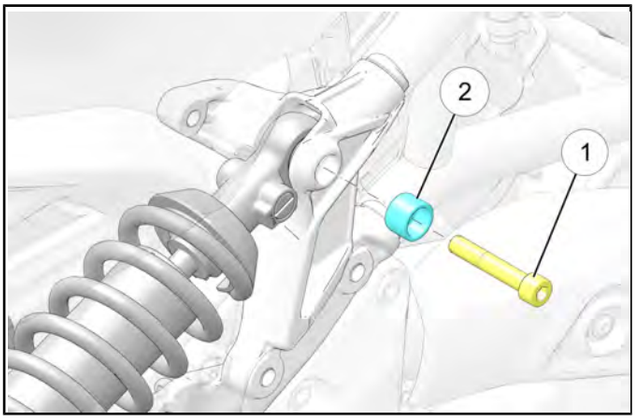
3. Thoroughly clean the shock spring.
4. Inspect eyelets ② and ③ for cracks, damage or loose fitting eyelet. Replace shock if either eyelet is cracked or damaged.



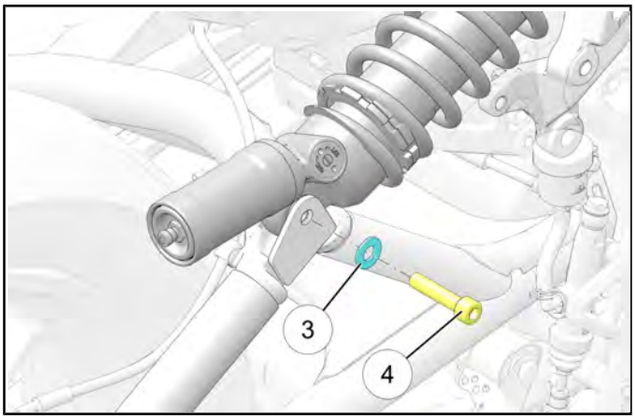
5. With shock upright, move damper rod through entire travel range. Damper rod should move smoothly with consistent damping through the entire travel range, and return to the fully extended position when released.
6. Inspect shock spring for cracks or distortion. Measure free length and compare to specification. See **Service Specifications - Rear Wheel & Suspension page 8.59**.
7. Install spring onto shock body.

SHOCK ABSORBER INSTALLATION

1. Lift shock into position and install bushing ② and tighten top fastener ① finger tight.



2. Install the lower shock washer ③ and tighten bottom fastener ④ finger tight.



3. Torque upper and lower shock fasteners to specification.

TORQUE
Shock Fasteners (upper & lower): **44 ft-lbs (60 N·m)**

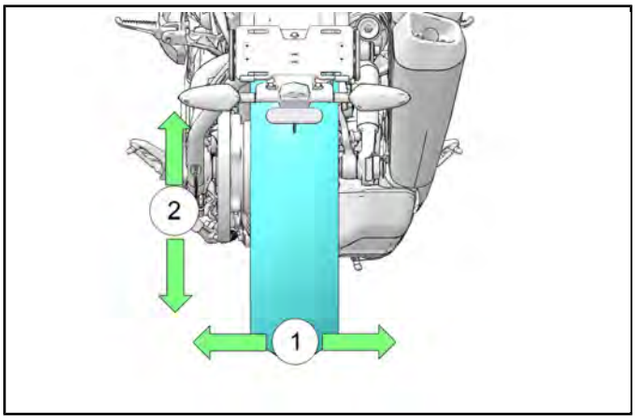
SWINGARM SERVICE

SWINGARM INSPECTION

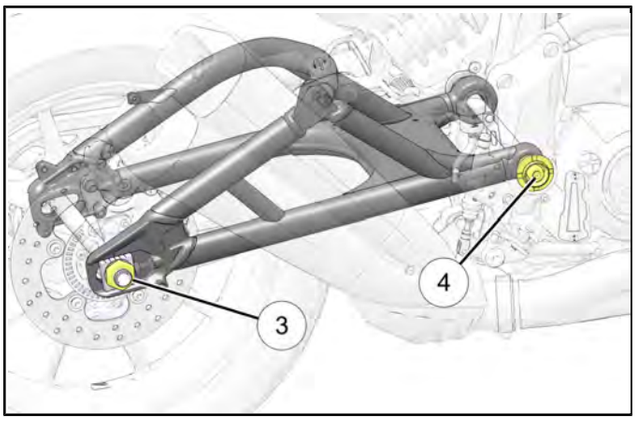
⚠ WARNING

Care should be taken to be sure the motorcycle will not tip or fall while elevated. Severe personal injury or death may occur if the motorcycle tips or falls.

1. Sit astride the motorcycle. Compress the rear suspension several times and check for smooth and quiet operation.
2. Secure motorcycle with rear wheel elevated.
3. Inspect for worn swingarm bearings by grasping the rear wheel and attempting to move wheel side-to-side ① . Inspect for worn bearings and linkages by moving the wheel up and down ②.



4. If movement is detected, determine if movement is at axle area ③ or swingarm pivot area ④. Refer to wheel bearing and swingarm bearing replacement.



5. Rotate rear wheel and inspect for smooth rotation of rear wheel bearings. If roughness or unusual sounds are detected, inspect rear wheel bearings, chaint tension and alignment, and brake pads.
6. Inspect rear shock for leakage and all rear suspension components for damage or loose fasteners.
7. Inspect shock mounts for radial movement in all pivot joints. If a joint has radial movement, remove rear shock absorber and inspect suspension pivots. See Steering / Suspension Chapter.
8. Replace any worn or damaged parts.
9. Verify axle nut is tight.

TORQUE
Axle Nut (Rear): **92 ft-lbs (125 N·m)**

SWINGARM REMOVAL

⚠ WARNING

Swingarm removal involves supporting the machine with the rear end elevated. Take precautions so that the motorcycle is securely supported when the rear tire is off the ground. Severe personal injury or death can occur if the motorcycle tips or falls.

⚠ WARNING

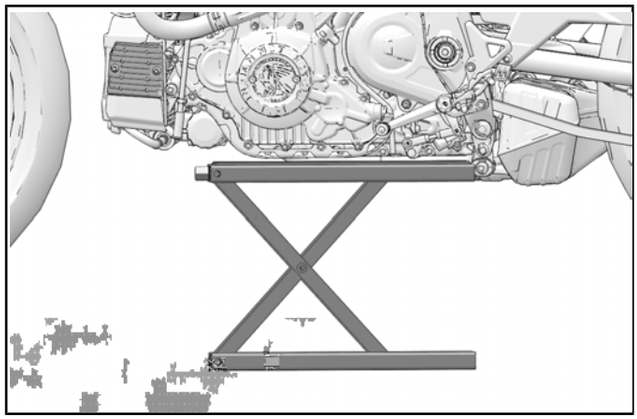
Make sure the exhaust system has cooled to room temperature before elevating the motorcycle.

1. Remove rear brake caliper. See **Rear Caliper Removal page 9.57**
2. Remove driver's foot control. See **Foot Peg (Driver) Removal / Installation page 7.16**
3. Disconnect tail light / turn signal electrical connector.
4. Remove chain guard.
5. Remove sprocket cover.
6. Remove chain. See **Drive Chain Replacement page 8.75**

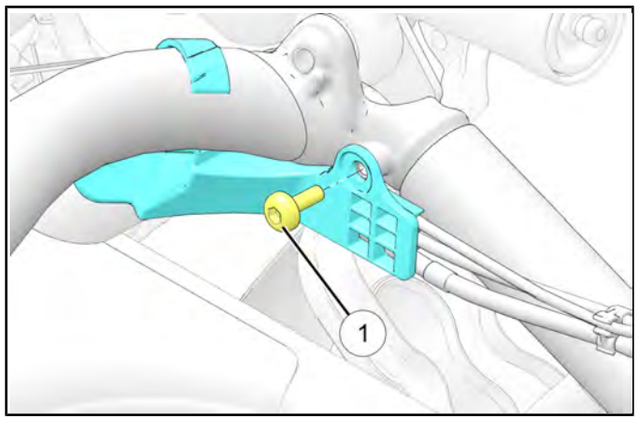
IMPORTANT
Use care not to damage the swingarm.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

7. Position a platform jack beneath the engine cases and raise until it contacts the engine and the rear wheel is off the stand.



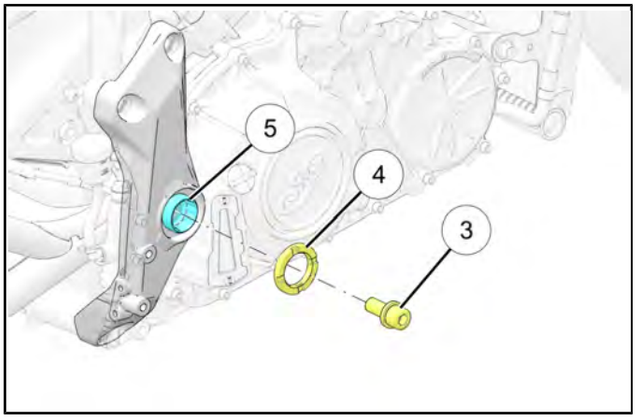
8. Remove rear wheel assembly. See **Rear Wheel Removal / Installation page 8.87**.
9. Remove top shock fastener. See **Shock Absorber Removal page 8.91**.
10. Remove the rear brake hose rear p-clamp bolt ① located on the left inner surface of the swingarm.



NOTICE

2019–20 models used the clip shown above, newer model years use a different style clip.

11. Remove pivot bolt ③ and washer.

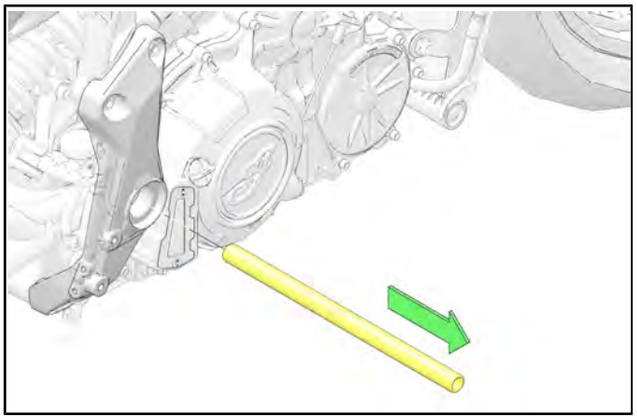


12. Remove lock ring ④ with special tool **PF-52737**.
13. Loose pivot adjuster ⑤ with special tool **PF52738**.

NOTICE

Pivot adjuster does **NOT** need to be removed for swingarm removal.

14. Repeat step 11–13 for remaining side.
15. Remove Christmas tree clips securing tail light wiring to swingarm.
16. Remove the pivot shaft ⑦ .

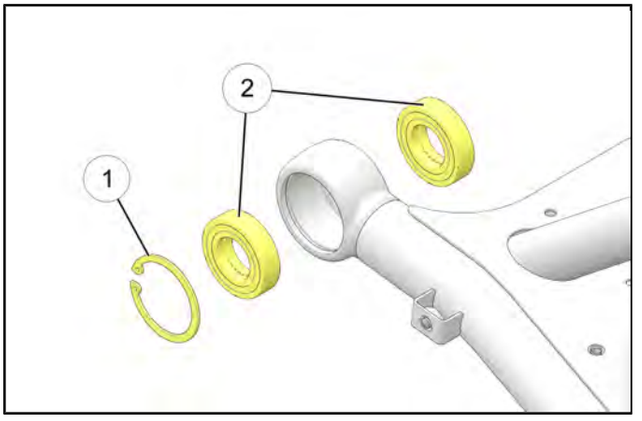


17. Support and remove the swingarm assembly towards the rear of the motorcycle.

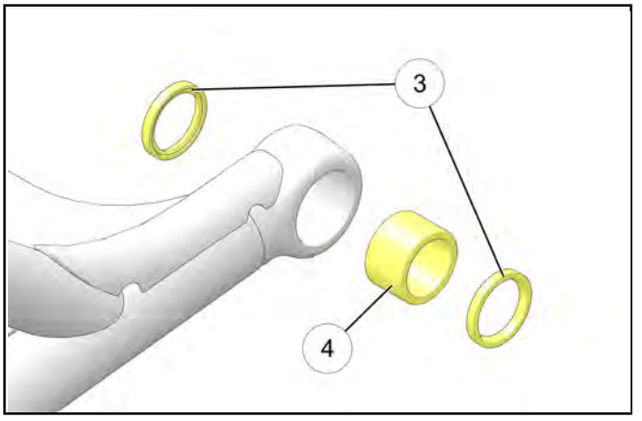
SWINGARM BUSHING / BEARING REPLACEMENT

REMOVAL

1. Remove swingarm assembly from motorcycle. See **Swingarm Removal page 8.94**.
2. Remove shock absorber assembly from swingarm. See **Shock Absorber Removal page 8.91**.
3. Remove the internal snap-ring ① followed by the bearings ② from the Left-Hand side of the swingarm.



4. Working from the Right-Hand side of the swingarm, gently pry the seals ③ out of the bearing bore.



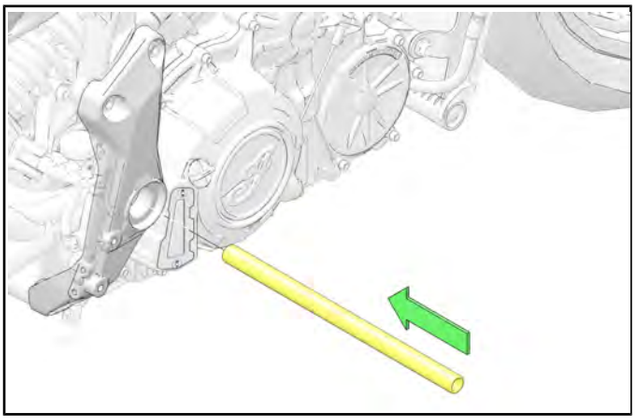
5. Remove needle roller bearing ④.
6. Inspect bearing bores for any galling or damage.

INSTALLATION

1. Working on the Left-Hand side of the swingarm, press or drive *new* bearings ② into the bearing bore using a suitable bearing driver.
2. Install internal snap-ring ①.
3. Using the bearing driver drive a new needle bearing ④ into the Right-Hand side of the swingarm until it is in the middle of the race.
4. Press new *outer* seals ③ into the bearing bore until seated.
5. Install swingarm assembly. See **Swingarm Installation page 8.97**.
6. Install shock absorber assembly. See **Shock Absorber Installation page 8.93**.

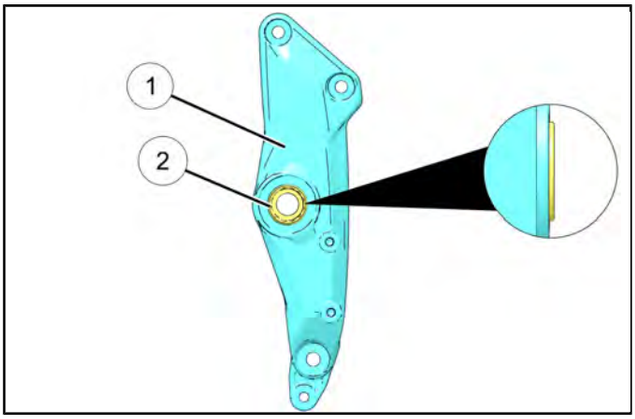
SWINGARM INSTALLATION

1. Install the swingarm onto the unit.
2. Install the pivot shaft.

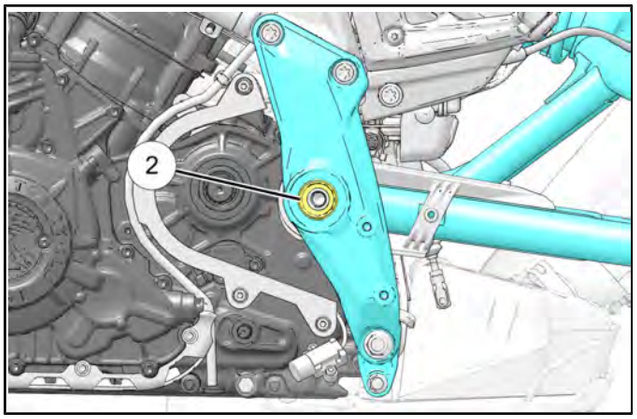


IMPORTANT
Ensure the pivot shaft is protruding from the bushings on both sides.

3. Install Christmas tree clips securing tail light wiring to swingarm.
4. Thread the adjuster ② until flush with the mid frame ①. Repeat step for opposite side.



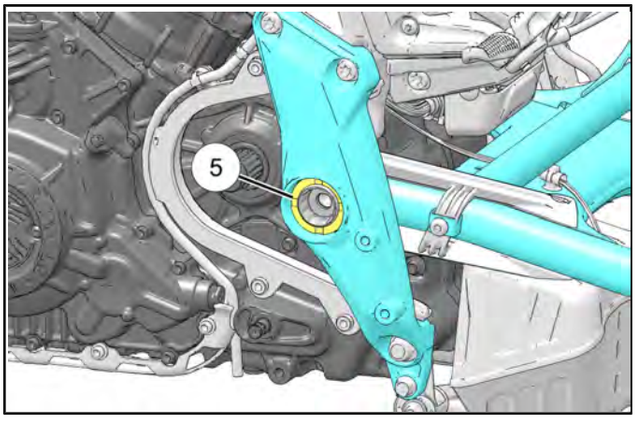
5. Tighten left pivot adjuster ② with special tool **PF-52738**. To watch a video of the swingarm torque procedure, scan the QR code or click **HERE**.



TORQUE
Swingarm Pivot Adjuster: **11 (15 N·m)**

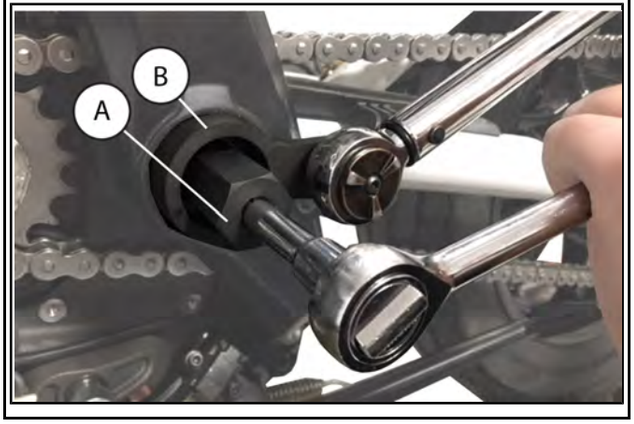
8

6. Install lock ring ⑤ and torque to specification with special tool **PF-52737**.



IMPORTANT

Ensure the adjusters are not turning while torquing by holding the adjuster with special tool **PF–52738** Ⓐ while turning special tool **PF-52737** Ⓑ as shown.



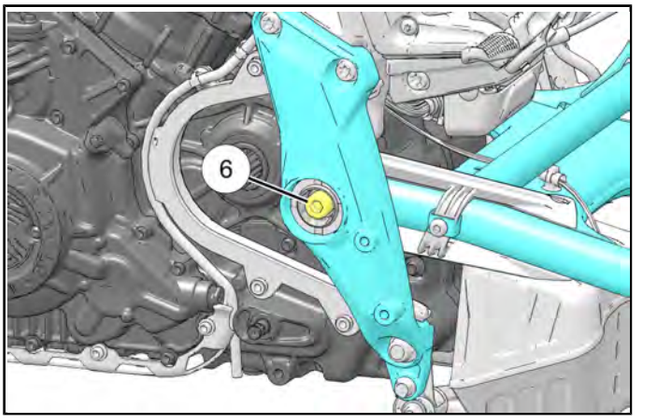
TORQUE

Swingarm Lock Ring:
44 ft-lbs (60 N·m)

7. Install pivot bolt ⑥.

IMPORTANT

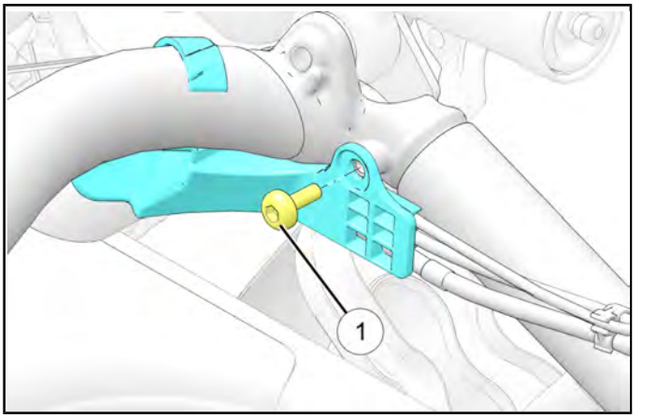
Pivot bolts have to be tightened at the same time, they can **NOT** be torqued separately.



TORQUE

Swingarm Pivot Bolt:
52 ft-lbs (70 N·m)

8. Install the rear brake hose rear p-clamp bolt ①. Torque fastener to specification.



TORQUE

P-Clamp Fastener:
84 in-lbs (9 N·m)

9. Install upper shock fastener.

TORQUE

Shock Fastener (upper):
44 ft-lbs (60 N·m)

10. Install rear wheel. See **Rear Wheel Removal / Installation page 8.87**.
11. Install rear brake caliper. See **Rear Caliper Removal page 9.57**.
12. Connect tail light / turn signal electrical connectors.
13. Install chain and adjust as needed.. See **Drive Chain Adjustment page 8.75**.
14. Install sprocket cover.

TORQUE
Drive Sprocket Cover Fasteners: **88 in-lbs (10 N·m)**

15. Install driver's foot controls. See **Foot Peg (Driver) Removal / Installation page 7.16**

TROUBLESHOOTING REAR WHEEL / SUSPENSION

PROBLEM	POSSIBLE CAUSE	REPAIR RECOMMENDED
Rear Wheel Feels "Loose" or Wobbles	Loose fasteners	Torque to specification
	Distorted (bent) rear wheel	Replace wheel
	Worn or damaged wheel bearings	Replace wheel bearings
	Worn or damaged swingarm bushings.	Replace swingarm bushings
	Damaged or incorrect rear tire	Replace rear tire
	Unbalanced rear wheel assembly	Balance tire/wheel
	Low tire pressure	Inflate to specification
	Loose swingarm, axle or suspension fasteners	Torque to specification
	Shock bushing failure	Replace shock bushings
Rear Suspension Too Hard	Incorrect preload adjustment	Adjust to rider & load
	Damaged or corroded suspension mount bushing	Correct as necessary
	Damaged or corroded swingarm bushings	Replace
	High tire pressure	Deflate to specification
	Drive chain adjustment too tight	Adjust drive chain tension
Rear Suspension Too Soft	Incorrect preload adjustment	Adjust to rider & load
	Damaged shock absorber	Replace shock
	Weak shock spring	Replace shock spring
	Excessive load placed on motorcycle	Reduce load weight
	Low tire pressure	Inflate to specification
Rear Suspension Noisy	Loose fasteners	Torque to specification
	Worn wheel bearings	Replace
	Worn swingarm bushings	Replace
	Damaged shock absorber	Replace as necessary
	Worn shock bushings	Replace shock bushings
Wheel Drags (Turns Hard)	Incorrect drive chain adjustment	Adjust drive chain tension
	Brake problem	Diagnose and Service
	Loose fasteners	Torque to specification
	Bent rear axle	Replace
	Damaged wheel bearings	Replace
	Tire contact with object or chassis	Determine point of contact and correct

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

TROUBLESHOOTING FINAL DRIVE

PROBLEM	POSSIBLE CAUSE	POSSIBLE REPAIR NEEDED
Chain Shows Excessive Wear On One Side	Out-of-Alignment	Align rear wheel
Chain Whine / Noise	Out-of-Alignment Chain Damage Incorrect Chain Tension	Align rear wheel Inspect Chain Adjust Tension
Broken Sprocket Teeth	Foreign material damage / Loose drive chain or sprocket	Replace parts or repair as necessary
Missing or Damaged Rollers on Chain	Foreign material damage / Loose drive chain or sprocket	Replace parts as necessary
Chain Jumps Sprocket Teeth	Worn, damaged or out of adjustment chain or sprockets	Replace parts as necessary
	Chain Loose	Adjust Chain
Excessive Wear, Binding Suspension	Chain Tight	Adjust Chain
Broken Chain	Chain weakened by foreign material damage. Chain run excessively tight or loose.	Replace Chain, Replace Sprockets

TIRES

GENERAL INFORMATION

SERVICE NOTES

⚠ WARNING

The use of tires other than original equipment may cause instability which can lead to a crash resulting in serious injury or death. Use *only* the recommended tires inflated to the recommended tire pressures. Tires other than OEM may or may not adversely affect the handling characteristics of the motorcycle or may not have adequate tire clearance. Operating the motorcycle with damaged rims creates a safety hazard including air pressure loss, steering imbalance and/or reduced steering control. Do not attempt to repair or straighten damaged rims.

⚠ WARNING

Do not attempt to repair tires that have:

- Punctures with a diameter of greater than 6mm (0.240").
- Cuts with a length of greater than 6mm (0.240").
- Any punctures or cuts on the sidewall of the tire.
- Tread depth of less than 1.6mm (.063") for the front tire.
- Tread depth of less than 1.6mm (.063") for the rear tire.
- Ply separation.
- Tread separation.
- Severe tread cupping.
- Cuts, gouges or scratches on the sealing surface of the bead.
- Flat spots on the tread.
- Bubbles, separation or any unusual damage to the inner liner of the tire.
- Chemical sealants or balance additives added to the tire.

⚠ WARNING

All repairs must be made from inside the tire.
No form of temporary repair should ever be attempted. Secondary damage caused by a penetrating object may not be detected and tire or tube deflation may occur at a later date.
When a tire reaches the minimum tread depth listed below, replace the tire immediately.

⚠ CAUTION

Overloading and under-inflation lead to premature tire wear. Do not deviate from the specifications for loading or inflation.

TIRE PRESSURE / SPECIFICATIONS

⚠ WARNING

Indian motorcycles are produced using the designated tires listed below as original equipment. This includes field testing to ensure stability and superior handling. The use of tires other than original equipment may cause instability. See Steering / Suspension Chapter for a review of all tire related warnings.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

1. Inspect tires for weather checking, cuts, imbedded foreign objects, etc.
2. Inspect front and rear wheels for damage.
3. Measure tread depth at center of tread.
4. Measure in 3-4 places equally spaced around the tire and record the smallest measurement.

⚠ WARNING

It is dangerous to ride with a worn tire. When a tire reaches the minimum tread depth listed below, replace the tire immediately.

Tire Pressure Table (Cold)

NOTICE

Also refer to Manufacturing Information label.

Model:	Location:	Type:	Size:	Rim Size:	PSI:	Minimum Tread Depth:
2019-2020: FTR / FTR S	FRONT	Dunlop DT3R Pirelli Scorpion Trail II Pirelli Scorpion Rally STR	120/70R19	3.0 x 19	36 PSI (248 kPa)	1/16 in (1.6 mm)
	REAR	Dunlop DT3R Pirelli Scorpion Trail II Pirelli Scorpion Rally STR	150/70R18	4.25 x 18	40 PSI (276 kPa)	
FTR Rally	FRONT	Pirelli Scorpion Rally STR	120/70R19	3.0 x 19	36 PSI (248 kPa)	1/16 in (1.6 mm)
	REAR	Pirelli Scorpion Rally STR	150/70R18	4.25 x 18	40 PSI (276 kPa)	
2022: FTR / FTR S / FTR R Carbon	FRONT	Metzeler Sportec M9 RR	120/70ZR17	3.5 x 17	36 PSI (248 kPa)	1/16 in (1.6 mm)
	REAR	Metzeler Sportec M9 RR	180/55ZR17	5.5 x 17	40 PSI (276 kPa)	
2023: FTR / FTR S / FTR R Carbon	FRONT	Metzeler Sportec M9 RR	120/70ZR17	FTR S = 3.5 x 1.7 FTR / FTR Carbon = 5.5 x 17	36 PSI (248 kPa)	1/16 in (1.6 mm)

	REAR	Metzeler Sportec M9 RR	180/55ZR17	5.5 x 17	40 PSI (276 kPa)	
2023: FTR Rally	FRONT	Metzeler Sportec M9 RR	120/70R19M/C	3.0 x 19	36 PSI (248 kPa)	1/16 in (1.6 mm)
	REAR	Metzeler Sportec M9 RR	150/70R18M/C	4.25 x 18	40 PSI (276 kPa)	

TIRE INSPECTION

TIRE WEAR PATTERNS

TIRE WEAR PATTERNS

SYMPTOM	POSSIBLE CAUSE
Wear on Left Side	Riding on Crowned Roads
Edges Worn	Under-inflation or Excessive Loads
Excess Wear in the Middle of Tire	Over-inflation or Tire Abuse
Cracks in Tread Grooves	Under-inflation, Excessive Loads, Suspension Bottoming
Tread Block Cupping (Usually Front Tire -See Below)	Normal Braking Wear

OZONE CRACKING

Ozone cracking usually shows up on the sidewalls of tires and is caused by sunlight, electric motor emissions, smog, or other environmental factors. Ozone cracking does not pose a problem unless the cracks reach the cords. If this occurs, moisture may penetrate the carcass of the tire causing cord separation. Tires showing signs of severe ozone cracking (cords visible at the bottom of the cracks) must be replaced.

FRONT TIRE CUPPING

Front of tread block worn more than rear of tread block:

- The cupping of front tires is somewhat normal.
- Rear tires are subjected to forces in both directions. The forces of braking and acceleration result in even tire wear.
- Front tires are subjected only to the forces of braking. When the brakes are applied, tire deflection is increased and wear occurs in only one direction.
- Incorrect tire pressure is the number one cause of excessive tire cupping. Too little tire pressure causes the tire to over-deflect which increases the amount of scrubbing and causes more tire cupping.
- Binding or improperly assembled front forks can also contribute to excessive tire cupping. If the front forks do not react as they should the tire acts as the sole suspension component and tread deflection increases.

TIRE SERVICE

TIRE CHANGING

There are three generally acceptable methods to dismount and mount a motorcycle tire to its rim. For each of the three methods, there are countless variations.

The three general methods are:

- Pneumatic or electrically operated tire machine
- Manually operated tire machine
- Manual manipulation of tire irons

Indian Motorcycle permits and recommends all three of the general methods, but realizes that careless or improper work habits can damage both the tire and rim no matter which method is used. With any of the methods, care must still be taken to avoid damaging the rim, tire, inner tube (if applicable), brake disk, or sprocket.

The pneumatic or electrically operated tire machine is preferred because it is the most efficient method to dismount and mount tires.

The manually operated tire machine is the next preferred method. It can be just as efficient as a power assisted tire machine but with some of the machines it may be necessary to remove the chain driven sprocket in order to gain sufficient clearance for tire removal.

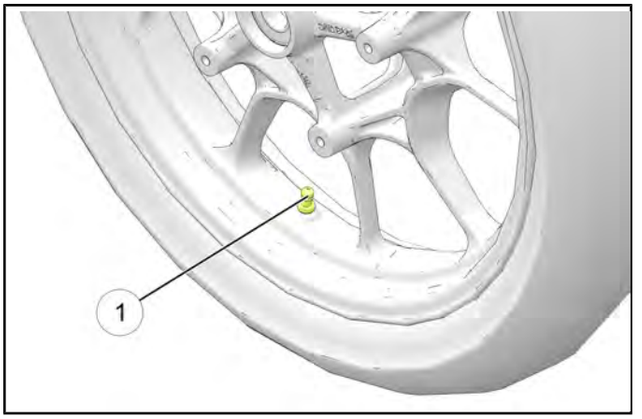
Manual manipulation is the least preferred method since it will generally not deliver the same efficiency as the other methods and greater care needs to be taken when performed. Care must be taken when using tire irons to not damage or stress the tire bead, Also, the opposite bead needs to be in drop center of wheel during mounting and dismounting of the tire.

Be very careful not to damage the rim, tire, inner tube, brake disk, or sprocket regardless of which method is used.

TIRE REMOVAL

IMPORTANT
This procedure is written assuming that a pneumatic, electric, or manually operated rim-clamp type tire machine is being used.

1. Remove wheel / tire assembly from motorcycle. See **Front Wheel Removal / Installation page 8.29** and **Rear Wheel Removal / Installation page 8.87**.
2. Remove valve core ① from valve stem and let all air escape.



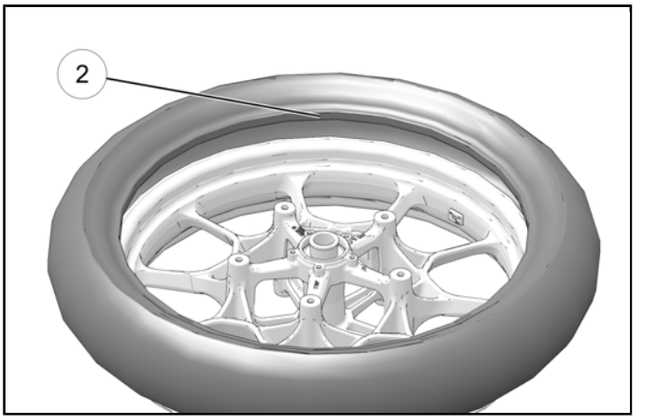
3. Mount the wheel assembly onto a tire bead breaker and break the bead starting at the valve stem and continue around the circumference of the rim as necessary.
4. Flip the wheel assembly over and repeat STEP 3 on the other side.

IMPORTANT
Take great care not to bend or otherwise damage the brake disc and/or chain driven sprocket. If the bead breaker being used interferes with either the brake disk and/or chain driven sprocket, remove the disc or sprocket as required.

5. Mount the tire and wheel assembly on the tire machine per the manufacturers instructions.

NOTICE
Refer to manufacturer's instructions for proper tire changer operation.

6. Carefully work around the circumference of the upper bead ② with the tire lever until it is completely off of the rim.



7. Lift the lower tire bead up until the tire lever can be positioned and the tire completely removed.
8. Work around the circumference of the rim until the tire can be lifted free of the rim.

TIRE INSTALLATION

NOTICE

This procedure is written assuming that a pneumatic, electric, or manually operated rim-clamp type tire machine is being used.

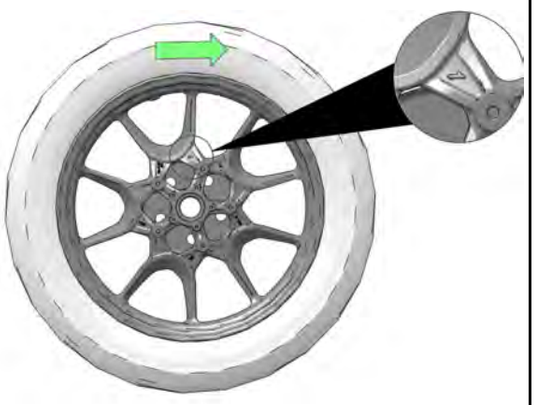
⚠ DANGER

Balance Dots

Indian Motorcycle does not recommend the use of liquid balancer/sealers. These are a form of temporary repair which may adversely affect ply material and mask secondary damage caused by the penetrating object. Reliance upon sealants can result in sudden tire failure and accident.

Directional Arrows

Tires ① have directional arrows that must be observed when installing tires to rims ②.



The wheel assemblies must be free of foreign debris that would affect balancing.

Carefully inspect the wheel bearings, seals and axle for damage or corrosion.

1. Lubricate both tire beads with rubber lubricant.

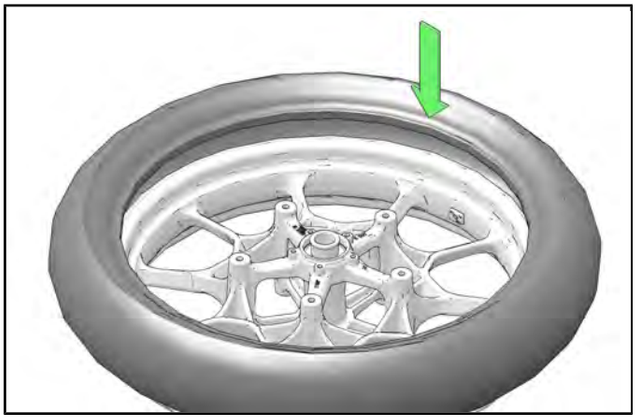
⚠ WARNING

Never apply grease, oil, gasoline, spray type lubricants or anything other than rubber lubricant or a neutral soap and water solution to the tire bead. Doing so can damage the tire.

NOTICE

Refer to manufacturer's instructions for proper tire changer operation.

2. Orient tire correctly as to the directional arrows.
3. Push tire on to rim until one bead is installed. It shouldn't be necessary to use tire irons to put one side of the tire onto the rim. Remember to keep bead(s) in the drop center of the wheel whenever possible.



IMPORTANT

Confirm tire is positioned correctly by observing directional arrows.

4. Lubricate the tire bead.
5. With your hands, push as much of the remaining tire bead as possible into the rim, pinching both upper and lower beads into the drop center.
6. When no more of tire can be installed by hand, press down on portion of tire in front of you with your knee to keep the top bead in the drop center.
7. Install the tire lever and work around the remaining circumference of the wheel until the bead is fully installed onto the rim.

IMPORTANT

Be sure both beads are forced as far as possible into the drop center of the rim.

8. Install valve core if it was removed.
9. Line up balance dot.
10. Confirm that the directional arrows are pointing in the correct direction.
11. Bounce tire on the floor several times while rotating tire. This will expand tire bead outward slightly which will make tire inflation easier.
12. Inflate tire observing the precautions listed below.

Tire Inflation & Precautions

- Wear approved eye protection
- Lubricate the tire beads with a tire mounting lubricant before inflation.

8

- Lock assembly on mounting machine or place in safety cage before inflating to seat beads
- Use extension gauge and hose with slip-on air chuck.
- Stand back with no part of your body within the perimeter of the assembled tire and rim.
- Inflate with core in valve stem
- Never inflate above 42 psi to seat beads
- If beads do not seat by 42 psi. Deflate and repeat procedures. Never use a volatile substance or rubber "donut" to aid bead seating.

13. Inspect the line molded onto the tire side walls. It must be the same distance from the rim all the way around the tire. If the distance varies it indicates that tire is not seated properly.
14. If tire is not seated correctly, deflate and unseat the tire, lubricate the tire beads and repeat inflation procedure.
15. Install wheel assembly onto balance stand and spin. Observe the wheel assembly while it is spinning to make sure the tire is seated properly.
16. Adjust tire pressures to specifications.
17. Balance tire / wheel assembly.

⚠ WARNING

FOR NEW TIRES: Replacement of OEM tires or replacement with differently constructed tires will not immediately produce improved reactions the same as the original tires when new. When new tires are installed, they should not be subjected to maximum power or hard cornering until a reasonable "scrub" period of approximately 100 miles has been covered. This will permit the rider to become accustomed to "feel" of new tires or tire combination, and achieve optimum road grip. Inspect and adjust tire inflation pressure after tire cools down for at least three hours following "run-in".

TIRE BALANCING

⚠ WARNING

It is essential that the wheel assembly be balanced before use and rebalanced each time the tire is removed. Wheel balance affects stability, handling and overall safety of the motorcycle.

The use of liquid balancer/sealer is not recommended.

This procedure will outline balancing wheel assembly in a gravity balance stand. If a pendulum or spin type balancer is being used, reference the manufacturer's instructions that came with the equipment.

1. Mount wheel assembly in a commercially available balance stand.
2. Remove all balance weights. Clean tire and rim thoroughly.

IMPORTANT

While it is possible to balance a wheel assembly with axle and grease-free wheel bearings as the pivot point, it is not recommended. Use an inspection stand that has knife edge bearings and its own axle.

3. Spin the wheel assembly. Allow it to stop on its own and mark the highest (lightest) part of the wheel.
4. Repeat the spinning process to verify the heaviest part of the wheel.
5. Place balance weights at the lightest portion of wheel in small increments.
6. When correct amount of weight has been added to wheel, it will no longer stop in the same location and the wheel assembly is balanced.

⚠ CAUTION

Do not add more than 85 grams (3.0 oz.) of weight to the front or rear wheel.

If more than the recommended weight is necessary to balance the wheel, dismount the tire and rotate it 90° without regard to the yellow balance dot, and re-balance the wheel / tire.

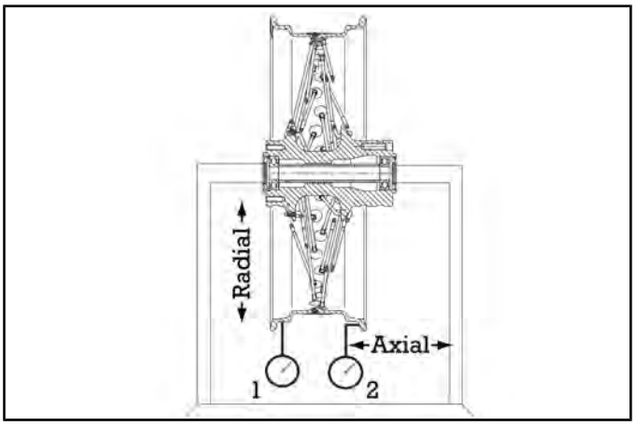
Adhesive Weight P/N 1525326

7. Install wheel / tire assembly onto motorcycle. See **Steering / Suspension Chapter for front wheel installation** and **rear wheel installation**.

WHEEL INSPECTION

VISUAL INSPECTION / RUNOUT

1. Clean the rim of all rubber particles and corrosion.
2. Inspect wheel for cracks and/or distortion.
3. Inspect bead seating area for scratches, distortion, or damage that could prevent proper sealing.
4. Measure wheel for radial runout ①.
5. Measure wheel for axial runout ②.



NOTICE

Measure runout on tire bead sealing surface of wheel. Be sure surface is clean.

6. Compare measurements of axial and radial runout to specifications. See **Service Specifications - Front Wheel & Suspension page 8.5 OR Service Specifications - Rear Wheel & Suspension page 8.59**.
7. Clean the sealing surfaces of the rim thoroughly. Use a soft brush (nylon) soap and water if necessary.

⚠ WARNING

Do not scratch or damage sealing surfaces of rim. Loss of air pressure can cause a loss of control and an accident, resulting in serious injury or death.

TIRE REPAIR PRECAUTIONS

⚠ WARNING

Only permanent plug-patch repairs of small tread area punctures from **inside** the dismounted tire are recommended. Never perform an exterior repair and never use an inner tube as a substitute for a proper repair. Speed should not exceed 50 MPH for the first 24 hours after repair and the repaired tire should never be used over 80 MPH. Inspect inflation pressure after tire cools for at least three hours following initial operation.

VALVE STEM

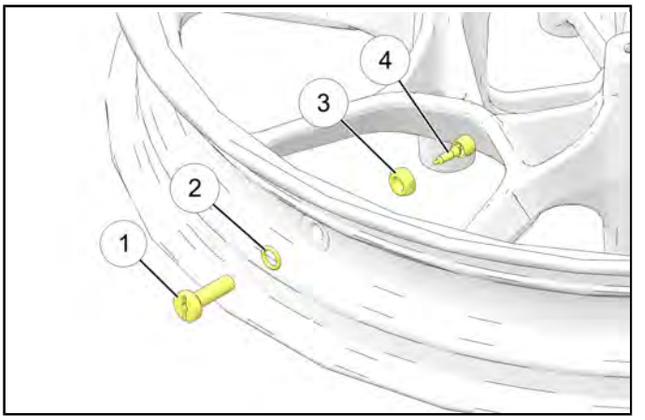
VALVE STEM INSPECTION

1. Remove the valve stem cap and spray the valve stem down with a mild soap and water solution.
2. Observe the area around the base of the valve stem and valve core area. If any bubbles form over a 1–2 minute period, the valve stem or inner tube should be replaced.
3. Inspect valve stem for cracks or visible damage and replace if necessary.

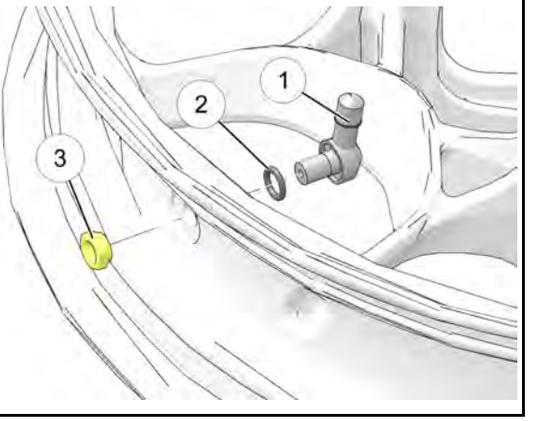
IMPORTANT
Valve stem replacement is recommended when tire is being replaced.

VALVE STEM INSTALLATION - METAL

1. Remove tire from wheel. See **Tire Removal page 8.106**.
2. Remove valve stem ①, o-ring ②, nut ③ and valve stem ④.



NOTICE
90° valve stem is assembled as shown.



3. Clean gasket or o-ring sealing surface of rim.
4. Place new valve stem (with seal washer or O-ring installed).
5. Hold stem and tighten nut to specification.

TORQUE
Valve Stem Nut: **44 in-lbs (5 N·m)**

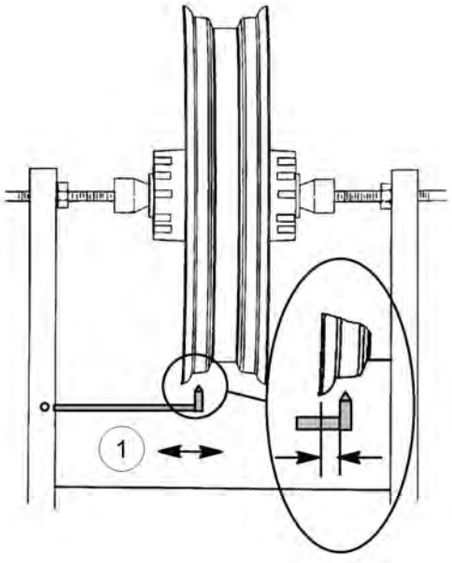
6. Install tire. See **Tire Installation page 8.107**.

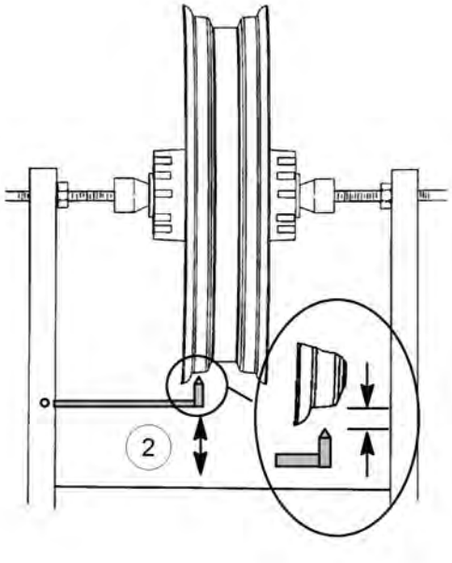
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

SPOKED WHEEL SERVICE

WHEEL TRUING

1. Measure axial ① and radial ② runout.





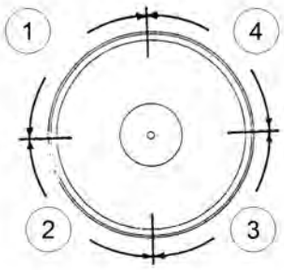
NOTICE
Axial runout is side to side movement (wobble) of the rim. Radial runout is the up and down movement (hop) of the rim.

2. First, adjust radial runout by loosening spokes around any high spots, rotate wheel 1/2 turn and tighten spokes directly opposite the high spot.
3. Adjust axial runout.

NOTICE
It's important to work slowly and make adjustments in small increments. Alternate between radial and axial adjustments until runout is within specification.

FINAL TIGHTENING

1. Using tape, divide wheel into four quadrants to perform final spoke torque sequence. Tighten each spoke equally. **(Tightening Sequence ①, ③, ②, ④)**
2. Maintain proper runout adjustment during final tightening of spokes.



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WHEEL LACING

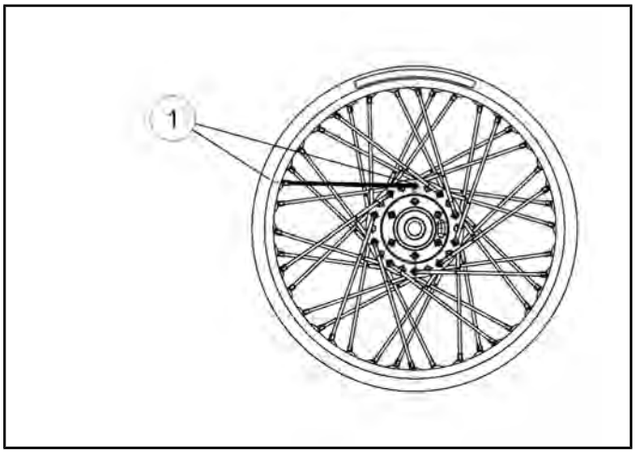
NOTICE

If an assembled wheel is available, it can be referenced for proper spoke pattern.

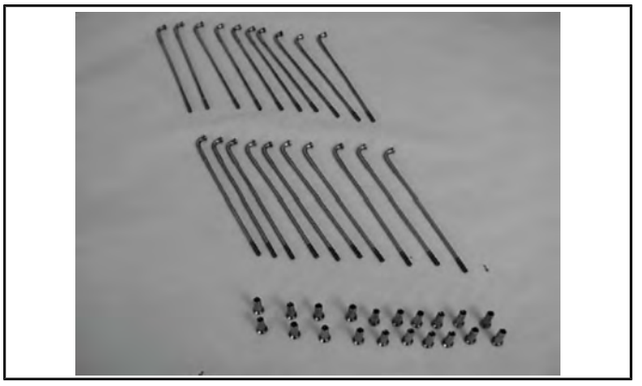
NOTICE

Using tape or a grease pen, mark one side of the hub and rim for reference during reassembly. These parts **must** be assembled the same way they came apart.

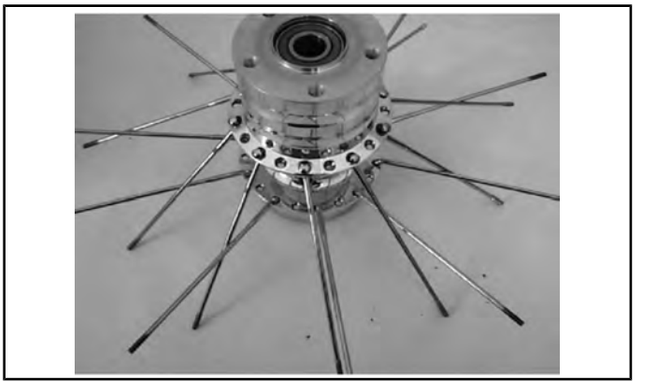
1. Before disassembly, select a "starting spoke" and make index marks at its anchor points on the hub and rim ①. This will help ensure the spokes are installed and grouped correctly upon assembly.



2. Organize 20 inside spokes and nipples on a clean work surface. Lubricate spoke threads and rim nipple-holes with a light oil.



3. Using the index marks from step one, insert all inside spokes skipping one hole between each.



NOTICE

Install inside spokes on the opposite flange one hole to the right or left.

4. Lay rim in position around the hub assembly making sure the valve stem hole and spoke index marks are correctly located.

5. Thread the "starting spoke" into the corresponding nipple and continue to thread inside spokes until they are all finger tight.
6. Install outside spokes and screw on nipples. Work your way around the wheel, installing spokes on alternate sides of wheel. Continue until all spokes and nipples are installed. Tighten nipples equally by hand.
7. With all nipples installed, evenly snug all nipples using a spoke wrench. Equally tighten around the wheel until one thread shows above each nipple.
8. Place wheel assembly onto a truing stand for rim offset adjustment, final spoke tightening and wheel truing of wheel.

TROUBLESHOOTING TIRES

PROBLEM	POSSIBLE CAUSE	REPAIR RECOMMENDED
Rear Wheel (Wobbles)	Bent rim	Replace
	Worn or damaged wheel bearings	Replace as a set
	Worn or damaged swingarm bushings	Replace as a set
	Damaged or incorrect tire	Replace rear tire
	Wheel assembly out-of-balance	Balance wheel
	Low tire pressure	Inflate to specification
	Loose swingarm, axle or suspension fasteners	Torque to specification
Handlebars Oscillate (Wobble)	Bent front axle	Replace
	Worn or damaged wheel bearings	Replace as a set
	Tire mounted incorrectly	Inspect and re-mount tire
	Damaged tire	Replace
	Loose steering stem nut	Adjust to specification
	Incorrect tire	Replace
	Incorrect tire pressure	Inflate to specification
Front Wheel Oscillates (Wobbles)	Bent rim	Replace
	Worn or damaged wheel bearings	Replace as a set
	Damaged or incorrect tire	Replace
	Loose axle or axle pinch fasteners	Torque to specification
	Right and left fork not installed at same height	Repair
	Fork oil level incorrect	Fill to specification
	Fork spring free length different between right & left	Replace spring that does not meet specification
	Wheel assembly out-of-balance	Balance wheel

NOTES

CHAPTER 9
BRAKES

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

GENERAL INFORMATION

SERVICE NOTES

Use only genuine Indian Motorcycle replacement parts when servicing the brake system. Clean all system components prior to disassembly, including the fluid reservoir cover(s) to reduce the chance of debris entering the system during repair or maintenance work. Start with a clean work area away from dust, water or other contamination. Cleanliness is very important for proper brake system maintenance and repair. Follow procedure outlined in this manual carefully, including fastener torques and the application of special lubricant in required areas. Special lubricants are included with service kits.

⚠ WARNING

Contaminated brake discs or pads greatly reduce the amount of stopping force available & increase stopping distance. Brake discs can be cleaned using a commercially available brake disc cleaner. Follow the manufacturer instructions printed on the container. NEVER attempt to clean contaminated brake pads. Always replace pads as a set.

⚠ WARNING

The brake system uses ethylene-glycol based fluid (DOT 4). Do not use or mix with different types of fluid such as silicone-based (DOT 5) or any petroleum-based fluid.

Do not let water or moisture enter the master cylinder when refilling. Water significantly lowers the boiling point of the fluid and can result in poor braking.

Do not use brake fluid taken from old, used or unsealed containers. Never reuse brake fluid.

Keep brake fluid containers completely sealed and out of reach of children.

Brake fluid should be replaced atleast every two years.

Brake hoses should be replaced whenever the exterior shows signs of deterioration or damage. Brake hoses should be replaced every four (4) years regardless of their exterior condition.

Bleed the brake system any time it is disassembled or when the brake action is spongy.

Always inspect the operation of the brakes before riding the motorcycle.

Replace sealing washers whenever brake lines are removed.

Always remove the master cylinder fluid reservoir cover and inspect the fluid level when brake pads are replaced.

⚠ CAUTION

Brake fluid and some types of brake cleaners will damage paint, plastics and some rubber compounds. Cover or remove plastic and painted parts before working on the brake system. If brake fluid is spilled on cosmetic surfaces, immediately rinse the area with a mild solution of soap and water until all traces of brake fluid are removed. Make sure the master cylinder reservoir being worked on is level and clean before removing the cap.

SPECIAL TOOLS - BRAKES

TOOL DESCRIPTION	PART NUMBER
ABS Tool (Lever Reserve)	PV-50104
Vacuum Brake Bleeder	Commercially Available

SERVICE SPECIFICATIONS - BRAKES

ITEM	STANDARD	SERVICE LIMIT
Specified Brake Fluid	DOT 4	Replace every 24 months
Brake Disc Thickness, Front	5.0 mm	4.5 mm (.177") (Min)
Brake Disc Thickness, Rear	5.0 mm	4.5 mm (.177") (Min)
Brake Disc Runout	-	.30 mm (.012") (Max)
Brake Pad Wear Limit (Front & Rear)	-	When wear limit groove is no longer visible or when friction material is 1mm thick
Brake Pedal Free Play (Pedal Clearance)	3-7 mm	-
Brake Lever Freeplay (Front)	No Adjustment	-

FRONT BRAKE LEVER INSPECTION

1. Pull and release the front brake lever. It should move freely and smoothly and return to its rest position quickly when released. Lubricate brake lever if binding, or if it does not return quickly and completely when released. See **Front Brake Lever Lubrication page 9.4**.
2. Freeplay is adjusted from the factory and is set to an optimal position.

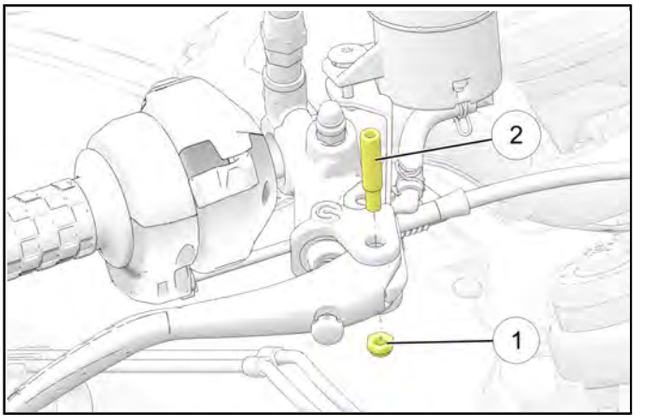
⚠ CAUTION

Changing of this adjustment could cause brake damage or failure.

3. Safely elevate the front wheel. Verify wheel rotates freely without drag or binding when lever is released.

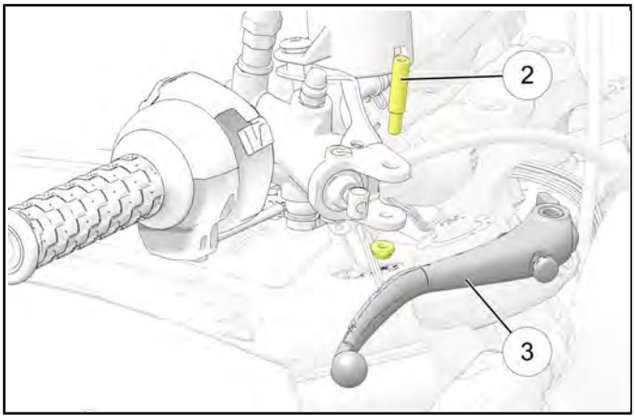
FRONT BRAKE LEVER LUBRICATION

1. Remove the nut ① and pivot fastener②.



2. Clean pivot bolt, lever and lever perch.

3. Remove brake lever and apply grease to pivot fastener ②, as shown.

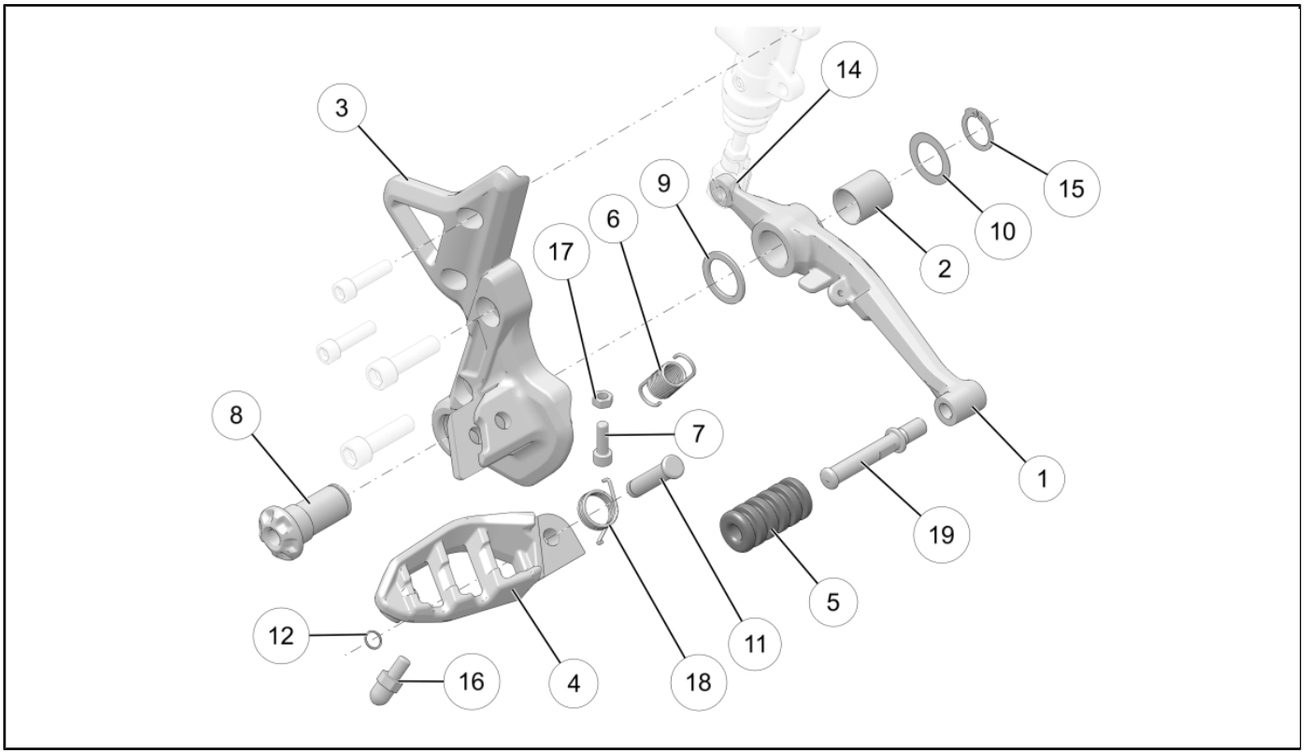


4. Assemble brake lever.
5. Torque brake lever pivot fastener nut to specification.

TORQUE
Brake Lever Pivot Fastener: **52 in-lbs (6 N·m)**

BRAKE PEDAL LUBRICATION

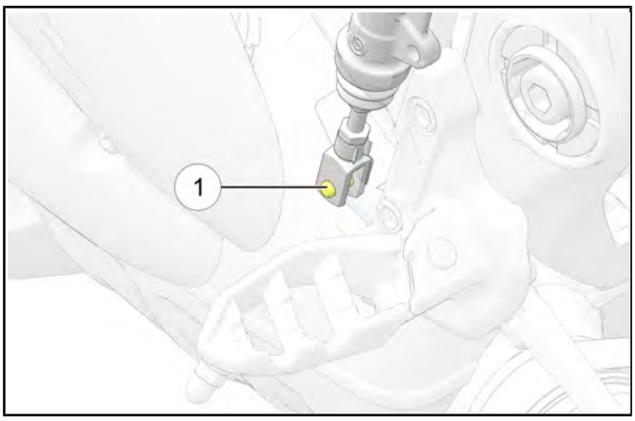
2019–2020



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Brake Pedal	–
②	Brake Pedal Pivot Bearing	–
③	Footpeg Mount	–
④	Footpeg	–
⑤	Brake Pedal Pad	–
⑥	Brake Return Spring	–
⑦	Spacer Bolt	–
⑧	Footpeg Shoulder Fastener	**50 ft-lbs (68 N·m)**
⑨	Wave Washer	–
⑩	Washer	–
⑪	Pivot Footpeg Pin	–
⑫	Retaining Spiral Ring	–
⑭	Brake Pushrod Pin Clip	–
⑮	C-Clip	–
⑯	Feeler Peg	**96 in-lbs (11 N·m)**
⑰	Adjuster Nut	**54 in-lbs (6 N·m)**
⑱	Spring	–
⑲	Shift / Brake Pedal Peg	**15 ft-lbs (20 N·m)**

Lubricate brake pedal at intervals listed on periodic maintenance table. See **Maintenance Intervals page 2.4**.

1. Place the motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Working on the right-hand side of the motorcycle, remove the master cylinder pin ①.



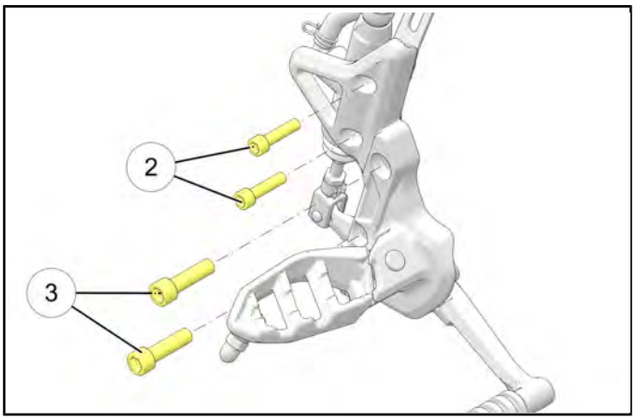
NOTICE

It is not necessary to disconnect the brake line from the master cylinder to perform this procedure.

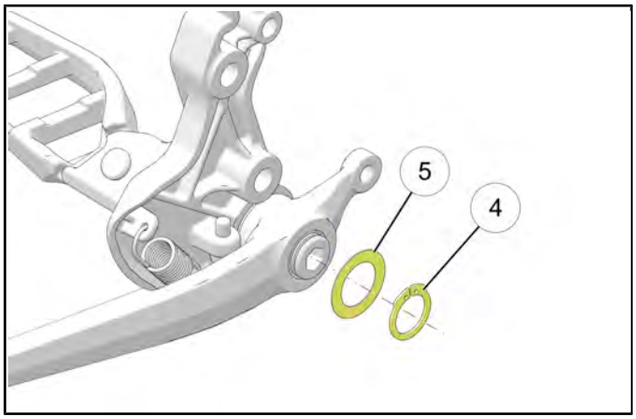
IMPORTANT

Keep the master cylinder assembly in an upright position at all times to ensure air does not enter the brake system.

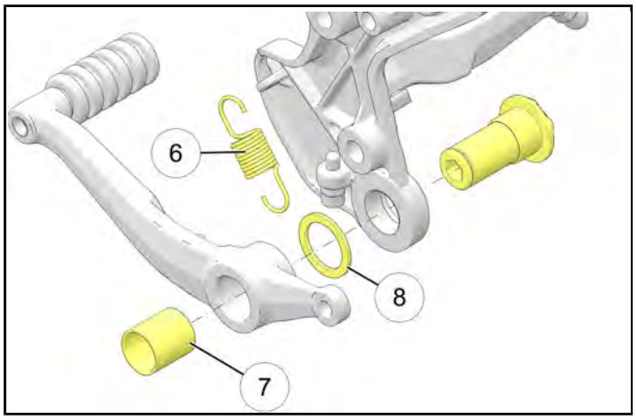
3. Remove the Master Cylinder mounting fasteners ② and footpeg mounting fasteners ③



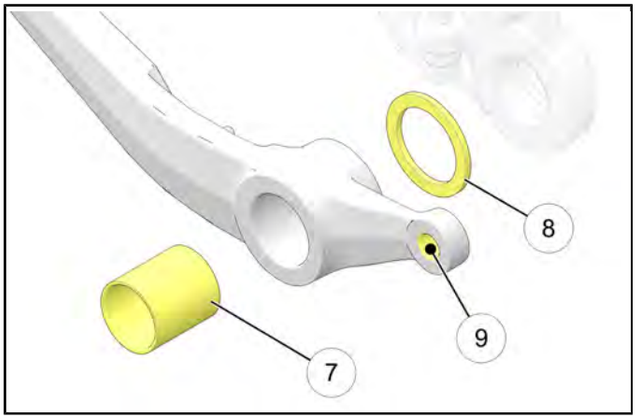
4. Remove the brake pedal pivot c-clip ④ and flat washer ⑤.



5. Remove brake pedal return spring ⑥. Remove the brake pedal bushing ⑦ and washer ⑧.



6. Clean off old lubricant and dirt from all parts.
7. Apply all-purpose grease to pushrod and pedal bushings ⑦, ⑧ and ⑨.



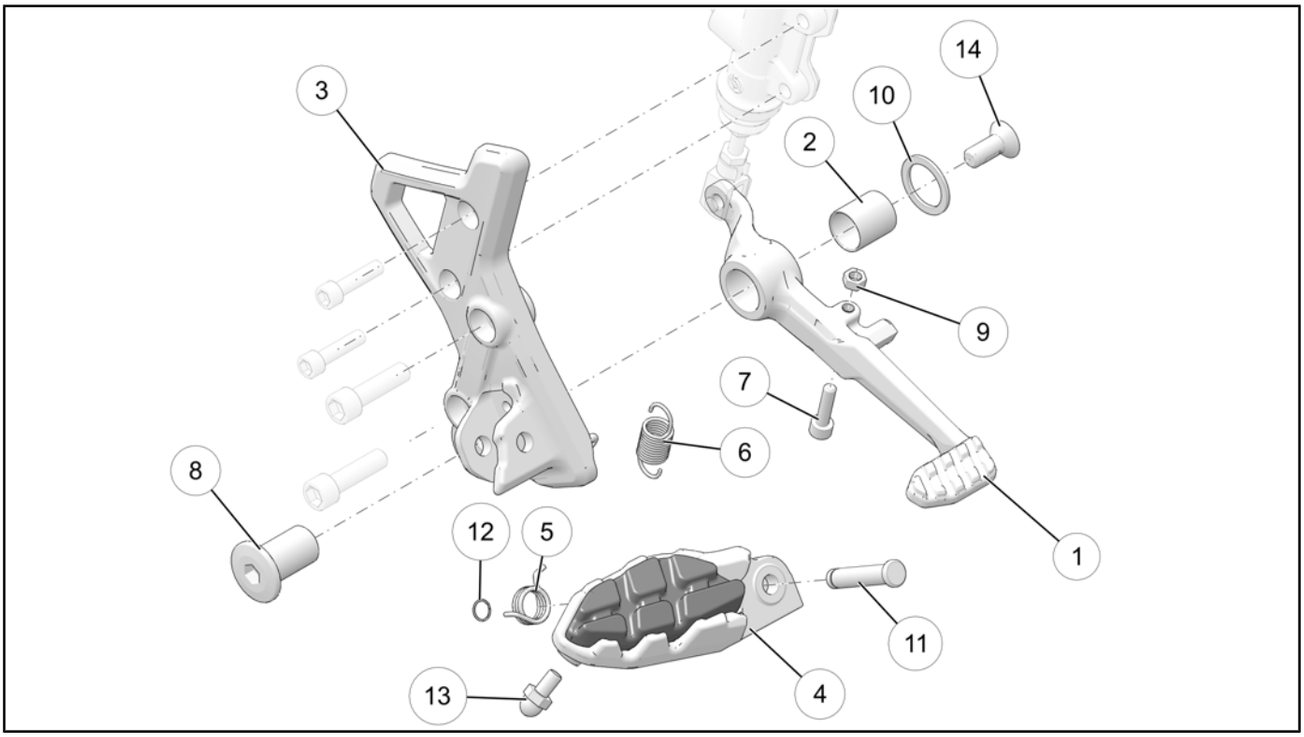
8. Install pedal bushing ⑦. Assemble pedal, washer ⑧, brake pedal pivot c-clip④ and flat washer to the foot peg mount.

9

9. Install pushrod pivot pin.
10. Assemble foot peg support to frame. Torque mounting bolts ② and ③ to specification. See **Foot Peg (Driver) Removal / Installation page 7.16**.
11. Depress brake pedal to verify proper operation and pedal feel. Bleed brakes if necessary. See "Brake System Bleeding" in the Brakes Chapter.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

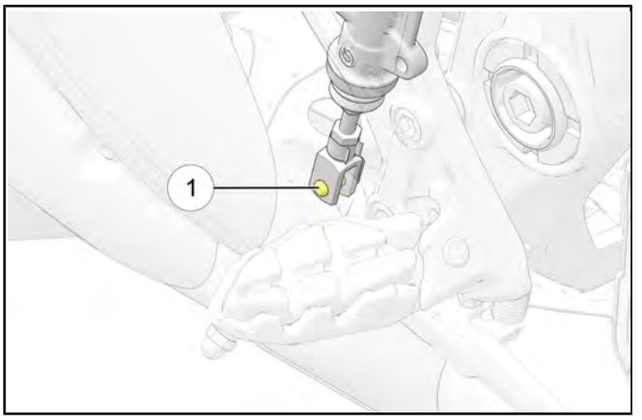
2022+



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Brake Pedal	–
②	Brake Pedal Pivot Bearing	–
③	Footpeg Mount	–
④	Footpeg	–
⑤	Spring	–
⑥	Brake Return Spring	–
⑦	Spacer Bolt	–
⑧	Brake Pedal Pivot Outer Fastener	–
⑨	Adjuster Nut	**54 in-lbs (6 N·m)**
⑩	Washer	–
⑪	Pivot Footpeg Pin	–
⑫	Retaining Spiral Ring	–
⑬	Feeler Peg	**96 in-lbs (11 N·m)**
⑭	Brake Pedal Pivot Inner Fastener	**18 ft-lbs (24 N·m)**

Lubricate brake pedal at intervals listed on periodic maintenance table. See **Maintenance Intervals page 2.4**.

1. Place the motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Working on the right-hand side of the motorcycle, remove the master cylinder pin ①.



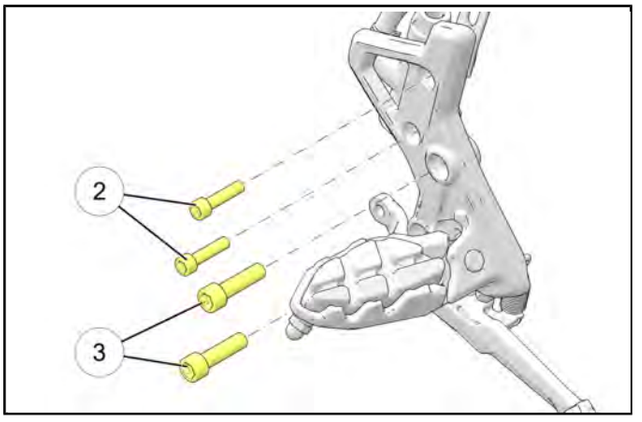
NOTICE

It is not necessary to disconnect the brake line from the master cylinder to perform this procedure.

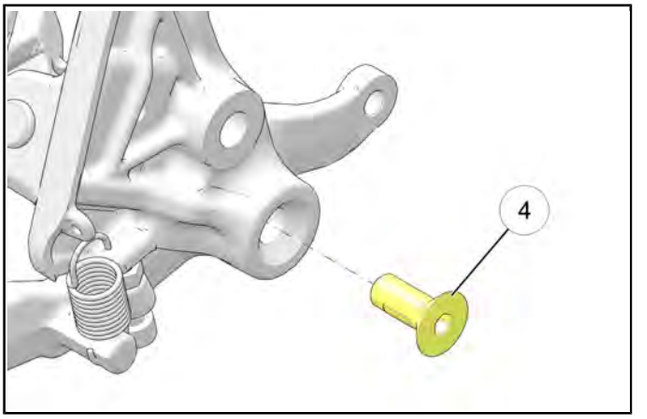
IMPORTANT

Keep the master cylinder assembly in an upright position at all times to ensure air does not enter the brake system.

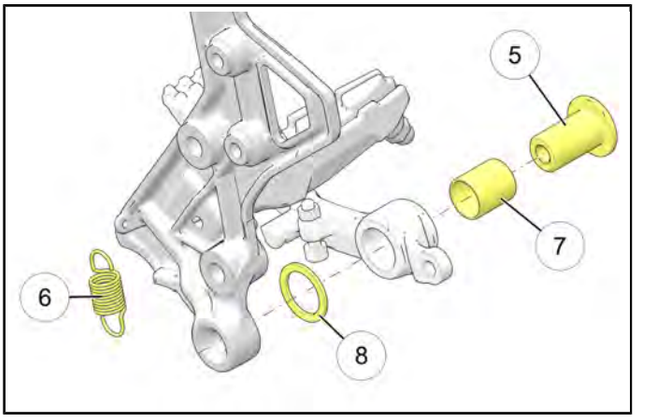
3. Remove the Master Cylinder mounting fasteners ② and footpeg mounting fasteners ③



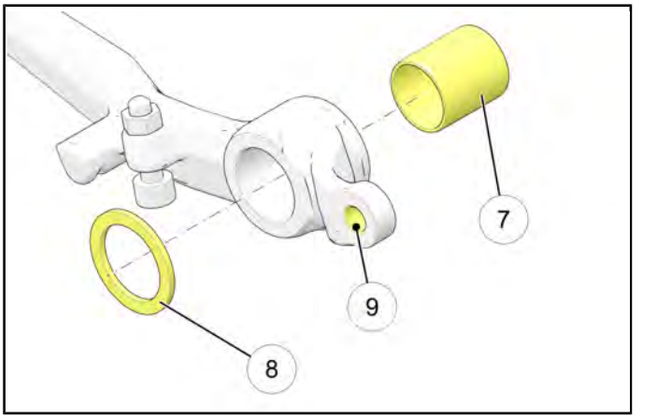
4. Remove the Brake Pedal Pivot Inner Fastener ④.



5. Remove brake pedal return spring ⑥ and Brake Pedal Pivot Outer Fastener ⑤. Remove the brake pedal bushing ⑦ and washer ⑧.



6. Clean off old lubricant and dirt from all parts.
7. Apply all-purpose grease to pushrod and pedal bushings ⑦, ⑧ and ⑨.



8. Install pedal bushing ⑦. Assemble pedal, washer ⑧, Brake Pedal Pivot Inner Fastener ④ to the foot peg mount.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

9. Install pushrod pivot pin.
10. Assemble foot peg support to frame. Torque mounting bolts ② and ③ to specification. See **Foot Peg (Driver) Removal / Installation page 7.16**.
11. Depress brake pedal to verify proper operation and pedal feel. Bleed brakes if necessary. See "Brake System Bleeding" in the Brakes Chapter.

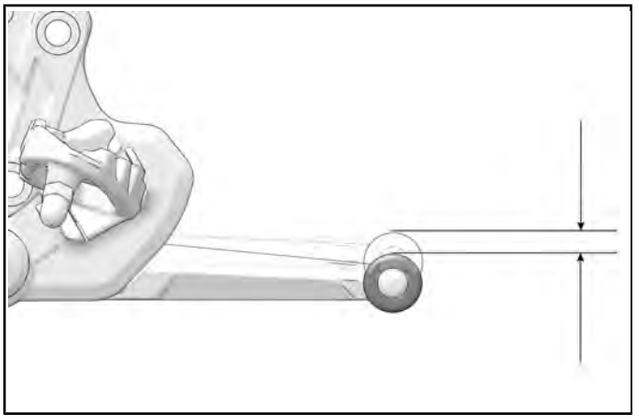
REAR BRAKE PEDAL ADJUSTMENT

2019–2020 FTR / FTR S – REAR BRAKE PEDAL ADJUSTMENT

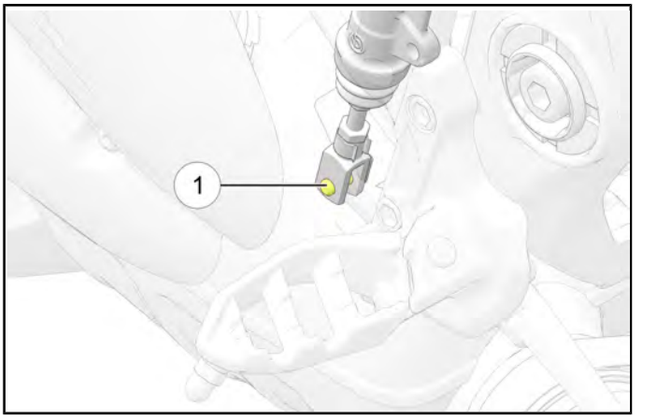
⚠ CAUTION

Free travel must be present on the brake pedal lever or pressure could build up in the rear brake system causing overheating and failure. The brake pedal free travel must always be set in accordance with the specification.

Free travel at brake lever peg: 3 - 7 mm



1. Place the motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Working on the right-hand side of the motorcycle, remove the master cylinder pin ①.



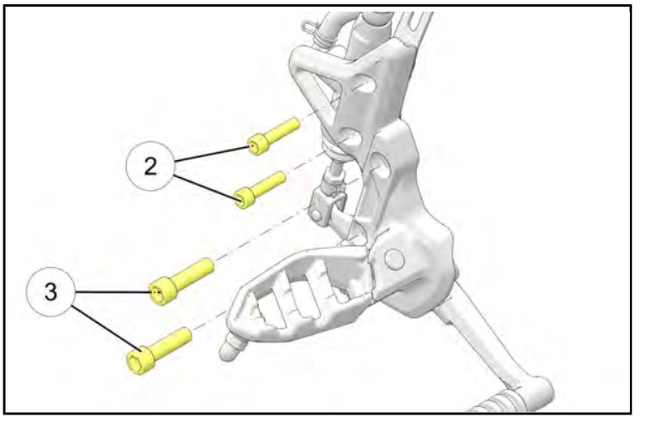
NOTICE

It is not necessary to disconnect the brake line from the master cylinder to perform this procedure.

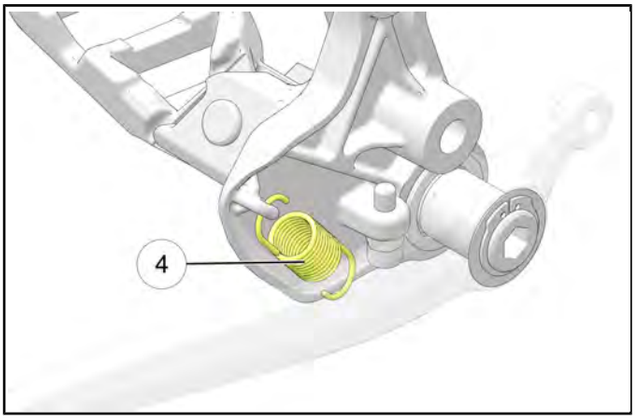
IMPORTANT

Keep the master cylinder assembly in an upright position at all times to ensure air does not enter the brake system.

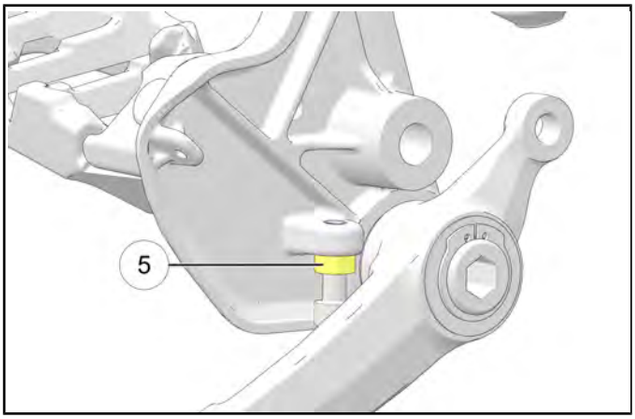
3. Remove the master cylinder mounting fasteners ② and footpeg mounting fasteners ③.



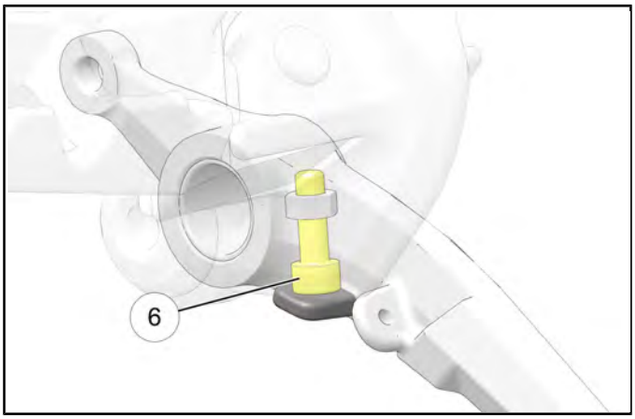
4. Remove the spring ④.



5. Loosen the nut ⑤ on the stop adjustment screw.



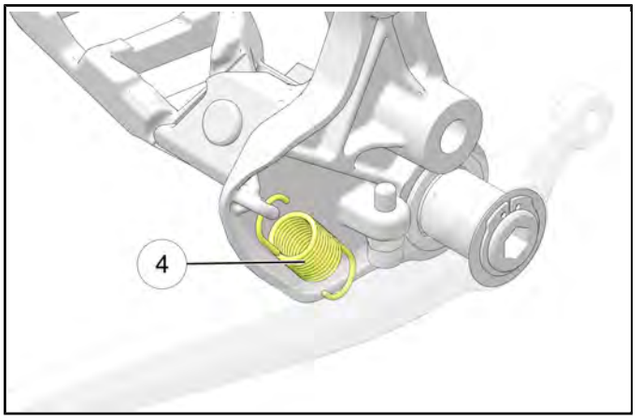
6. Adjust stop screw ⑥ until desired brake pedal position is achieved.



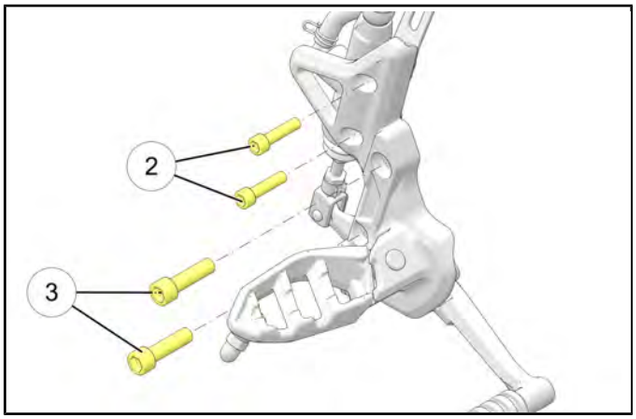
7. Tighten nut on stop adjustment screw. Torque to specification.

TORQUE
Brake Pedal Stop Screw Adjustment Nut: **54 in-lbs (6 N·m)**

8. Install the spring ④.



9. Install the master cylinder control assembly with mounting fasteners ② and footpeg mounting fasteners ③. Torque to specification.

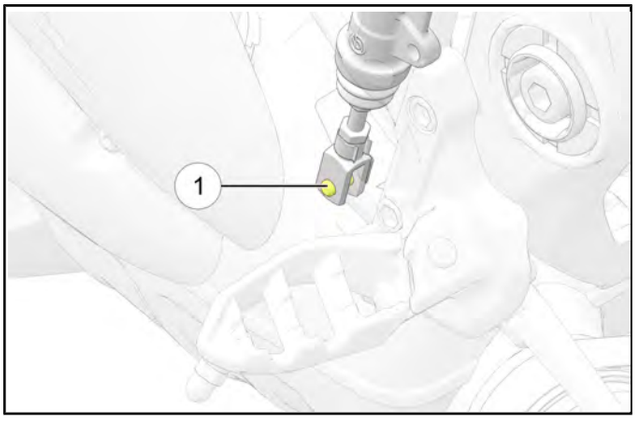


TORQUE
Footpeg Fasteners ③: **17 ft-lbs (23 N·m)**

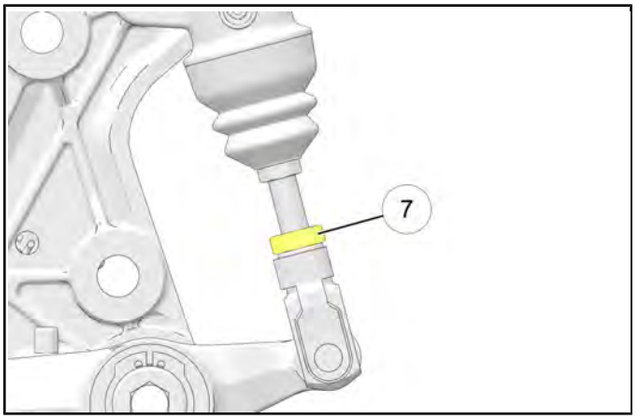
TORQUE
Master Cylinder Reservoir Mounting Fastener (rear) - 2019,2020 ②: **84 in-lbs (9 N·m)**

TORQUE
Master Cylinder Reservoir Mounting Fastener (rear) - 2022+ ②: **62 in-lbs (7 N·m)**

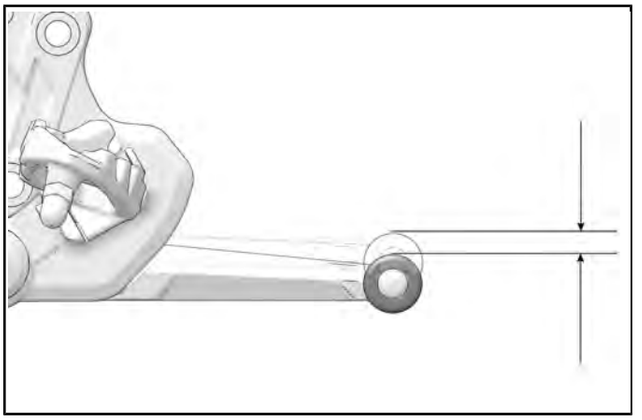
10. Connect the master cylinder pin ① to the brake pedal.



11. Loosen adjuster nut ⑦ on master cylinder pushrod.



12. Adjust pushrod length until the correct brake lever free travel is achieved.



Free travel at brake lever peg: 3 - 7 mm

13. Tighten nut on master cylinder pushrod.

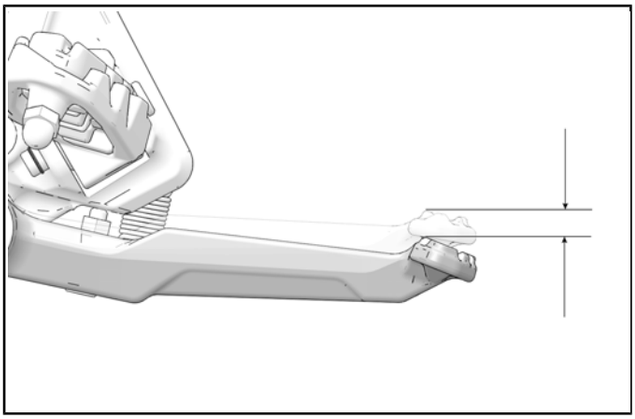
TORQUE
Master Cylinder Pushrod Nut: **54 in-lbs (6 N·m)**

2022+ FTR / FTR S / FTR R CARBON – REAR BRAKE PEDAL ADJUSTMENT

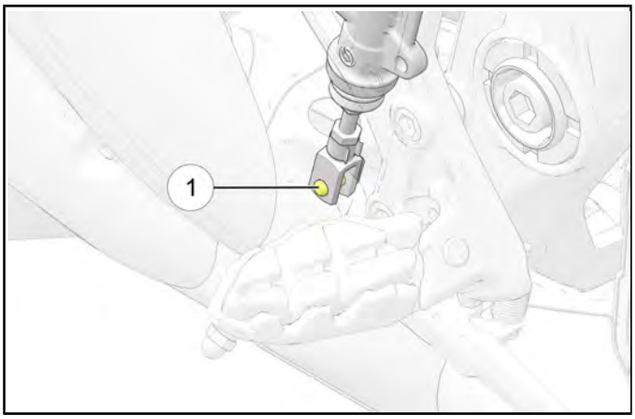
⚠ CAUTION

Free travel must be present on the brake pedal lever or pressure could build up in the rear brake system causing overheating and failure. The brake pedal free travel must always be set in accordance with the specification.

Free travel at brake lever peg: 3 - 7 mm



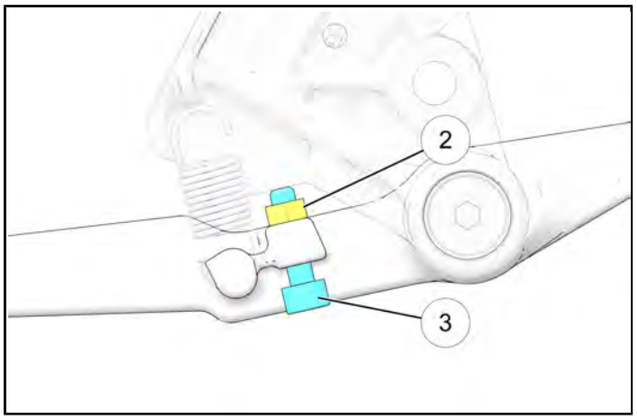
1. Place the motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Working on the right-hand side of the motorcycle, remove the master cylinder pin ①.



NOTICE

It is not necessary to disconnect the brake line from the master cylinder to perform this procedure.

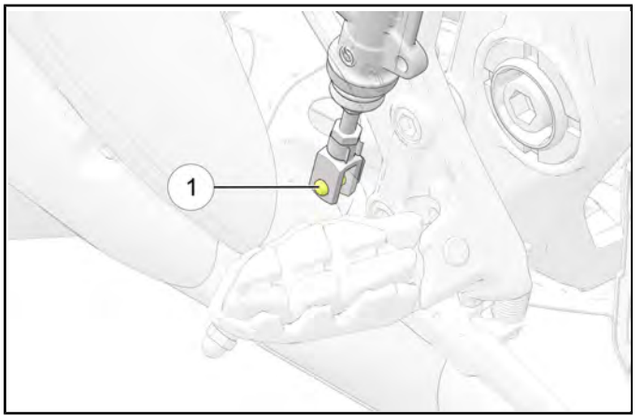
3. Loosen the nut ② on the adjuster screw.



4. Adjust stop screw ③ until desired brake pedal position is achieved.
5. Tighten nut on stop adjustment screw. Torque to specification.

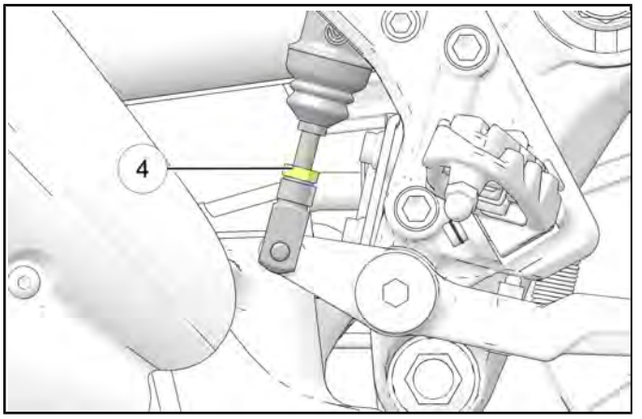
TORQUE
Brake Pedal Stop Screw Adjustment Nut: **54 in-lbs (6 N·m)**

6. Connect the master cylinder pin ① to the brake pedal.

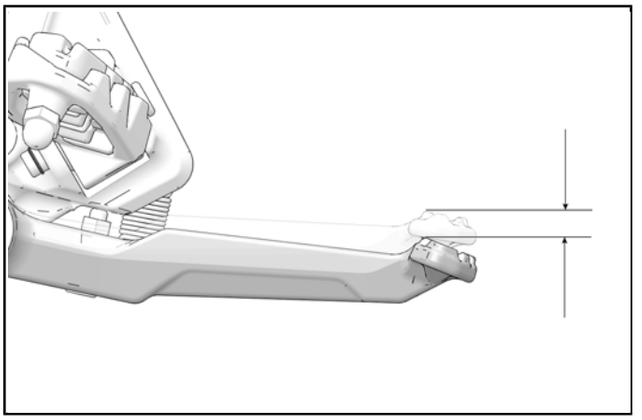


9

7. Loosen adjuster nut ④ on master cylinder pushrod.



8. Adjust pushrod length until the correct brake lever free travel is achieved.



Free travel at brake lever peg: 3 - 7 mm

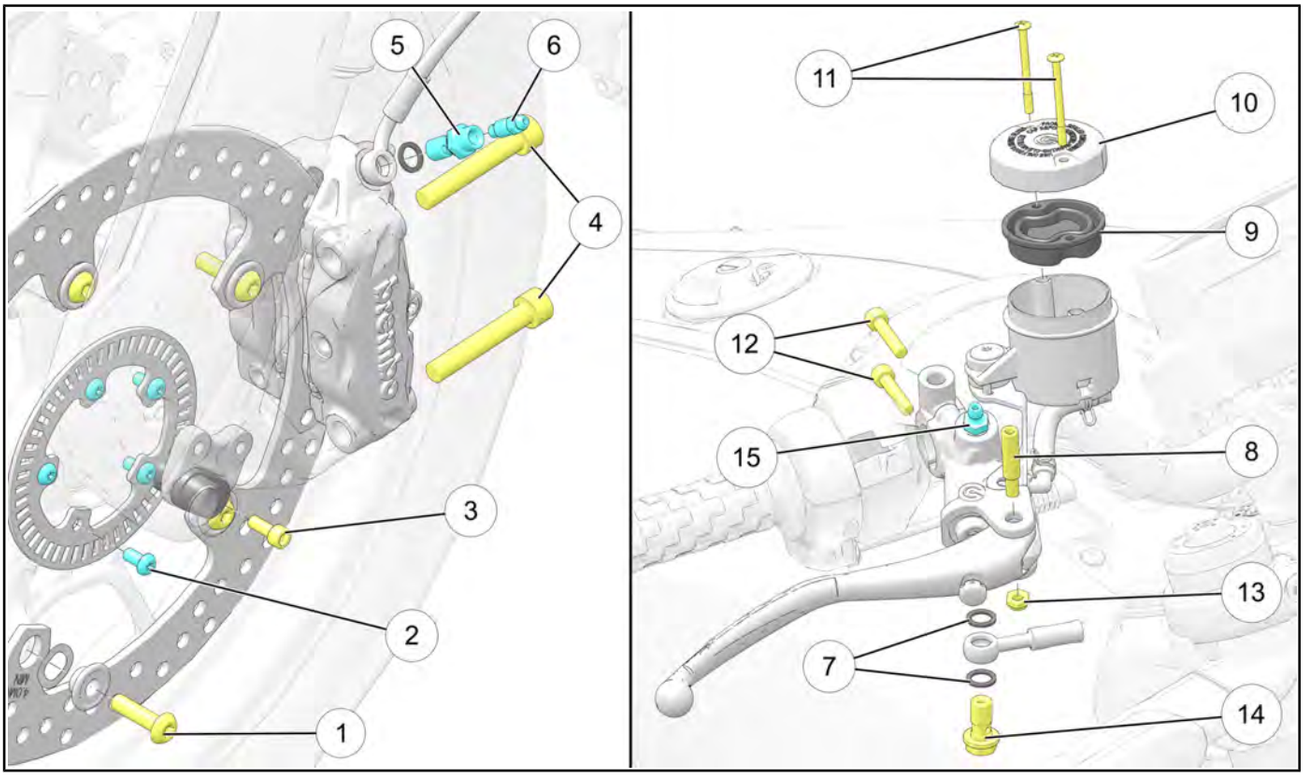
9. Tighten nut on master cylinder pushrod.

TORQUE
Master Cylinder Pushrod Nut: **54 in-lbs (6 N·m)**

ASSEMBLY VIEWS

FRONT BRAKE SYSTEM – ASSEMBLY VIEW

2019–2020 FTR Models

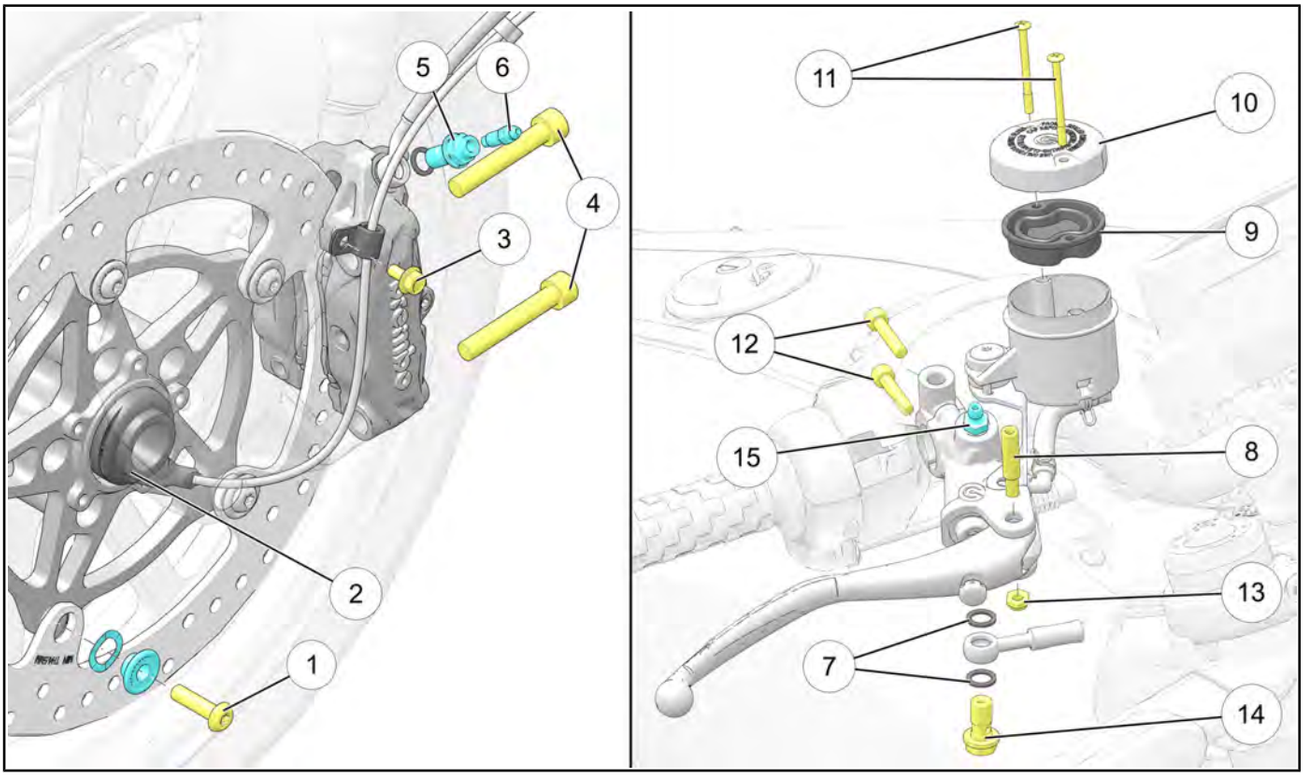


NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Brake Disc Fasteners (front)	**22 ft-lbs (30 N·m)**
②	Tone Ring Fasteners	**84 in-lbs (9 N·m)**
③	Wheel Speed Sensor Fastener	**88 in-lbs (10 N·m)**
④	Caliper Mounting Fasteners (front)	**35 ft-lbs (48 N·m)**
⑤	Banjo Bolt (to caliper)	**18 ft-lbs (24 N·m)**
⑥	Front Caliper Bleeder Screw (on banjo bolt)	**80 in-lbs (9 N·m)**
⑦	Sealing Washer	-
⑧	Brake Lever Pivot Fastener	**52 in-lbs (6 N·m)**
⑨	Rubber Diaphragm	-
⑩	Front Master Cylinder Cover	-
⑪	Master Cylinder Cap Screws (front)	**10 in-lbs (1 N·m)**
⑫	Master Cylinder Clamp Fasteners (front)	**88 in-lbs (10 N·m)** IMPORTANT Torque the **Master Cylinder Clamp** upper fastener first and the bottom fastener second.

9

NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
⑬	Brake Lever Pivot Nut	**52 in-lbs (6 N·m)**
⑭	Banjo Bolt	**18 ft-lbs (24 N·m)**
⑮	Master Cylinder Bleeder Screw (front)	**10 ft-lbs (14 N·m)**

2022+ FTR Models



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Brake Disc Fasteners (front)	**22 ft-lbs (30 N·m)**
②	Front Wheel Speed Sensor	-
③	Sensor Wire Retaining Fastener	**84 in-lbs (9 N·m)**
④	Caliper Mounting Fasteners (front)	**35 ft-lbs (48 N·m)**
⑤	Banjo Bolt (to caliper)	**18 ft-lbs (24 N·m)**
⑥	Front Caliper Bleeder Screw (on banjo bolt)	**80 in-lbs (9 N·m)**
⑦	Sealing Washer	-
⑧	Brake Lever Pivot Fastener	**52 in-lbs (6 N·m)**
⑨	Rubber Diaphragm	-
⑩	Front Master Cylinder Cover	-
⑪	Master Cylinder Cap Screws (front)	**10 in-lbs (1 N·m)**
⑫	Master Cylinder Clamp Fasteners (front)	**88 in-lbs (10 N·m)** IMPORTANT Torque the **Master Cylinder Clamp** upper fastener first and the bottom fastener second.

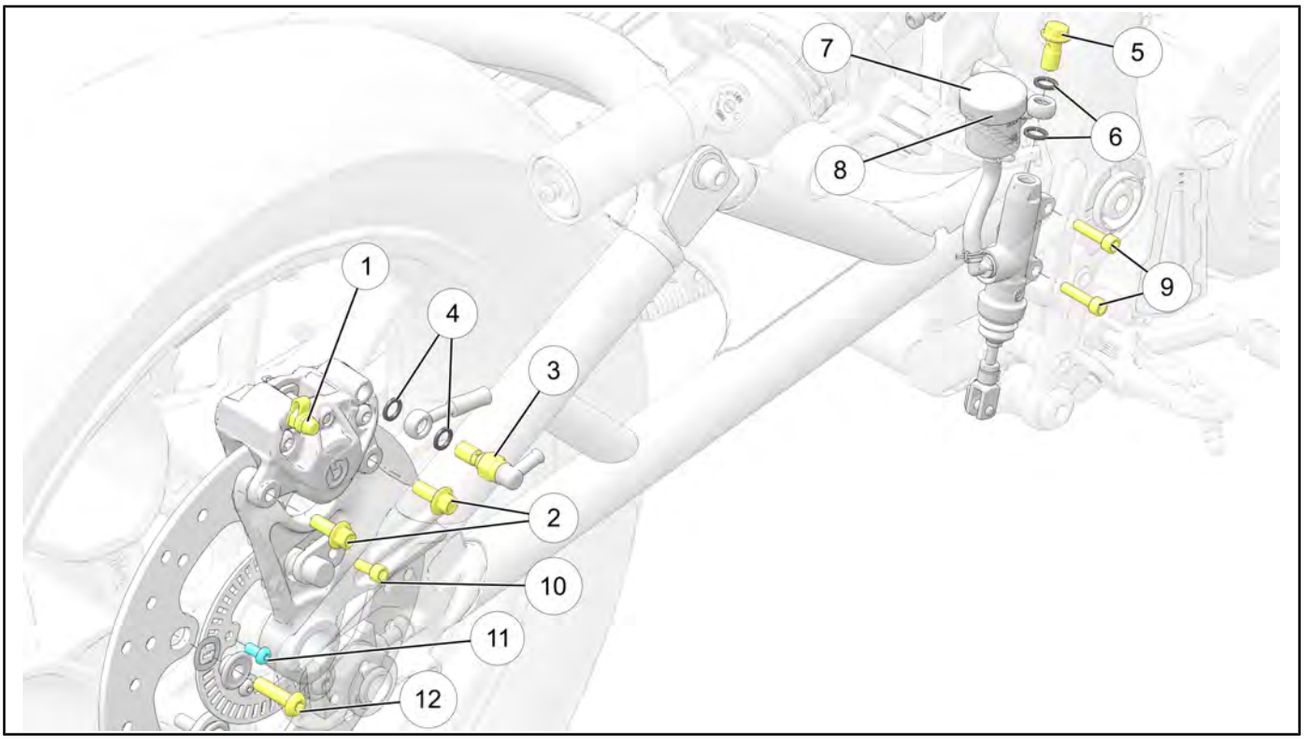
9

NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
⑬	Brake Lever Pivot Nut	**52 in-lbs (6 N·m)**
⑭	Banjo Bolt	**18 ft-lbs (24 N·m)**
⑮	Master Cylinder Bleeder Screw	**10 ft-lbs (14 N·m)**

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

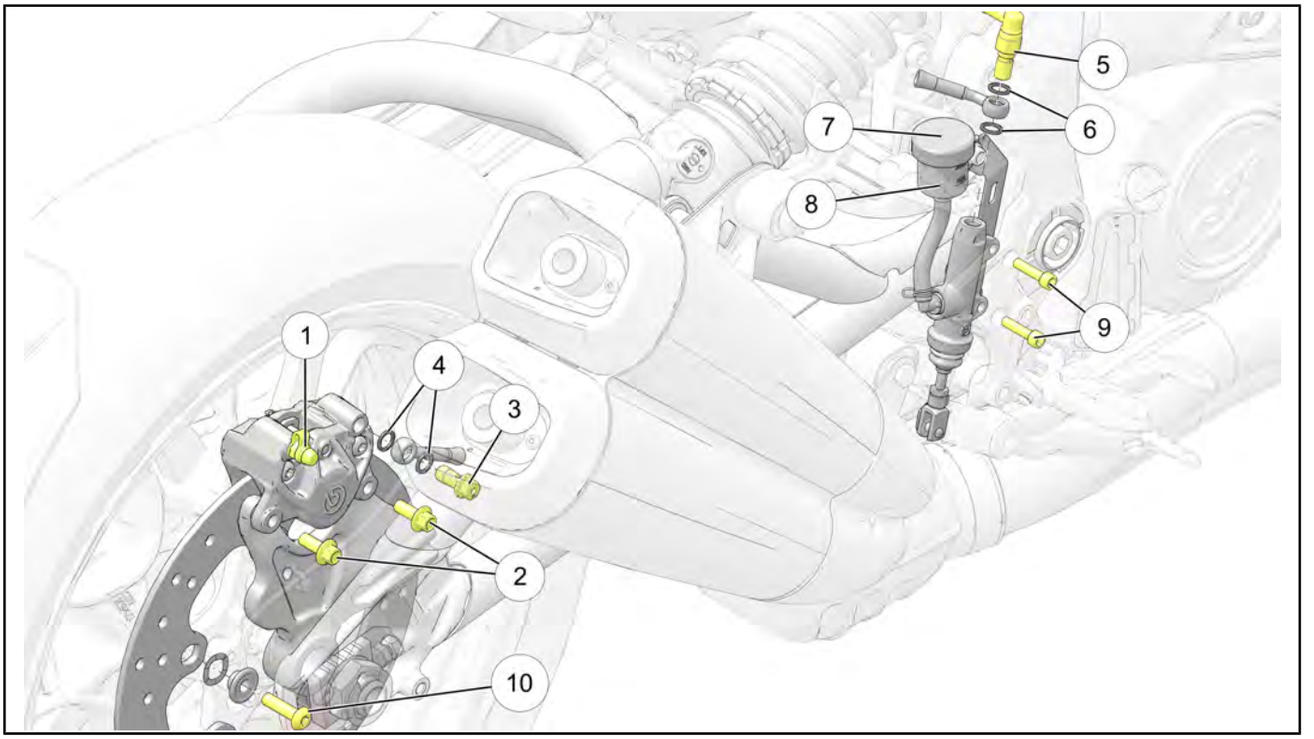
REAR BRAKE SYSTEM - ASSEMBLY VIEW

2019–2020 FTR Models



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Rear Caliper Bleeder Screw	**10 ft-lbs (14 N·m)**
②	Caliper Mounting Fasteners (rear)	**18 ft-lbs (24 N·m)**
③	Banjo Switch Fastener	**18 (24 N·m)**
④	Sealing Washer	-
⑤	Banjo Bolt	**18 ft-lbs (24 N·m)**
⑥	Sealing Washers	-
⑦	Rubber Diaphragm (under cover)	-
⑧	Master Cylinder Cover (rear)	-
⑨	Master Cylinder Mount Fasteners (rear)	**84 in-lbs (9 N·m)**
⑩	Wheel Speed Sensor Fastener	**88 in-lbs (10 N·m)**
⑪	Tone Ring Fastener	**84 in-lbs (9 N·m)**
⑫	Brake Rotor Fastener (Rear)	**22 ft-lbs (30 N·m)**

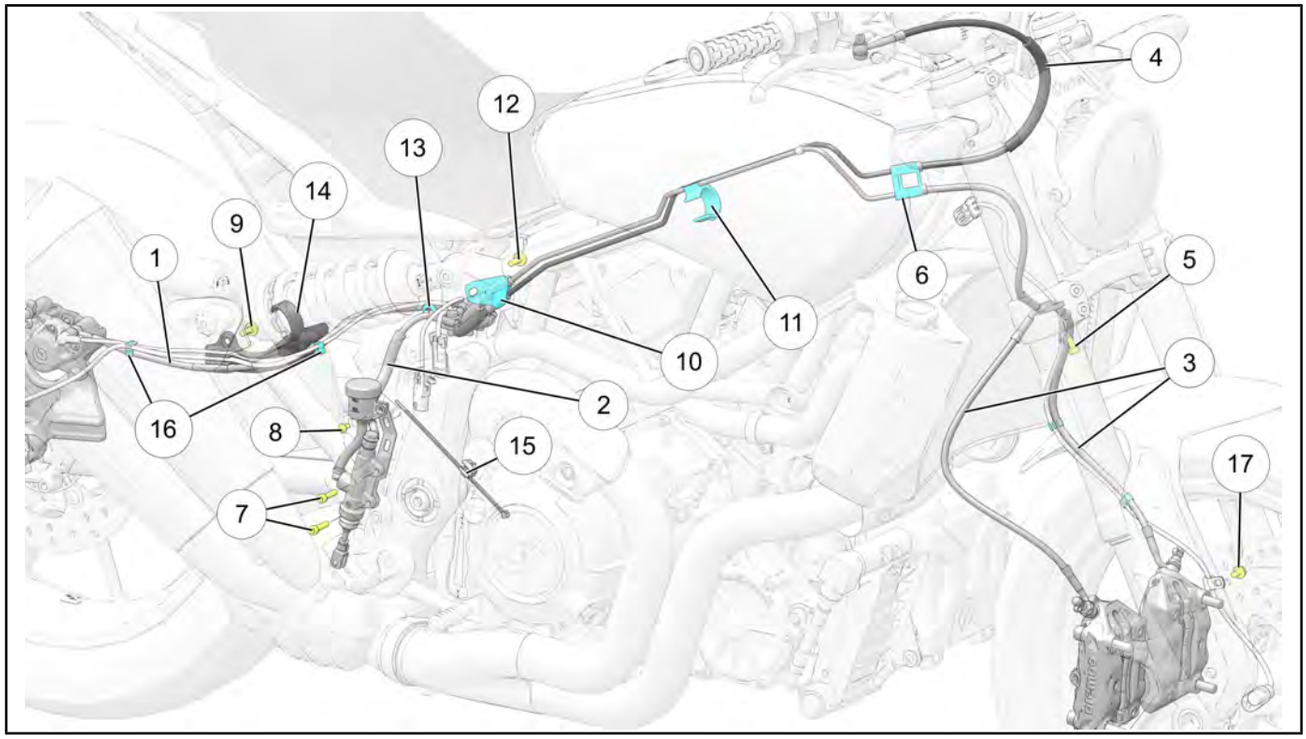
2022+ FTR Models



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Rear Caliper Bleeder Screw	**10 ft-lbs (14 N·m)**
②	Caliper Mounting Fasteners (rear)	**18 ft-lbs (24 N·m)**
③	Banjo Fastener	**18 ft-lbs (24 N·m)**
④	Sealing Washer	-
⑤	Banjo Switch Fastener	**18 (24 N·m)**
⑥	Sealing Washers	-
⑦	Master Cylinder Cover (rear)	-
⑧	Rubber Diaphragm (under cover)	-
⑨	Master Cylinder Mount Fasteners (rear)	**62 in-lbs (7 N·m)**
⑩	Brake Rotor Fasteners	**22 ft-lbs (30 N·m)**

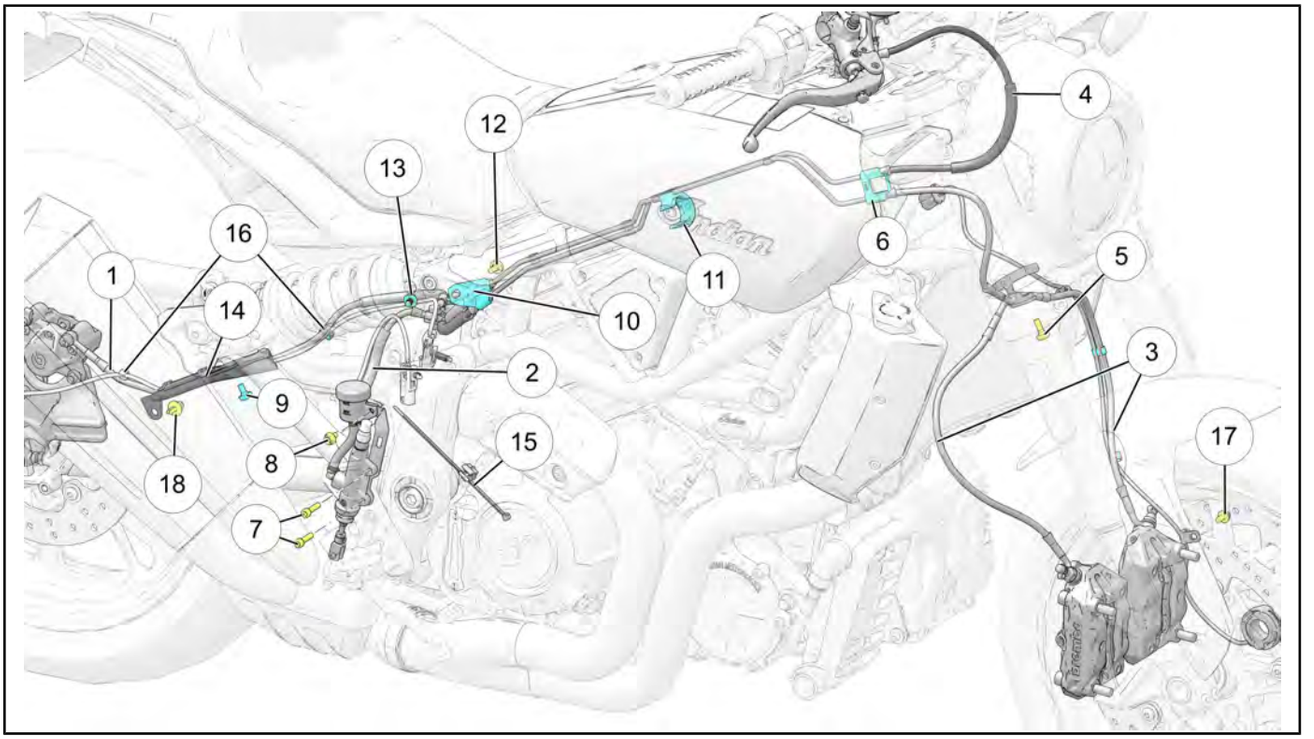
BRAKE LINE ROUTING

2019, 2020 FTR / FTR S & 2022 FTR Rally



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Brake Line (Rear Caliper to ABS Module)	-
②	Brake Line (Rear Master Cylinder to ABS Module)	-
③	Brake Line (Front Caliper to ABS Module)	-
④	Brake Line (Handlebar to ABS Module)	-
⑤	Brake Line Junction Fastener (front)	**84 in-lbs (9 N·m)**
⑥	Holder, Front Brake Lines	-
⑦	Master Cylinder Mounting Fasteners (rear)	**84 in-lbs (9 N·m)**
⑧	Master Cylinder Reservoir Mounting Fastener (rear) - 2019,2020	**84 in-lbs (9 N·m)**
⑨	Brake Line Retaining Clip Fastener (rear)	**84 in-lbs (9 N·m)**
⑩	Retainer, Front Brake Lines (rear)	-
⑪	Retaining Clip, Brake Line (mid-rear)	-
⑫	Fastener, Front Brake Lines (rear)	**84 in-lbs (9 N·m)**
⑬	Clip, Routing	-
⑭	Retaining Clip, Rear Brake Line (rear)	-
⑮	Strap, Cable Tie	-
⑯	Three Way Clip, Rear Brake Line	-
⑰	P-Clamp Fastener	**84 in-lbs (9 N·m)**

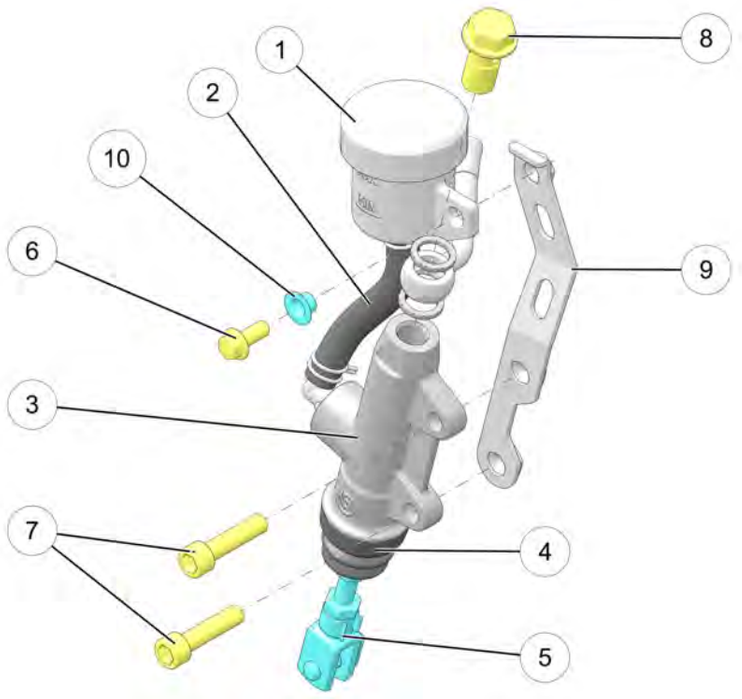
2022+ FTR / FTR S / FTR R Carbon



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Brake Line (Rear Caliper to ABS Module)	-
②	Brake Line (Rear Master Cylinder to ABS Module)	-
③	Brake Line (Front Caliper to ABS Module)	-
④	Brake Line (Handlebar to ABS Module)	-
⑤	Brake Line Junction Fastener (front)	**84 in-lbs (9 N·m)**
⑥	Holder, Front Brake Lines	-
⑦	Master Cylinder Mounting Fasteners (rear)	**84 in-lbs (9 N·m)**
⑧	Master Cylinder Reservoir Mounting Fastener (rear) - 2022+	**62 in-lbs (7 N·m)**
⑨	Brake Line Retaining Clip Fastener (rear)	**84 in-lbs (9 N·m)**
⑩	Retainer, Front Brake Lines (rear)	-
⑪	Retaining Clip, Brake Line (mid-rear)	-
⑫	Fastener, Front Brake Lines (rear)	**84 in-lbs (9 N·m)**
⑬	Clip, Routing	-
⑭	Retaining Clip, Rear Brake Line (rear)	-
⑮	Strap, Cable Tie	-
⑯	Three Way Clip, Rear Brake Line	-
⑰	P-Clamp Fastener	**84 in-lbs (9 N·m)**
⑱	Push Rivet	-

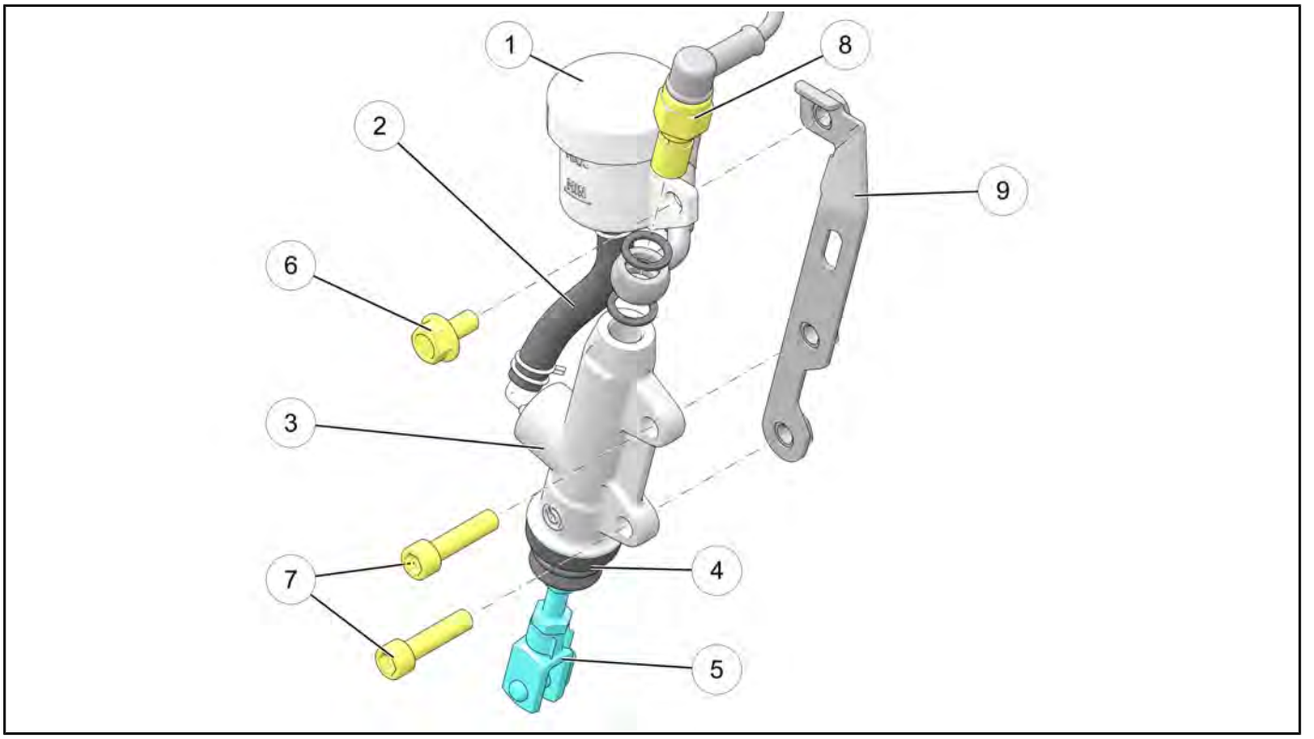
REAR MASTER CYLINDER - ASSEMBLY VIEW

2019, 2020 FTR / FTR S



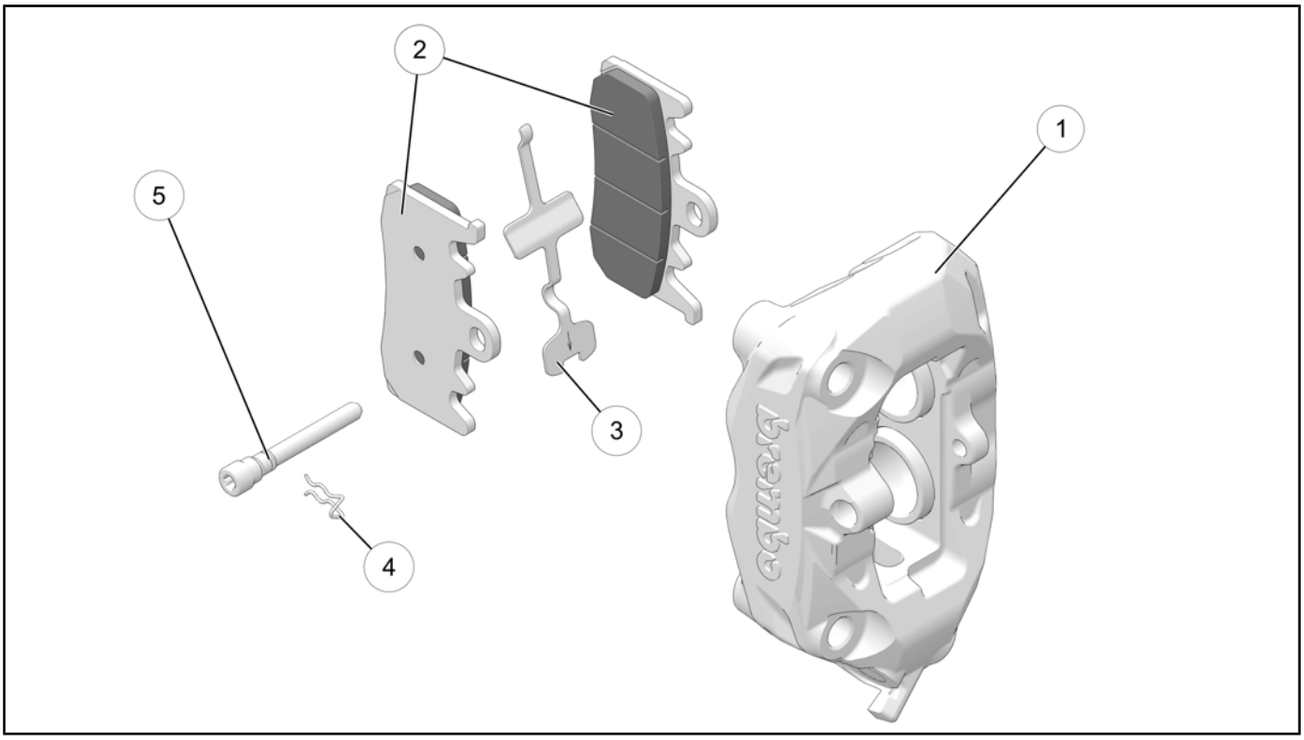
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Brake Fluid Reservoir	-
②	Hose	-
③	Master Cylinder Body	-
④	Dust Boot	-
⑤	Clevis	-
⑥	Master Cylinder Reservoir Mounting Fastener (rear) - 2019,2020	**84 in-lbs (9 N·m)**
⑦	Master Cylinder Mounting Fasteners	**84 in-lbs (9 N·m)**
⑧	Banjo Bolt	**18 ft-lbs (24 N·m)**
⑨	Mounting Bracket	-
⑩	Spacer	-

2022+ FTR models



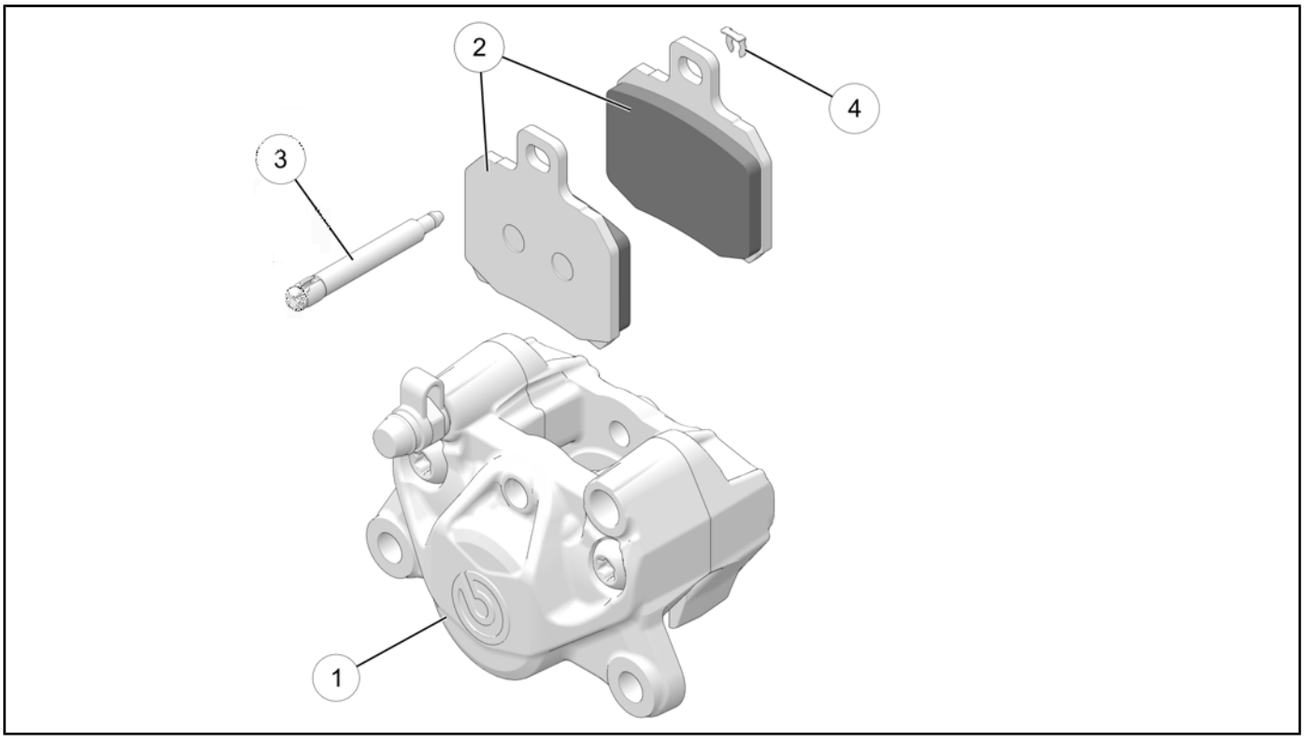
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Brake Fluid Reservoir	-
②	Hose	-
③	Master Cylinder Body	-
④	Dust Boot	-
⑤	Clevis	-
⑥	Master Cylinder Reservoir Mounting Fastener (rear) - 2022+	**62 in-lbs (7 N·m)**
⑦	Master Cylinder Mounting Fasteners	**84 in-lbs (9 N·m)**
⑧	Banjo Switch Fastener	**18 (24 N·m)**
⑨	Mounting Bracket	-

FRONT BRAKE CALIPER - ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Caliper Body Assembly	-
②	Brake Pads (shims not shown)	-
③	Pad Spring	-
④	Pin Clip	-
⑤	Brake Pad Retaining Pin	**53 in-lbs (6 N·m)**

REAR BRAKE CALIPER - ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Caliper Body Assembly, Rear	-
②	Brake Pads (shims not shown)	-
③	Brake Pad Retaining Pin	-
④	Pin Clip	-

ANTILOCK BRAKE SYSTEM (ABS) INFORMATION

ABS SYSTEM SAFETY PRECAUTIONS

Before working on an Indian Motorcycle equipped with anti-lock brakes, review and understand all general brake system, brake fluid, and ABS specific precautions and system information. Do not attempt maintenance or repair of the anti-lock brake system without the proper tools.

⚠ WARNING

Proper brake system bleeding is extremely important to ensure adequate lever reserve in the system. Always perform the Brake Lever Reserve test described in this manual after bleeding the anti-lock brake system.

- Operating with non-recommended tires or improper tire pressure may reduce the effectiveness of the anti-lock brake system.
- Always install the recommended size and type of tires specified for the vehicle.
- Always maintain the recommended tire pressure.
- Indian Motorcycle DOT 4 Brake Fluid is recommended. Change brake fluid at least every 2 years.
- The anti-lock brake system will not prevent wheel lock-up, loss of traction, or loss of control *under all conditions*. Always adhere to all safe motorcycle riding practices as recommended.
- It is not unusual to leave tire marks on the road surface during a hard braking event.
- The anti-lock braking system does not compensate for or reduce the risk associated with:
- excessive speed
- reduced traction on rough, uneven or loose surfaces
- poor judgement
- *improper operation*

ABS GENERAL INFORMATION

The Anti-Lock Brake System is a safety feature designed to prevent wheel lock-up and improve control of the motorcycle during extreme braking events, including:

- Panic braking
- Slick surface braking (such as wet road surfaces)
- Surface transitions (from asphalt to oily asphalt or cobblestone, etc.)

Here are a few general points to note about ABS:

- The anti-lock brake system can be turned OFF (2019, 2020 models). The anit-lock brake system can not be turned OFF for 2022+ models.
- The ABS indicator lamp (located on the Instrument Cluster) always illuminates when the key is in the ON position and remains on until the anti-lock system activates, which occurs when vehicle speed exceeds 6 mph (10 kph).
- If the lamp is not illuminated when the key is ON, connect Digital Wrench and perform an ABS System inspection to determine the cause.
- When the ABS lamp is illuminated, the anti-lock brakes will not activate, but the conventional brake system will continue to operate normally.
- If the lamp continues to illuminate after the vehicle speed exceeds 6 mph (10 kph), the system is not functioning. Connect Digital Wrench and perform an ABS System inspection to determine the cause.
- When the anti-lock brakes engage during a braking event, the rider will feel pulsing at the brake lever or pedal. *Continue to apply steady pressure to the brakes for the best stopping performance*.
- The wheel speed sensor-to-pulse ring air gap is adjustable, unless the wheel speed sensor has the front axle inserted through it. Shims can be added or removed to bring the air-gap into specification. See adjustment procedure outlined in this chapter.
- The ABS system *can* be reprogrammed by an authorized dealer.
- The ABS light is controlled via CAN BUS.
- Wheel speed sensors provide feedback for anti-lock brake operation.
- If fuse is open or removed, the ABS light will remain ON after 6 mph (10 kph). ABS will not be active. Normal (conventional) braking will be available provided the system components (master cylinder, lines, calipers, etc.) are in working order.

ABS OVERVIEW OF OPERATION

The ABS system is active and available when vehicle speed exceeds 6 mph (10 kph).

The system uses two independent Hall-Effect *Wheel Speed Sensors*. One sensor is mounted to the front fork and one is mounted to the rear brake caliper bracket. Two *Pulse Rings* are also used, one mounted to the left front wheel hub (2019,2020 models) or inside the left-hand front wheel bearing (2022+ models) and one to the rear wheel hub. When the vehicle is in motion, the multiple reluctor segments on each pulse ring pass by the center pole of the respective wheel speed sensor, generating an electrical pulse signal in the sensor which is sent to the *ABS Module* which is located in front of the rear wheel.

The ABS Module interprets wheel speed signal pulses to determine speed, rate-of-change, and front / rear wheel speed differential to determine if wheel lock-up is about to occur. When wheel lock-up is imminent during a braking event, the ABS Module controls the operation of solenoids and a pressure pump (located inside the *ABS Module)* to regulate the amount of line pressure and cycles (length of time) applied to the caliper pistons and brake pads. This pressure / time modulation can often be felt at the brake lever or the brake pedal during an ABS braking event and is a normal condition. Note that the brake fluid is not diverted inside the module and does not "flow" in the system any more than occurs in a conventional (non-ABS) brake system.

If the surface coefficient changes (such as moving from wet pavement to dry pavement) the ABS system will recalculate (in a matter of milliseconds) and adjust pressure output to caliper(s) as required.

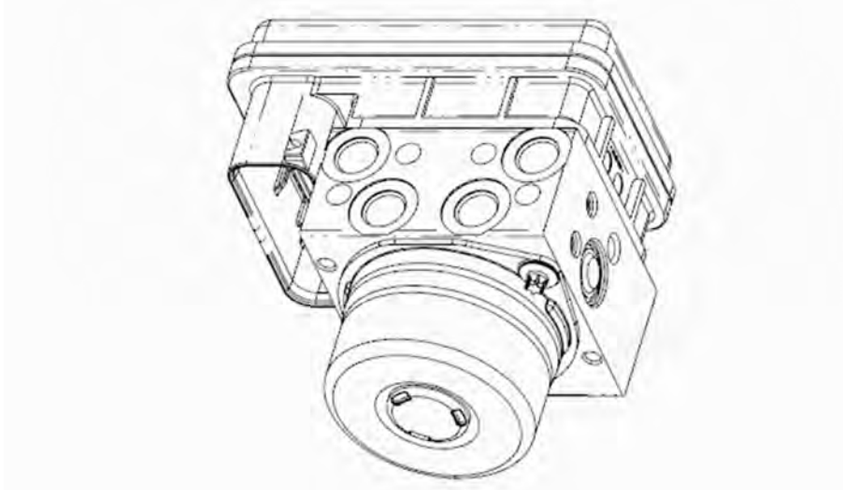
In the event of a system fault, the ECM turns on the ABS indicator lamp (via the CAN BUS) and leaves it on even after vehicle speed exceeds 6 mph (10 kph) activation speed.

If a system fault occurs, the light will remain on (and ABS will not be active) until the ignition key is turned to OFF position and back to ON.

The ABS Module Assembly is serviceable only as an assembly. The module itself is not rebuildable.

Disconnect negative (-) battery cable from battery before servicing ABS brake lines or system components.

ABS MODULE



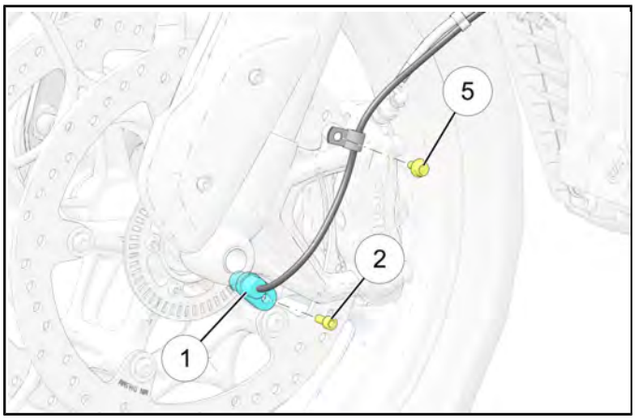
PIN	FUNCTION	PIN	FUNCTION
1	Ground for ECU	10	Ground for Motor
2	CAN High	11	CAN Low
3	Front Wheel Speed Sensor — Signal	12	Front Wheel Speed Sensor — Voltage
4	Ignition	13	Rear Wheel Speed Sensor — Voltage
5	Unused	14	Rear Wheel Speed Sensor — Signal
6	Unused	15	Unused
7	Unused	16	Unused
8	Unused	17	Unused
9	Voltage Supply — ECU	18	Voltage Supply — Motor

ABS SYSTEM SERVICE

WHEEL SPEED SENSOR - REPLACEMENT (2019-2020, 2023 MODELS)

REMOVAL — FRONT

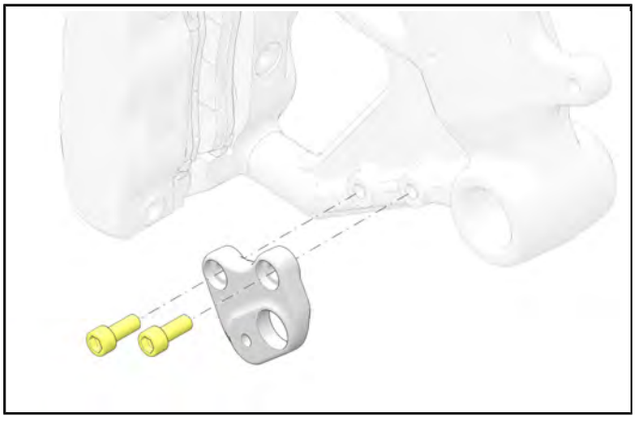
1. Remove the wheel speed sensor ① by removing its fastener ② and P-Clamp fastener ⑤.



2. Withdraw speed sensor and remove any existing shims.
3. Locate connector under the left airbox cover panel and disconnect the wheel speed sensor.

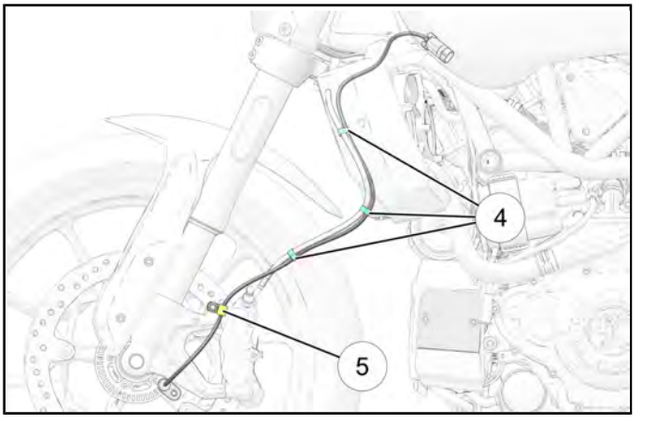
INSTALLATION — FRONT

1. Installation is performed by reversing the removal procedure.
2. If removed, install the wheel speed sensor bracket. Torque fasteners to specification.



TORQUE
Wheel Speed Sensor Bracket Fastener: **97 in-lbs (11 N·m)**

3. Make sure to properly route the wiring using the brake line retention clips ④ and P-Clamp ⑤. Torque P-Clamp fastener to specification.

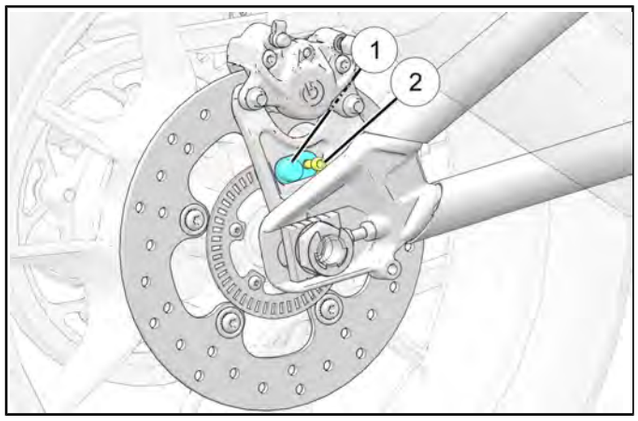


TORQUE
P-Clamp Fastener: **84 in-lbs (9 N·m)**

4. Verify speed sensor air gap is within specification. Perform adjustment procedure if necessary. See **Wheel Speed Sensor - Air Gap Adjustment page 9.36**.

REMOVAL — REAR

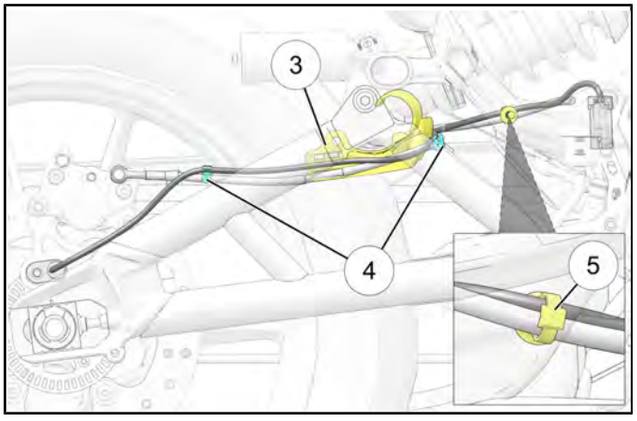
1. Remove the wheel speed sensor ① by removing its fastener ②.



2. Withdraw speed sensor and remove any existing shims.
3. Noting their position, remove the wiring from the retaining clip and three way clips. Snip the routing clip securing the speed sensor harness to remove the speed sensor wire.
4. Remove plastic cover and clips behind the ABS.
5. Locate connector below the ABS module. Disconnect the wheel speed sensor.

INSTALLATION — REAR

1. Installation is performed by reversing the removal procedure.
2. Make sure to properly route the wiring using the brake line retaining clip ③ three way clips ④ and routing clip ⑤.

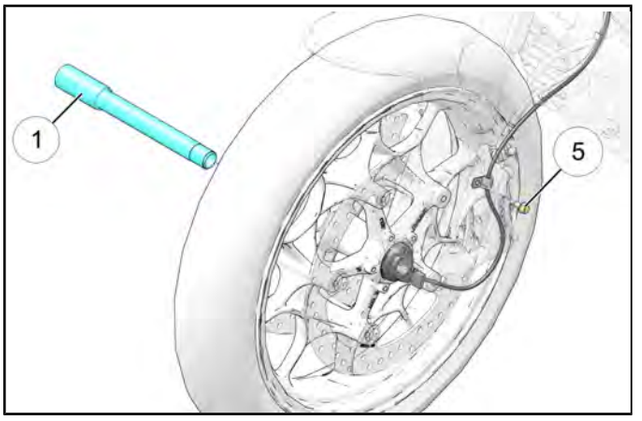


3. Verify speed sensor air gap is within specification. Perform adjustment procedure if necessary. See **Wheel Speed Sensor - Air Gap Adjustment page 9.36**.

WHEEL SPEED SENSOR - REPLACEMENT (2022 MODELS)

REMOVAL — FRONT

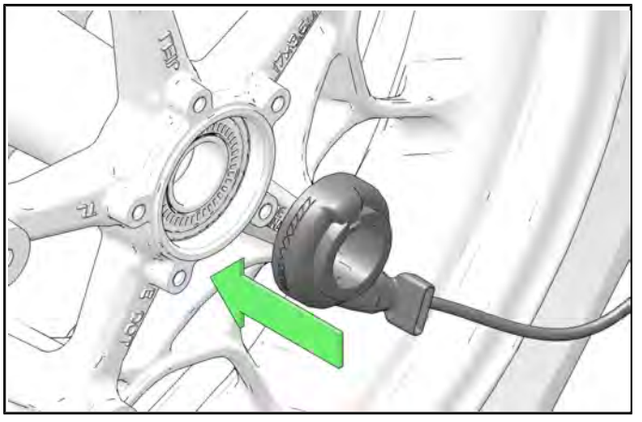
1. Remove the speed sensor line P-Clamp fastener ⑤.



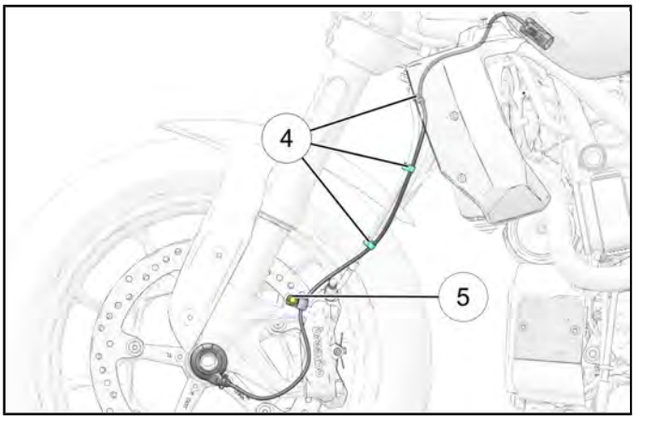
2. Remove the front wheel by removing the front axle ①. See Front Wheel Removal / Installation page 8.29
3. Withdraw speed sensor from the front wheel.
4. Locate connector under the left airbox cover panel and disconnect the wheel speed sensor.

INSTALLATION — FRONT

1. Install the speed sensor into the front wheel.



2. Install the front wheel. See Front Wheel Removal / Installation page 8.29
3. Make sure to properly route the wiring using the brake line retention clips ④ and P-Clamp ⑤. Torque P-Clamp fastener to specification.

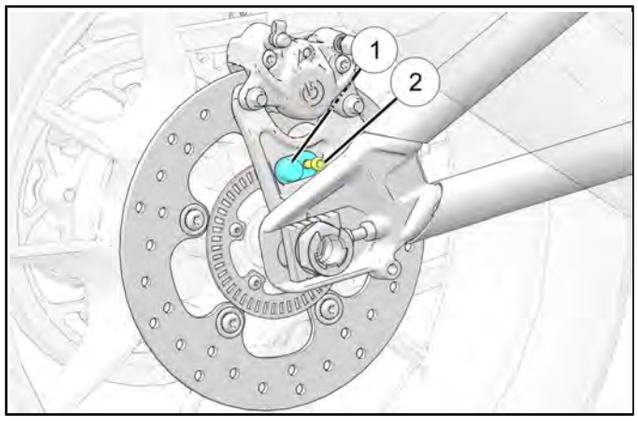


TORQUE
P-Clamp Fastener: **84 in-lbs (9 N·m)**

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

REMOVAL — REAR

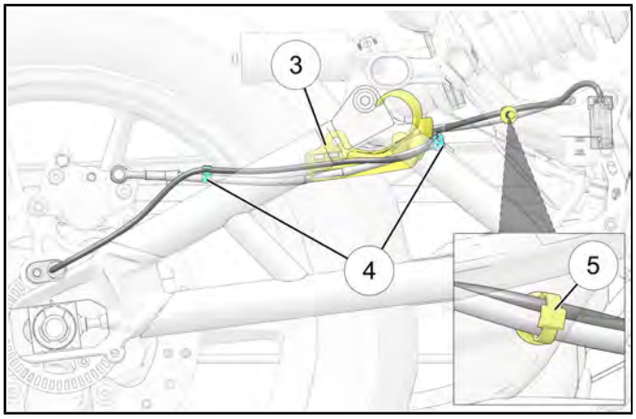
1. Remove the wheel speed sensor ① by removing its fastener ②.



2. Withdraw speed sensor and remove any existing shims.
3. Noting their position, remove the wiring from the retaining clip and three way clips. Snip the routing clip securing the speed sensor harness to remove the speed sensor wire.
4. Remove plastic cover and clips behind the ABS.
5. Locate connector below the ABS module. Disconnect the wheel speed sensor.

INSTALLATION — REAR

1. Installation is performed by reversing the removal procedure.
2. Make sure to properly route the wiring using the brake line retaining clip ③ three way clips ④ and routing clip ⑤.



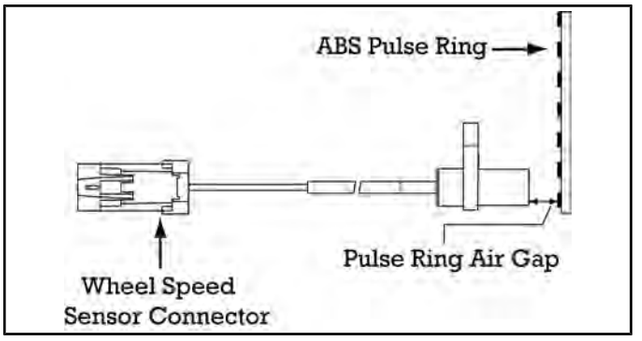
NOTICE
2019–2020 model shown. 2022+ models have a different item ③.

3. Verify speed sensor air gap is within specification. Perform adjustment procedure if necessary. See **Wheel Speed Sensor - Air Gap Adjustment page 9.36**.

WHEEL SPEED SENSOR – AIR GAP ADJUSTMENT

NOTICE
Wheel Speed Sensor air gap is adjusted by adding and removing shims. Shims are added to increase gap and removed to decrease gap. No more than 3 shims (per Wheel Speed Sensor) should be used at one time.

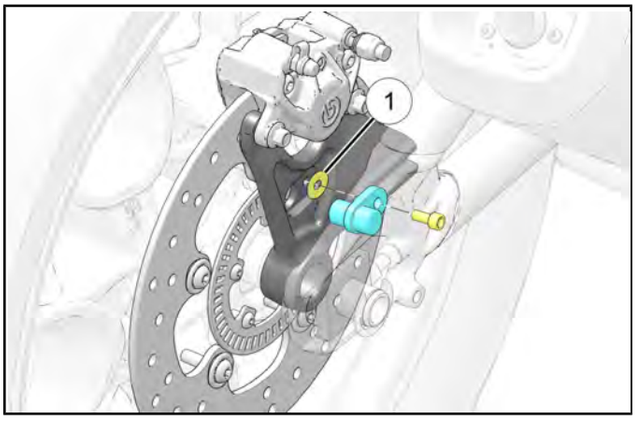
1. Using a suitable feeler gauge, measure the air gap between the ABS Pulse Ring and the Wheel Speed Sensor.



2. If the Wheel Speed Sensor air gap is out of specification, proceed to step 3.

MEASUREMENT
Wheel Speed Sensor Air Gap **Parallel: 1.50–3.0 mm**

3. Remove Wheel Speed Sensor from bracket.
4. Withdraw the speed sensor and remove any existing shims.
5. Based on air gap measurement, add or remove shims ① to achieve the specified air gap.



MEASUREMENT
WSS Shim Thickness: **0.019 in (0.5 mm)**

6. Reinstall Wheel Speed Sensor and torque to specification.

TORQUE
Wheel Speed Sensor Fastener: **88 in-lbs (10 N·m)**

ABS MODULE REPLACEMENT

IMPORTANT

Do not disassemble the ABS module. The ABS module is serviceable only as a sealed (pre-bled) assembly. If ABS module has failed internally, replace complete assembly.

⚠ WARNING

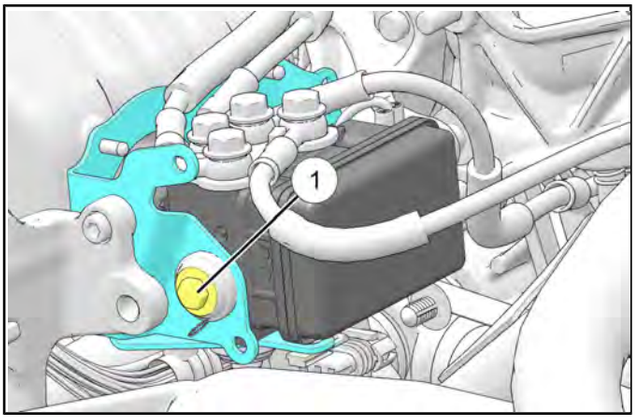
The hydraulic brake system MUST be completely bled following removal or replacement of the ABS module. Follow the brake bleeding procedure outlined in this chapter after ABS module service.

1. Remove seat. See **Seat Removal / Installation page 7.19**.
2. Remove fuel tank. See **Fuel Tank Removal page 4.24**.
3. Remove brake banjo bolts securing brake lines to ABS module.

IMPORTANT

Note orientation and location of brake lines for reinstallation.

4. Remove two fasteners ① securing ABS module to ABS module mount bracket.



5. Disconnect ABS module electrical connector.
6. Remove ABS module from unit.
7. **Installation is performed by reversing the removal procedure.**

TORQUE

Wheel Speed Sensor Mount Fastener:
88 in-lbs (10 N·m)

TORQUE

Banjo Fastener:
18 ft-lbs (24 N·m)

8. Bleed brake system. See Front Brake Bleeding page 9.41,Rear Brake Bleeding page 9.40.

ABS BRAKE SYSTEM BLEEDING

BRAKE FLUID REPLACEMENT / BLEEDING PRECAUTIONS

⚠ WARNING

Contaminated brake discs or brake pads greatly reduce braking performance and increase stopping distance. Do not attempt to clean contaminated pads. Replace them. Clean the brake disc with brake cleaner.

⚠ WARNING

This brake system requires ethylene-glycol based fluid (DOT 4). Do not use or mix different types of fluid such as silicone-based or petroleum-based.

⚠ WARNING

Do not use brake fluid taken from old, used or unsealed containers. Never reuse brake fluid. Brake fluid can accumulate moisture, reducing it's performance.

⚠ WARNING

Brake fluid is poisonous. Keep brake fluid tightly sealed and out of reach of children.

⚠ WARNING

A soft, spongy feeling in the brake lever and/or brake pedal could indicate a hazardous condition in the brake system. Do not operate the motorcycle until the failure in the brake system is corrected.

⚠ WARNING

An unsafe condition exists when air is trapped in the hydraulic brake system. Air in the brake hydraulic system acts like a soft spring and absorbs a large percentage of the pressure developed by the master cylinder. Without this pressure, the braking system cannot develop full braking force to allow for safe, controlled stops. It is extremely important to bleed the brakes properly after any brake system work has been performed or when inspection reveals spongy brakes.

Keep these points in mind when bleeding hydraulic brakes:

- The master cylinder reservoirs have limited capacities. It is easy to empty them during the bleeding procedure. This introduces air into the system which you are trying to purge. Watch the reservoir closely and add fluid when necessary to keep the level above the LOW mark and prevent air from re-entering the system.
- Apply only light to moderate pressure to the lever or pedal when bleeding the brake system. Extreme pressure or rapid movement will cause a surge of fluid through the small orifices of the brake system when the bleeder screw is opened and could introduce air into the system by means of cavitation.
- Always torque banjo bolts and other brake system fasteners and components to specified torque.
- Always install NEW genuine Indian Motorcycle replacement parts and rubber parts upon assembly. Apply special lubricant where indicated (included in service kits).

ABS BRAKE VACUUM BLEEDER

A vacuum bleeder is recommended for ABS system bleeding and can also be used to bleed conventional (non-ABS) brake systems. One style of bleeder is shown below.

BRAKE FLUID CHANGE

Review Brake Fluid Replacement and Bleeding Precautions before working with brake fluid.

IMPORTANT

When bleeding or flushing the system, monitor fluid level in master cylinder reservoir constantly. DO NOT allow fluid level to fall below the LOW level.

Use only DOT 4 brake fluid from a sealed container.

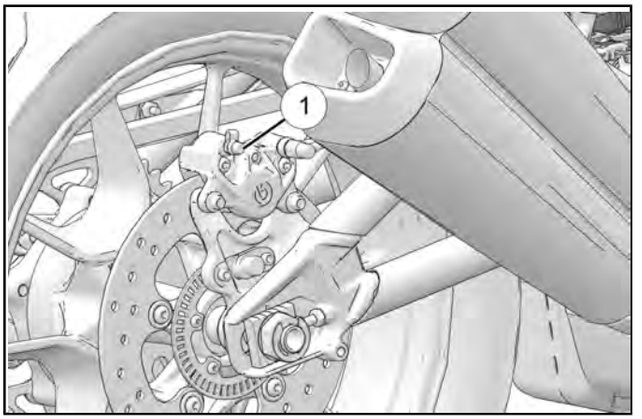
IMPORTANT

FLUSHING THE SYSTEM - Brake systems should be flushed every 2 years or more often if the fluid is discolored. To flush the system, follow normal brake bleeding process, and pump fluid through the system until fluid moving through the bleeder hose is clear. Do not allow reservoir level to fall below the LOW level or complete system bleeding will be required.

REAR BRAKE BLEEDING

IMPORTANT
The use of a vacuum bleeder is recommended. DO NOT allow fluid level in reservoir to drop below the LOW mark at any time during the bleeding procedure. Repeat entire bleed procedure at least once.

1. Remove rubber cap from rear caliper bleed screw ① and place a box end wrench on the screw.
2. Attach a tight-fitting clear hose from the vacuum bleeder to the bleed screw and apply vacuum.

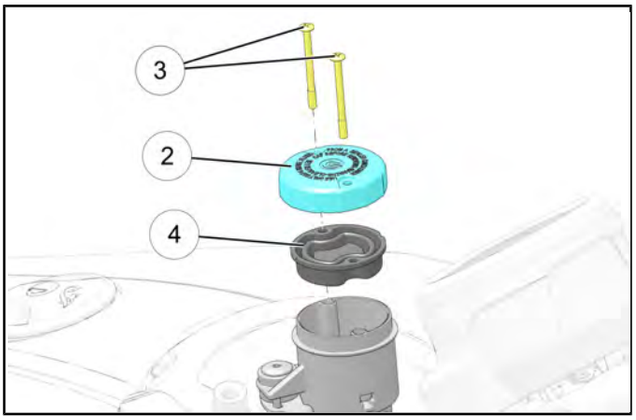


3. Fill rear brake fluid reservoir and leave cover off so fluid can be added as it is drawn through the system.
4. Open bleed screw about 1/4 turn.
5. While making sure the reservoir does not become empty, allow the vacuum bleeder to pull air and fluid through the system. Continue to do so until the brake fluid in the hose is clear and bubble free. Close bleeder screw.
6. With vacuum bleeder still attached to the bleeder screw and the bleeder screw closed, pump the brake pedal multiple times and continue applying force to pedal. While maintaining the force on the pedal, crack the bleeder screw open, then close. Pump the brake pedal repeatedly again.
7. Repeat step 6 until each time the fluid coming out of the bleeder screw does not show any bubbles.
8. *Repeat the entire bleeding process as needed* to be sure all air is purged from the system.
9. After completing the bleeding procedure a second time, inspect brake fluid level and add if necessary.
10. Clean the reservoir cover, diaphragm, and reservoir sealing surface. If diaphragm is extended, return it to normal (flat) position. Install diaphragm and cover.
11. If pedal is not firm, repeat bleeding procedure and insect brake system.
12. Torque all bleed screws to specification and install the rubber caps.

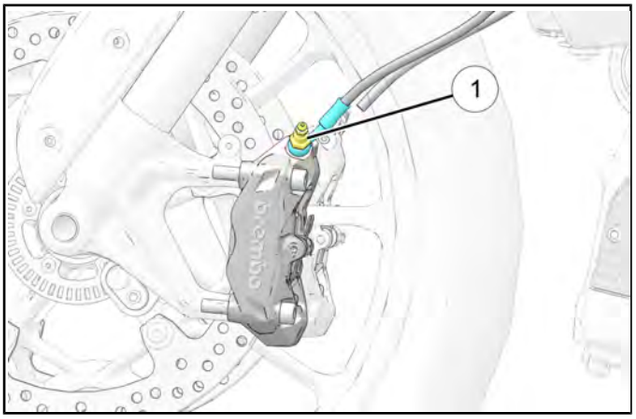
TORQUE
Rear Caliper Bleeder Screw: **10 ft-lbs (14 N·m)**

FRONT BRAKE BLEEDING

1. Pull brake lever forward to ensure smooth lever operation.
2. Remove front master cylinder cover fasteners ③, cover ② and diaphragm ④ and leave cover off so fluid can be added as it is drawn through the system.



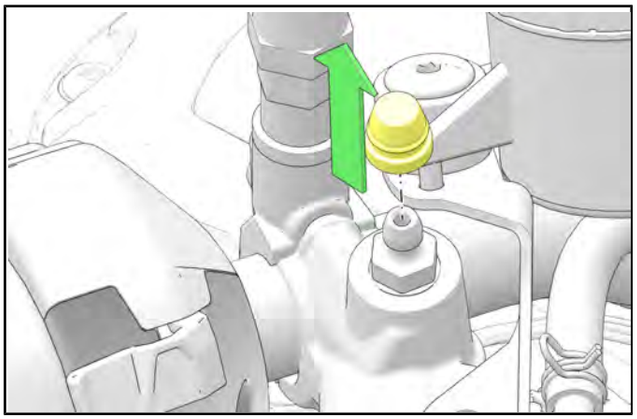
3. Remove rubber cap from bleeder screw ① on front caliper and place a box end wrench on the screw.



NOTE

Front caliper bleeding needs to happen on both left-hand and right-hand calipers. Order is not important.

4. Attach tight fitting clear hose from vacuum bleeder to bleed screw and apply vacuum.
5. Open bleed screw about 1/4 turn.
6. While making sure the reservoir does not become empty, allow the vacuum bleeder to pull air and fluid through the system. Continue to do so until the brake fluid in the hose is clear and bubble free. Close bleeder screw.
7. With vacuum bleeder still attached to the bleeder screw and the bleeder screw closed, pump the brake lever multiple times and continue applying force to lever. While maintaining the force on the lever, crack the bleeder screw open, then close. Pump the brake lever repeatedly again.
8. Repeat step 6 until each time the fluid coming out of the bleeder screw does not show any bubbles.
9. *Repeat the entire bleeding process as needed* to be sure all air is purged from the system.
10. Remove the rubber cap from the bleeder screw on the master cylinder. Attach a clear hose to the bleeder screw with the other end into a container to catch the brake fluid as it comes out.



11. Pump the brake lever multiple times then continue applying force to lever. While maintaining the force on the lever, crack the master cylinder bleeder screw open, then close. Do not release the lever until the bleeder screw is closed. Pump the brake lever repeatedly again.
12. Repeat step 11 until the fluid coming out of the bleeder screw each time does not show any bubbles.

9

13. Fill fluid reservoir and install diaphragm and cover. Torque cover screws to specification.

TORQUE
Master Cylinder Cap Screws (front): **10 in-lbs (1 N·m)**

NOTICE
If all of the above steps have been completed and there is still air in the system, perform the following steps. Attach a hose to a caliper bleed screw, pump up the lever and hold, then crack the caliper bleed screw. Hold the lever to the grip, keep the bleed screw open, and push the caliper pistons back into the caliper to push out air stuck in the caliper. Close the bleed screw, and repeat this process as necessary on both calipers

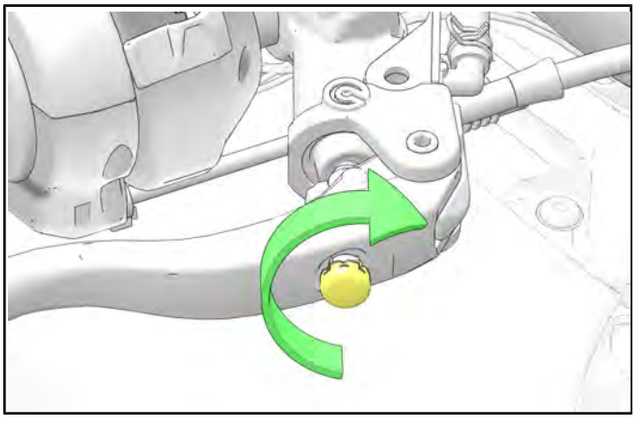
14. Perform Brake Lever Reserve Inspection. See **Brake Lever Reserve Inspection page 9.42**.
15. Torque bleeder screws to specification.

TORQUE
Front Caliper Bleeder Screw (on banjo bolt): **80 in-lbs (9 N·m)**

TORQUE
Master Cylinder Bleeder Screw (front): **10 ft-lbs (14 N·m)**

BRAKE LEVER RESERVE INSPECTION

1. Turn the brake lever adjustment knob clockwise fully until the knob stops.



2. Turn handlebars fully RIGHT.
3. Place grommet of Brake Lever Reserve Inspection Tool **PV-50104** on ball end of front brake lever.
4. Connect a scale (commercially available) with a minimum of 25 kg / 50 lb capacity to end of tool.
5. Keep tool centered so it does not touch hand grip. Pull on scale to specified force.

Brake Lever Reserve Force (minimum): **42 lbs (19 kg)**

6. Have an assistant verify brake lever *does not* contact hand grip. Clearance must exist at specified pull force as shown.
7. If lever makes contact with hand grip or bar end, bleed the front brake system.
8. See troubleshooting if bleeding problems persist.

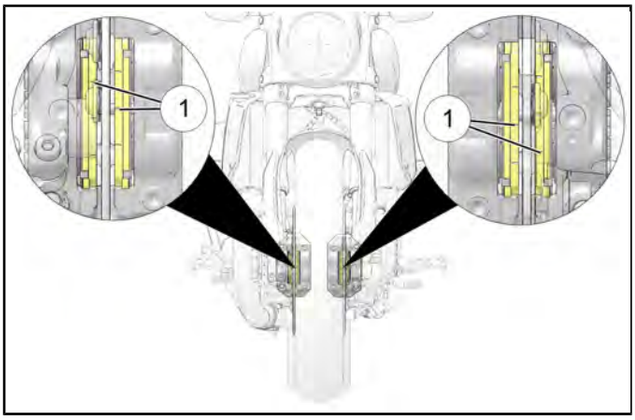
BRAKE SYSTEM SERVICE

FRONT BRAKE PAD INSPECTION

NOTICE

Wear indicator grooves are provided on each front brake pad to allow for a visual inspection without pad removal. Inspect pads by viewing from rear of caliper.
Replace pads if worn to bottom of grooves. See **Front Brake Pad Replacement page 9.43**.

1. Viewing the front brake pads from the rear of the calipers, locate the wear indicator grooves ①.
2. Wear indicator grooves should be visible on both inboard and outboard brake pads.



⚠ CAUTION

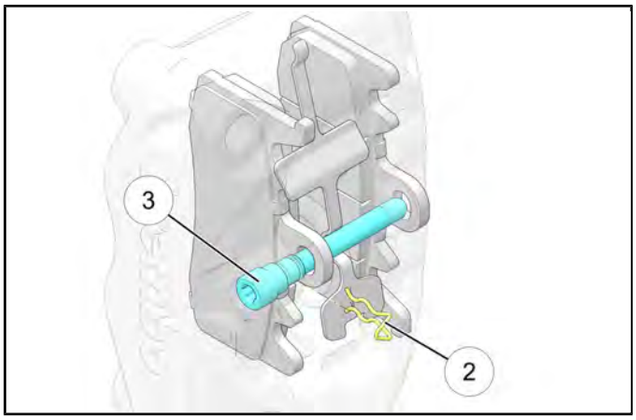
Front brake pads should always be replaced as a complete set. If it is determined that an individual brake pad has worn past the wear indicator groove, the front caliper should receive a new pad set. Failure to replace both front brake pads together may cause reduced braking performance or brake failure, resulting in a vehicle crash.

FRONT BRAKE PAD REPLACEMENT

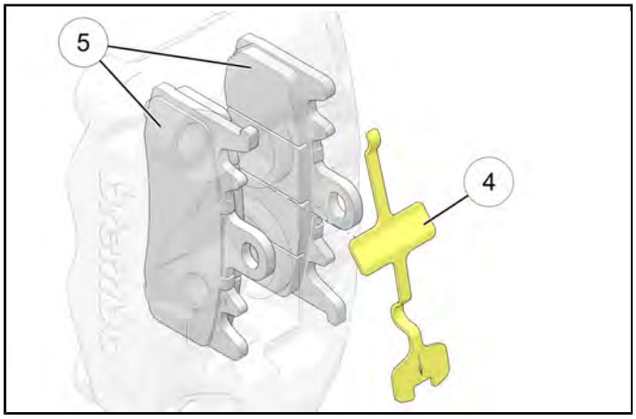
IMPORTANT

Always replace brake pads as a set and always replace pads in both front calipers at the same time.

1. Remove the pin clip ② and brake pad retaining pin ③.



2. Pull out pad spring ④ from the body.



3. Push each pad back by hand to gain clearance for new pads.

NOTICE

Brake fluid will be forced back into the reservoir when pads are pushed back. Remove reservoir cover and monitor fluid level while pushing the pads and pistons back.

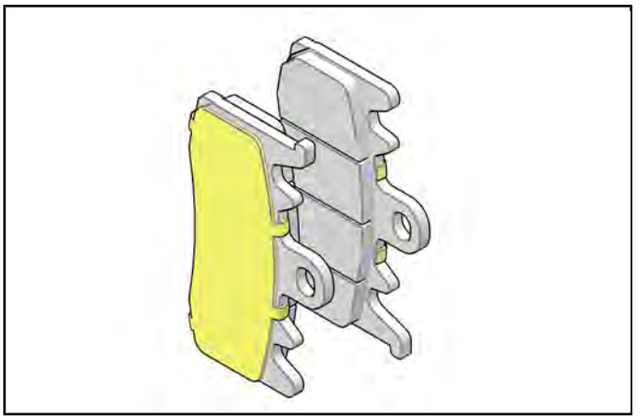
4. Remove each pad ⑤.

9

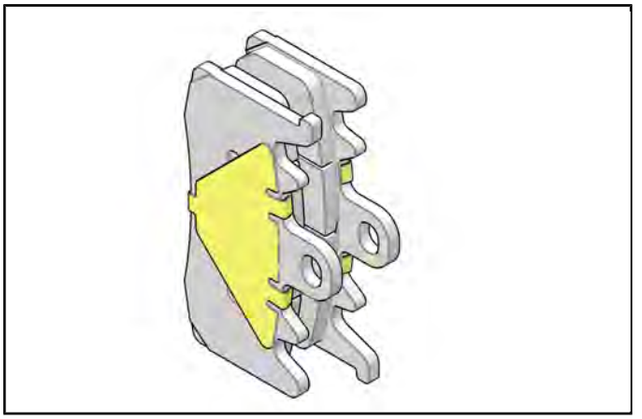
5. Install shims onto brake pads as shown.

NOTICE
2019 did not have shims

2020–22:



2023+



6. Inspect caliper piston for any sign of fluid leakage.

NOTICE
Clean brake caliper surfaces with brake cleaner.

7. Install new brake pads with friction material toward disc.
8. Install the brake pad retaining pin ③ and pin clip ② .
9. Torque brake pad retaining pin to specification.

TORQUE
Brake Pad Retaining Pin: **53 in-lbs (6 N·m)**

10. Inspect brake fluid in reservoir and set to proper level.
11. Slowly pump lever to set brake pads against disc. Lever should be firm, not spongy. If lever is spongy, inspect pad installation, bleed brake lines and inspect brake disc.
12. Install reservoir cover and torque fasteners to specification.

TORQUE
Master Cylinder Cap Screws (front): **10 in-lbs (1 N·m)**

13. Operate brake lever several times until lever is firm and pressure can be felt.

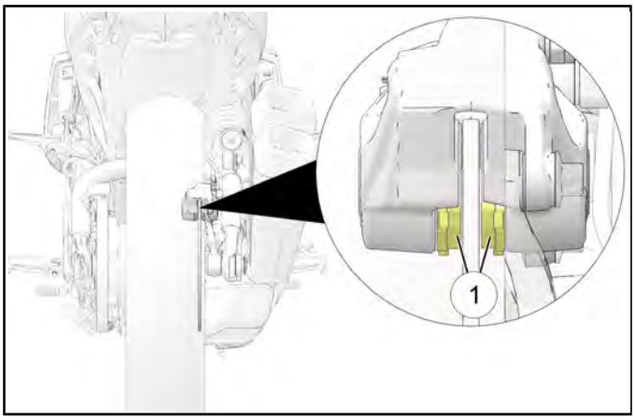
⚠ WARNING
After pad installation or any brake system repair, safely elevate wheel, apply and release brake pedal or lever 2-3 times and release. Verify wheel turns freely without drag. If brake drag is evident, do not operate the motorcycle. Inspect vehicle to determine cause and then repair as necessary.

NOTICE
New brake pads may exhibit reduced braking performance until they are broken in. Refer to owner's manual for break in procedure.

REAR BRAKE PAD INSPECTION

NOTICE
Inspect pads by viewing from the rear of the motorcycle, directly behind the muffler. Replace pads if friction material has worn to a thickness of 1mm. See **Rear Brake Pad Replacement page 9.46**.

1. Place the motorcycle in an upright position with the front wheel clamped in a wheel vise.
2. Viewing the rear brake pads from behind the motorcycle, locate the friction material and measure its thickness①.



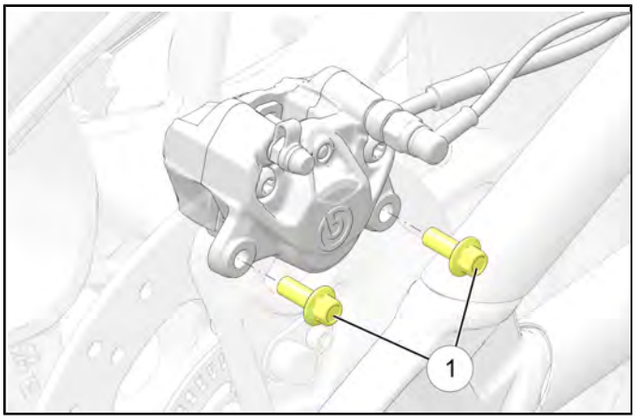
3. Friction material thickness should be at least 1mm on both inboard and outboard brake pads.

REAR BRAKE PAD REPLACEMENT

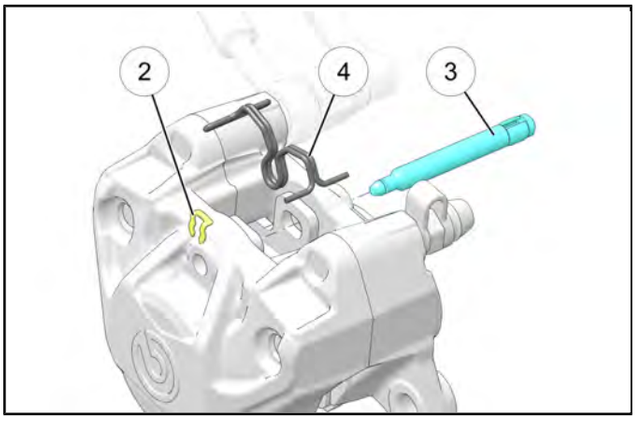
IMPORTANT

Always replace brake pads as a set.

1. Remove the rear brake caliper from the swingarm by removing the two fasteners ①.



2. Remove the pin clip ②, spring ④ and brake pad retaining pin ③.

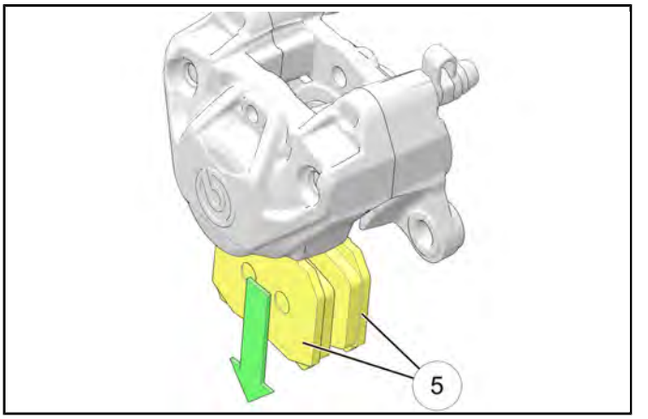


3. Push each pad back by hand to gain freeplay for new pads.

NOTICE

Brake fluid will be forced back into the reservoir when pads are pushed back. Remove reservoir cover and monitor fluid level while pushing the pads and pistons back.

4. Remove each pad ⑤ through the bottom of the caliper.



5. Inspect caliper piston for any sign of fluid leakage.

NOTICE

Clean brake caliper surfaces with brake cleaner.

6. Install new brake pads with friction material toward disc.

NOTICE

Make sure the shim is positioned on the trailing side of each brake pad during forward rotation.

7. Insert pads into caliper until the pad is engaged into the channel.
8. Install the brake pad retaining pin ④, spring ③, and pin clip ② .
9. Install the caliper onto the bracket, ensuring one pad is on each side of the disc. Torque fasteners to specification.

TORQUE

Caliper Mounting Fasteners (rear):
18 ft-lbs (24 N·m)

10. Inspect fluid level in the reservoir and adjust as necessary.
11. Pump brake pedal slowly several times to set new pads against disc, until pedal is firm and pressure can be felt.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

12. Bleed brake system if necessary.

⚠ WARNING

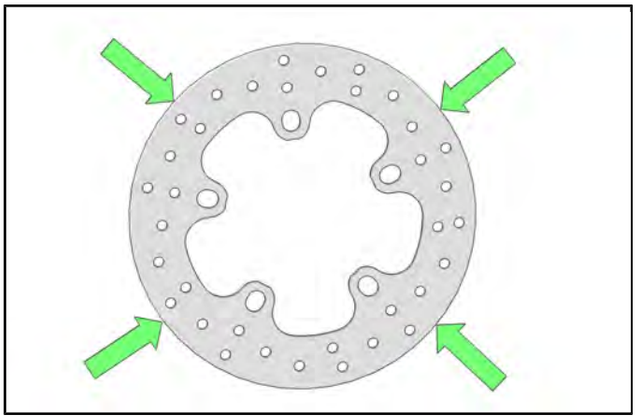
After pad installation or any brake system repair, safely elevate wheel, apply and release brake pedal or lever 2-3 times and release. Verify wheel turns freely without drag. If rear brake drag is evident, inspect pedal freeplay. Do not operate the motorcycle if drag is still evident after freeplay adjustment. Inspect vehicle to determine cause and repair as necessary.

NOTICE

New brake pads may exhibit reduced braking performance until they are broken in. Refer to owner's manual for break in procedure.

BRAKE DISC INSPECTION

1. Visually inspect disc for cracks or damage.
2. Measure brake disc thickness in several locations around disc with a micrometer, and along *wear surface* and compare to specifications. See **Service Specifications - Brakes page 9.4**.



IMPORTANT

Replace the brake disc if any measurement is worn beyond the service limit.

3. With disc mounted to wheel, inspect for brake disc runout / warpage with a dial indicator and compare to specifications. See **Service Specifications - Brakes page 9.4**.

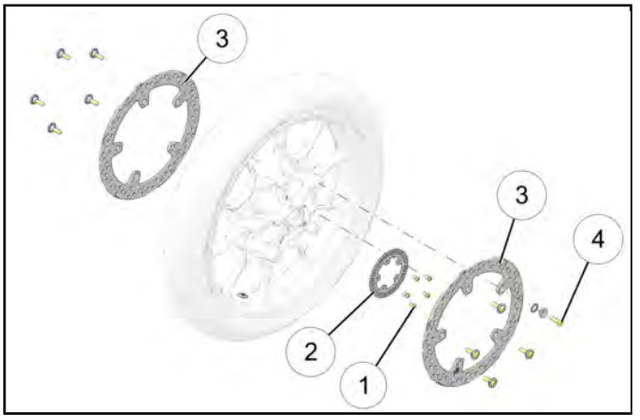
IMPORTANT

Runout should be measured *2-4 mm* in from outside edge of disc.

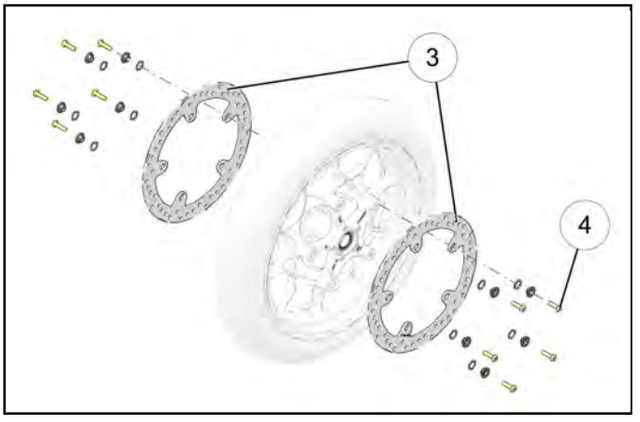
4. Replace brake disc if dial indicator reading displays excessive brake disc runout and other possible causes have been eliminated.

BRAKE DISC REMOVAL / INSTALLATION

1. Remove front wheel. See **Front Wheel Removal / Installation page 8.29**.
2. Position wheel with brake disc facing up.
3. Remove and discard brake disc fasteners ④ .
4. Remove tone ring fasteners ①, tone ring ②, and brake discs ③ from wheel.
   - **2019, 2020, 2023 models**

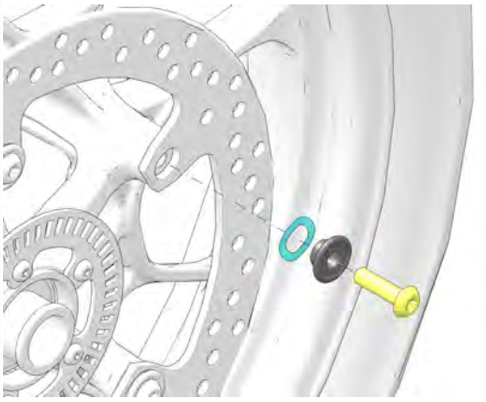


   - **2022 models**



5. **Installation is performed by reversing the removal procedure. Use new brake disc fasteners for installation**

IMPORTANT
Make sure the fastener, bushing, and wave spring are installed in the order shown.



6. Torque *new* brake disc fasteners to specification in a star pattern.

TORQUE
Tone Ring Fasteners (2019–2020, 2023+ models): **84 in-lbs (9 N·m)**

TORQUE
Brake Disc Fasteners: **22 ft-lbs (30 N·m)**

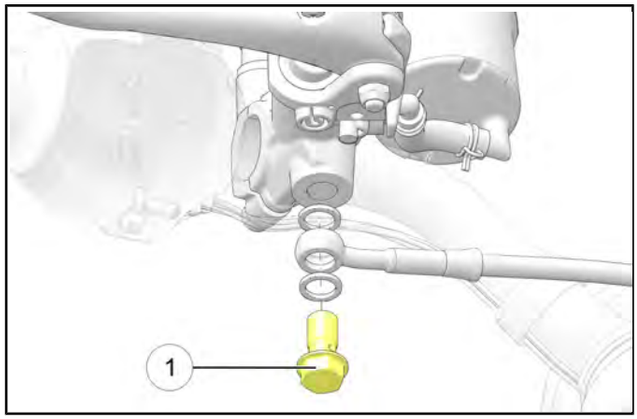
FRONT MASTER CYLINDER REPLACEMENT

⚠ CAUTION

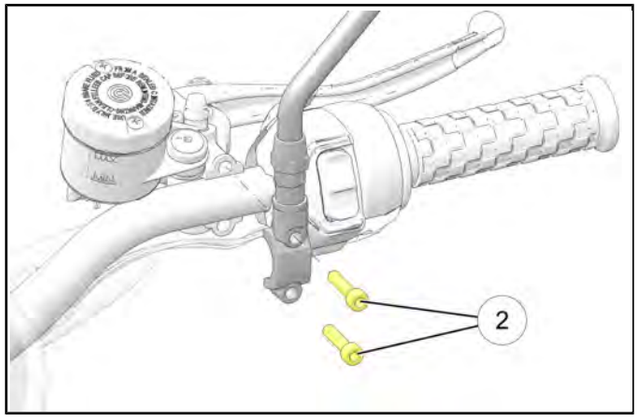
Brake fluid and brake cleaners could damage paint, plastics and some rubber compounds. Cover or remove plastic and painted parts before working on the brake system. If brake fluid is spilled on cosmetic surfaces, immediately rinse the area with a mild solution of soap and water until all traces of brake fluid are removed. Be sure master cylinder reservoir is level before removing cover.

REMOVAL

1. Clean the master cylinder.
2. Remove Banjo Bolt ①, sealing washers, and brake line from the master cylinder.

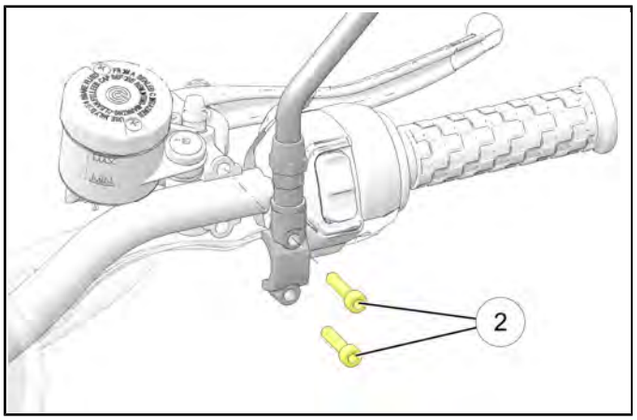


3. Remove the master cylinder from the handlebar by removing the brake lever perch fasteners ②.



INSTALLATION

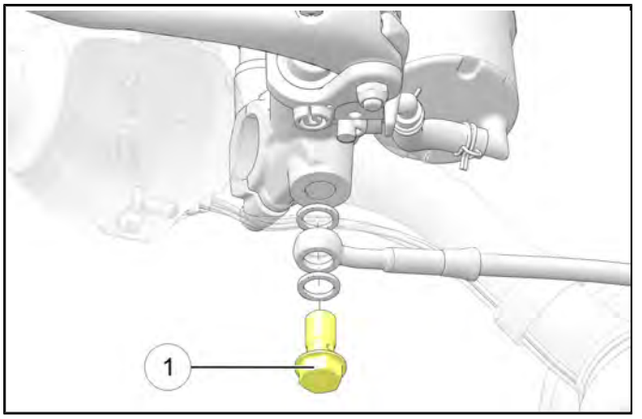
1. Install the master cylinder onto the handlebar using the brake lever perch fasteners. Torque brake lever perch fasteners to specification.



TORQUE
Master Cylinder Clamp Fasteners (front): **88 in-lbs (10 N·m)**

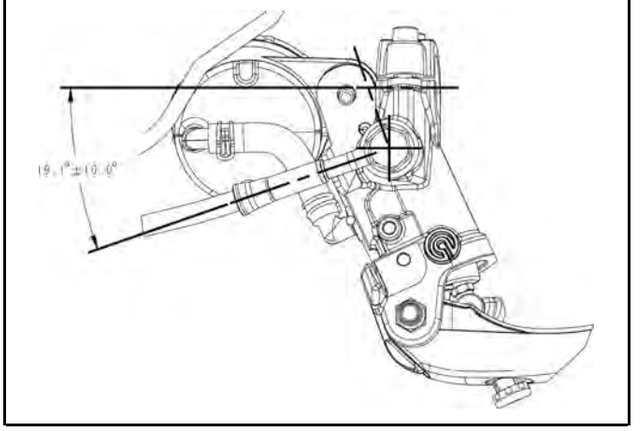
IMPORTANT
Torque the **Master Cylinder Clamp** upper fastener first and the bottom fastener second.

2. Install two NEW sealing washers, brake line and Banjo Bolt ① to the master cylinder.



IMPORTANT

Make sure the brake line is clocked properly as shown before torquing Banjo Bolt.



MEASUREMENT
19.1° ±10.0°

TORQUE
Banjo Bolt: **18 ft-lbs (24 N·m)**

3. Fill the master cylinder reservoir with brake fluid. Set the brake fluid to the proper level and bleed the master cylinder.
4. Slowly pump lever to set brake pads against disc. Lever should be firm, not spongy. If lever is spongy, inspect pad installation, bleed brake lines and inspect brake disc.
5. Install reservoir cover and torque to specification.

TORQUE
Master Cylinder Cap Screws (front): **10 in-lbs (1 N·m)**

6. Operate brake lever several times until lever is firm and pressure can be felt.

⚠ WARNING

After pad installation or any brake system repair, safely elevate wheel, apply and release brake pedal or lever 2-3 times and release. Verify wheel turns freely without drag. If brake drag is evident, do not operate the motorcycle. Inspect vehicle to determine cause and then repair as necessary.

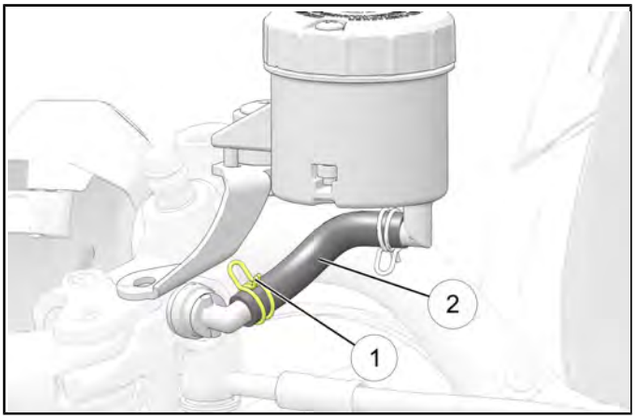
FRONT MASTER CYLINDER RESERVOIR REPLACEMENT

⚠ CAUTION

Brake fluid and brake cleaners could damage paint, plastics and some rubber compounds. Cover or remove plastic and painted parts before working on the brake system. If brake fluid is spilled on cosmetic surfaces, immediately rinse the area with a mild solution of soap and water until all traces of brake fluid are removed. Be sure master cylinder reservoir is level before removing cover.

REMOVAL

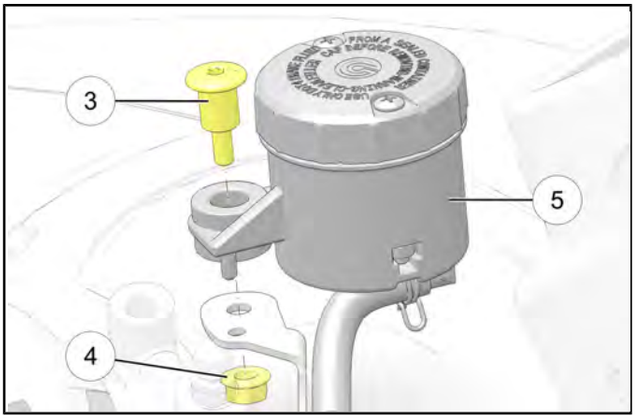
1. Clean the master cylinder.
2. Remove the lower hose clamp ① and place the lower hose end ② in a suitable container to drain fluid from master cylinder.



NOTICE

Drain brake fluid from the front brake system by slowly pumping brake lever.

3. Remove fastener ③ and nut ④. Remove master cylinder reservoir assembly ⑤ from the handlebar.



9

INSTALLATION

1. Install fastener ③ and nut ④ to secure master cylinder reservoir ⑤ on handlebar. Torque nut to specification.

TORQUE
Brake Fluid Reservoir Mounting Nut (front): **44 in-lbs (5 N·m)**

2. Install the lower end of the hose ② onto barb fitting and slide clamp ① into place.
3. Fill the master cylinder reservoir with brake fluid. Set the brake fluid to the proper level.
4. Slowly pump lever to set brake pads against disc. Lever should be firm, not spongy. If lever is spongy, inspect pad installation, bleed brake lines and inspect brake disc.
5. Install reservoir cover and torque to specification.

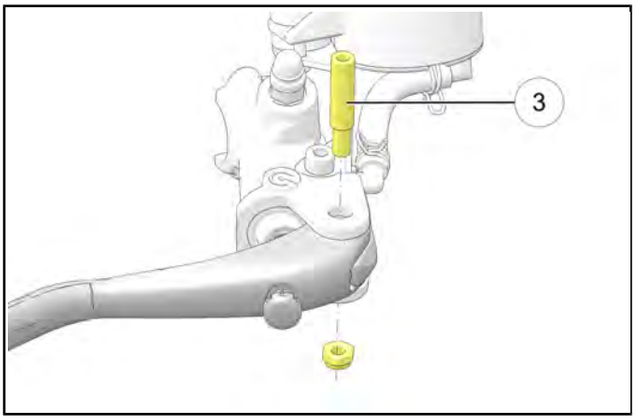
TORQUE
Master Cylinder Cap Screws (front): **10 in-lbs (1 N·m)**

6. Operate brake lever several times until lever is firm and pressure can be felt.

⚠ WARNING
After pad installation or any brake system repair, safely elevate wheel, apply and release brake pedal or lever 2-3 times and release. Verify wheel turns freely without drag. If brake drag is evident, do not operate the motorcycle. Inspect vehicle to determine cause and then repair as necessary.

FRONT BRAKE LEVER REPLACEMENT

1. Remove the brake handle from the master cylinder by removing the pivot fastener ③ and nut.



2. Install brake handle onto the master cylinder and secure it with brake lever pivot fastener ③ and nut. Torque brake lever pivot fastener to specification.

TORQUE
Brake Lever Pivot Fastener: **52 in-lbs (6 N·m)**

3. Freeplay is adjusted from the factory and is set to an optimal position.

⚠ CAUTION
Changing of this adjustment could cause brake damage or failure.

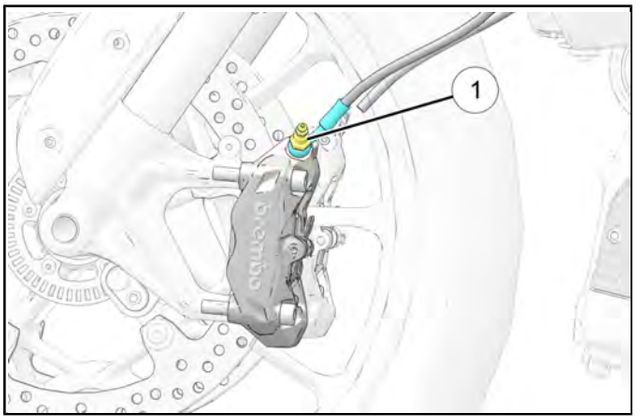
4. Perform Brake Lever Reserve Inspection. SeeBrake Lever Reserve Inspection page 9.42

FRONT CALIPER REMOVAL

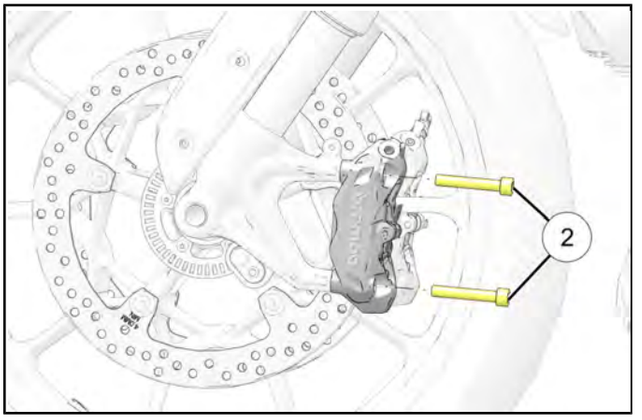
⚠ CAUTION

Brake fluid and brake cleaners will damage paint, plastics and some rubber compounds. Cover or remove plastic and painted parts before working on the brake system. If brake fluid is spilled on cosmetic surfaces, immediately rinse the area with a mild solution of soap and water until all traces of brake fluid are removed. Make sure the master cylinder reservoir being worked on is level before removing the cap.

1. Remove banjo fastener ①, sealing washers, and brake hose from caliper assembly and allow it to drain into a container. Cover the end of brake line to prevent debris from entering.



2. Remove front caliper mounting fasteners ② and remove the caliper.



3. Cover the brake hose connection on the caliper and clean the outer surfaces of caliper assembly with brake cleaner (commercially available) or isopropyl alcohol. Dry with compressed air.
4. Remove brake pads. See Front Brake Pad Replacement page 9.43

IMPORTANT

Pads contaminated with oil or grease must be replaced as a set.

5. Apply brake cleaner to outer surface of all pistons.
6. Install brake pads. Torque retaining pin to specification.

TORQUE

Brake Pad Retaining Pin:
53 in-lbs (6 N·m)

FRONT CALIPER INSTALLATION

1. Clean mounting surfaces of caliper and fork leg.
2. Apply brake cleaner or isopropyl alcohol to a clean shop towel and wipe brake discs clean.
3. Separate brake pads and install caliper assembly over brake disc.
4. Install caliper mounting fasteners and torque to specification.

TORQUE
Caliper Mounting Fasteners (front): **35 ft-lbs (48 N·m)**

5. Connect brake hose to caliper with banjo bolt and new sealing washers. Torque to specification.

TORQUE
Banjo Bolt (Brake Line): **18 ft-lbs (24 N·m)**

6. Fill and bleed the front brake hydraulic system. See **Front Brake Bleeding page 9.41**.

⚠ WARNING
After pad installation or any brake system repair, safely elevate the wheel, apply and release the brake pedal or lever 2-3 times and release. Verify the wheel turns freely without drag. If brake drag is evident, do not operate the motorcycle. Inspect the vehicle to determine the cause and then repair as necessary.

REAR MASTER CYLINDER SERVICE

⚠ CAUTION

Brake fluid and brake cleaners will damage paint, plastics and some rubber compounds. Cover or remove plastic and painted parts before working on the brake system. If brake fluid is spilled on cosmetic surfaces, immediately rinse the area with a mild solution of soap and water until all traces of brake fluid are removed. Make sure the master cylinder reservoir being worked on is level before removing the cap. Replace all rubber parts upon assembly.

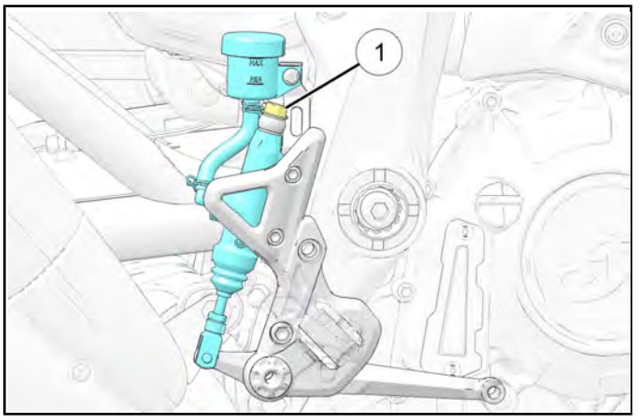
IMPORTANT

Replace all rubber parts upon assembly.

1.

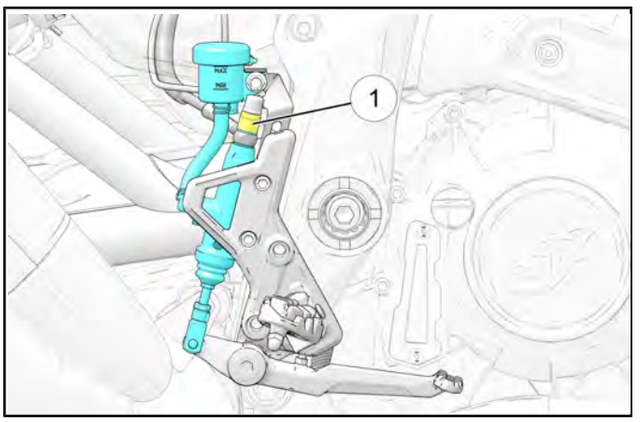
- **2019–2020 models:**

  Remove brake line banjo bolt ①, sealing washers and brake line. Allow fluid to drain into a container.

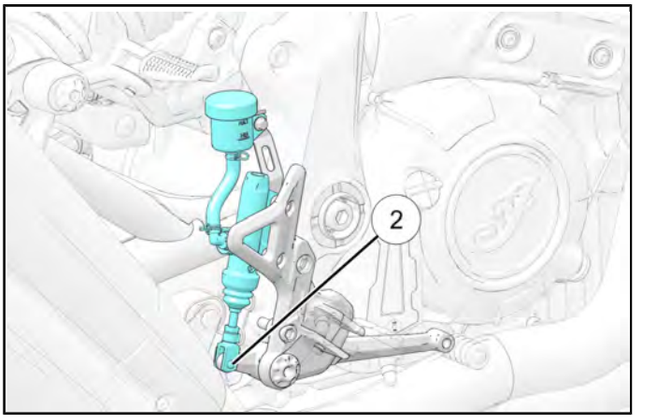


- **2022+ models:**

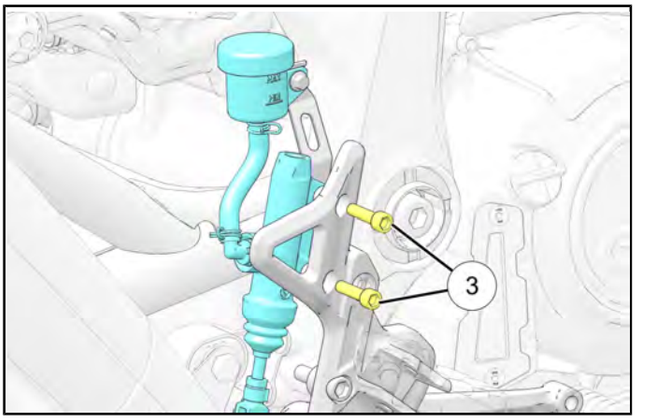
  Remove brake line pressure switch banjo bolt ①, sealing washers and brake line. Allow fluid to drain into a container.



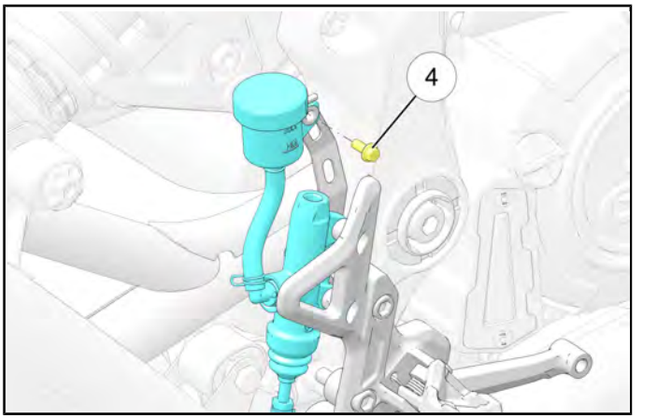
2. Remove clip ② retaining the clevis to the brake pedal.



3. Remove mounting fasteners ③ from master cylinder to footpeg mount. Remove the master cylinder.



4. Remove rear master cylinder reservoir fastener ④.



5. Clean all parts with isopropyl alcohol.
6. Replace ALL RUBBER PARTS with new.

7. Install the master cylinder and torque reservoir fastener, mounting fasteners, and brake line banjo bolt to specification.

TORQUE
Master Cylinder Reservoir Mounting Fastener (rear) - 2019,2020: **84 in-lbs (9 N·m)**

TORQUE
Master Cylinder Reservoir Mounting Fastener (rear) - 2022+: **62 in-lbs (7 N·m)**

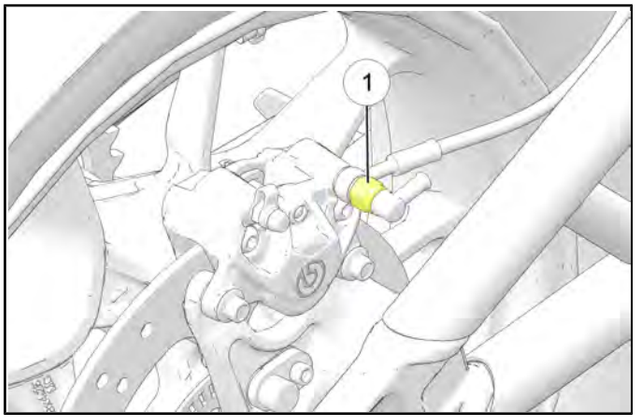
TORQUE
Master Cylinder Mount Fasteners (rear): **84 in-lbs (9 N·m)**

TORQUE
Banjo Fastener: **18 ft-lbs (24 N·m)**

REAR CALIPER REMOVAL

1. Unplug the pressure switch connector (to the right of the ABS module) and remove the cable ties which hold the wire to the brake cable.
2.
   - **2019–2020 models:**

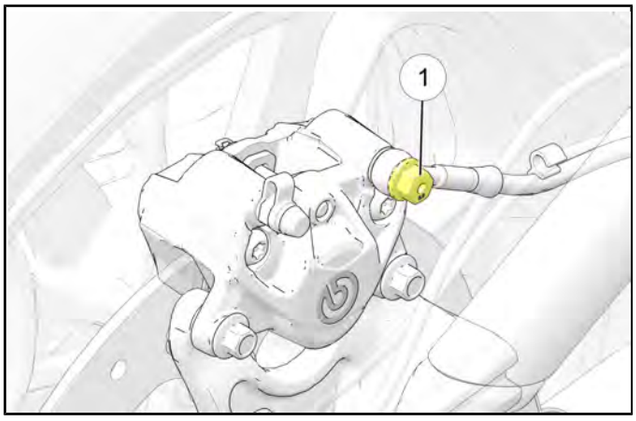
     Remove pressure switch banjo fastener ① and sealing washers from rear caliper and allow fluid to drain into a container.



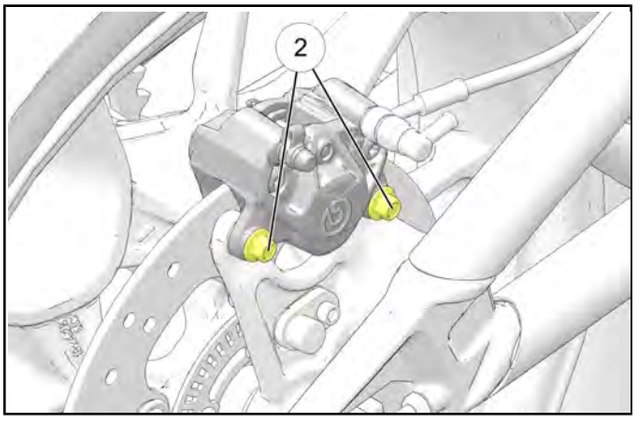
IMPORTANT
Make sure the wire doesn't get twisted while removing the banjo fastener switch.

   - **2022+ models:**

     Remove banjo fastener ① and sealing washers from rear caliper and allow fluid to drain into a container.



3. Remove caliper fasteners ② and remove caliper from the mounting bracket.



4. Remove the rear brake pads. Refer to **Rear Brake Pad Replacement page 9.46**.

REAR CALIPER INSTALLATION

1. Apply brake cleaner to outer surface of all pistons.
2. Install spring clip and outer brake pad. Start pad pin through outer pad.
3. Install inner pad.
4. Install caliper to bracket and torque caliper fasteners to specification.

TORQUE
Caliper Mounting Fasteners (rear): **18 ft-lbs (24 N·m)**

5. **2019-20 MODELS ONLY:** Install zip ties holding the pressure switch to the brake cable. Connect the pressure switch connector.
6. Install brake line with new sealing washers and torque banjo fastener to specification.

TORQUE
Banjo Fastener (rear): **18 ft-lbs (24 N·m)**

7. Fill and bleed the rear brake hydraulic system. See **Front Brake Bleeding page 9.41**.

⚠ WARNING
After pad installation or any brake system repair, safely elevate the wheel, apply and release the brake pedal or lever 2-3 times and release. Verify the wheel turns freely without drag. If brake drag is evident, do not operate the motorcycle. Inspect the vehicle to determine the cause and then repair as necessary.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	POSSIBLE REPAIR NEEDED
Weak Brakes or Erratic Braking Action	Fluid Leakage (External) Fluid Leakage (Internal of Master Cylinder) Worn Pads Oil Contamination of Brake Pads and/or Brake Disc Air In System Low Brake Fluid Level In Reservoir Excessive Brake Disc Runout Worn or Damaged Wheel Bearings Loose Front Axle Nut or Clamps or Loose Rear Axle Caliper Mount Surface Uneven Or Misaligned; Missing or Damaged Fasteners Clogged or Restricted Hydraulic Line Caliper Bracket Misaligned, Bent or Distorted Loose Brake Disc Brake Pads Glazed	Repair or Replace Leaking Component Replace Master Cylinder Replace Brake Pads Pads Must Be Replaced. Disc May Be Cleaned. Bleed Air From System Fill Reservoir, Bleed Brakes, Top Off Fluid Level. Replace Brake Disc. Replace Wheel Bearings. Torque Correctly Inspect / Repair Replace Line(s) Replace Bracket Install New Screws. Torque to Specification Replace Pads. Avoid Needless Heavy Braking for 100-200 miles (Burnish New Brake Pads).
Poor Brakes or No Brakes When First Applied. Brake Lever Pressure Present If Lever Is "Pumped".	Air In System Low Brake Fluid Level In Reservoir Brake Disc is Bent or Warped Caliper Misalignment External Leak Internal Leak (master cylinder) Faulty Brake Hose	Bleed Air From System Fill Reservoir, Bleed Brakes, Top Off Fluid Level. Replace Brake Disc Determine Cause and Correct Repair or Replace Damaged Component Repair or Replace Master Cylinder Inspect for Bulges / Replace
Brake Pedal or Brake Lever Pulsates	Brake Disc Bent or Warped Mounting Surface of Brake Disc Uneven / Disc Loose Caliper Mount Surface Uneven Or Misaligned; Missing or Damaged Fasteners	Replace Brake Disc Repair or Replace as Necessary Repair or Replace as Necessary
Excessive Lever or Pedal Travel / Spongy Brake Feel.	Air in System Loose Mounting Hardware Low Brake Fluid Level In Reservoir Incorrect Brake Fluid Used See "Weak / Erratic Brakes" and Poor Brakes" possible causes above.	Bleed Air From System Repair as Necessary Fill Reservoir, Bleed Brakes, Top Off Fluid Level. Flush System and Replace With Correct Fluid
Fluid Leakage	Loose Banjo Fittings Damaged Banjo Fitting Sealing Washers Cracked / Damaged Hose Worn Master Cylinder Piston, Caliper Piston(s) or Seals Diaphragm (master Cylinder reservoir) Leaking Fluid level too high (new brake pads installed without removing added fluid)	Tighten to Specified Torque Replace Replace Repair / Replace Master Cylinder or Wheel Caliper. Inspect / Replace Cover, Cap, Diaphragm or Reservoir as Required Correct fluid level

PROBLEM	POSSIBLE CAUSE	POSSIBLE REPAIR NEEDED
Brakes Drag Excessively or Self-Apply (Brakes Overheat)	Reservoir Over Filled Brake Pedal Or Lever Not Returning Completely To Rest Position Inadequate Freeplay Compensating Port Plugged Internal Corrosion of Components (Master Cylinder / Caliper) Rear Caliper: Corrosion of Sliding Parts, Bent or Damaged Parts Contaminated Brake Fluid Caliper Pistons Sticking Rider Error (Operator Riding Brakes)	Adjust Level As Necessary Inspect Linkage, Pivots and Mechanism For Cause Of Binding Or Restricted Movement; Replace Master Cylinder Repair or Replace Master Cylinder Replace Damaged Component Repair or Replace As Necessary Flush System, Install Correct Fluid Repair / Replace Caliper (Corrosion / Buildup of Residue In Caliper Piston Seal Grooves) Educate Operator
Brake Squeal/ Squeak	If noise is minor and inconsistent, some brake squeak / squeal is characteristic of disc brakes and usually caused by dust / dirt on pads and / or brake disc. Pad Not Secure in Caliper Aftermarket (not genuine Indian Motorcycle) Parts Worn or Damaged Wheel Bearing(s) Worn Pads / Disc	Apply non oil-based solvent to a clean shop towel and wipe dust / dirt from brake disc. Repair as Necessary. Inspect Pad Installation Install Genuine Indian Motorcycle Parts Replace Replace

CHAPTER 10
ELECTRICAL

STARTING / CHARGING

GENERAL INFORMATION

SERVICE NOTES

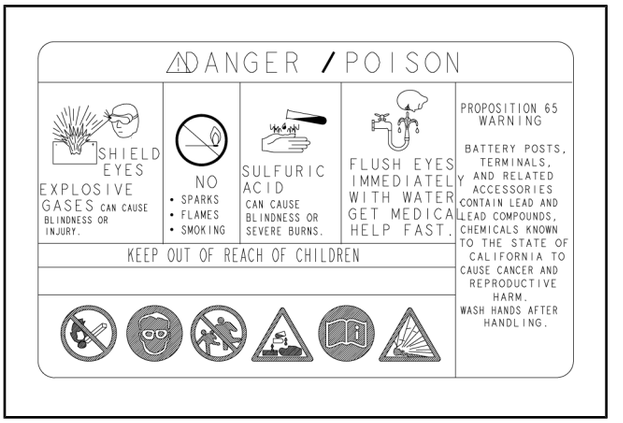
All electrical system and component service can be performed with the engine in the frame.

IMPORTANT

CAUTIONS TO OBSERVE DURING ELECTRICAL SYSTEM SERVICE

- Always turn off ignition switch before disconnecting any electrical component.
- Always verify that bullet-type connectors are free of corrosion, contamination or breaks when troubleshooting electrical problems.
- Verify that bullet-type connectors are firmly seated. Listen and/or feel for a click when connecting them.
- Ensure to release the lock on lock-type couplers before disconnecting them to avoid damaging the connector.
- Pulling on the wires when disconnecting couplers can introduce problems. Hold the connectors themselves when disconnecting them, not their associated wires.
- Inspect each male and female terminal of multi-pin connectors for corrosion, contamination, loose or bent pins.

Battery Label



⚠ WARNING

Battery electrolyte is poisonous. It contains sulfuric acid. Serious burns can result from contact with skin, eyes or clothing. Antidote:

- **External:** Flush with water.
- **Internal:** Drink large quantities of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Call physician immediately.
- **Eyes:** Flush with water for 15 minutes. Call physician immediately.

Batteries produce explosive gases. Keep sparks, flame, cigarettes, etc. away. Ventilate when charging or using in an enclosed space. Always shield eyes when working near batteries.KEEP BATTERIES AND BATTERY ACID OUT OF REACH OF CHILDREN.

The charging system used on the motorcycle is calibrated for the maintenance free battery that is installed as original equipment. Do not replace with a conventional lead-acid battery. Before troubleshooting the charging system, inspect the battery thoroughly. A discharged, poorly charged or faulty battery will make the readings obtained during charging system troubleshooting erroneous or difficult to interpret.

A battery will self-discharge when the motorcycle is not in use. Make sure to properly store the battery as outlined later in this section.

Maximum voltage and service life is only achieved when the battery is properly serviced initially. Make sure to follow instructions outlined later in this section.

Overcharging can be caused by a faulty battery (shorted cell). Test system with a known good battery when diagnosing an overcharge condition.

New batteries must be properly maintained as outlined in this section to ensure proper service life.

⚠ CAUTION

Even with a good battery, battery voltage can recover after charging, but under excessive loads the battery voltage will drop quickly and eventually "die". Often the charging system is suspect when it is not the cause of the problem. Always inspect for excessive loads if the battery continues to lose its charge. Items such as incorrect wattage bulbs, sticking brake light switch(s), continuous low rpm operation or leaving the lights on without the engine running for long periods of time can drain a battery even if the charging system is operating correctly.

⚠ CAUTION

WIRE ROUTING

Make sure that all wires are routed correctly away from moving parts, hot exhaust, or sharp edges.

⚠ CAUTION

FUSES

Fuses are in place to protect circuit wiring and components. Always determine the cause of an open fuse before installing a new fuse.

Do not increase the value of the fuse to correct the problem.

Do not use wire, tin foil or other substitutes for fuses.

⚠ CAUTION

ELECTRONIC COMPONENTS

Semiconductor parts used in electronic components will not withstand careless handling.

Do not drop or strike parts that contain semiconductors such as the ECM or rectifier/regulator. Dropping electronic components can cause damage to the component.

Follow instructions supplied in this chapter, including Fuel Delivery / EFI Chapter (Fuel Injection) and Electrical Chapter (Ignition System), very carefully when working on electronic components. Failure to follow instructions may cause irreparable damage to the part being inspected.

SPECIAL TOOLS - ELECTRICAL (STARTING / CHARGING)

TOOL DESCRIPTION	PART NUMBER
Battery Tester	PU-50296
Electrical Tester Kit	PV-43526
Relay Bypass	PU-49466
MultiLink XP	PU-52792
USB to Serial Adapter	PU-50621

SERVICE SPECIFICATIONS - ELECTRICAL (STARTING / CHARGING)

ELECTRICAL SPECIFICATIONS

ITEM		SPECIFICATIONS
Electrical (General)	Ignition System	Distributor-less Transistorized Dual Coil Type Ignition
	Starting System	Electric
	Charging System	Permanent Magnet / 3 Phase / Full Wave Rectification
	Regulator/ Rectifier	Solid State Three Phase Voltage Regulator/ Rectifier
	Lighting System	12 V DC

CHARGING SYSTEM SPECIFICATIONS

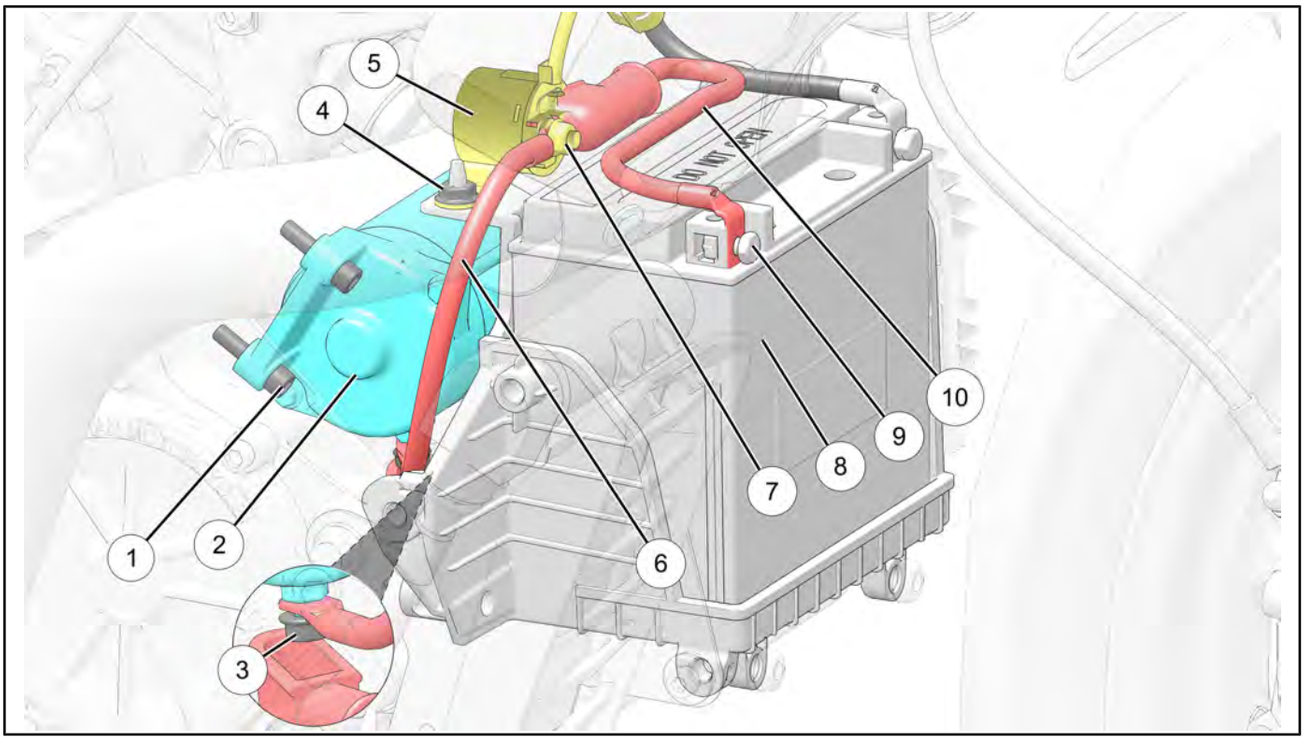
ITEM		SPECIFICATIONS
Alternator No Load AC Output @ 800 - 1000 RPM (Engine cool)		27 VAC @ Idle
Alternator No Load AC Output @ 2000 RPM (Engine cool)		34 VAC @ 2000 RPM
Stator Coil Resistance (@ 21°C / 70°F) (Black to each other black) (Disconnect regulator - see test.)		146 milliohms ±20%
Stator Coil Resistance To Ground (Each black wire)		Infinity (no continuity)
Regulator/Rectifier Regulated Voltage		14.3 - 14.7 V DC
Alternator Output (Amps / Watts)		32A (460 Watts) @ 6000 RPM
Battery	Type	Yuasa: YTX14H
	Voltage	12 Volts DC
	Nominal Capacity @ 10 Hr Rate	12 AH
	Recommended Battery Charging Current	STD: 1.20 A for 5 to 10 hrs
	Cold Cranking Amp Rating	240

STARTING SYSTEM SPECIFICATIONS

ITEM	SPECIFICATION
Battery Voltage, No Load	Above 12.8 V DC
Resistance: Between Any Two Commutator Bars	Continuity (0 Ohms)
Resistance: Commutator to Armature Shaft	Infinity (OL on Fluke™ 73)
Resistance: Battery Input Terminal to Insulated Brush	Continuity (0 Ohms)
Resistance: Bat. Input Terminal to Starter Motor Case	Infinity (OL on Fluke™ 73)
Starter Motor Operating Amp Draw	140 - 160 Amps
Starter Motor No Load Amp Draw (Bench Test)	30 - 37 Amps after initial surge
Starter Torque Limit Clutch Break-Away Torque	50 - 60 ft-lbs (70 - 80 Nm) when new

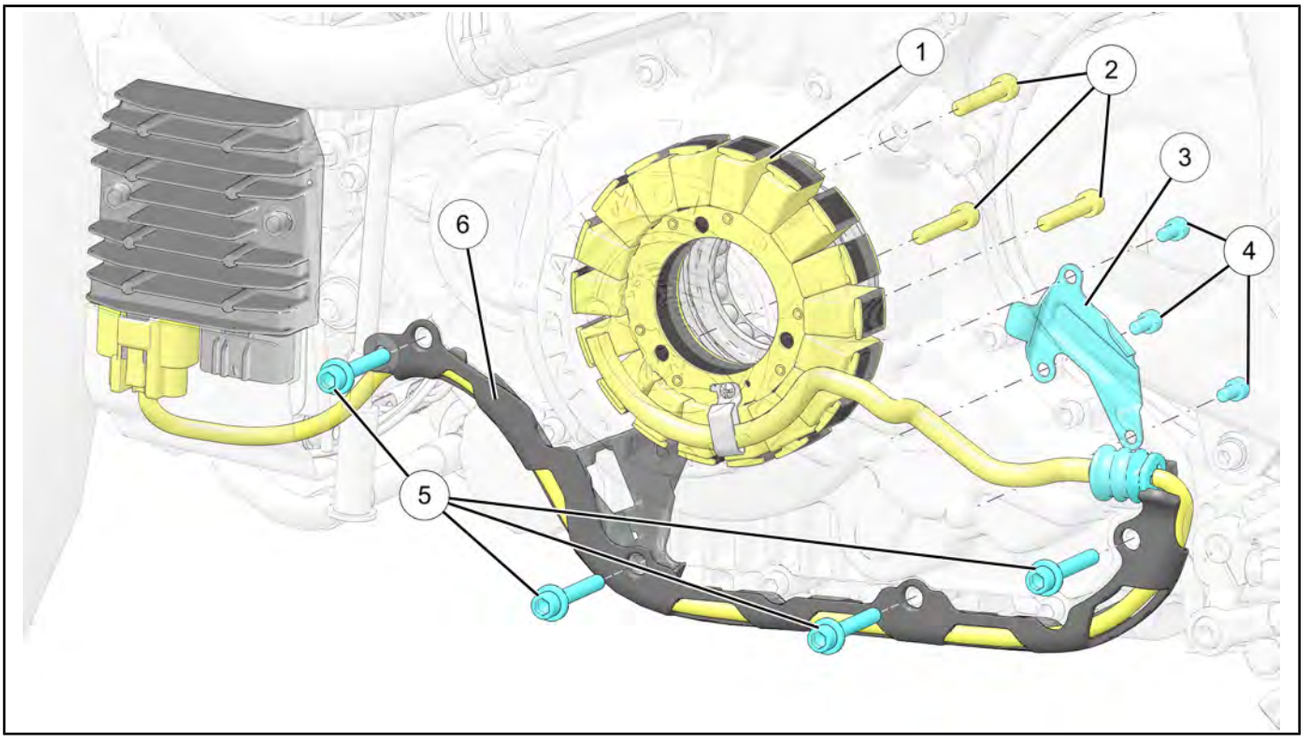
ASSEMBLY VIEWS

STARTER MOTOR / SOLENOID - ASSEMBLY VIEW



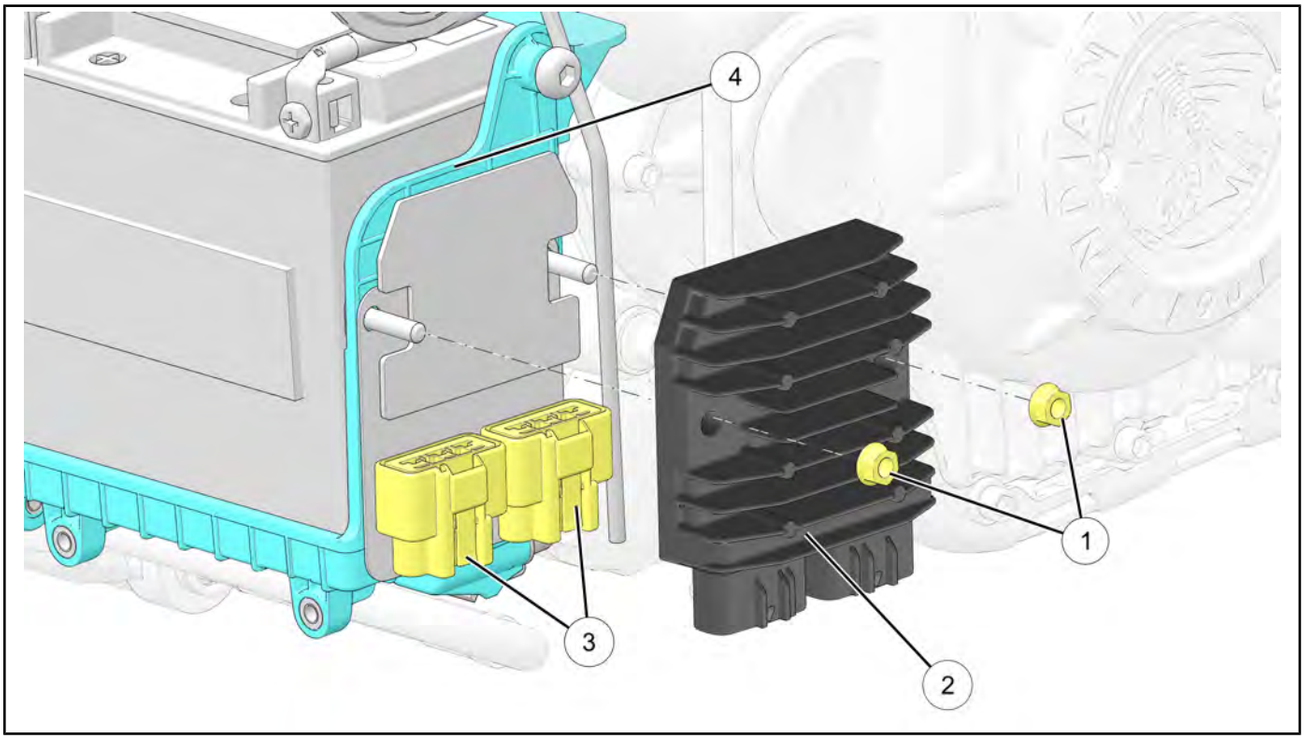
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Starter Motor Fastener	**88 in-lbs (10 N·m)**
②	Starter Motor	—
③	Battery Cable To Starter Motor Nut	**60 in-lbs (7 N·m)**
④	Starter Solenoid Bracket Nut	**12 in-lbs (1 N·m)**
⑤	Starter Solenoid	—
⑥	Starter Motor Battery Cable	—
⑦	Starter Solenoid Terminal Nut	**47 in-lbs (5 N·m)**
⑧	Battery	—
⑨	Battery Terminal Fastener	**25 in-lbs (3 N·m)**
⑩	Starter Solenoid Battery Cable	—

STATOR - ASSEMBLY VIEW



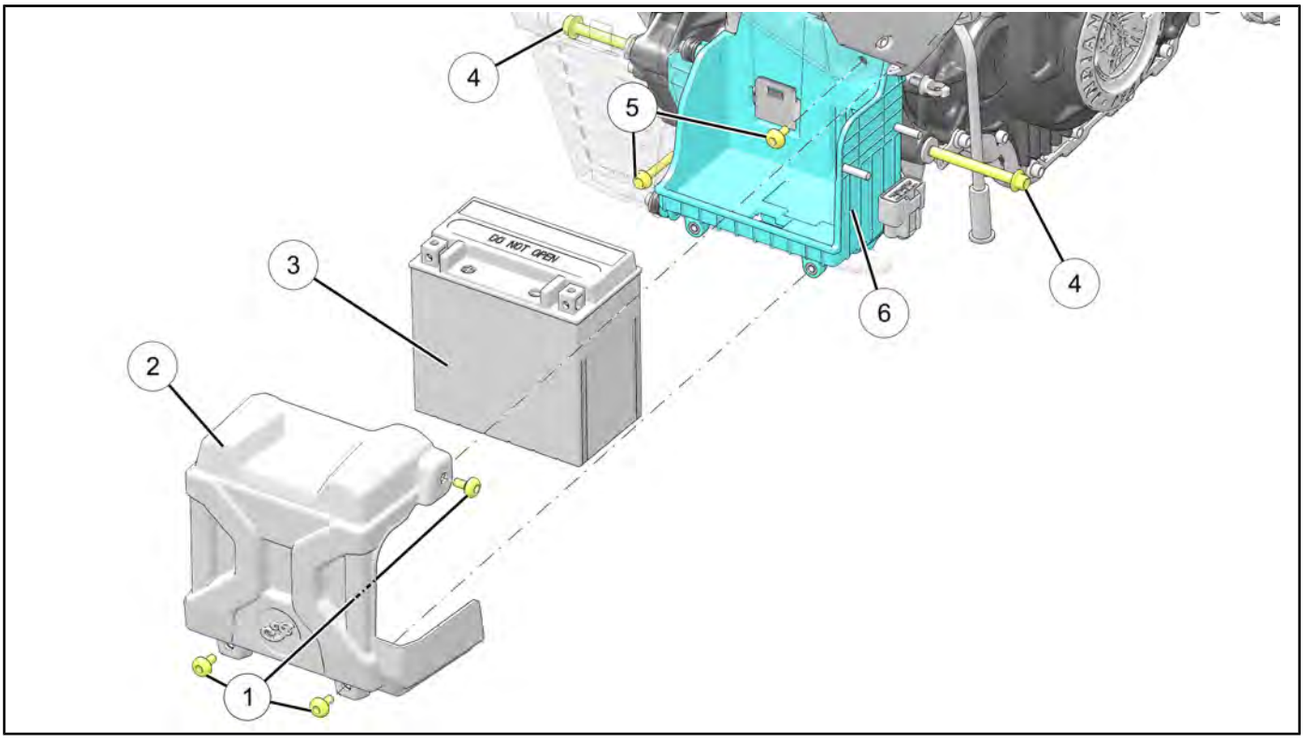
NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Stator	—
②	Stator Mounting Fasteners to Cover - (QTY.3)	**88 in-lbs (10 N·m)**
③	Stator Wire Clip	—
④	Stator Clip Fasteners - (QTY.3)	**71 in-lbs (8 N·m)**
⑤	Stator Cable Retainer Fasteners	**108 in-lbs (12 N·m)**
⑥	Stator Cable Retainer	—

REGULATOR / RECTIFIER - ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Regulator / Rectifier Nuts	**30 in-lbs (3 N·m)**
②	Voltage Regulator / Rectifier	—
③	Regulator / Rectifier Electrical Connections	—
④	Battery Tray	—

BATTERY TRAY - ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Battery Cover Fasteners	**36 in-lbs (4 N·m)**
②	Battery Cover	—
③	Battery	—
④	Battery Tray Through Bolts	**96 in-lbs (11 N·m)**
⑤	Battery Tray Base Fasteners	**96 in-lbs (11 N·m)**
⑥	Battery Tray	—

BATTERY SERVICE

BATTERY

This motorcycle is equipped with a maintenance free battery. DO NOT remove cell caps or add distilled water to the battery. If the battery discharges, refer to Electrical Chapter for diagnostic information.

⚠ WARNING

Battery electrolyte is poisonous. It contains sulfuric acid. Serious burns can result from contact with skin, eyes or clothing. Antidote:

External: Flush with water.

Internal: Drink large quantities of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Call physician immediately.

Eyes: Flush with water for 15 minutes and get prompt medical attention.

Batteries produce explosive gases. Keep sparks, flame, cigarettes, etc. away. Ventilate when charging or using in an enclosed space. Always shield eyes when working near batteries. **KEEP CHILDREN AWAY FROM BATTERY.**

⚠ CAUTION

Whenever removing the battery, disconnect the negative (black) cable first. When reinstalling the battery, connect the negative (black) cable last.

Do not remove the battery cables while the engine is running. Doing so may damage the Electronic Control Module (ECM).

Take great care NOT to reverse the battery leads when installing the battery.

BATTERY DISCONNECT

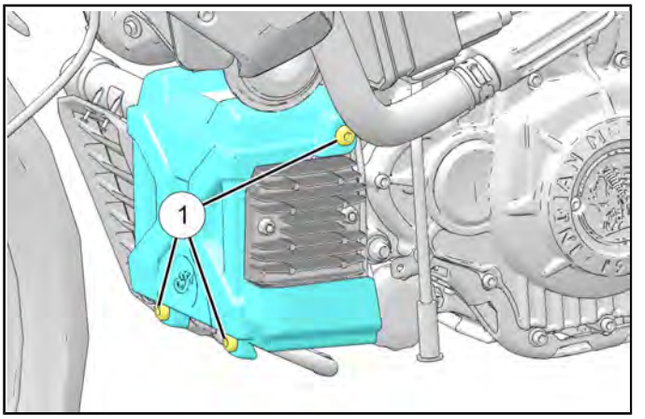
⚠ CAUTION

Some repair procedures require the battery cables to be disconnected to reduce the chance of any electrical shorts.

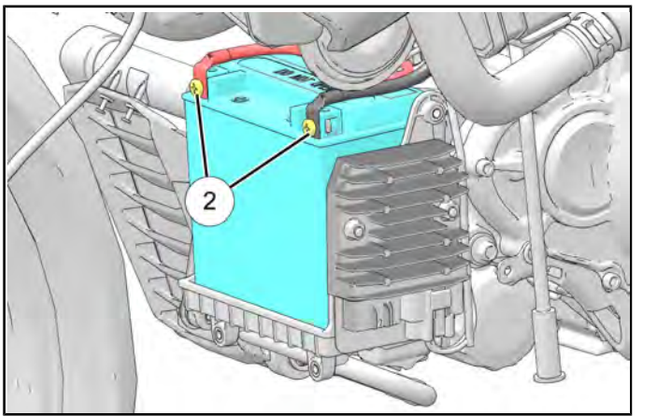
⚠ CAUTION

Do not allow battery cables to touch opposing terminals. When connecting battery cables, attach the positive (red) cable to positive (+) battery terminal first, followed by negative (black) cable to negative (-) battery terminal. When disconnecting battery cables, remove the negative (-) cable first.

1. Remove three battery cover fasteners ①.



2. Remove the negative and positive battery cable terminal fasteners ②.



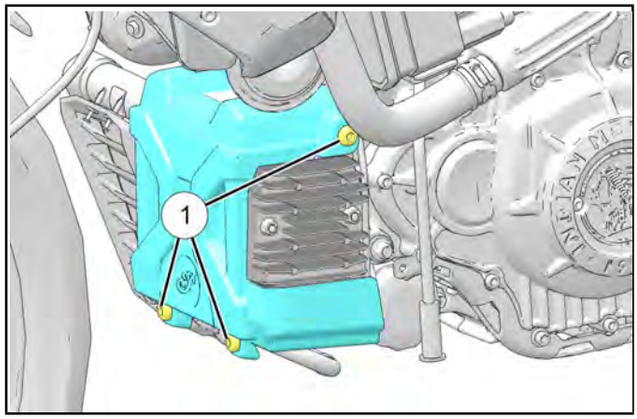
9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

BATTERY REMOVAL

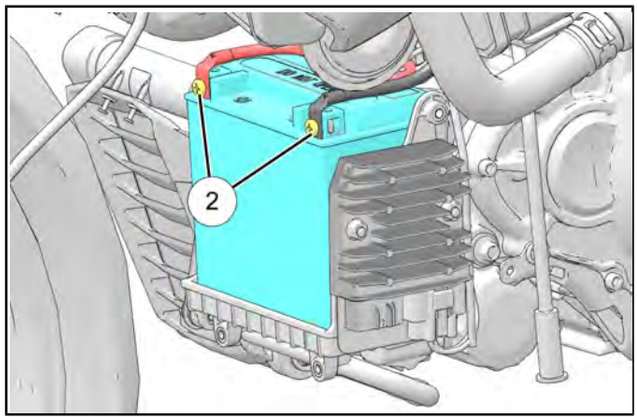
⚠ CAUTION

Do not allow battery cables to touch opposing terminals. When connecting battery cables attach the positive (red) cable to positive (+) battery terminal first, followed by negative (black) cable to negative (-) battery terminal.

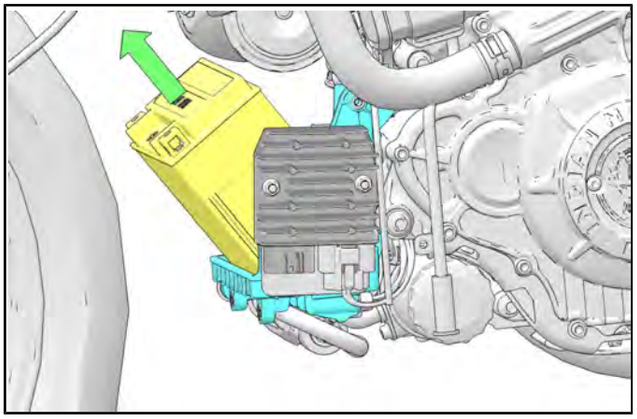
1. Remove three battery cover fasteners ①.



2. Remove the positive and negative battery cable terminal fasteners ②.



3. Remove battery from battery tray.



BATTERY INSTALLATION

⚠ CAUTION

Do not allow battery cables to touch opposing terminals. When connecting battery cables attach the positive (red) cable to positive (+) battery terminal first, followed by negative (black) cable to negative (-) battery terminal.

⚠ CAUTION

Never operate unit without battery cover installed.

NOTICE

Be sure cable ends and battery terminals are clean. Apply a light film of di-electric grease to terminal bolt threads.

1. Carefully install battery.
2. Connect positive cable to the battery and torque to specification.
3. Connect ground (negative) cable to battery and torque to specification.

TORQUE
Battery Terminal Fasteners: **25 in-lbs (3 N·m)**

4. Apply dielectric grease over terminal areas for corrosion protection.
5. Install battery cover and fasteners.

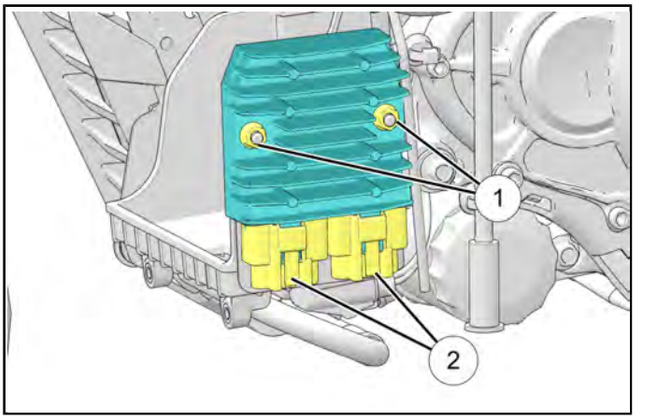
TORQUE
Battery Covers Fasteners: **36 in-lbs (4 N·m)**

BATTERY TRAY REMOVAL / INSTALLATION

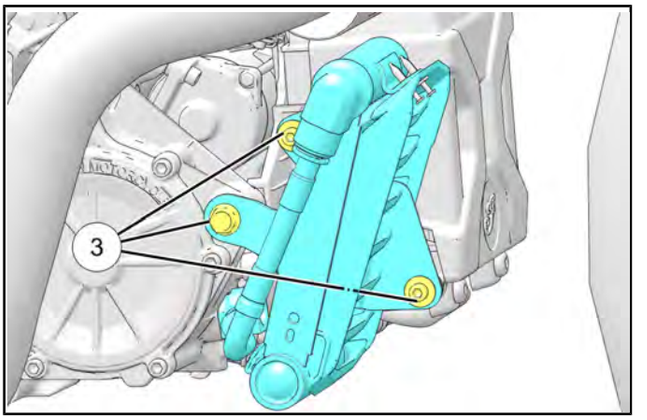
⚠ CAUTION

Never operate unit without battery cover installed.

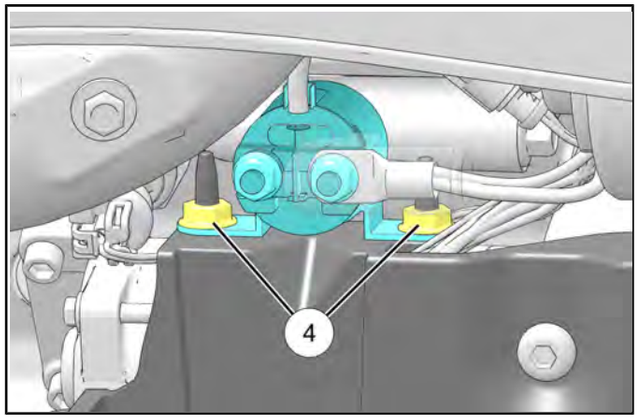
1. Remove Battery. See **Battery Removal page 10.13**
2. Remove chin fairing. See **Chin Fairing Replacement page 7.38**
3. Remove Regulator/Rectifier fasteners ①.



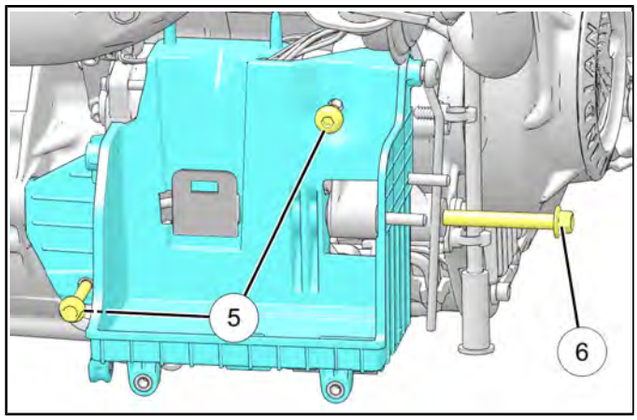
4. Unplug Regulator/Rectifier electrical connectors ②.
5. Remove two fasteners securing oil cooler. Support oil cooler so it is not hanging by its own weight.



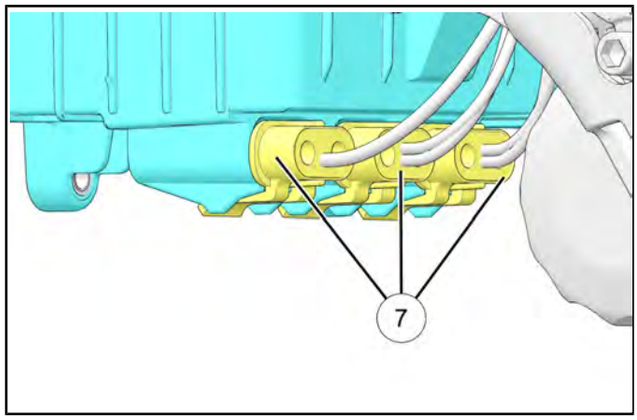
6. Remove the two nuts ④ securing the stater solenoid from the battery tray.



7. Remove two battery fasteners ⑤ and through bolt ⑥.



8. Remove three fuses ⑦ from the battery tray



9. Disconnect the angle sensor from the back of the battery tray.
10. Remove battery tray.
11. **Installation is performed by reversing the removal procedure.**

TORQUE
Battery Tray Through Bolt: **96 in-lbs (11 N·m)**

TORQUE
Battery Tray Base Fasteners: **96 in-lbs (11 N·m)**

TORQUE
Starter Solenoid Bracket Nuts: **12 in-lbs (1 N·m)**

TORQUE
Oil Cooler Mount Fasteners: **72 in-lbs (8 N·m)**

TORQUE
Regulator / Rectifier Nuts: **30 in-lbs (3 N·m)**

12. Install battery. See **Battery Installation page 10.14**.
13. Install chin fairing. See **Chin Fairing Replacement page 7.38**

BATTERY CHARGING AND MAINTENANCE

AGM BATTERY CHARGER RECOMMENDATIONS

Indian Motorcycle recommends using the BatteryMINDer® 2012 AGM - 2 AMP battery charger (PN 2830438) to charge and maintain AGM batteries. The charger can be found on the Polaris PG&A website and ordered in DEX – Item Availability.

Batteries that fall below 12.5V run the risk of sulfation, a condition whereby sulfate crystals form inside the battery and significantly reduce performance. AGM chargers are designed specifically for charging AGM type batteries and use high frequency pulses to partially reverse sulfation.

IMPORTANT
The use of non-AGM battery chargers or non-AGM battery tenders may result in a misleading "battery not found" or "open cell" fault message. Please ensure you are using the recommended AGM charger when charging AGM type batteries.

INDIAN MOTORCYCLE RECOMMENDED AGM BATTERY TESTING PROCEDURE:

1. Test battery using the battery tester PU-50296.
2. If the tester indicates a test result other than "Good Battery," follow the steps below before replacing the battery:
   a. Connect battery to the recommended battery charger. If charging sequence begins as normal, fully charge battery and proceed to step 3.

      The time listed on the PU-50296 battery tester printout is an estimate. The recommended automatic charger will indicate when the battery is fully charged on its display.

   b. If charging sequence does not initialize, refer to **AGM Battery Charging Recommendations – Deeply Discharged (below 3 volts)** to attempt to restore the deeply discharged battery. If charging sequence will not finish as intended, the battery needs to be replaced.
3. Re-test battery. If the test results show that battery failed, proceed with battery replacement.

IMPORTANT
If battery is below 10.5 volts before charging, when light turns green on the charger, unplug and plug back in to ensure battery is fully charged.

AGM BATTERY CHARGING RECOMMENDATIONS – LOW CHARGE

The nominal voltage for an Indian Motorcycle battery is 12.8 Volts when fully charged. The battery will self-discharge when disconnected from a vehicle, and will discharge at a faster rate when connected. If the battery voltage falls below 12.5V, it should be charged immediately using the recommended battery charger. Listed below are the recommended battery inspection schedules.

- Batteries which are not connected to a vehicle should be inspected every 60 days. The battery must be charged if found to be below 12.5 volts.
- Batteries which are connected to motorcycles should be inspected when they arrive at your dealership and at least once every month thereafter. The battery must be charged if found to be below 12.5 volts.
- Showroom bikes used to demonstrate radio, display and infotainment features should be charged daily. If possible, these bikes should be connected to the recommended battery charger continuously.

Always use the recommended automatic battery charger, and wait for the charger to complete the charge cycle before disconnecting it.

AGM BATTERY CHARGING RECOMMENDATIONS – DEEPLY DISCHARGED (BELOW 3 VOLTS)

AGM batteries discharged to a voltage of 3 volts or less may not be recognized by the recommended automatic battery charger. (The minimum voltage threshold recognized by other battery chargers may be as high as 10.5 volts). Often times deeply discharged batteries can be restored by attaching another, fully-charged, battery to "jump start" the low battery. Follow the steps below to restore a deeply discharged battery.

1. Carefully connect the two batteries' positive terminals, then the negative terminals using jumper cables.
2. Connect the recommended battery charger to the low battery and initiate the charging sequence.

⚠ WARNING

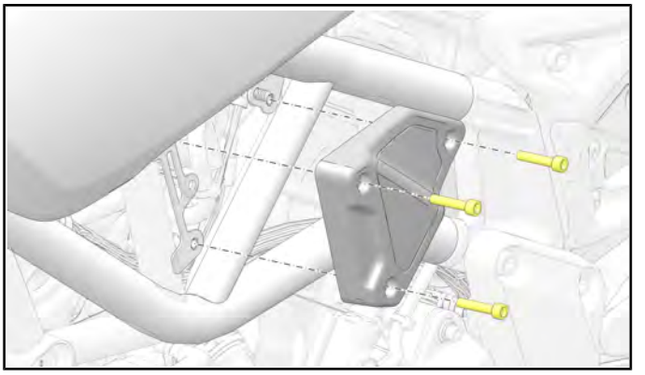
Always check to ensure the positive cables are connected to the positive terminals before powering the charger on. Reversing polarity when charging can damage electrical components and risk personal injury. Be careful not to let battery cable clamps touch each other.

3. After the charging sequence has initiated, disconnect the fully-charged battery. Always disconnect the fully-charged battery positive first, followed by low battery positive, low battery negative, and finally fully-charged battery negative
4. Proceed with charging both batteries to full capacity. Listed in the table below are the approximate charging times for deeply discharged batteries. Always use the recommended automatic battery charger, and wait for the charger to complete the charge cycle before disconnecting it. The recommended automatic charger will indicate when the battery is fully charged on its display.

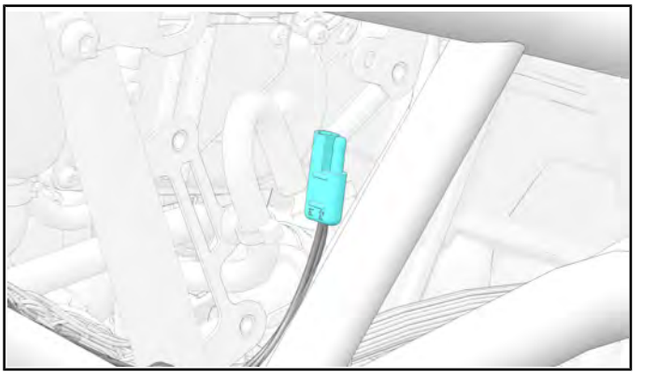
BATTERY PN	CHARGING TIME	BATTERY CAPACITY	CHARGING RATE
4017581	8 hours	12 AH	2 amps

AGM BATTERY MAINTENANCE TIPS

1. If the motorcycle will not be driven for more than 2 weeks, maintaining the battery with the BatteryMINDer® 2012 AGM - 2 AMP charger (PN 2830438) is recommended.
2. To help prolong battery life, it is recommended to remove the battery from vehicles stored ONE month or longer. To maximize the life of stored batteries, they should be kept in a cool / dry location. Batteries will self discharge more rapidly when stored in extreme temperatures. Batteries should be maintained using the recommended battery charger while in storage.
3. Batteries will self-discharge more quickly when dirty. Periodic cleaning of the battery terminals using a terminal brush will help maximize battery life. Wash terminals with a solution of one tablespoon baking soda and one cup water. Rinse well with tap water and dry off with clean shop towels. Coat the terminals with dielectric grease or petroleum jelly.
4. Battery connections should be tightened to the correct torque during installation. This will reduce voltage drop and ensure a reliable connection between the regulator/rectifier and battery.
5. FTR motorcycles equipped with a SAE bullet style connector for quick access to charging the battery. The recommended BatteryMINDer® 2012 charger comes with the mating connector for easy plug and play maintenance. The connector is located behind the left-hand side V cover and taped to the chassis harness.



Carefully remove the tape to expose the connector and length of wire. Be sure to properly secure the wire and connector before operating the vehicle.



BATTERY INSPECTION

1. Remove battery. See **Battery Removal page 10.13**.
2. Inspect for cracked or broken battery case.

> **⚠ CAUTION**
>
> Do not remove the battery cap assembly in an attempt to inspect fluid level, specific gravity or attempt to add fluid to battery. After initial servicing, battery should remain sealed.

3. Inspect terminals for corrosion. If corrosion is found, remove battery and clean terminals with a solution of baking soda and water. Finish process by cleaning terminals (both battery and battery cables) with a wire brush.
4. Install battery. See **Battery Installation page 10.14**.

STARTING SYSTEM TESTS

BATTERY LOAD TEST

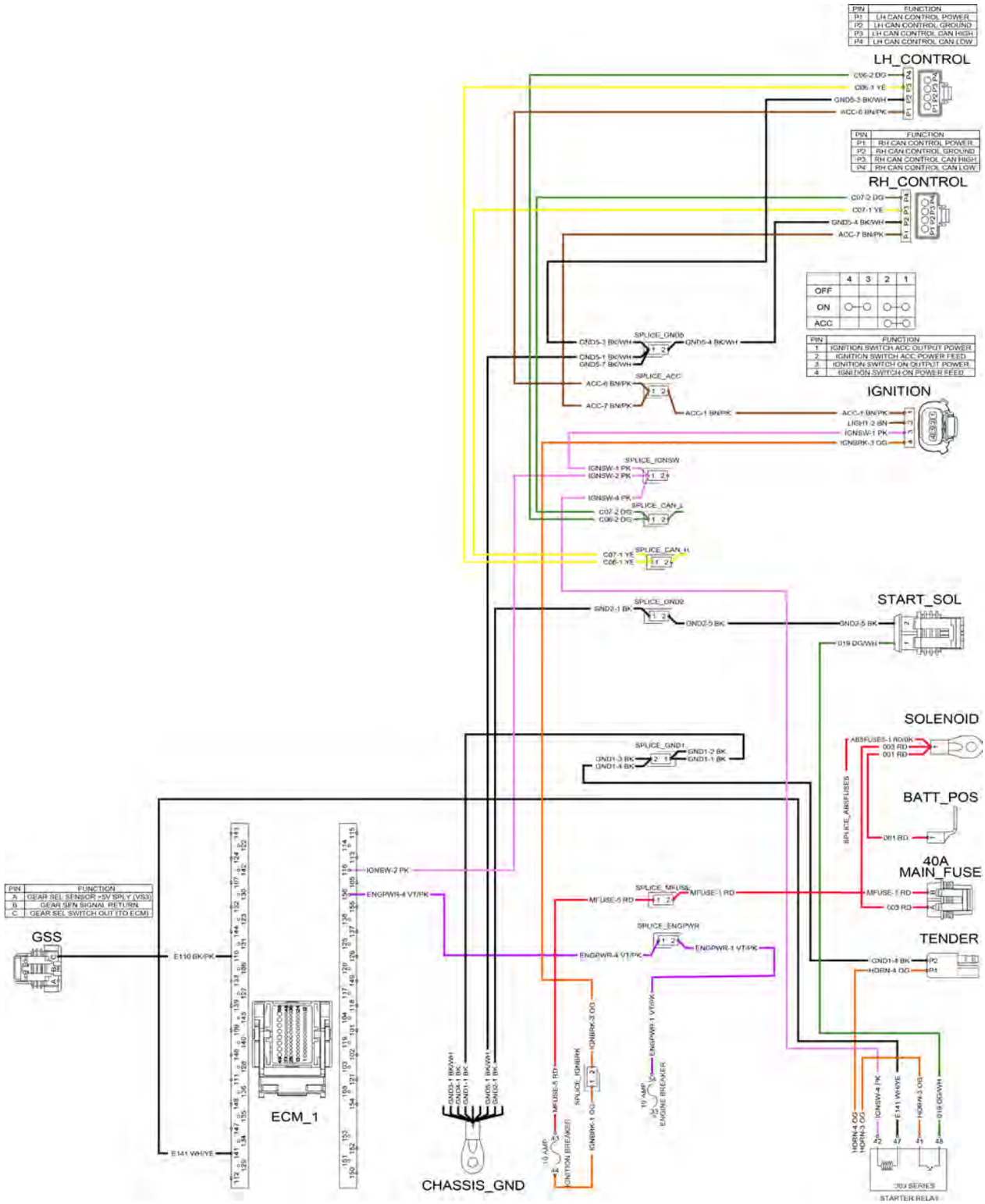
1. Load test battery using a commercially available battery load tester. Follow the battery load tester manufacturer instructions.

NOTICE
Although not as conclusive, the following test can be used to direct troubleshooting efforts if a battery load tester is not readily available.

2. Charge battery until open circuit voltage is above 12.8 Volts.
3. Install battery and connect battery cables.
4. Connect digital multimeter to battery and keep it connected for duration of test.
5. Turn ignition key on and move head light high beam switch to High Beam for 30 minutes (without the engine running).
6. Measure battery voltage.
7. If battery voltage has dropped below 10.5 V DC, re-charge and re-test battery or replace it.

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

STARTER CIRCUIT DIAGRAM

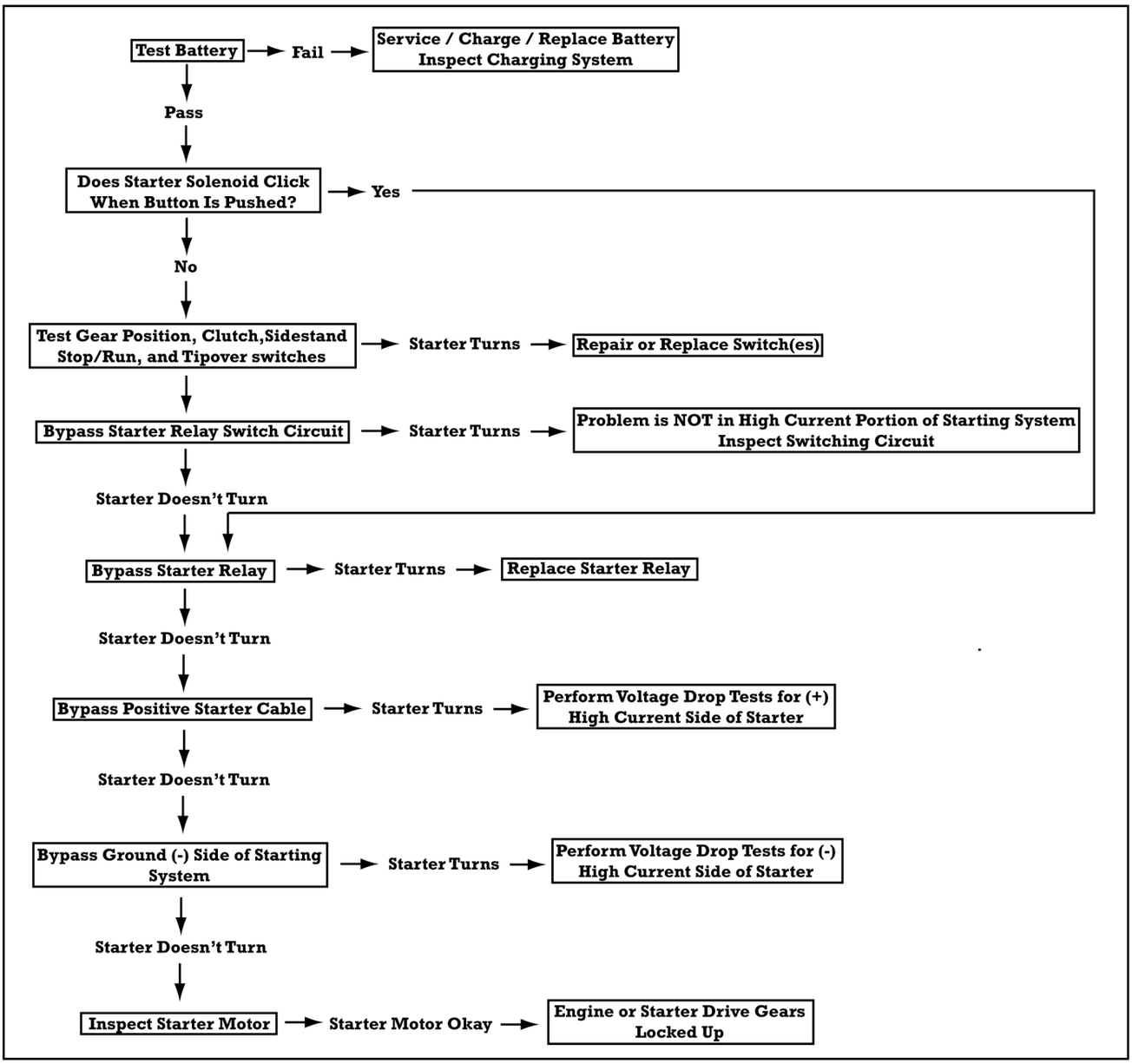


STARTING SYSTEM DIAGNOSTIC TABLE

SYMPTOM	POSSIBLE CAUSE	RECOMMENDATION
Starter motor does not turn with transmission in neutral. Turns with clutch pulled in.	Gear Position Switch or circuit malfunction.	Test Gear Position Switch.
Starter motor does not turn with transmission in gear and clutch lever pulled in. Turns with transmission in neutral. *NOTICE* Unit will not start if side-stand is down, even with the clutch pulled in.	Clutch Switch or Side-Stand switch circuit malfunction.	Test Switches.
Starter motor will not turn.	Low battery voltage. Poor cable connections. Main ground loose. Blown horn/starter fuse	See Troubleshooting Flow Chart 1
Starter motor turns slowly. Engine may or may not start.	Low battery. Faulty starter motor or drive mechanism. Engine mechanical problem.	See Troubleshooting Flow Chart 2
Starter motor turns, but engine does not turn.	Starter torque limit clutch slipping.	See Troubleshooting Flow Chart 3
Starter motor turns at normal speed, but engine does not start.	Ignition Problem Engine Problem Fuel Delivery Problem	Electrical Chapter Engine / Cooling / Exhaust Chapter Fuel Delivery / EFI Chapter

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

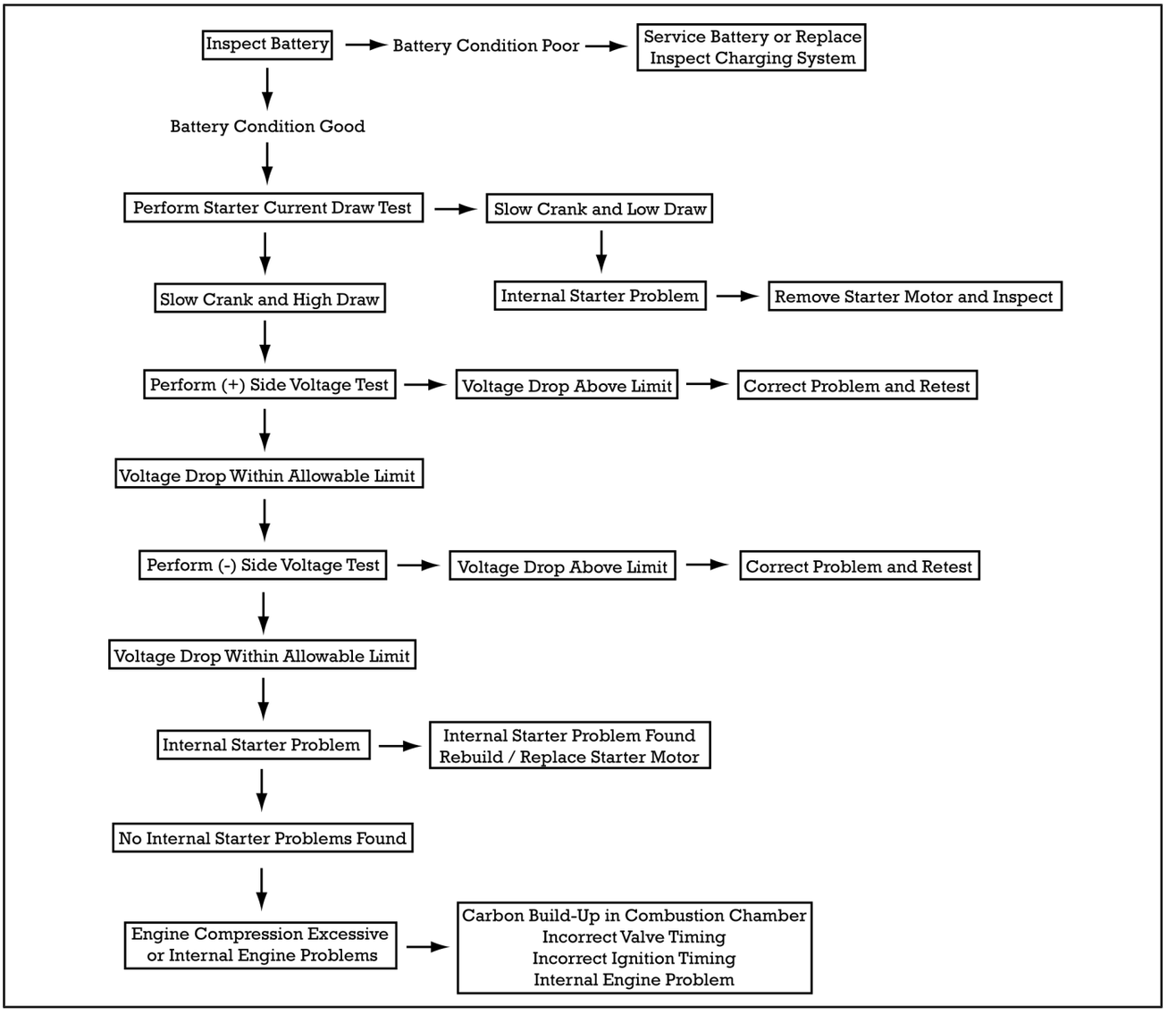
TROUBLESHOOTING FLOW CHART 1



TROUBLESHOOTING FLOW CHART 2

NOTE

These procedures require a Digital Multi Meter (DMM) and high a high current shunt, or an inductive ammeter clamp and a DMM.



TROUBLESHOOTING FLOW CHART 3

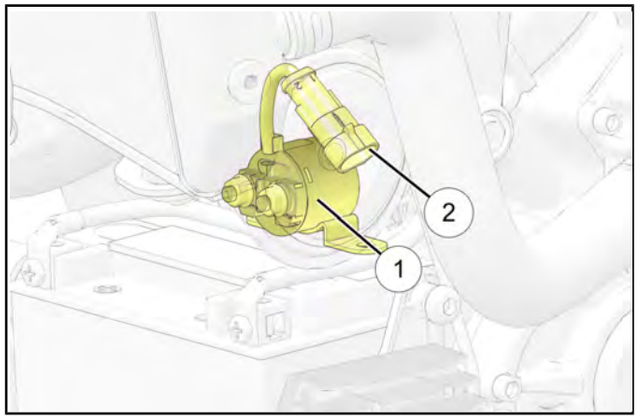
SYMPTOM	POSSIBLE CAUSE
Starter motor turns, but engine does not turn. The starter motor can be heard spinning.	Starter clutch malfunction.
	Starter torque limit clutch slipping.
	Starter gears damage.

STARTER SOLENOID GROUND CIRCUIT TEST

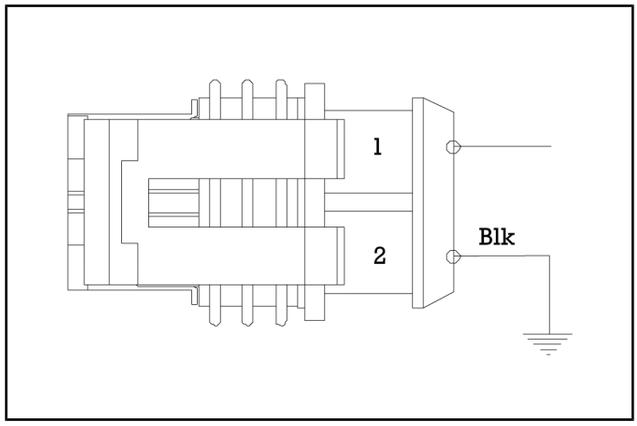
⚠ WARNING

Ensure that the motorcycle is secure and that the transmission is in neutral for the following test.

1. Shift transmission to Neutral.
2. Locate the starter solenoid ① and disconnect the start solenoid connector ②.



3. Set the multi-meter to read resistance and insert meter leads into the appropriate jacks.
4. Working on the vehicle side of the harness, test continuity between terminal 2 (black wire) and chassis ground.



Resistance should be ≤ 0.5 Ω

GEAR POSITION SWITCH NEUTRAL INDICATOR TEST

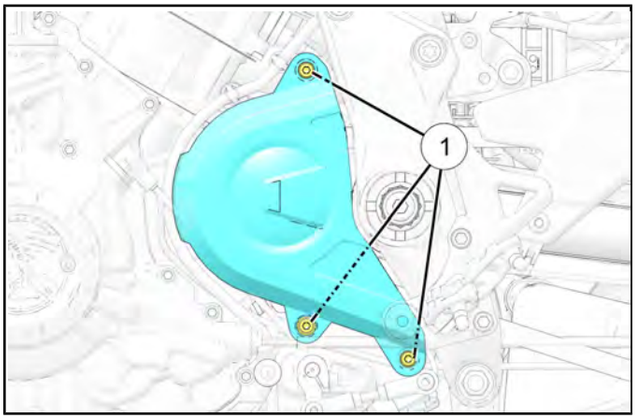
Symptoms of a faulty Gear Position Switch may include:

- Starter motor does not operate when transmission is in neutral,

but...

- Starter motor does operate when clutch is pulled in.

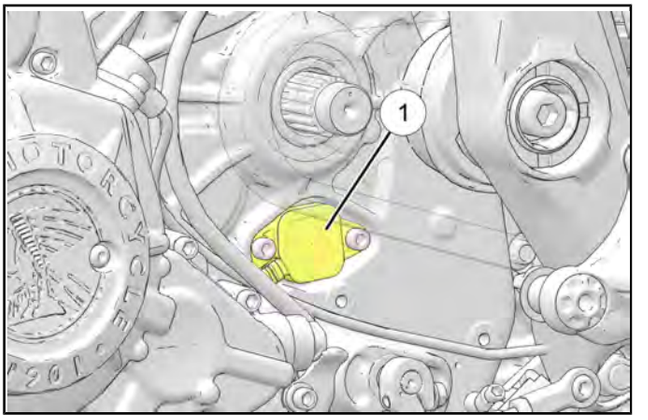
1. Remove three fasteners securing sprocket cover.



2. Place the ignition switch in the RUN position to power up the electrical system.
3. Place engine stop switch in the RUN position.
4. Shift transmission into Neutral.
5. Observe neutral indicator light.
6. If indicator is not lit with transmission in neutral:
   - Place the RUN/STOP switch in the STOP position and turn motorcycle power off.
   - Roll the motorcycle forward and back enough to verify that it is in neutral.
   - Locate the gear position switch ① and trace the wires to the connector located near the rear of the engine.

NOTICE

Remove the seat to access the electrical connection. See Seat Removal / Installation page 7.19



Letter	Wire Color	Function
A	Red	VCC
B	Black	Ground
C	Blue	Gear

- Backprobe the connector and compare the value with the table below.

Gear	Voltage
1	.63
N	1.0
2	1.38
3	2.13
4	2.88
5	3.63
6	4.38

IMPORTANT

Voltage can also be viewed by using digital wrench.

7. If the reading is not within specified parameters, replace neutral switch or repair wiring as necessary.

CLUTCH SWITCH CIRCUIT TEST

IMPORTANT

The side-stand **MUST** be in the up position to start the unit.

The symptom of a faulty clutch switch circuit is:

- Starter motor will not operate with transmission in gear and clutch lever pulled in. Starter *operates* with transmission in neutral. Use an ohmmeter to determine if continuity is present when the switch is closed (lever pulled in).

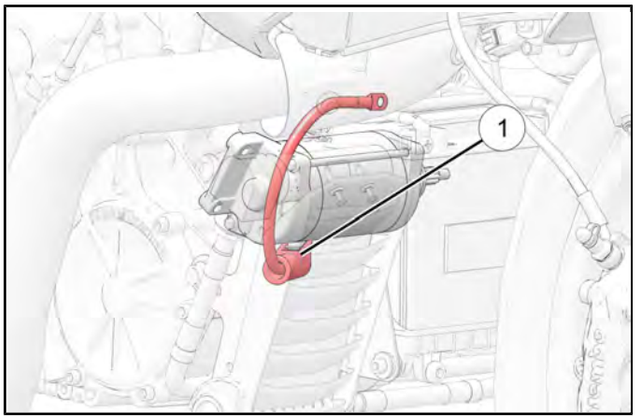
1. Transmission can be in neutral or in any gear.
2. Disconnect the clutch switch connectors.
3. Set multimeter to measure resistance and insert meter leads into appropriate jacks.
4. Connect red (+) lead of multi meter to either of the clutch switch terminals and the black meter lead to the other clutch switch terminal.
5. Operate clutch lever while observing meter display.
6. Pull clutch lever to the handlebar. Meter should display continuity or very low resistance (less than 1 ohm) when the clutch switch closes.
7. Release clutch lever, meter should display OL (open line).
8. If clutch switch does not test as described inspect clutch switch, clutch switch wiring or mounting of switch to clutch lever for fault.
9. If switch is mounted correctly and physically operates but does not open and close electrically, replace switch.

STARTER SOLENOID POSITIVE CIRCUIT TEST

⚠ WARNING

Secure motorcycle on the side-stand and place transmission in neutral for the following test.

1. Place the transmission in neutral.
2. Disconnect positive cable ① from starter motor.



3. Set multi-meter to **DC Volts** and insert meter leads in the appropriate jacks.
4. Connect the red meter lead (+) to the positive starter cable eyelet and the black (-) meter lead to chassis ground.
5. Place key switch in RUN position to power up the electrical system and place the STOP/RUN switch in the RUN position.
6. Press starter button. The meter should display battery voltage. If voltage is more than .2 volts below battery voltage, inspect the power supply circuit.

STARTER CURRENT DRAW TEST

IMPORTANT

This procedure requires the use of an inductive ammeter to read current draw and a volt meter to monitor battery voltage during the test.

⚠ WARNING

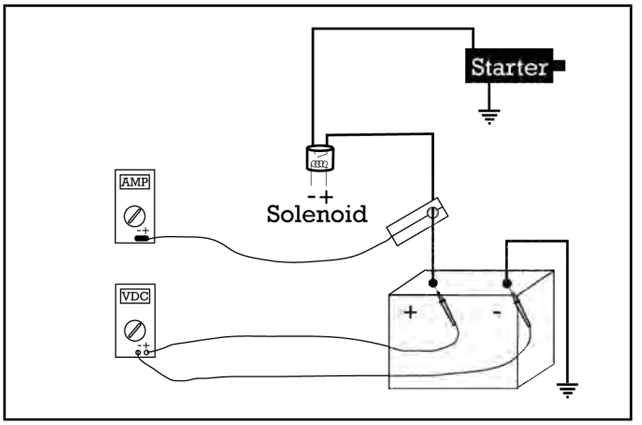
Do not allow any part of the jumper cable clamp to touch the chassis or any other ground.

⚠ CAUTION

Disable the ignition system so that the engine will NOT start during this test.

- Disconnect the ignition coil electrical connectors or the ignition coil fuse.

1. Remove battery cover. Reference **Battery Removal page 10.13**.
2. Inspect the battery. Charge or replace battery as necessary before proceeding.
3. Place transmission in neutral.
4. Position an inductive ammeter clamp on battery positive cable.
5. Zero the ammeter.
6. Set the multi meter to **Volts DC** scale and connect red lead of meter to positive post of battery.
7. Connect black lead of meter to negative post of battery.



8. Turn the ignition switch ON to power up the electrical system and observe ammeter. It should register positive amps. If it does not, turn the ammeter probe around.
9. Place the engine STOP/RUN switch is in the RUN position, transmission is in neutral, clutch lever pulled in and that the ignition system is disabled.
10. Press starter switch and crank starter for about 5 seconds and observe both meters and the tachometer.
11. The battery voltage should remain above 9.6 volts.
12. The amperage draw of the starter should not exceed 160 amps.

Starter current draw @ 77°F (25°C): ≤**160 Amps**

STARTER MOTOR SERVICE

SAFETY INFORMATION

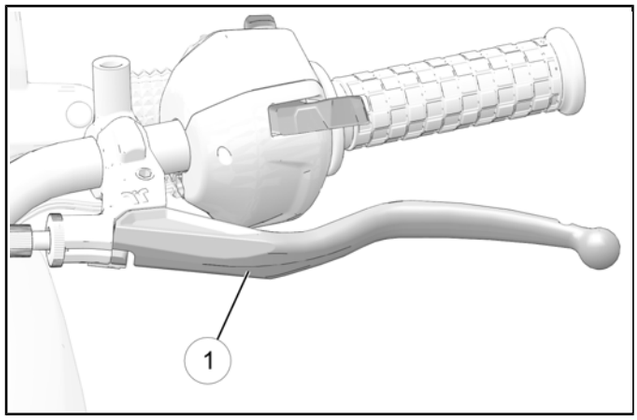
⚠ WARNING

Always disconnect the battery (negative terminal first) before servicing the starter motor.

- Inspect the condition of the battery before troubleshooting the starter system. Also inspect main engine ground and battery cable connections.

CLUTCH SWITCH REMOVAL / INSTALLATION

1. Remove the clutch cable from the lever.
2. Remove clutch lever ①.



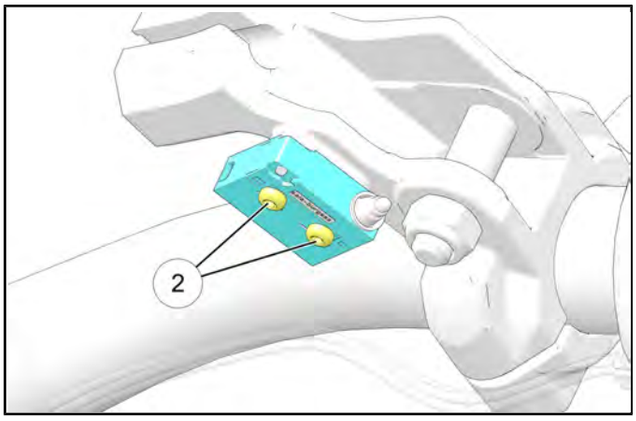
NOTICE

Hold the lever to the grip when removing the pivot bolt.

⚠ CAUTION

Be careful not to damage the switch flag lever during this step.

3. Disconnect the electrical connectors at the switch cube. Remove two screws ② and remove the switch.



4. **Installation is performed by reversing the removal procedure.**

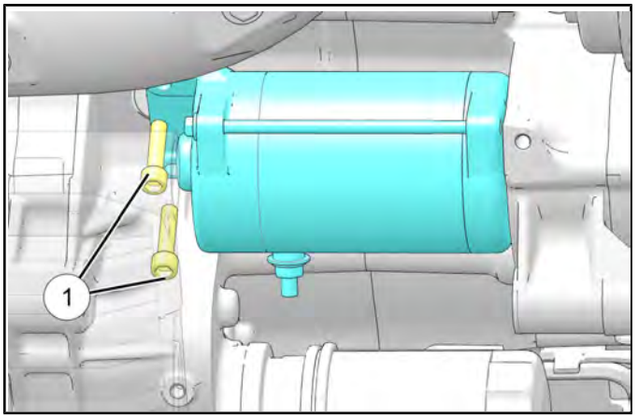
TORQUE
Clutch Switch Fasteners: **3 in-lbs (0.5 N·m)**

STARTER MOTOR, REMOVAL / INSTALLATION

⚠ WARNING

Ensure that the ignition switch is turned off. Remove the negative cable at the battery before removing the starter motor.

1. Disconnect negative battery cable. See **Battery Removal page 10.13**.
2. Remove battery tray. See page 10.14.
3. Disconnect positive terminal from the starter motor.
4. Remove the two fasteners ① from rear of starter motor ②. Slide starter to the right-hand side of the motorcycle to release from engine case.



5. Remove starter motor.
6. **To install the starter motor, reverse the removal procedure.**
7. Torque the starter mounting bolts to specification.

TORQUE
Starter Motor Fasteners: **88 in-lbs (10 N·m)**

8. Torque the starter motor positive terminal nut to specification.

TORQUE
Battery Cable to Starter Motor Nut: **60 in-lbs (7 N·m)**

⚠ CAUTION

Hold the lower terminal nut with an open ended wrench while tightening the upper nut to avoid damage.

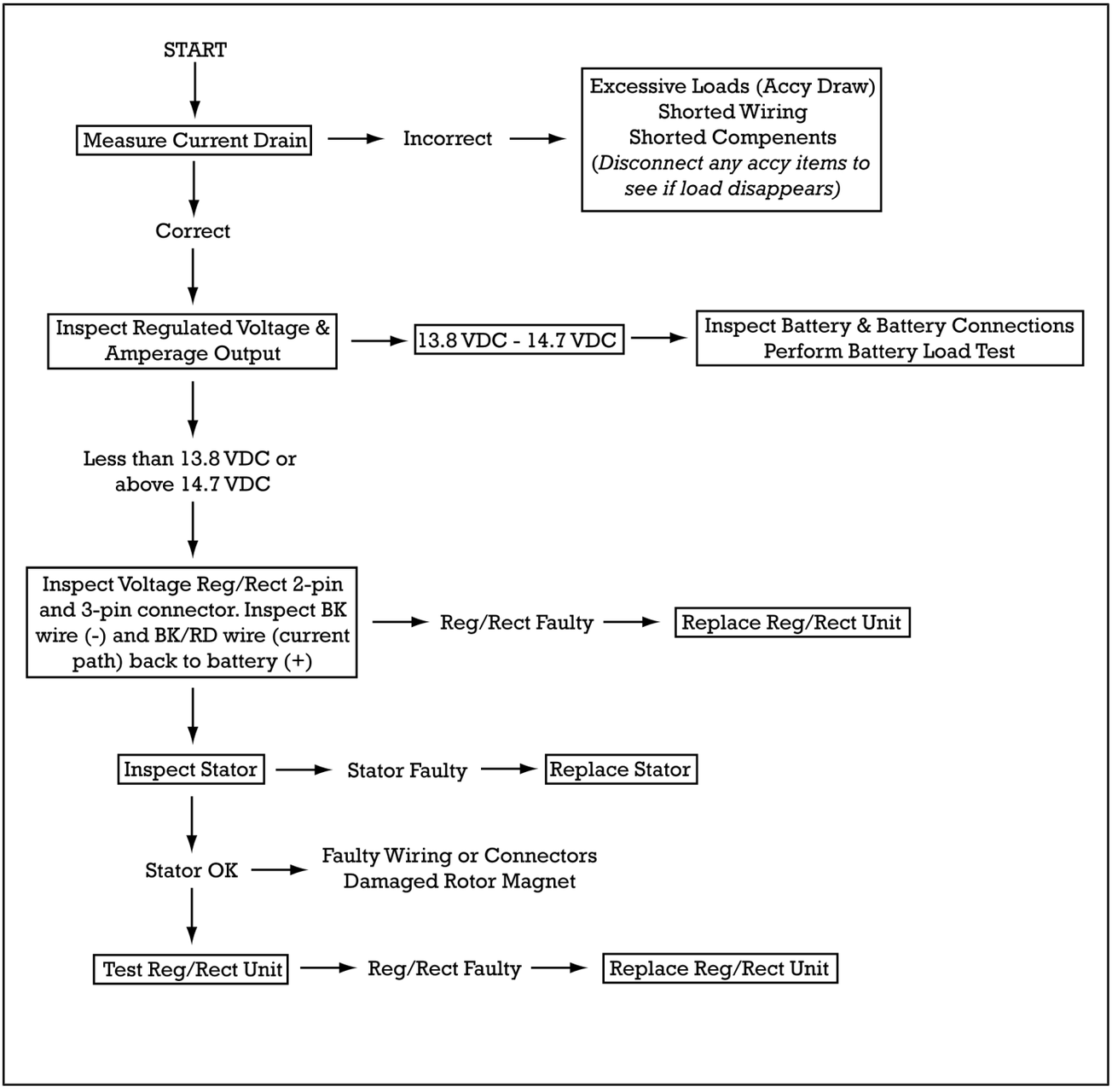
STARTER CLUTCH REMOVAL

- See **Starter Drive Removal page 6.23**.

CHARGING SYSTEM SERVICE

TROUBLESHOOTING, CHARGING SYSTEM

NOTE
The battery must be fully charged and in good condition to obtain accurate readings. Battery charging current is automatically reduced by the regulator / rectifier if the regulator / rectifier unit reaches a critical temperature (overheated). The system should be cool when testing DC charging output or when testing the regulator / rectifier to ensure accurate readings. Refer to test procedure for individual charging system components for more information.



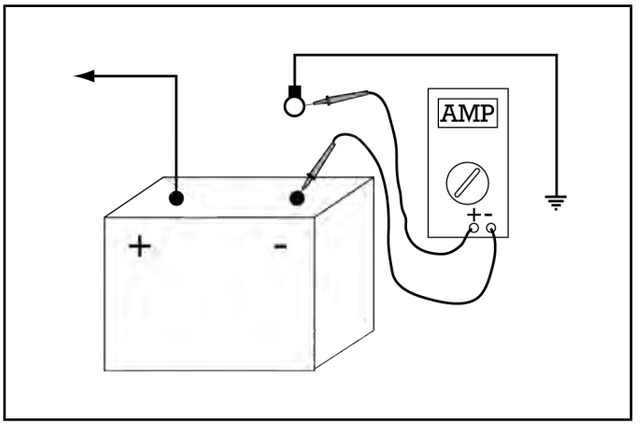
CURRENT DRAIN INSPECTION

IMPORTANT

Current drain should only be measured after all systems have timed out and gone to sleep. Leave power OFF and do not disturb for approximately **12 MINUTES** for an accurate reading.

Current drain is suspect if battery discharges when motorcycle is not in operation (short periods of storage).

1. Remove battery cover. Reference **Battery Removal page 10.13**.
2. Disconnect ground cable (-) from battery.
3. Set multimeter to read milliamps (mA) and insert meter leads into appropriate jacks. Connect red meter lead to ground cable eyelet and connect black meter lead to battery negative (-) terminal.



⚠ CAUTION

Do not operate electric starter or meter fuse will be damaged.

4. With ignition switch off, **and after 12 minutes have passed**, read current drain.
5. If current drain exceeds specifications inspect wiring and components for short to ground.

Parasitic Draw Specification (after 12 minutes with power OFF): 2.5 mA MAX

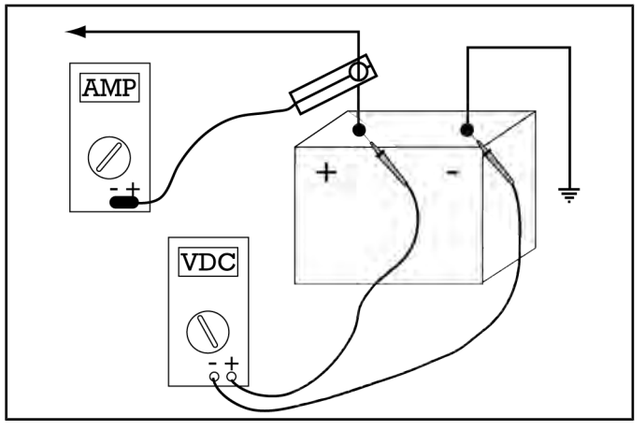
6. Locate the faulty component or wiring by disconnecting accessories, wiring connections, and fuses one-at-a-time while observing current drain. When current drain falls within specifications, focus efforts on the last circuit or component that was disconnected.

REGULATED VOLTAGE / AMPERAGE OUTPUT INSPECTION

IMPORTANT

This procedure requires the use of an inductive ammeter to read current draw and a volt meter to monitor battery voltage during the test.

1. Remove battery cover. Reference **Battery Removal page 10.13**.
2. Place the inductive ammeter over the positive (+) battery cable.
3. Set multi meter to V DC scale.
4. Connect voltmeter red (+) lead to battery red (+) lead and black (-) voltmeter lead to battery black (-) lead.



5. Start engine and warm to operating temperature.
6. At 1000 RPM or slightly above; the ammeter should reach the “break-even” point (no amperage leaving the battery) and the voltmeter should be rising toward 14 VDC.

Specification: Break-even point for charging System: 1500 RPM

7. Increase engine RPM to 2500. The ammeter should rise a slight amount, then stabilize. Volt meter should read above 14 V DC.

8. Use results obtained from preceding tests and the following descriptions to determine if charging system is functioning properly.

   CHARGING SYSTEM OPERATING CORRECTLY: Ammeter goes up a small amount, then stabilizes slightly above +0 amps. Volt meter rises toward 14.8 ± V DC, drops off a little and starts to stabilize.

   LOW BATTERY: Amperage continues to rise, voltage levels off as battery is absorbing voltage. Charging system may be okay. Need to charge battery fully or use a good battery and repeat test. Meters will indicate similar reading to the overcharging chart.

   CHARGING SYSTEM UNDERCHARGING: Ammeter drops to 0 or remains below 0 (negative reading) at all rpm, volt meter remains the same or goes down. Go to voltage drop inspection.

   CHARGING SYSTEM OVERCHARGING: Ammeter rises well above 0 and remains there or continues to rise. Volt meter goes well above 14.8 V DC and may continue to rise.

   EXCESSIVE LOAD: Current levels off or starts to drop, voltage continues to rise. Load may be excessive (accessories or shorted components). Determine if excessive loads are present. Disconnect accessories and re-test.

9. Turn ignition key off.
10. Remove inductive ammeter clamp.

STATOR AC VOLTAGE OUTPUT TEST

IMPORTANT

Set multimeter to VAC (alternating current). Engine cold. Regulator / Rectifier disconnected (2-pin and 3-pin connector). Engine must be running. Be sure to heed the following Warnings and Cautions.

⚠ WARNING

HOT COMPONENTS: The engine and exhaust system become very hot during operation and remain hot for a period of time after the engine is shut off. Wear insulated protection for hands and arms or wait until the engine and exhaust system have cooled sufficiently before working on the machine.

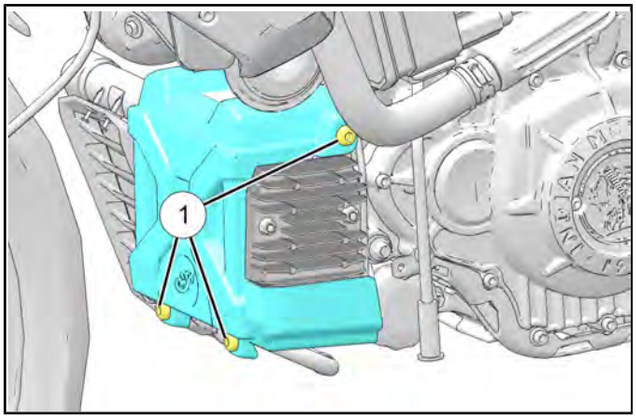
⚠ WARNING

CARBON MONOXIDE: Never run an engine in an enclosed area. Exhaust contains poisonous carbon monoxide gas that can cause loss of consciousness and may lead to death. If you must run the engine to do some repairs, do so in an open area or with an exhaust evacuation system operating.

⚠ CAUTION

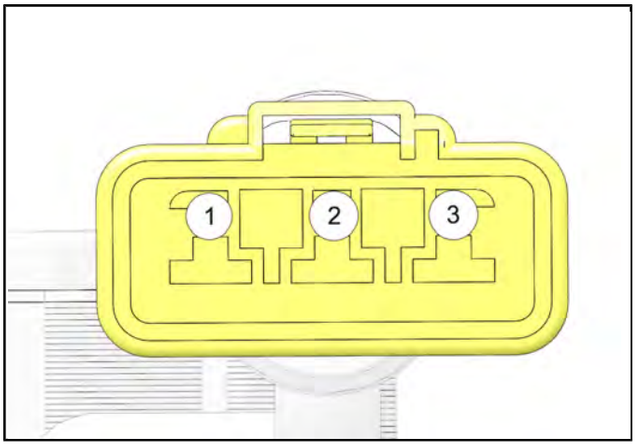
VOLTAGE / ARCING: Use caution not to touch any of the connections or allow the exposed terminals to come close to any other part of the vehicle or other objects, as an arc may occur.

1. Remove three battery cover fasteners ①.



2. Disconnect the 3-pin stator connector.
3. Set multi meter to measure AC Volts.

4. Connect one lead of the multi meter to pin A ① and one lead to pin B ② on the 3-pin stator connector.



⚠ CAUTION

VOLTAGE / ARCING

Use caution not to touch any of the connections or allow the exposed terminals to come close to any other part of the vehicle or other objects, as an arc may occur.

5. Start the engine and let it run at idle. Observe the multi meter reading.
6. The meter should indicate a minimum reading of 24 VAC at idle.
7. Repeat test for pins A ① & C ③.
8. Repeat test for pins B ② & C ③.

No load AC Volts @ 800 RPM: Approx 24 VAC

NOTICE

The test results in Steps 6, 7, and 8 can read more than 24 VAC, but it is **important that the reading for each pair of wires are within two volts of each other.**

9. Increase RPM to 2000. Repeat Steps 4-8.
10. At 2000 RPM the reading should be at least 34 VAC.

NOTICE

The test results obtained in step 10 can read more than 34 VAC, but it is **important that they are all within two volts of each other.**

No load AC Volts @ 2000 RPM: Approx 34 VAC

STATOR RESISTANCE TEST

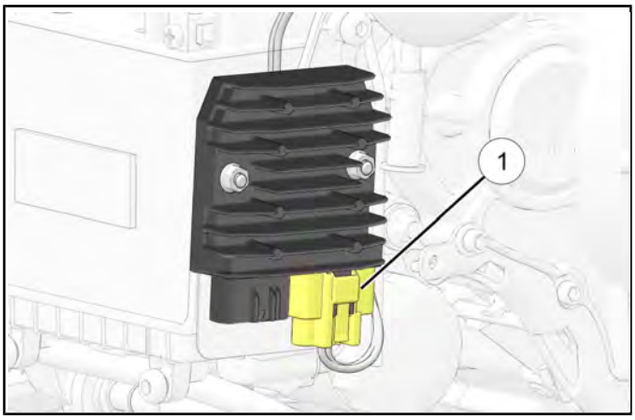
⚠ CAUTION

The *engine must not be running* while performing the following resistance test.

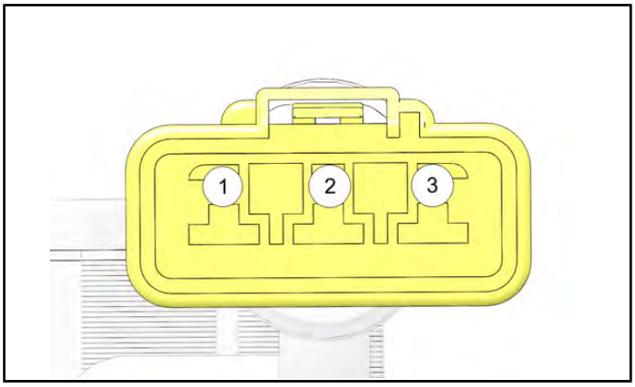
NOTICE

Set multimeter to measure resistance. Engine OFF and cold. Regulator Rectifier 3-pin connector unplugged.

1. Disconnect the three pin connector ① from stator.



2. Set the multi meter to measure resistance (Ω) and insert the meter leads in to the appropriate jacks.
3. Connect one meter lead to pin A ① and the other lead to pin B ② on the stator connector. Note resistance value.



Stator Resistance: Less than 1 Ohm

4. Repeat test for pins A ① & C ③.
5. Repeat test for pins B ② & C ③.
6. If resistance values do not match specification, inspect stator and replace as necessary.

STATOR WINDINGS TO GROUND INSPECTION

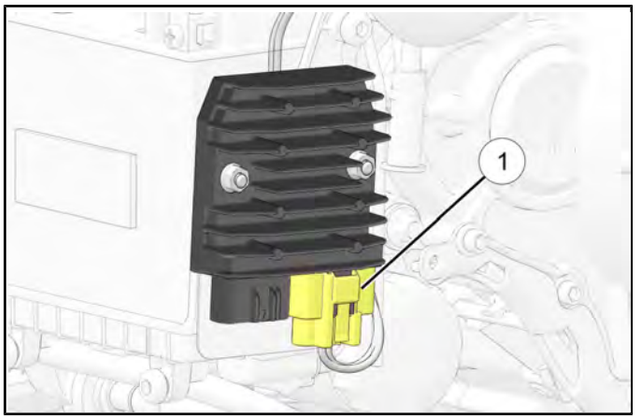
⚠ CAUTION

The *engine must not be running* while performing the following resistance test.

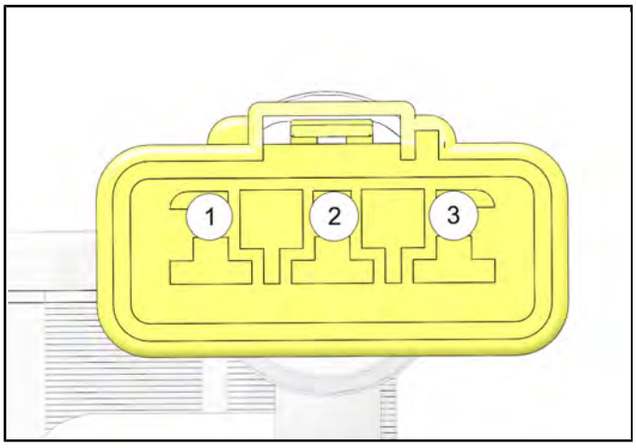
NOTICE

Set multimeter to measure resistance. Engine OFF and cold. Regulator Rectifier 3-pin connector unplugged.

1. Disconnect the three pin connector ① from stator.



2. Connect one multi meter lead to pin A ① and place the other lead of the multi meter in contact with a good engine ground, observe resistance to ground reading.



Stator to Ground (-) Continuity Specifications: Open Circuit (OL)

3. Repeat test for other two stator leads (② & ③) to ground.

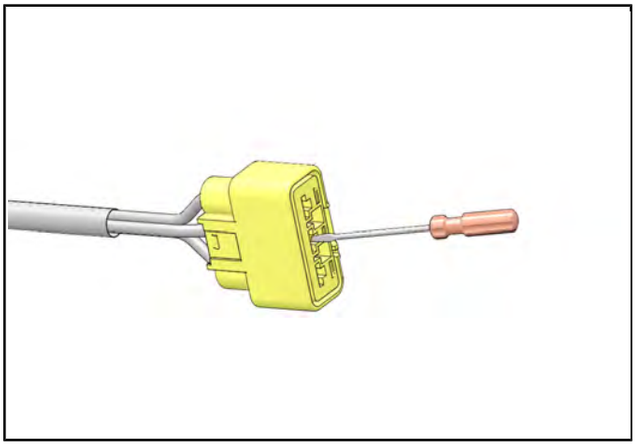
10

4. There should be no connection from stator windings to ground.

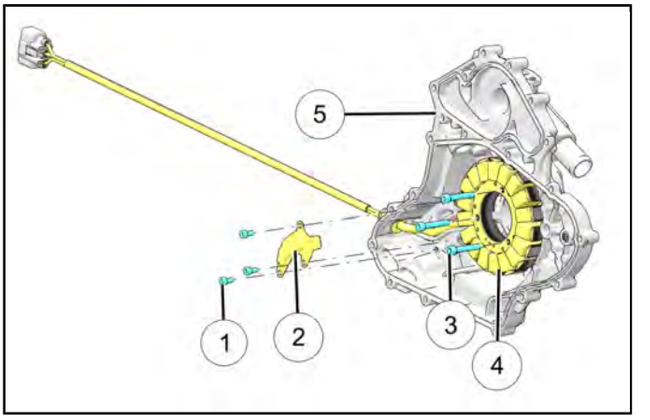
STATOR REMOVAL

1. Remove stator cover. See **Stator Cover Removal page 5.35**.
2. Disconnect the stator connector from the regulator.
3. Remove the locking clip from the connector.
4. Using a terminal tool or pick tool, remove the three electrical terminals from the stator connector. To watch a video of this procedure, scan the QR code or click **HERE**.

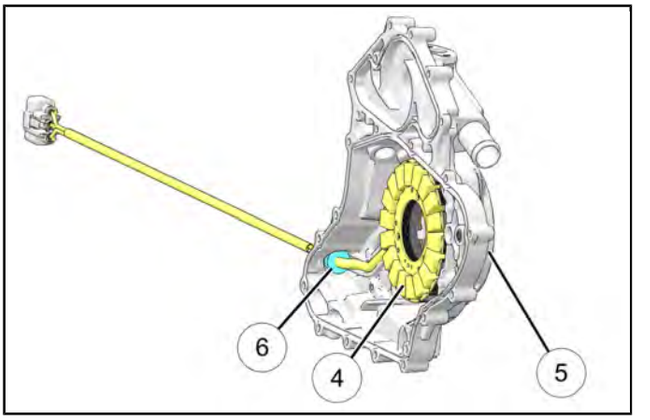
IMPORTANT
Pay attention to the orientation of each terminal for reinstallation.



5. Remove fasteners ① from stator wire guide ②.



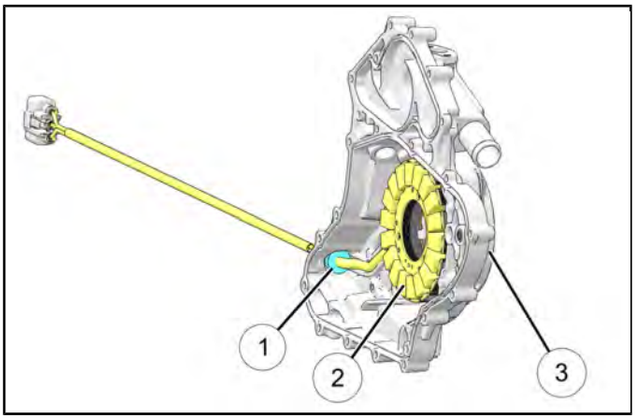
6. Remove three stator bolts ③.
7. Push the rubber harness seal ⑥ to inside of stator cover ⑤. Remove stator assembly ④.



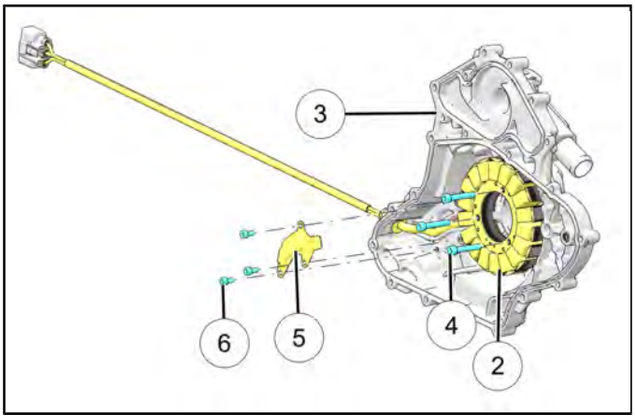
STATOR INSTALLATION

The electrical connector must be removed from the stator assembly before it can be installed in the motorcycle. See **Stator Removal page 10.36** for information on connector removal.

1. Feed the stator wires through the hole and seat the rubber harness seal ① in cover.
2. Position the stator ② inside the stator cover ③.



3. Install stator screws ④ and torque to specification.



TORQUE
Stator Mounting Fasteners to Cover: **88 in-lbs (10 N·m)**

4. Install the stator wire clip ⑤ and fasteners ⑥. Torque fasteners to specification.

TORQUE
Stator Clip Fasteners: **71 in-lbs (8 N·m)**

5. Insert wire terminals into stator connector housing.

IMPORTANT
Verify there is an audible “click” and the wires cannot be backed out.

NOTICE
Wires can be installed into any position on the electrical connector. Charging performance will not be affected.

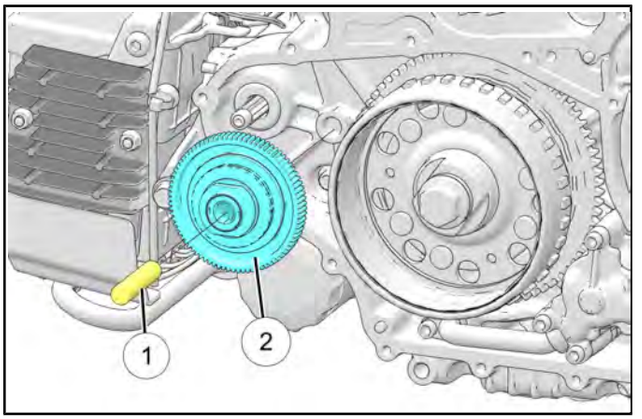
6. Connect the stator connector to the regulator / rectifier.
7. Install the stator cover. See **Stator Cover Installation page 5.35**.

FLYWHEEL REMOVAL

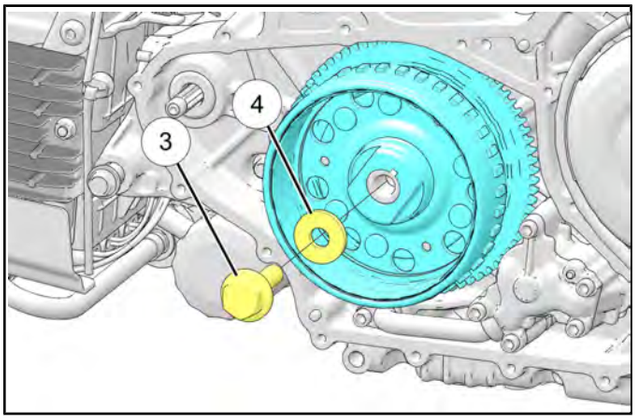
⚠ WARNING

The flywheel contains powerful magnets. Use caution when lifting stator cover off of flywheel to avoid personal injury.

1. Remove stator cover. See **Stator Cover Removal page 5.35**.
2. Remove the torque limiter gear pin ① and torque limiter assembly ②.



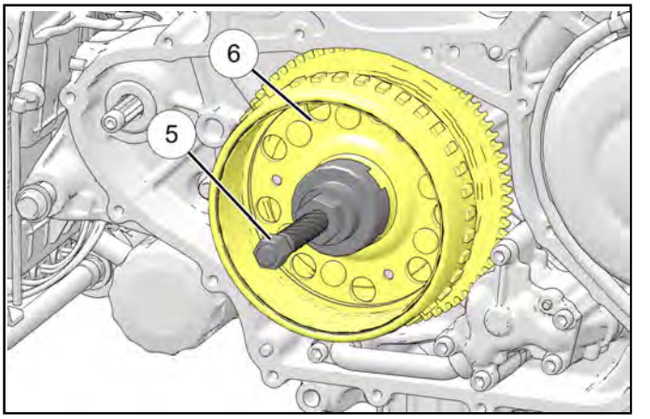
3. Remove flywheel bolt ③ and washer ④.



4. Install flywheel remove tool **PA-49316-A** ⑤ on the flywheel ⑥ and tighten puller to remove flywheel assembly.

⚠ CAUTION

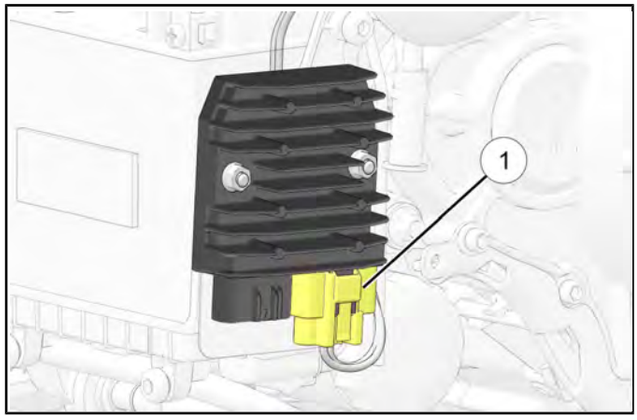
The puller has left hand threads. Ensure the tool is fully threaded to prevent damage.



5. Grasp flywheel assembly and lift off the crankshaft.

RECTIFIER / REGULATOR CONNECTOR INSPECTION

1. Remove the regulator / rectifier assembly. See **Regulator / Rectifier Replacement page 10.40**.
2. Disconnect both 2-pin and 3-pin connectors ①.



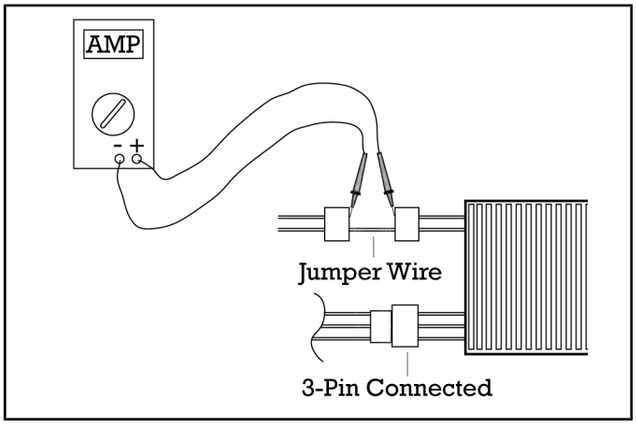
3. Inspect pins in the 3-pin and 2-pin connectors carefully. Check for corrosion, loose pins, poor connections, or evidence of overheating or other damage.
4. If the wiring and connectors are undamaged and appear to be clean and tight, inspect the battery, stator, and related wiring. Test the regulator / rectifier for diode leakage.

DIODE LEAKAGE TEST

IMPORTANT

Engine must be OFF. Perform this test at the regulator / rectifier 2-Pin connector. Testing at any other point (between battery and battery cable for example) could include leakage not attributable to the Regulator / Rectifier unit.

1. Disconnect the 2-pin connector at voltage regulator / rectifier unit.
2. Install a jumper across the connectors as shown for the Bk wire to provide a complete ground path.
3. Connect meter as shown, with red (+) meter lead to the RD / BK wire on harness side, and the black meter lead to the RD / BK wire on the regulator / rectifier side.

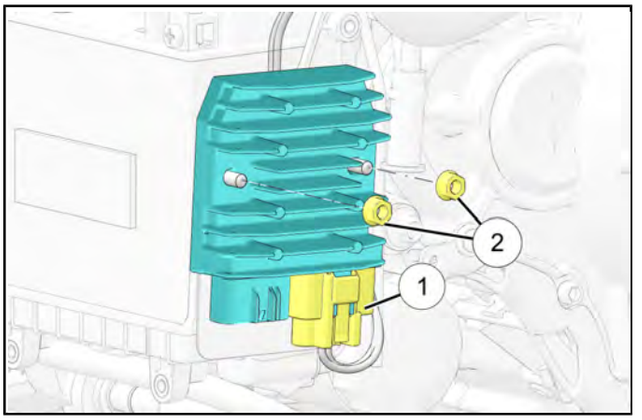


4. Compare leakage to specification below.

Specification:
Leakage: Less than 1.0 mA

REGULATOR / RECTIFIER REPLACEMENT

1. Disconnect the electrical connectors from the regulator / rectifier ①.



2. Remove the two nuts ② securing the regulator / rectifier to the bracket.
3. **INSTALLATION is performed by reversing the removal procedure.**
4. Torque the regulator / rectifier nuts to specification.

TORQUE
Regulator / Rectifier Nuts: **30 in-lbs (3 N·m)**

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

IGNITION SYSTEM

GENERAL INFORMATION

SERVICE NOTES

There are many hazards present when working on or around the ignition system. Read and pay close attention to the following warnings and cautions when working on any component in this section.

⚠ WARNING

Never run an engine in an enclosed area. Exhaust contains poisonous carbon monoxide gas that can cause loss of consciousness and may lead to death. If you must run the engine to do some repairs, do so in an open area or with an exhaust evacuation system operating.

⚠ WARNING

The engine and exhaust system become very hot during operation and remain hot for a period of time after the engine is shut off. Wear insulated protection for hands and arms or wait until the engine and exhaust system have cooled before working on the machine.

⚠ CAUTION

Some procedures call for the engine to be run in order to warm the engine to operating temperature. If this is done the exhaust pipes can "blue" if a cooling air stream is not provided by means of a shop fan directed the exhaust system.

⚠ CAUTION

Parts containing semi-conductors can be easily damaged if handled carelessly. Do not drop or subject the electronic components to shock loads.

⚠ CAUTION

Follow the instructions closely when troubleshooting items in this section. Some electrical components can be damaged if they are connected or disconnected while the ignition is powered ON and current is present.

⚠ CAUTION

Using incorrect heat range spark plugs can damage the engine. Always follow the manufacturer's recommendations for spark plug heat range.

GENERAL PRECAUTIONS

- This ignition system is controlled electronically and no provisions are available to inspect or change ignition timing. A timing light is still valuable as a diagnostic tool.
- Poor connections are the most common cause of ignition problems. Inspect all connections and replace the spark plugs before doing extensive ignition system troubleshooting.
- Make sure the battery is fully charged and that the charging system is operating correctly.
- A signal from the Crankshaft Position Sensor must be present at the ECM for spark to occur.

SPECIAL TOOLS - ELECTRICAL (IGNITION SYSTEM)

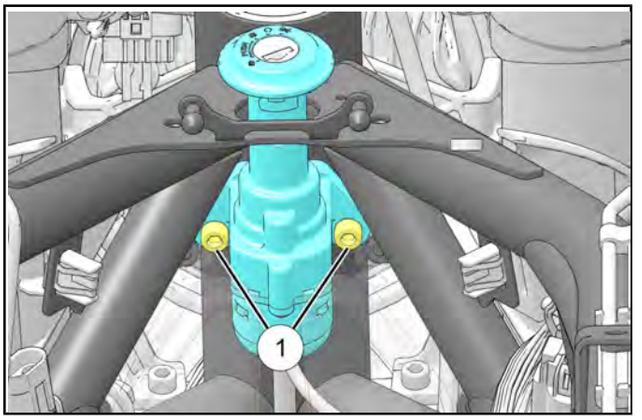
SPECIAL TOOL	PART NUMBER
Electrical Tester Kit	PV-43526
Digital Multimeter	Commercially Available
Inductive Timing Light	Commercially Available

SERVICE SPECIFICATIONS - ELECTRICAL (IGNITION SYSTEM)

ITEM		SPECIFICATIONS
Spark Plug		NGK MR7F
Spark Plug Gap		0.030 in (0.80 mm)
Coil on Plug	Primary	0.15 Ohms ± 20%
	Secondary	N/A
Crank Position Sensor Resistance		860 Ohms ± 10% @ 68°F (20°C)
* Spark plug end caps are not removable		

IGNITION REPLACEMENT

1. Remove airbox. See **Air Box Removal page 3.14**.
2. Disconnect the ignition electrical connector.
3. Remove two fasteners ① securing ignition.



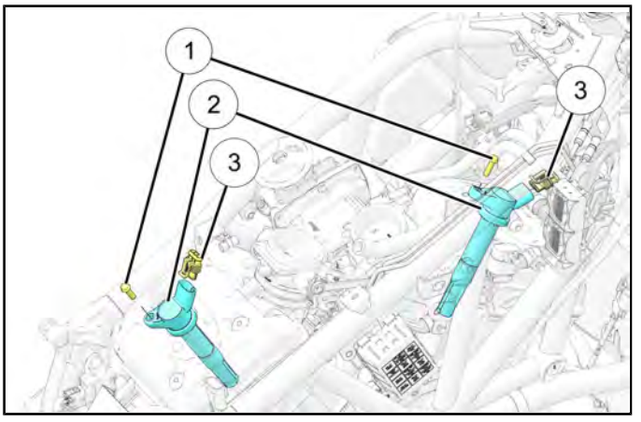
4. **Installation is performed by reversing the removal procedure.**

TORQUE
Ignition Fasteners: **88 in-lbs (10 N·m)**

5. Install airbox. See **Air Box Installation page 3.16**.

IGNITION COIL REPLACEMENT

1. Place the IGNITION and RUN / STOP switch in the OFF/STOP position.
2. Remove the seat. See **Seat Removal / Installation page 7.19**.
3. Remove the fuel tank. See **Fuel Tank Removal page 4.24**.
4. Remove air box. See **Air Box Removal page 3.14**.
5. Remove the ignition coil fastener ①.



6. Remove the ignition coil electrical connector ③ and lift the ignition coil ② out of the cylinder head.
7. **INSTALLATION of the ignition coil is performed by reversing the removal procedure. Torque fasteners to specification.**

TORQUE
Ignition Coil Fastener: **88 in-lbs (10 N·m)**

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

TROUBLESHOOTING

IGNITION SYSTEM TROUBLESHOOTING BASICS

Before troubleshooting the ignition system, ensure that the engine STOP/RUN switch is in the RUN position, the battery is fully charged, and system related fuses are not open (blown). Check visually for corroded, loose, or broken connections in critical areas (e.g. sensor connector). Check for loose wire pins in the individual sensor connectors and at the ECM (mounted on right side of the battery box).

Don't forget the spark plugs!

The Ignition System Troubleshooting flow chart (and the accompanying text) is designed to help you troubleshoot ignition system problems. It will not lead you to faulty or fouled spark plugs. Always inspect spark plug condition *first* (and replace if necessary) when troubleshooting ignition system problems.

Be sure that the spark plugs are the correct heat range and are the correct size specification.

⚠ WARNING

Extremely high voltage is present in the ignition system. Do not touch the ignition coils or spark plugs during test procedures.

TEST LEAD ADAPTER KIT

1. Tests in this section may include the testing of voltage and / or resistance at the connectors for various sensor and system components. Use the appropriate test adapter lead when performing these tests at connector pin(s).
2. Forcing an incorrect or oversized probe into a connector may cause inaccurate test results (due to lack of a solid mechanical connection to the terminal). It can also damage the connector being probed or the connector housing, creating another problem which greatly complicates the diagnostic process. Extreme care must be taken not to introduce problems while probing a connector.

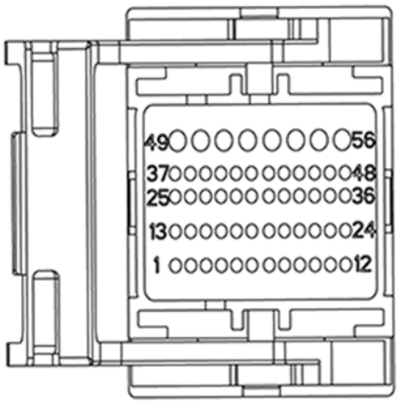
Electrical Tester Kit: PV-43526

⚠ CAUTION

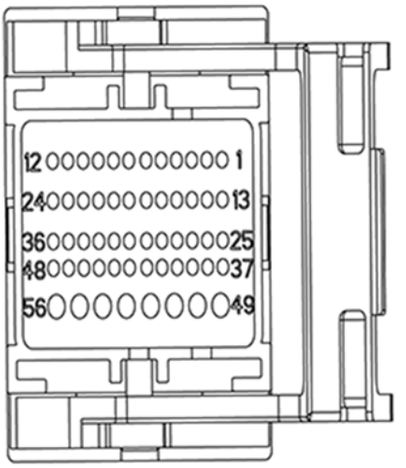
Once the ECM connector has been disconnected, do not touch the pins on the ECM. Static electricity from your body can damage the ECM. Do not attempt to perform tests on the ECM.

ECM CONNECTOR MAP

ECM 1



ECM 2



NOTICE

Unused pins are not included in the list below

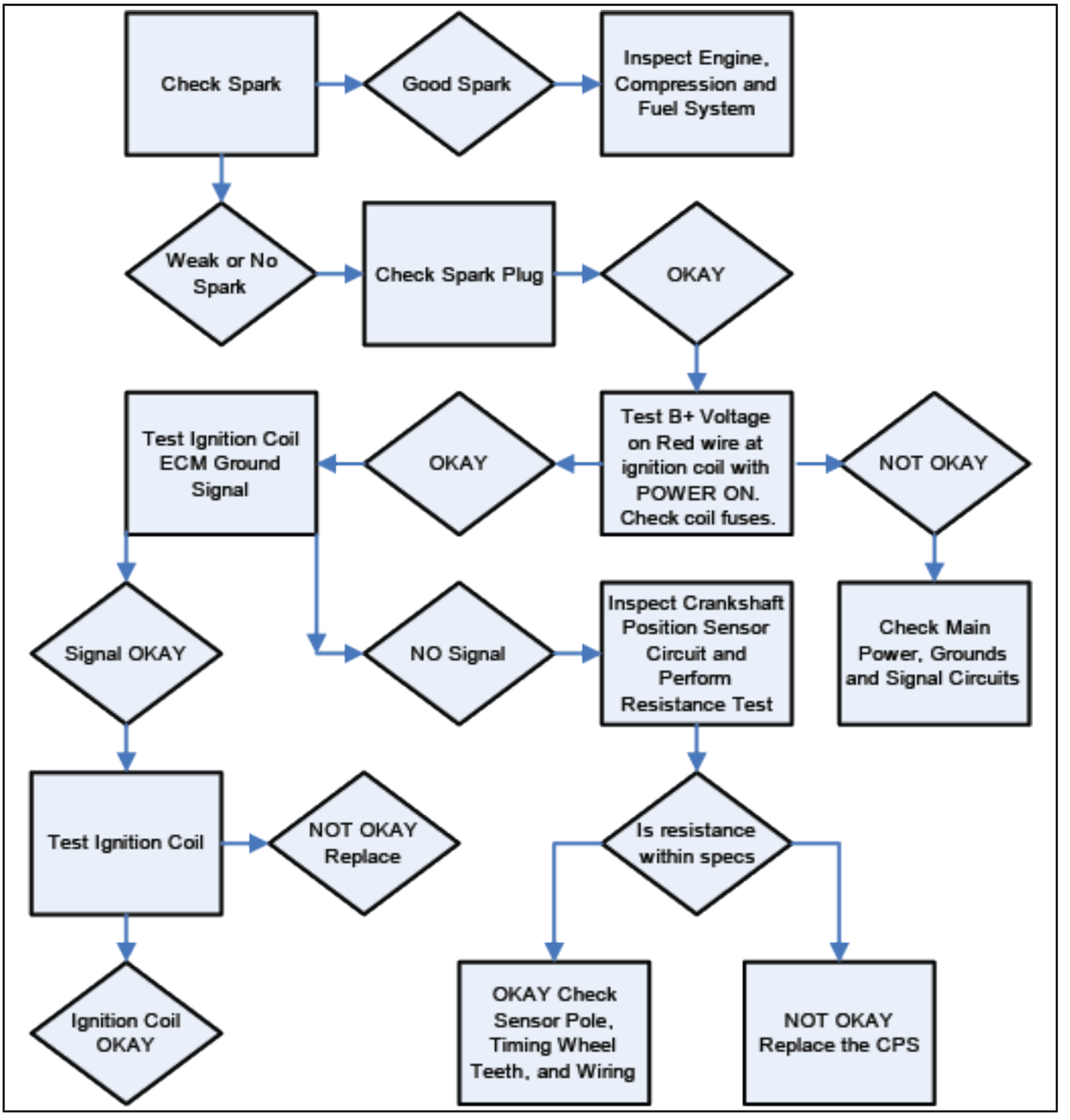
IMPORTANT

Last 2 digits of 100 series number correspond to connector cavity number. (Example: 110 = cavity 10)

PIN ECM 1	COLOR	FUNCTION	PIN ECM 2	COLOR	FUNCTION
101	BK/RD	HIGH BEAM RELAY CONTROL GROUND	201	BK	CRANKSHAFT POSITION SENSOR NEGATIVE SIGNAL
102	GY/OG	HORN RELAY CONTROL GROUND	202	GY/DB	FRONT HEATED OXYGEN (HO2) SENSOR SIGNAL 2
103	YE/BK	PEAL POSITION SENSOR 2 RETURN	203	OG/YE	THROTTLE POSITION SENSOR 1 SIGNAL
104	BN/GN	E104 SIGNAL RETURN SPLICE FEED	204	BN/YE	E204 SIGNAL RETURN SPLICE FEED
105	BN/WH	TPS SIGNAL RETURN	205	BG/WH	FRONT HEATED OXYGEN (HO2) SENSOR RETURN 2
106	WH/BK	PEDAL POSITION SENSOR 1 RETURN	206	BK/BU	FUEL LEVEL SENSOR SIGNAL RETURN
110	BK/PK	GEAR SELECT SWITCH OUTPUT (TO ECM)	207	BG	REAR HEATED OXYGEN (HO2) SENSOR RETURN 1
111	YE/GN	PEDAL POSITION SENSOR 2 SIGNAL	208	OG/BK	ENGINE COOLANT TEMPERATURE SENSOR RETURN
112	BK/DG	FUEL LEVEL SENSOR SIGNAL	210	WH/RD	PEDAL POSITION SENSOR 1 +5V SUPPLY (VS1)
115	GY/BK	ENGINE RELAY CONTROL GROUND	212	DB	FRONT LEFT TS LAMP OUTPUT

116	PK	ECM SWITCHED POWER	213	WH	CRANKSHAFT POSITION SENSOR POSITIVE SIGNAL
121	WH/GN	PEDAL POSITION SENSOR 1 SIGNAL	215	OG/DB	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
			216	OG/BD	AMBIENT AIR TEMP SENSOR SIGNAL
123	RD/BK	RUN/STOP SWITCH OUTPUT GROUND	217	BK/YE	REAR BRAKE PRESSURE SWITCH OUTPUT GROUND
125	YE/RD	PEDAL POSITION SENSOR 2 +5V SUPPLY (VS3)	218	OG/WH	TIP-OVER SENSOR (TOS) SIGNAL
126	BN/GN	TIP-OVER SENSOR +5V SUPPLY (VS1)	219	OG/BN	TMAP SENSOR MANIFOLD ABSOLUTE PRESSURE SIGNAL
131	BK/OG	COOLING FAN RELAY CONTROL GROUND	220	VT/RD	THROTTLE POSITION SENSOR 2 SIGNAL
132	YE	ECM CAN HIGH	223	BN/PK	TMAP SENSOR +5V SUPPLY
133	YE	ECM HS CAN HIGH	224	DB/RD	FRONT RIGHT TS LAMP OUTPUT GROUND
135 (2022 Models)	BN/PK	OFF / ACC DETECTION INPUT	225	BK/BN	OIL PRESSURE SENSOR SIGNAL
137	BN/RD	E137 +5V SUPPLY (VS3) SPLICE FEED	227	OG/DG	TMAP INTAKE AIR TEMPERATURE SIGNAL
138	BN/DB	TPS +3.3V SUPPLY (VS2)	230	GY/RD	REAR HEATED OXYGEN (HO2) SENSOR SIGNAL 1
140	DG/BK	LOW BEAM RELAY CONTROL GROUND	235	DB/BK	CANISTER PURGE VALVE (CPV) CONTROL
141	WH/YE	STARTER SOLENOID RELAY CONTROL GROUND	236	DB	REAR LEFT TS LAMP GROUND OUTPUT GROUND
142	GY	FUEL PUMP RELAY CONTROL GROUND	237	RD	KNOCK SENSOR SIGNAL
144	DG	ECM CAN LOW	238	BK	KNOCK SENSOR SIGNAL RETURN
145	DG	ECM HS CAN LOW	239	GY/YE	FRONT HEATED OXYGEN SENSOR (HO2) CONTROL 2
147	BG/BK	SIDE-STAND SWITCH OUTPUT GROUND	243	WH/GY	FRONT FUEL INJECTOR DRIVER 2
151	PK/DB	STOP LAMP POWER OUTPUT	244	WH/DB	REAR FUEL INJECTOR DRIVER 1
153	BK/WH	ECM POWER GROUND 2	246	GY/WH	REAR HEATED OXYGEN (HO2) SENSOR CONTROL 1
154	BK/WH	ECM POWER GROUND 3	247	BK/WH	ECM ELECTRONIC GROUND
155	VT/PK	ECM SWITCHED POWER 2	248	DB/RD	REAR RIGHT TS LAMP GROUND OUTPUT GROUND
156	VT/PK	ECM SWITCHED POWER 2	250	BK/WH	ECM POWER GROUND 1
			251	PK/RD	ETC MOTOR (+)
			252	YE	ETC MOTOR (-)
			254	WH	FRONT COIL SIGNAL 2
			256	WH	FRONT COIL SIGNAL 1

IGNITION SYSTEM TEST FLOWCHART



BATTERY INSPECTION (TEST 1)

Battery terminals and connections should be kept free of corrosion. If cleaning is necessary, remove the corrosion with a stiff wire brush. Wash with a solution of one tablespoon baking soda to one cup water. Rinse well with tap water and dry off with clean rags. Coat terminals with dielectric grease.

1. Visually inspect the exterior of the battery. Replace battery if housing is damaged, case is deformed, or if electrolyte is leaking.
2. To remove corrosion, remove battery from motorcycle and wash terminals with water and baking soda solution. Clean terminals, bolts, and cable ends with a brass wire brush and apply a thin film of dielectric grease.
3. Measure battery voltage.

Specification: 12.8 Volts DC minimum

4. If battery voltage is below 12.8 Volts DC, charge it thoroughly. See **BATTERY CHARGING AND MAINTENANCE page 10.16**.
5. Replace battery if it will not accept a charge.

SPARK INSPECTION (TEST 2)

1. Remove ignition coil(s). See **Ignition Coil Replacement page 10.42**.
2. Install secondary ignition cable test adapter (commercially available) between coil(s) and spark plug(s).
3. Connect timing light to secondary ignition cable test adapter.
4. Turn ignition key ON to power up the motorcycle and place the STOP/RUN switch in the RUN position.
5. Shift transmission into neutral and pull in clutch lever.
6. Depress starter button and observe timing light.
7. Determine if timing light flashes without interruption for both cylinders.
8. Consistent flashes indicate that some secondary voltage is present. The likelihood of an ignition related problem is reduced but not eliminated. Keep the following points in mind:
   - There is a threshold voltage and amperage requirement for timing lights below which they will not trigger and therefore, not flash.
   - Fouled spark plugs may drop secondary voltage so low that a timing light will not trigger and therefore, not flash.
   - With no current flowing (open secondary side of the ignition coil) the timing light will not flash.
   - A faulty high tension circuit or poor connection is one example of an open secondary.
9. Replace spark plugs, connect plug wires and re-test.
10. If timing light does not flash consistently for one or both cylinders, test ignition coil (Test 3).

IGNITION COIL POWER / GROUND SIGNAL (TEST 3)

Power To Ignition Coil

Battery voltage must be present at the ignition coil (Pin B) when the power button is switched on and the electrical system powered up.

1. Disconnect the electrical connector from the ignition coil. See **Ignition Coil Replacement page 10.42**.
2. Set the multimeter to measure VDC and insert the meter leads into the appropriate jacks.
3. Connect the black lead to ground (on the engine).
4. Connect a small thin test adapter lead to terminal 1 of the ignition coil primary connector and the red meter lead to the test adapter.
5. Turn ignition key ON to power up the motorcycle electrical system and place the STOP/RUN switch in the RUN position.
6. Battery voltage should appear on terminal 1 of the coil connector (RD wire).
7. With transmission in Neutral, crank the engine. Battery voltage should again be present on center wire.

   Ignition Coil Ground Signal

   The following steps will test the ECM (Ground) Signal To Ignition Coil

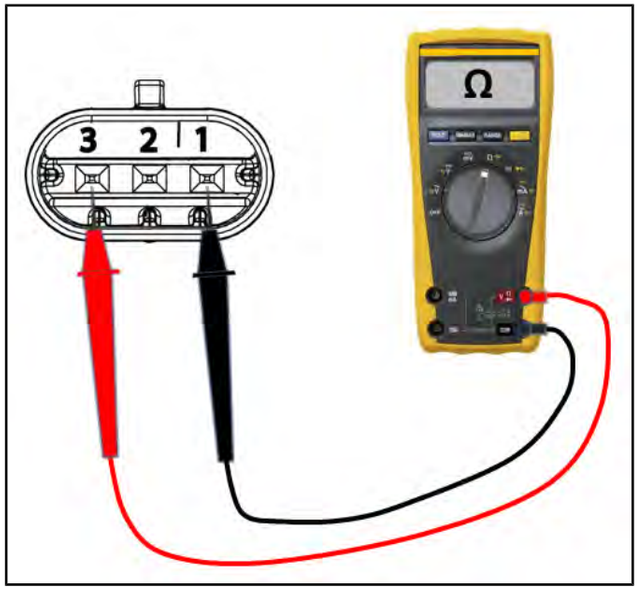
   ECM ground signal must be present at terminal 3 of the ignition coil primary harness connector. The signal will appear as a pulse on the meter between Ground (-) and Open (OL).
8. Set the multimeter to measure resistance (Ω).
9. Place a small thin test adapter into terminal 3 of the ignition coil connector (the WH wire) and connect one meter lead to the test adapter..
10. Ground the other lead to the engine.
11. Place transmission in Neutral.
12. Turn the ignition key ON to power up the motorcycle electrical system and place the STOP/RUN switch in the RUN position.
13. Crank the engine with the electric starter and watch the display on the multi meter. The meter display should pulse evenly while engine is cranking, indicating a ground signal is present.
14. Repeat the test on the other outside wire in the connector.

- If no pulse is present, test the Crankshaft Position Sensor.
- If the signal is present on one wire and not the other, test related wiring and connections.
- If both signals are present and there was battery voltage on the RD wire (center terminal) but still no spark, test the ignition coil windings. (Test 5).

IGNITION COIL RESISTANCE (TEST 4)

Ignition Coil Primary Winding

1. Remove ignition coil. See **Ignition Coil Replacement page 10.42**.
2. Set the multi meter to measure resistance (Ω) and insert the meter leads into the appropriate jacks.
3. Measure resistance between terminal ① and terminal ③ on the coil. Compare to specification.

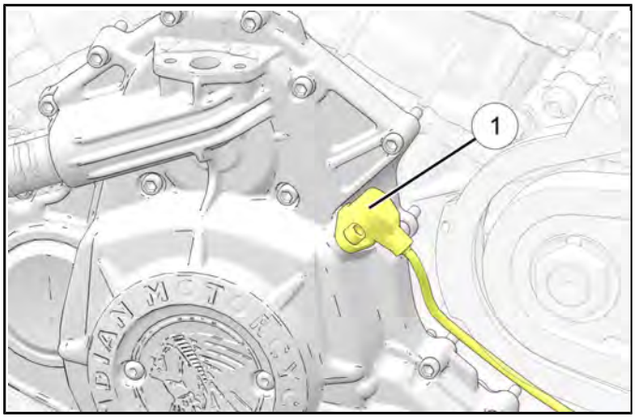


Primary Coil Resistance: 0.6 - 0.8 Ω

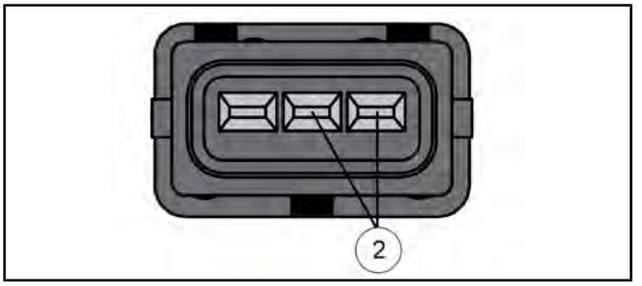
CRANKSHAFT POSITION SENSOR, TEST / REPLACE

Crankshaft Position Sensor (CPS) Test

1. Locate the CPS sensor ① .



2. Trace the wire to its connector and disconnect.
3. Connect an ohmmeter between the pin terminals ② and compare resistance readings to specification below.

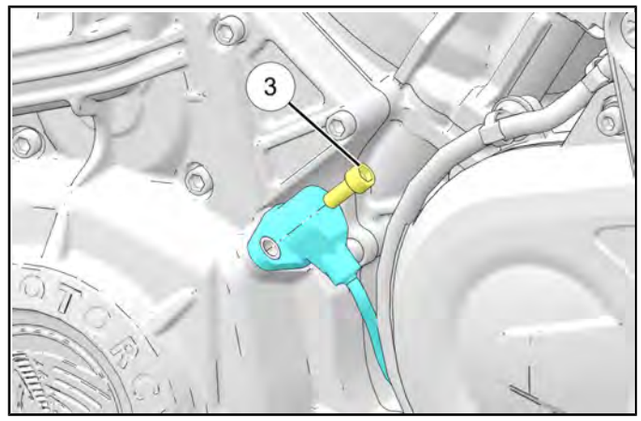


4. If resistance is correct, check to see that the sensor is mounted properly and that the fly wheel has not been damaged and is securely mounted to the crankshaft assembly.

Crankshaft Position Sensor: **860 Ohms @ 20°C (68°F)**

Crankshaft Position Sensor (CPS) Replacement

1. Remove regulator / rectifier assembly and bracket. See **Regulator / Rectifier Replacement page 10.40**.
2. Disconnect the CPS sensor from the vehicle harness and release flying lead from plastic darts and cable ties.
3. Remove the screw ③ securing the CPS sensor to the engine case and remove sensor.



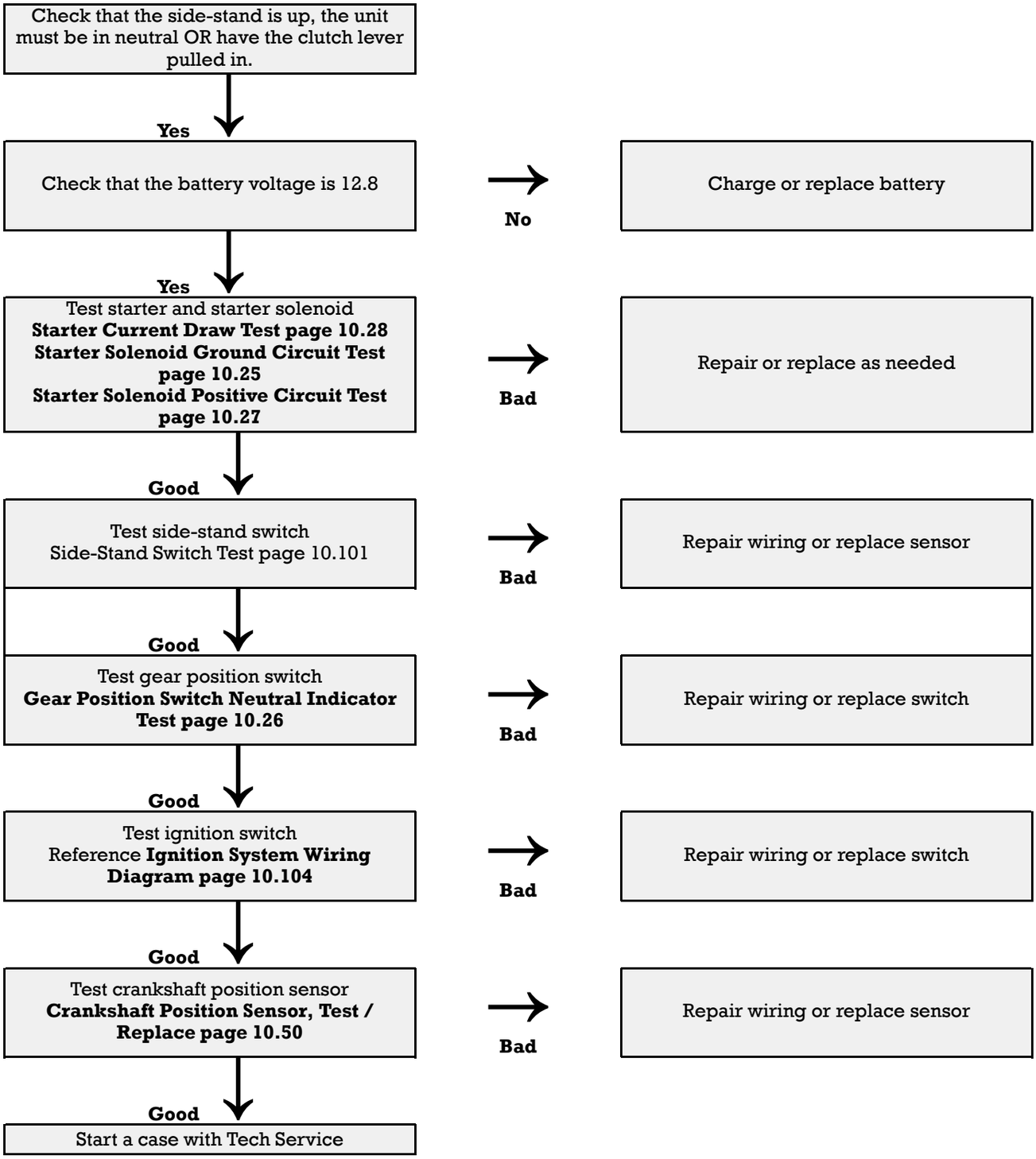
4. **Installation is performed by reversing the removal procedure.**

IMPORTANT
Apply rubber lubricant to the CPS sensor o-ring to ease installation.

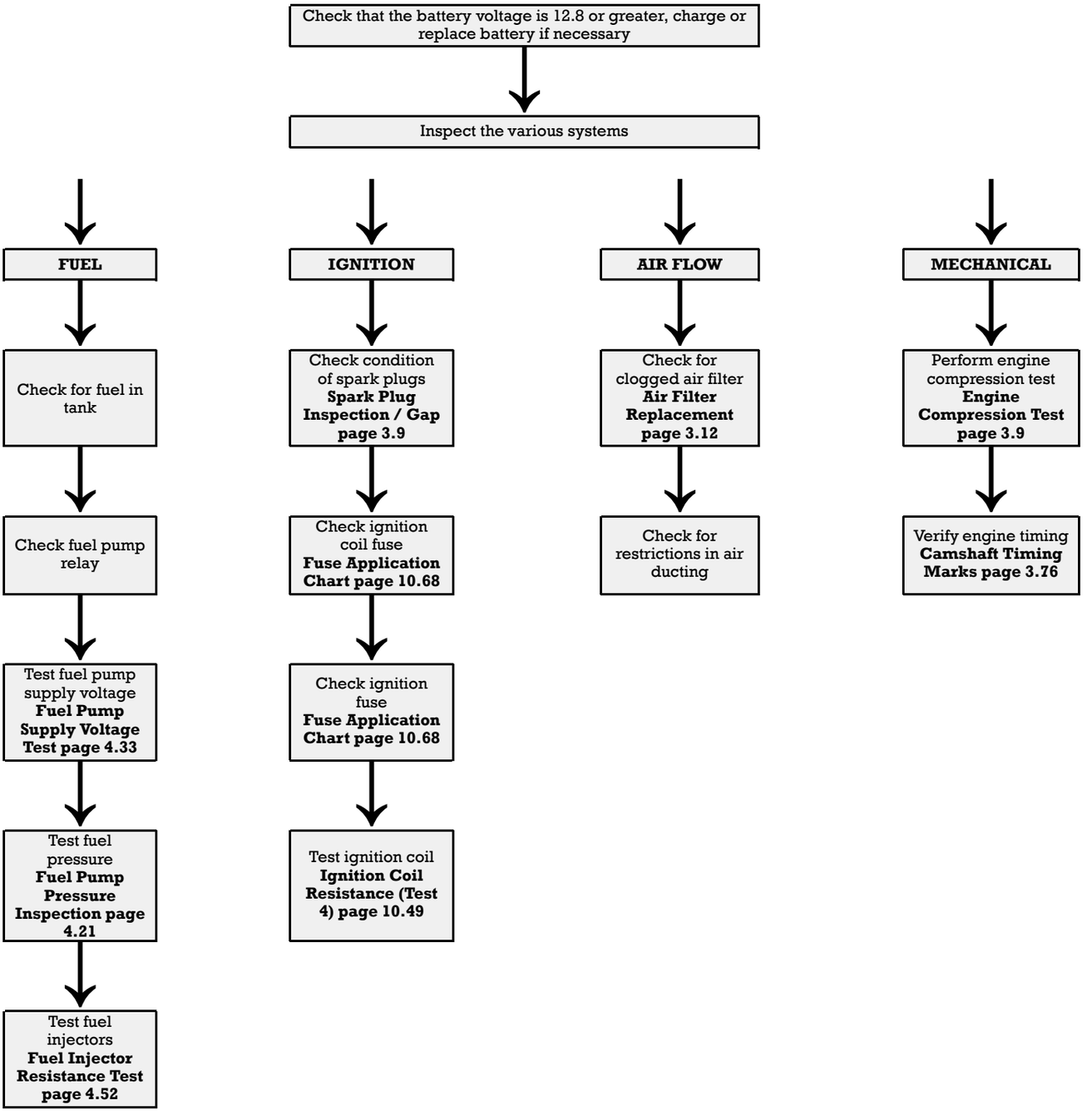
5. Torque the CPS retaining fastener to specification.

TORQUE
Crankshaft Position Sensor Fastener: **88 in-lbs (10 N·m)**

NO CRANK SITUATION



NO START SITUATION



CHASSIS ELECTRICAL

GENERAL INFORMATION

SERVICE NOTES

Keep the following notes in mind when diagnosing an electrical problem:

- Refer to wiring diagram for stator and electrical component resistance specifications.
- When measuring resistance of a component that has a resistance value under 10 Ohms, remember to subtract meter lead resistance from the reading. Connect the leads together and record the resistance. The resistance of the component is equal to tested value minus the lead resistance.
- Become familiar with the operation of your meter. Be sure leads are in the proper jack for the test being performed (i.e. 10 A jack for current readings). Refer to the Owner's Manual included with your meter for more information.
- Pay attention to the prefix on the multi-meter reading (K, M, etc.) and the position of the decimal point.
- For resistance readings, isolate the component to be tested. Disconnect it from the wiring harness or power supply.

SPECIAL TOOLS - ELECTRICAL (CHASSIS)

TOOL DESCRIPTION	PART NUMBER
Battery Tester	PV-50296
Electrical Tester Kit	PV-43526
MultiLink XP	PU-52792
USB to Serial Adapter	PU-50621

CONTROLLER OVERVIEW

OVERVIEW

Listed below are all the electronic controllers found on the FTR 1200 chassis. Under each electronic controller title is two boxes listing the inputs and outputs for it. There are signals and replaceable components listed within the input and output boxes. The signals are constant communication or rider initiated between the input or outputs and the electronic controller. The outputs are controlled by the electronic controllers they are connected to. Replaceable components are parts on the motorcycle that have communication with the electronic controller they are connected to and can be replaced. They may be replaceable as a single part or as part of an assembly

- The FTR 1200 operates on a single CANbus system
- Displays are controllers, but their info is not directly attached to any sensors.
- The display is connected via CANbus to the other controllers onboard and relays the information provided to it to the rider if needed. A couple examples of this are fault codes displayed as a check engine light or turning on the motorcycles high beam and displaying the high beam indicator light.

ECM (Engine Control Module)	
INPUT SIGNALS	**OUTUT SIGNALS**
• CANbus • Ambient Air Temp. Sensor Signal • Crankshaft Position Sensor Signal • Pedal Position Sensor Signal • Knock Sensor Signal • Throttle Position Sensor Signal • Gear Selector Switch Signal • Fuel Level Sensor Signal • Run/Stop Switch Signal • Tip-Over Sensor Signal • Side Stand Switch Signal • Front O2 Sensor Signal • Rear O2 Sensor Signal • Engine Coolant Temp. Sensor Signal • Oil Pressure Sensor Signal • TMAP Sensor Signal • Right Turn Signal Switch Signal • Left Turn Signal Switch Signal • Angle Sensor Signal	• CANbus • Rear Coil Power • Front Coil Power • ETC (Electronic Throttle Control) Motor Power • High Beam Power • Horn Power • Run/Stop Switch Power • Cooling Fan Relay Power • Low Beam Power • Starter Solenoid Power • Rear Brake Light Power • Front Left Turn Signal Power • Front Right Turn Signal Power • Canister Purge Valve Power • Front Fuel Injector Power • Rear Fuel Injector Power • Rear Left Turn Signal Power • Rear Right Turn Signal Power

REPLACEABLE COMPONENTS	
• Ambient Air Temp. Sensor • Crankshaft Position Sensor • Knock Sensor • Throttle Body – Throttle Position Sensor • Gear Selector Switch • Right-Hand Handlebar Control – Run/Stop Switch • Pedal Position Sensor • Lefthand Handlebar Control • Left Turn Signal Switch • Right Turn Signal Switch • Tip-Over Sensor • Side Stand Switch • Front O2 Sensor • Rear O2 Sensor • Engine Coolant Temp. Sensor • Oil Pressure Sensor • TMAP Sensor • Angle Sensor	• Rear Coil • Front Coil • Throttle Body – ETC (Electronic Throttle Control) Motor • Headlight Assembly – High Beam – Low Beam • Right-Hand Handlebar Control – Run/Stop Switch • Horn • Cooling Fan Relay Coil • Starter Solenoid • Taillight Assembly • Front Left Turn Signal Assembly • Front Right Turn Signal Assembly • Canister Purge Valve • Front Fuel Injector • Rear Fuel Injector • Rear Left Turn Signal Assembly • Rear Right Turn Signal Assembly

LEFT-HAND CONTROL Must replace as an assembly	
INPUT SIGNALS	**OUTPUT SIGNALS**
• CANbus • Clutch Switch Signal	• CANbus • Clutch Switch State • Right Turn Signal Switch Command • Left Turn Signal Switch Command • Hazard Light Command • Speedometer Mode Switch • Low Beam Signal • High Beam Signal • Horn Signal • Cruise Control • Digital Display 5-Way Switch Command

RIGHT-HAND CONTROL Must replace as an assembly	
INPUT SIGNALS	**OUTPUT SIGNALS**
• CANbus	• Run/Stop Switch Signal • CANbus – Start Switch Signal – Digital and Analog Display Toggle Switch Command

ABS Module (Antilock Brake System)	
INPUT SIGNALS	**OUTPUT SIGNALS**
• CANbus • Front Wheel Speed Sensor Signal • Rear Wheel Speed Sensor Signal	• CANbus • Front Brake Signal
REPLACEABLE COMPONENTS	
• Front Wheel Speed Sensor • Rear Wheel Speed Sensor	NA

Digital Speedometer Must replace as an assembly	
INPUT SIGNALS	**OUTPUT SIGNALS**
• USB Data • CANbus	• CANbus • Warning Light Indicators • High Beam Indicator • Oil Pressure Indicator

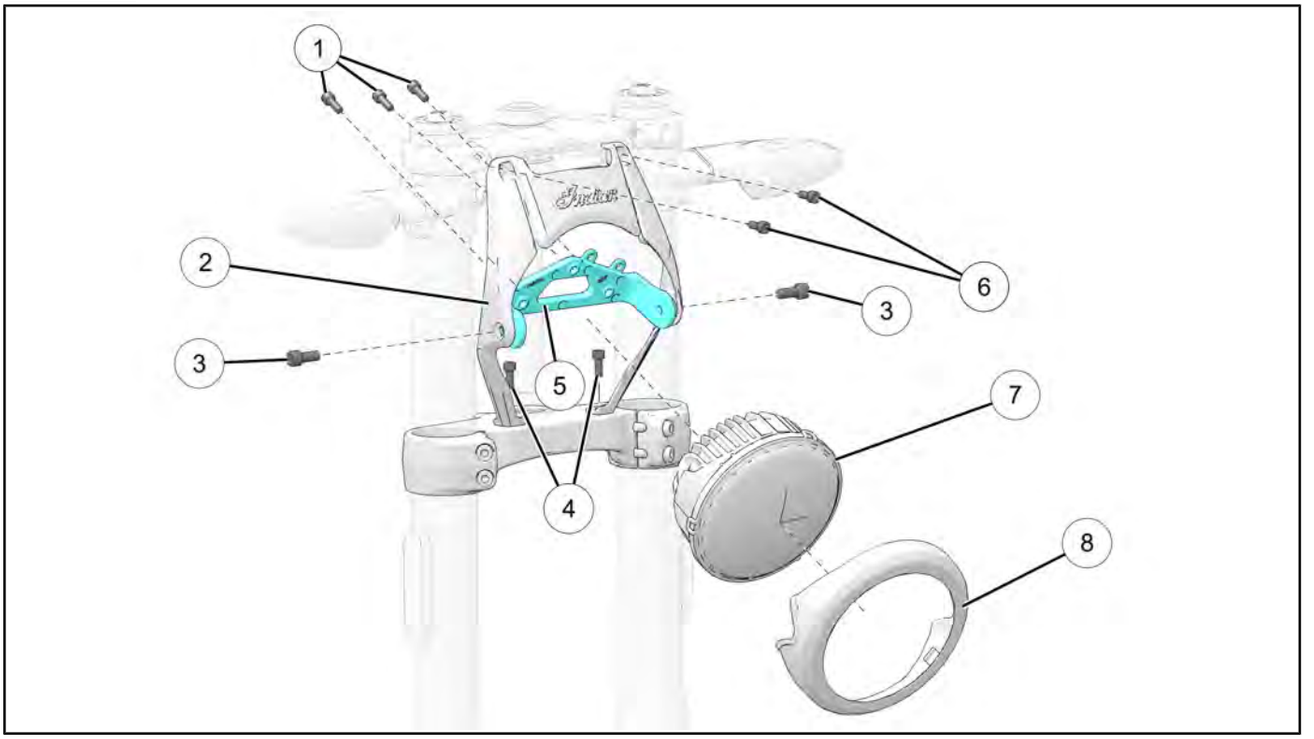
Analog Speedometer Must replace as an assembly	
INPUT SIGNALS	**OUTPUT SIGNALS**
• CANbus • Inputs from other controllers	• CANbus • Displays info from other controllers

IMU (Inertia Measurement Unit	
INPUT SIGNALS	**OUTPUT SIGNALS**
• CANbus	• CANbus • Accelerometer Data • Mode Control

ASSEMBLY VIEWS

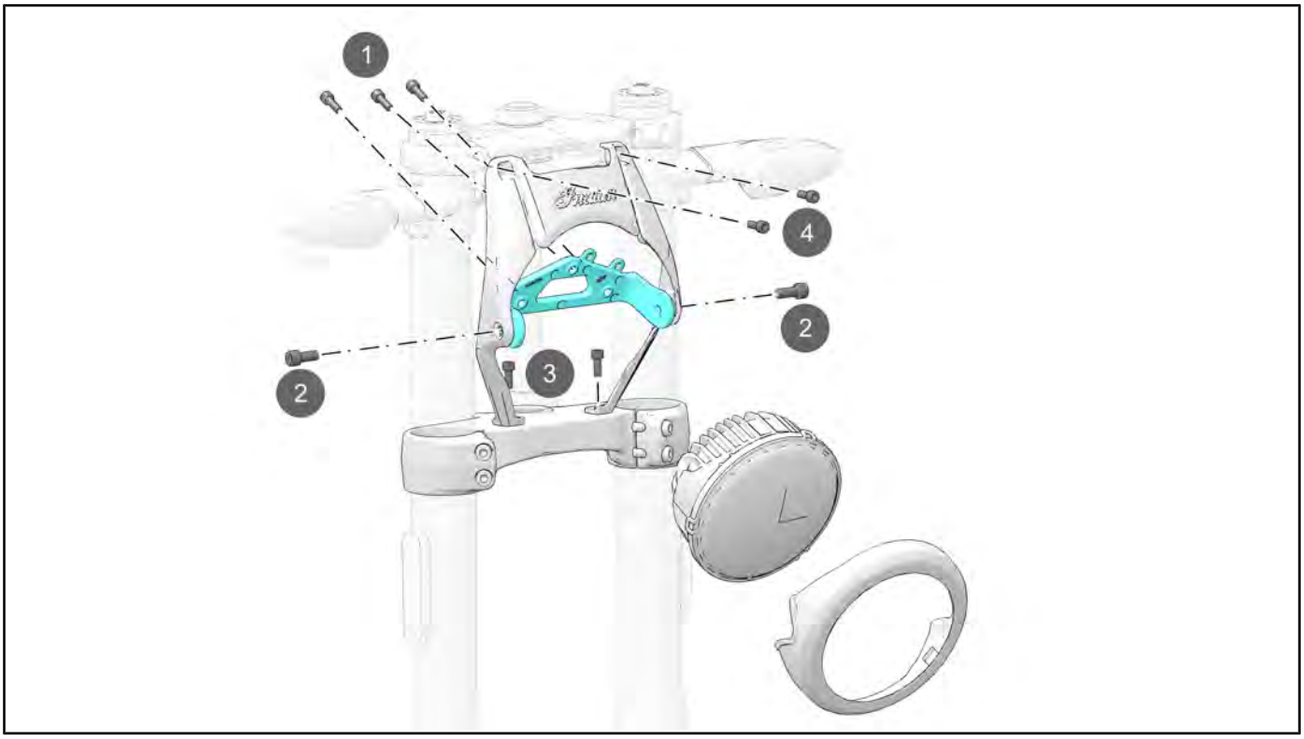
HEADLIGHT - ASSEMBLY VIEW

2019-2020

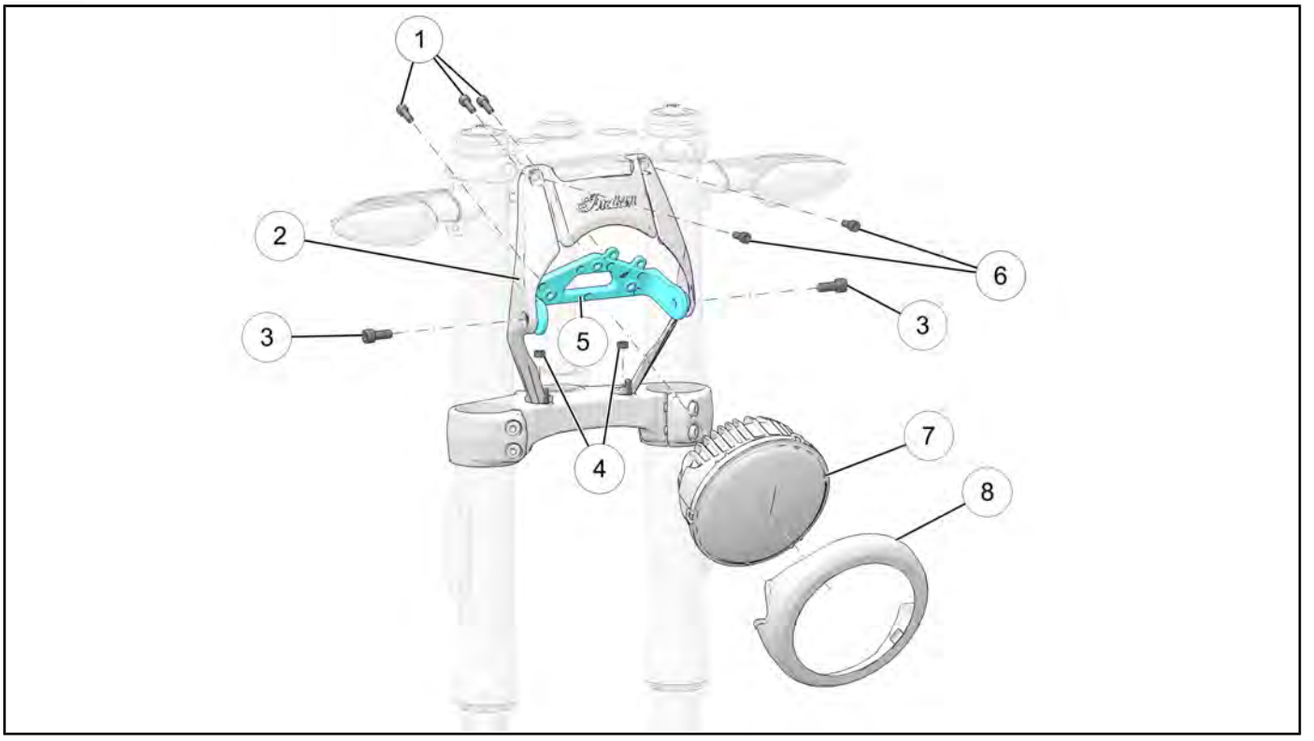


NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Headlight Carrier Bolts	**84 in-lbs (9 N·m)**
②	Headlight Mount Bracket	—
③	Headlight Adjustment Fasteners	**25 ft-lbs (34 N·m)**
④	Headlight Mount Fasteners (Lower)	**84 in-lbs (9 N·m)**
⑤	Headlight Carrier	—
⑥	Headlight Mount Fasteners (Upper)	**84 in-lbs (9 N·m)**
⑦	Headlight	—
⑧	Headlight Bezel	—

2019-2020 HEAD LIGHT TORQUE SEQUENCE

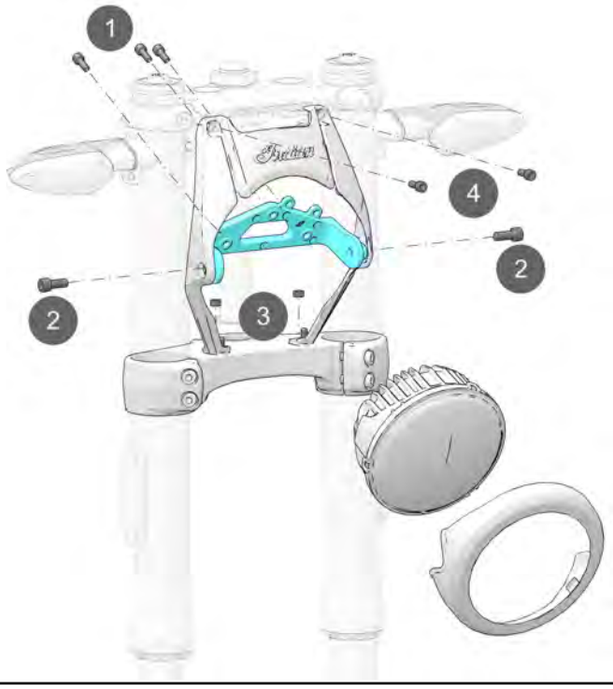


2022+

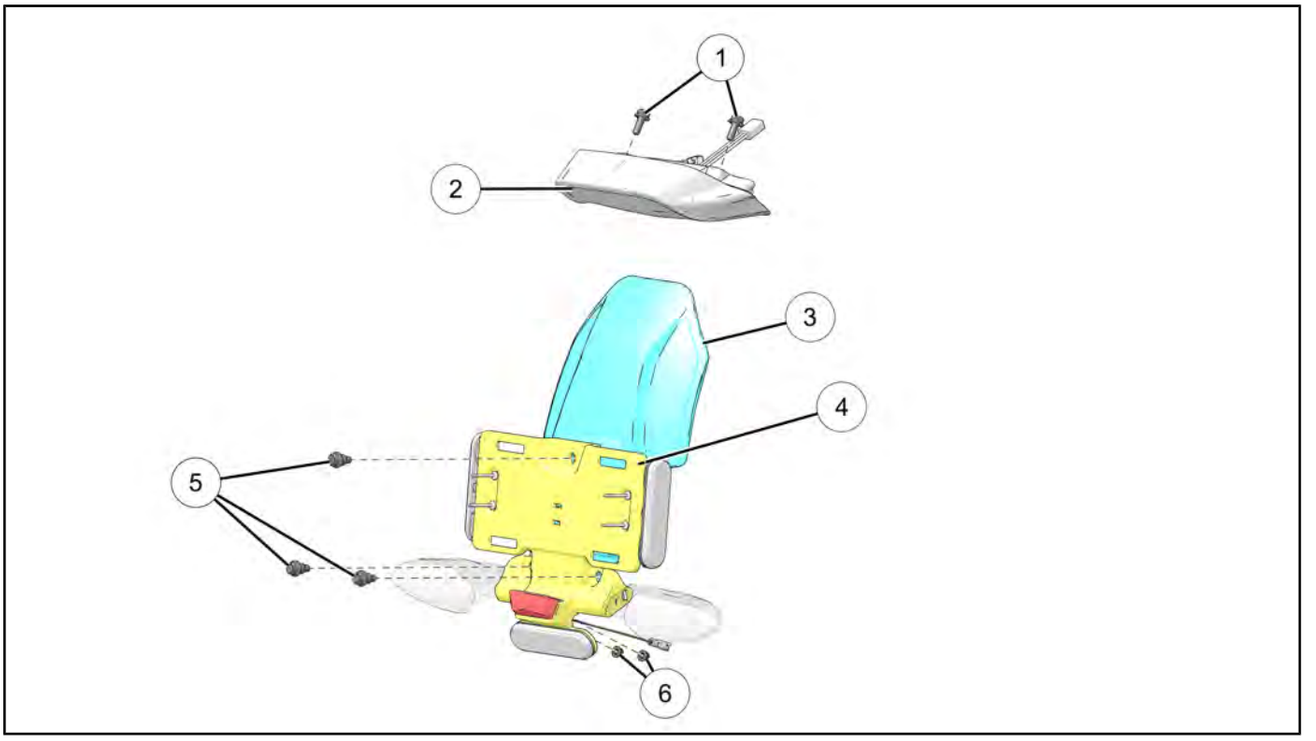


NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Headlight Carrier Bolts	**84 in-lbs (9 N·m)**
②	Headlight Mount Bracket	—
③	Headlight Adjustment Fasteners	**25 ft-lbs (34 N·m)**
④	Headlight Mount Nuts	**84 in-lbs (9 N·m)**
⑤	Headlight Carrier	—
⑥	Headlight Mount Fasteners (Upper)	**84 in-lbs (9 N·m)**
⑦	Headlight	—
⑧	Headlight Bezel	—

2022+ HEAD LIGHT TORQUE SEQUENCE



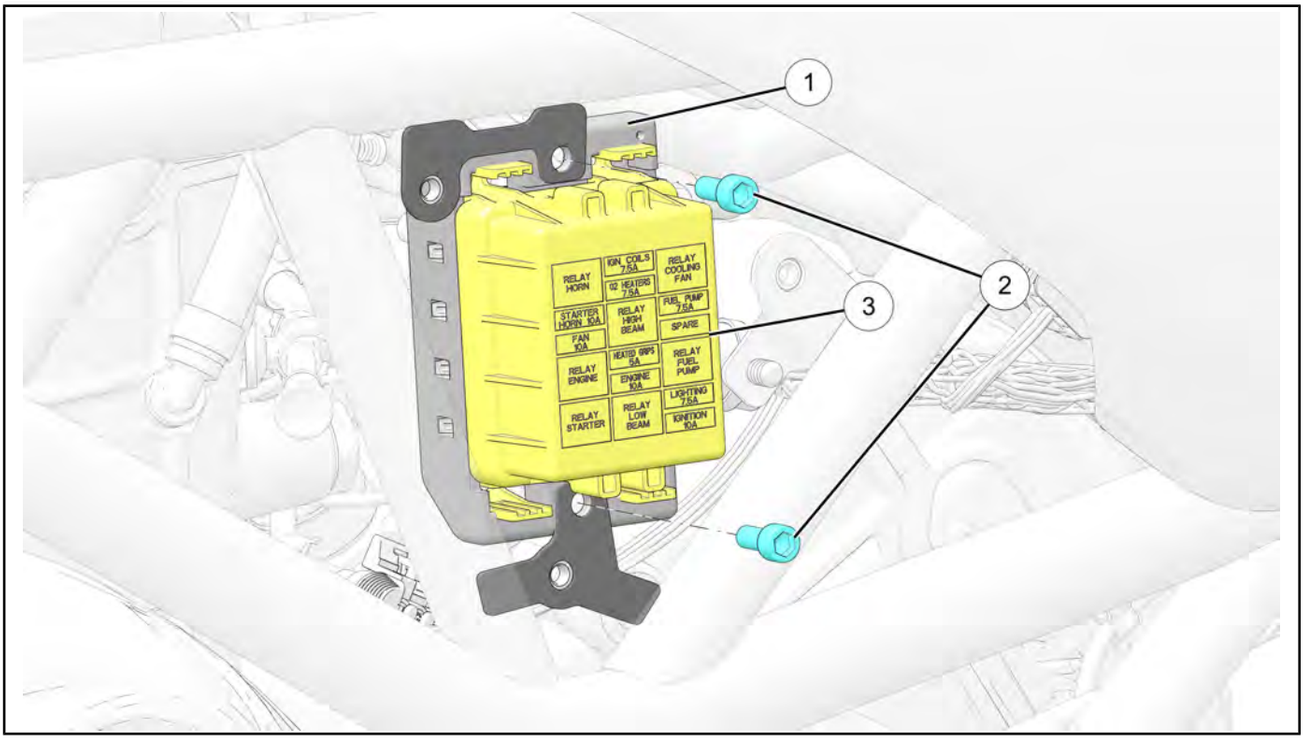
TAIL LIGHT - ASSEMBLY VIEW



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Tail Light Fasteners	**84 in-lbs (9 N·m)**
②	Tail Light	-
③	Debris Shield	-
④	License Plate Mount	-
⑤	License Plate Mount Fasteners	**96 in-lbs (11 N·m)**
⑥	License Plate Lamp Nuts	**24 in-lbs (3 N·m)**

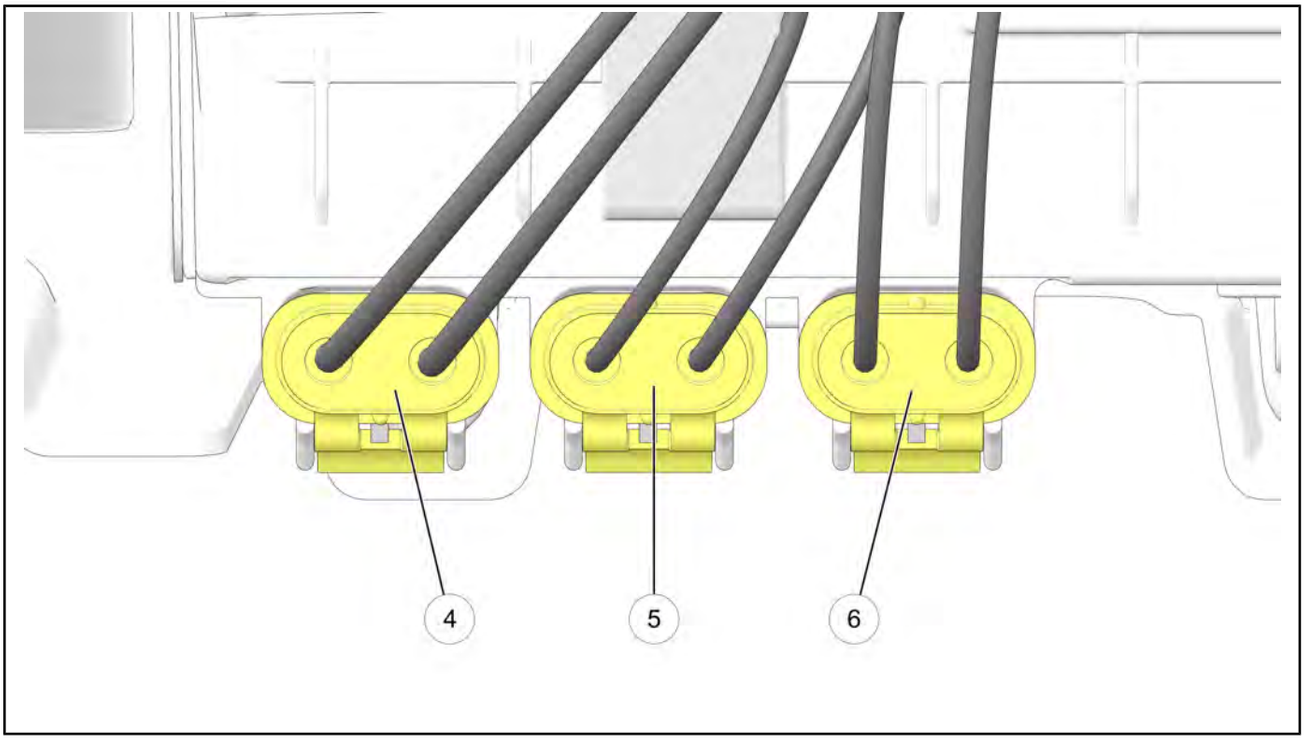
FUSE BOX - ASSEMBLY VIEW

MAIN FUSE BOX



NUMBER	DESCRIPTION	TORQUE (IF APPLICABLE)
①	Fuse Box	-
②	Fuse Box Mounting Fasteners	**36 in-lbs (4 N·m)**
③	Fuse Box Cover	-

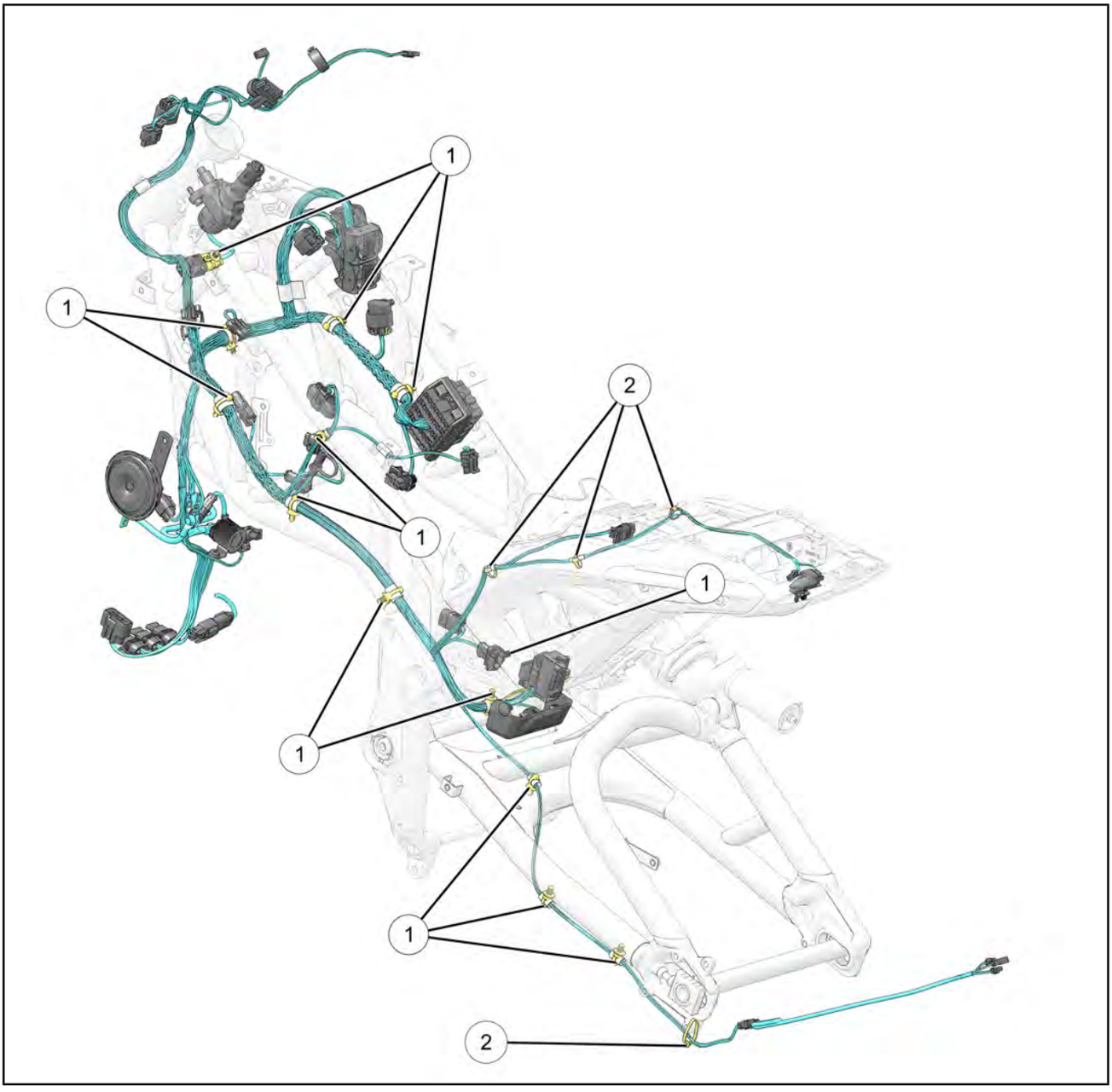
ADDITIONAL FUSES



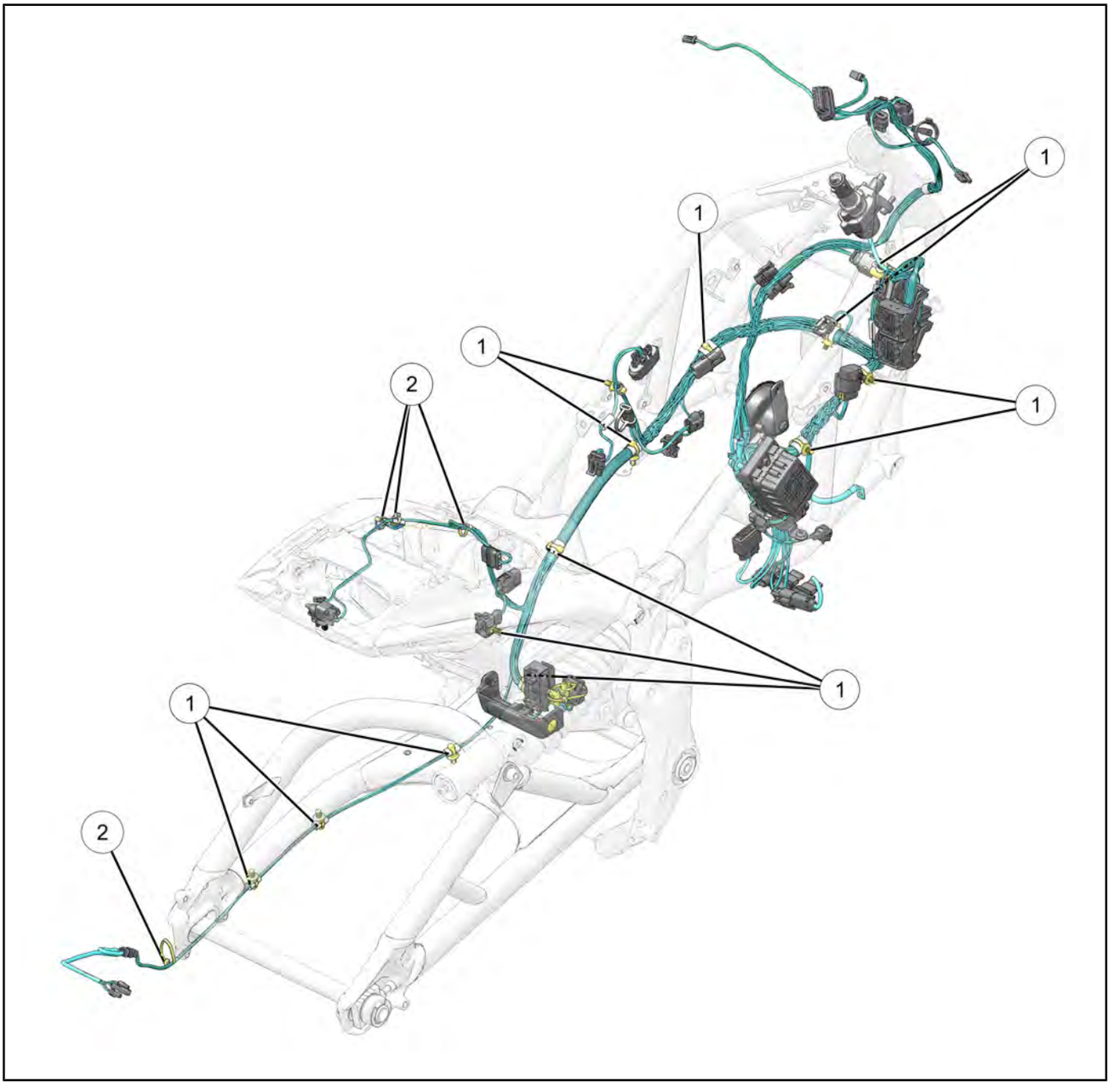
NUMBER	DESCRIPTION
④	Main Fuse
⑤	ABS Pump Fuse
⑥	ABS Valve Fuse

HARNESS ROUTING

NOTICE
If replacing the harness, noting routing during removal will aid in proper installation.



NUMBER	DESCRIPTION
①	Routing Clip
②	Panduit Strap



WIRING HARNESS REPLACEMENT

ELECTRICAL HARNESS REPLACEMENT

1. Remove fuel tank. See **Fuel Tank Removal page 4.24**
2. Remove airbox. See **Air Box Removal page 3.14**
3. Remove battery box. See **Battery Tray Removal / Installation page 10.14**
4. Remove headlight. See **Headlight Replacement page 10.74**
5. Follow the harness routing and disconnect all electrical connections.
6. Disconnect the harness from the chassis and remove the harness.

IMPORTANT
Note routing during removal to aid in proper installation.

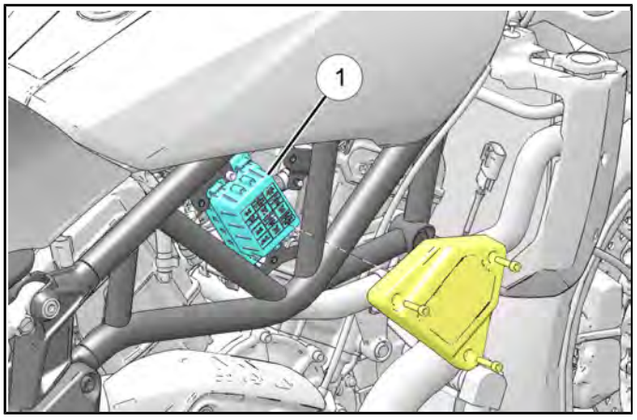
7. Reference Harness routing for reinstallation. See **Harness Routing page 10.65**

FUSE BOX

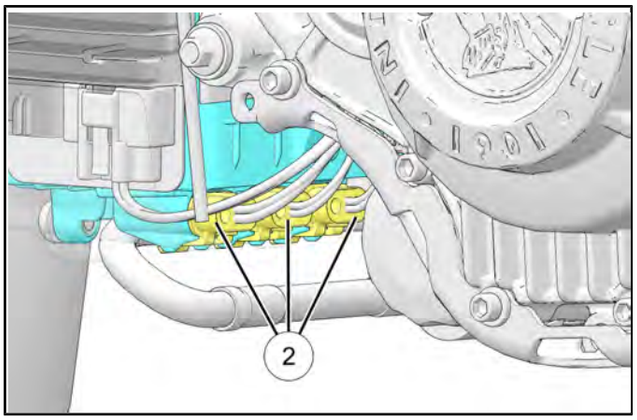
FUSE BOX LOCATION

There are a two fuse locations on the motorcycle:

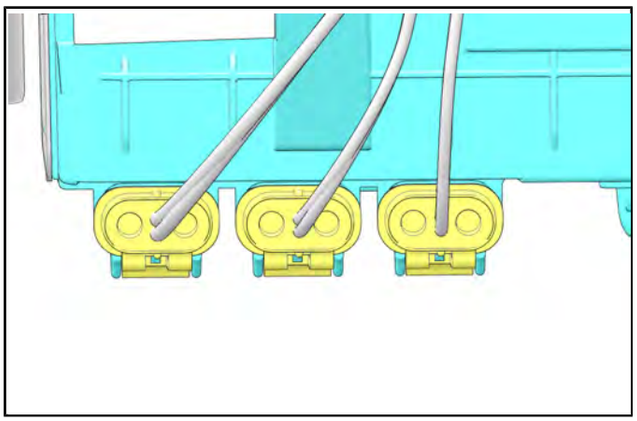
- The main fuse box ① is located right side of the unit beneath a v-cover.



- There are three fuses ② located under the battery tray from the left side of the unit.

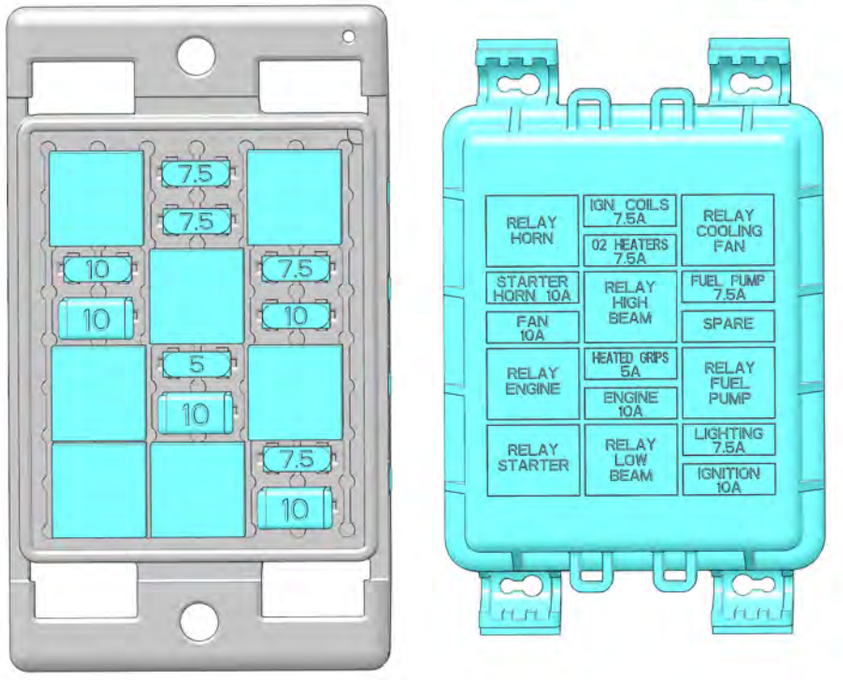


- The fuses from left to right are: Main fuse, ABS Pump fuse, ABS Valve Fuse.



10

FUSE APPLICATION CHART



RELAY HORN

WIRE COLOR	FROM	TO	FUNCTION
OG	Fuse Box Port: 5	Horn Splice	Horn Relay Power Feed
PK	Fuse Box Port: 6	Splice IGNSW	Horn Relay Coil Power
GY/OG	Fuse Box Port: 11	ECM 1	Horn Relay Control Ground
GY/DG	Fuse Box Port: 12	Horn Port A	Horn Power Feed

IGNITION COILS 7.5A

WIRE COLOR	FROM	TO	FUNCTION
RD	Fuse Box Port: 3	Front Coil	Front Coil Fuse Power Feed
RD	Fuse Box Port: 4	Rear Coil	Rear Coil Fuse Power Feed

O2 HEATERS 7.5A

WIRE COLOR	FROM	TO	FUNCTION
VT	Fuse Box Port: 9	Splice O2 Power	Fused Oxygen Sensor Heated Power
RD/BK	Fuse Box Port: 10	Splice ENGR	O2 Heater Fuse Power Feed

RELAY COOLING FAN

WIRE COLOR	FROM	TO	FUNCTION
RD	Fuse Box Port: 1	Splice MFUSE	Cooling Fan Circuit Breaker Power Feed
VT/PK	Fuse Box Port: 2	Splice ENGPWR	Fan Relay Coil Power
BK/OG	Fuse Box Port: 7	ECM 1 Port: 131	Cooling Fan Relay Control Ground
OG	Fuse Box Port: 8	Fuse Box Port: 23	Cooling Fan Relay Power Feed

STARTER / HORN 10A

WIRE COLOR	FROM	TO	FUNCTION
RD	Fuse Box Port: 17	Splice MFUSE	Horn / Starter Solenoid Fuse Power Feed
OG	Fuse Box Port: 18	Splice Horn	Horn Fuse Power Feed

RELAY HIGH BEAM

WIRE COLOR	From	TO	FUNCTION
PK	Fuse Box Port: 15	Splice IGNSW	High Beam Relay Power Feed
PK	Fuse Box Port: 16	Splice IGNSW	High Beam Relay Coil Power
BK/RD	Fuse Box Port: 21	ECM 1 Port: 101	High Beam Relay Control Ground
YE	Fuse Box Port: 22	Headlight	Headlight High Beam Power

FUEL PUMP 7.5A

WIRE COLOR	FROM	TO	FUNCTION
RD	Fuse Box Port: 13	Splice MFUSE	Fuel Pump Fuse Power Feed
OG	Fuse Box Port: 14	Fuse Box Port: 25	Fuel Pump Relay Power Feed

FAN 10A

WIRE COLOR	FROM	TO	FUNCTION
RD	Fuse Box Port: 23	Fuse Box Port: 8	Cooling Fan Relay Power Feed
OG/RD	Fuse Box Port: 24	Fan	Cooling Circuit Fan Circuit Breaker Output

RELAY ENGINE

WIRE COLOR	FROM	TO	FUNCTION
RD	Fuse Box Port: 29	Splice MFUSE	Engine Relay Power Feed
OG	Fuse Box Port: 30	Splice IGNBRK	Engine Relay Coil Power
GY/BK	Fuse Box Port: 35	ECM 1 Port: 115	Engine Relay Control Ground
RD/BK	Fuse Box Port: 36	Splice ENGR	Engine Relay Output

HEATED GRIPS 5A

WIRE COLOR	FROM	TO	FUNCTION
PK	Fuse Box Port: 27	Splice IGNSW	Heated Grip Fuse Power Feed
DB/PK	Fuse Box Port: 28	Heated Grips	Heated Grip Fuse Output

ENGINE 10A

WIRE COLOR	FROM	TO	FUNCTION
RD/BK	Fuse Box Port: 33	Splice ENGR	Engine Circuit Breaker Power Feed
VT/PK	Fuse Box Port: 34	Splice ENGPWR	Engine Circuit Breaker Output

RELAY FUEL PUMP

WIRE COLOR	FROM	TO	Function
OG	Fuse Box Port: 25	Fuse Box Port: 14	Fuel Pump Relay Power Feed
VT/PK	Fuse Box Port: 26	Splice ENGPWR	Fuel Pump Relay Coil Power
GY	Fuse Box Port: 31	ECM 1 Port: 142	Fuel Pump Relay Control Ground
VT/YE	Fuse Box Port: 32	Splice FPPWR	Fuel Pump Relay Output

RELAY STARTER

WIRE COLOR	FROM	TO	FUNCTION
OG	Fuse Box Port: 41	Splice Horn	Starter Relay Power Feed
PK	Fuse Box Port: 42	Splice IGNSW	Starter Relay Coil Power
WH/YE	Fuse Box Port: 47	ECM 1 Port: 141	Starter Solenoid Relay Control Ground
DG/WH	Fuse Box Port: 48	Starter Solenoid	Starter Relay Output Power

RELAY LOW BEAM

WIRE COLOR	FROM	TO	FUNCTION
PK	Fuse Box Port: 39	Splice IGNSW	Low Beam Relay Power Feed
PK	Fuse Box Port: 40	Splice IGNSW	Low Beam Relay Coil Power
DG/BK	Fuse Box Port: 45	ECM 1 Port: 140	Low Beam Relay Control Ground
DG	Fuse Box Port: 46	Headlight	Headlight Low Beam Power

LIGHTING 7.5A

WIRE COLOR	FROM	TO	FUNCTION
RD	Fuse Box Port: 37	Splice MFUSE	Lighting Fuse Power Feed
BN	Fuse Box Port: 38	Splice Light	Lights Fuse Output

IGNITION 10A

WIRE COLOR	FROM	TO	FUNCTION
RD	Fuse Box Port: 43	Splice MFUSE	Ignition Fuse Power Feed
OG	Fuse Box Port: 44	Splice IGNBRK	Ignition breaker output

LEAN ANGLE SENSOR SERVICE

LEAN ANGLE SENSOR REPLACEMENT

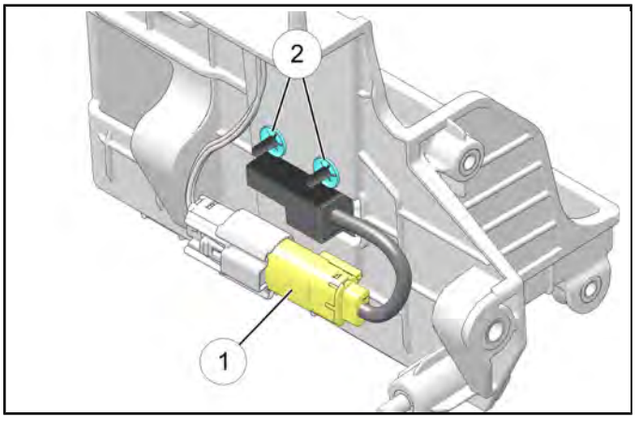
CONNECTOR PINOUT	FUNCTION	WIRE COLOR
1	+5V	Red
2	Signal Out	White
3	Ground	Black

REMOVAL

⚠ CAUTION

The battery MUST be removed from the battery box before the Lean Angle Sensor can be removed.

1. Remove the battery box and battery. See **Battery Tray Removal / Installation page 10.14**.
2. Disconnect the electrical connector ①.

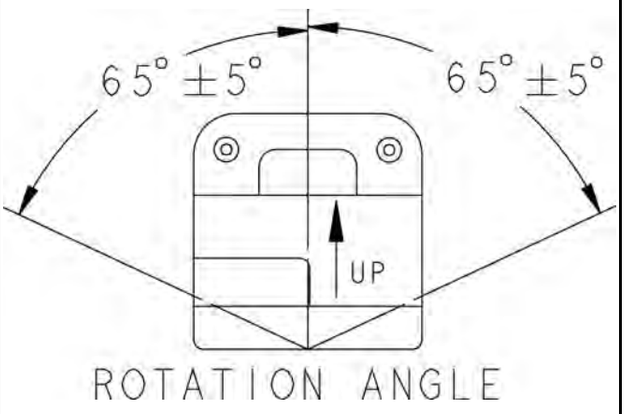


3. Remove two push fasteners ② securing the sensor in place and remove sensor through the opening in the battery box.

INSTALLATION

1. Route electrical plug through the battery box opening. Align the angle sensor bosses with the holes in the battery box.
2. Install two push fasteners ② onto the angle sensor bosses.

IMPORTANT



The sensor needs to be mounted straight for the angle sensor to function properly.

3. Connect the lean angle sensor electrical connector ①.
4. Install the battery and battery box. See **Battery Tray Removal / Installation page 10.14**.

HEADLIGHT SERVICE

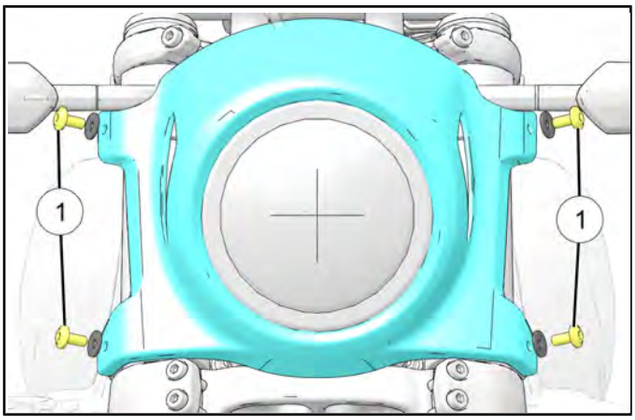
HEADLIGHT BULB REPLACEMENT

The headlight is comprised of LED lights that cannot be replaced individually. The headlight must be replaced in the event of a burnt out light. See **Headlight Replacement page 10.74**.

HEADLIGHT COVER REMOVAL / INSTALLATION

FTR S models only

1. Remove the four fasteners ① and washer securing headlight cover.

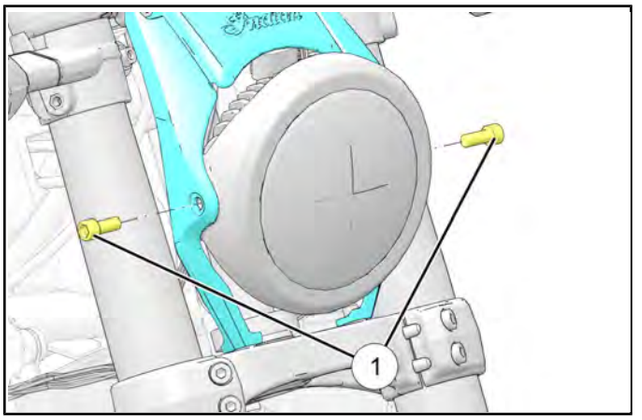


2. **Installation is performed by reversing the removal procedure.**

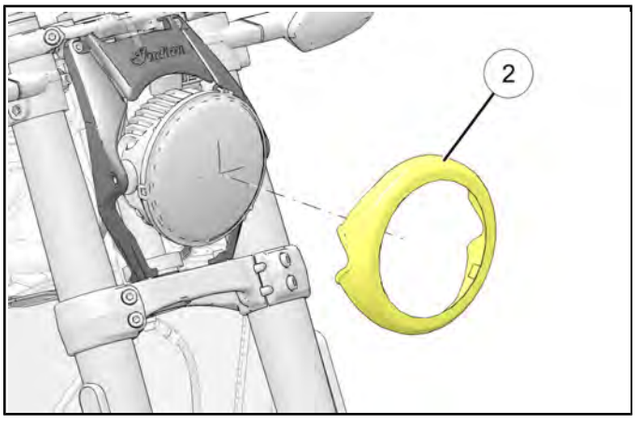
TORQUE
Headlight Cover Fasteners: **18 in-lbs (2 N·m)**

HEADLIGHT REPLACEMENT

1. Disconnect the battery. See **Battery Disconnect page 10.12**
2. If equipped, remove headlight cover. See **Headlight Cover Removal / Installation page 10.73**
3. Remove two headlight adjustment fasteners ①.



4. Remove headlight bezel ②.



5. Remove headlight and disconnect electrical connector.
6. **Installation is performed by reversing the removal procedure.**

TORQUE
Headlight Adjustment Fastener: **25 ft-lbs (34 N·m)**

TORQUE
Headlight Cover Fastener: **18 in-lbs (2 N·m)**

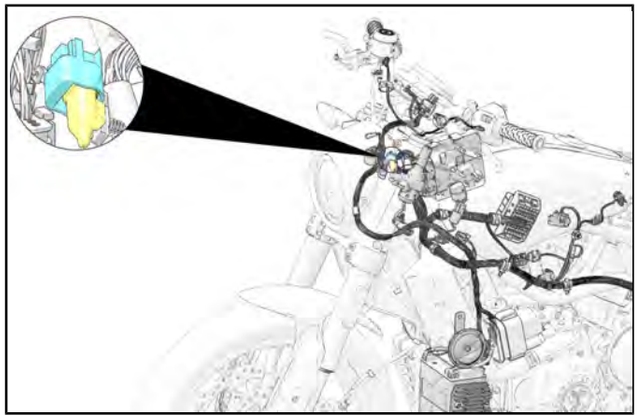
TORQUE
Battery Terminal Fastener: **25 in-lbs (3 N·m)**

TORQUE
Battery Covers Fasteners: **36 in-lbs (4 N·m)**

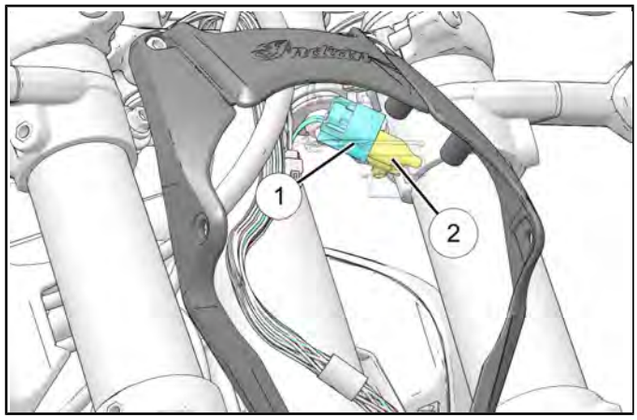
AMBIENT AIR TEMPERATURE SENSOR

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT

The ambient air temperature sensor is located toward the front of the unit behind the headlight.



1. Remove headlight. See **Headlight Replacement page 10.74**
2. Disconnect electrical connector ① and remove the sensor ②.

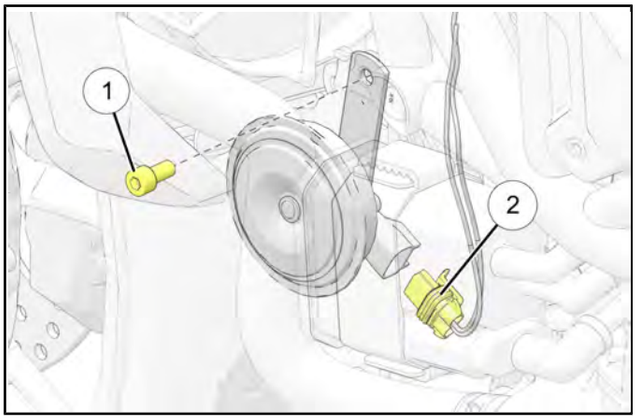


3. **Installation is performed by reversing the removal procedure.**
4. Reinstall headlight. See **Headlight Replacement page 10.74**

HORN SERVICE

HORN REPLACEMENT

1. Remove screw ① securing the horn to the frame bracket.
2. Disconnect the horn electrical connectors ②.



3. Remove the horn.
4. **Installation is performed by reversing the removal procedure.**
5. Torque fastener to specification.

TORQUE
Horn to Frame Bracket Fastener: **96 in-lbs (11 N·m)**

TAIL LAMP SERVICE

LED TAIL LIGHT OPERATION

The multiple LED tail / brake lamp functions much like a conventional incandescent tail / brake lamp. LED lights require a regulated current supply to prevent damage, so a current regulation circuit is incorporated inside the tail lamp unit. Direct 12 volt battery power can be applied directly to the brake or tail lamp wire for testing purposes, but polarity MUST be observed or the LEDs will be permanently damaged.

Tail Light Power Supply:

When the motorcycle is powered ON, battery voltage is delivered to the TAIL / BRAKE LEDs on the BN / PINK wire from the Headlight Relay. Current through each TAIL LED (WHITE wire) is limited (inside tail lamp unit) to approximately 250 mA.

Tail / Brake Light Ground Signal:

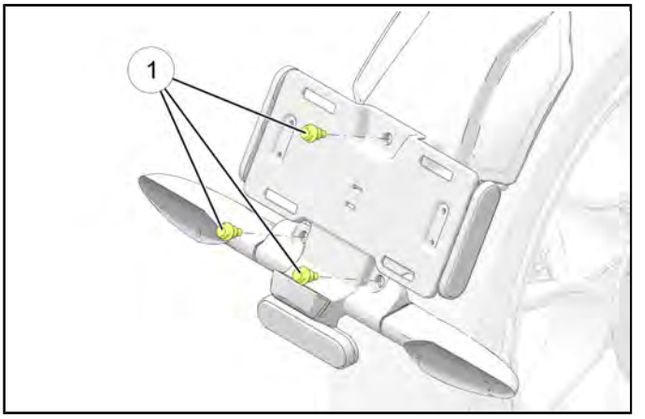
When the ECM receives a signal from either of the brake switches, power is provided to the brake light LED, thus illuminating the light.

LICENSE PLATE LIGHT REPLACEMENT

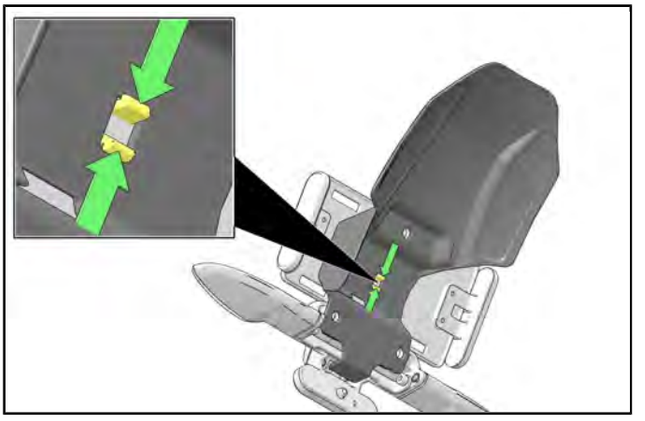
IMPORTANT
The tail and brake lights are LEDs and cannot be replaced individually. If the lights fail to function when activated, and all circuit tests indicate correct power and ground distribution, the tail /brake light must be replaced as an assembly. The license plate light can be replaced individually.

REMOVAL

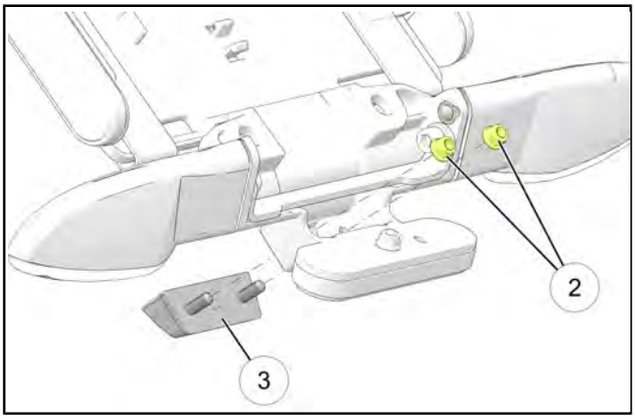
1. Remove three fasteners ① securing the license plate / fender assembly to the arm.



2. Disconnect the license plate light and turn signal electrical connectors.
3. Push in two retaining tabs on the rear fender to remove.



4. Remove license plate light nuts and remove license plate light.

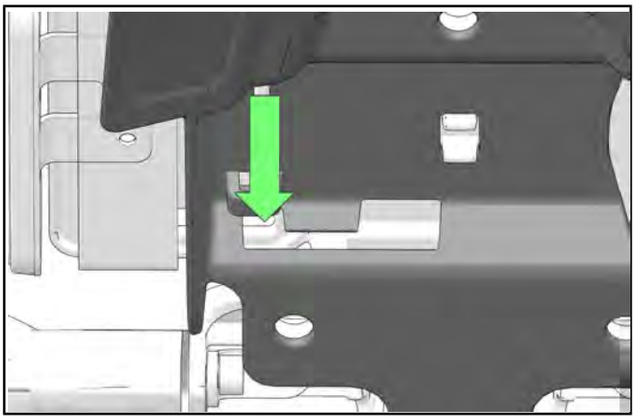


INSTALLATION

1. Install the license plate light.
2. Secure the license plate light with two nuts. Torque license plate nuts to specification.

TORQUE
License Plate Light Nuts: **24 in-lbs (3 N·m)**

3. Install rear fender.
4. Verify the license plate light wire is properly routed through the hole in the rear fender.

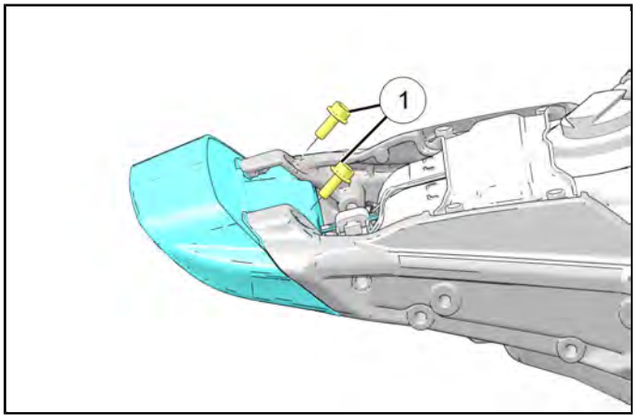


5. Connect the license plate light and turn signal electrical connections.
6. Install three fasteners to the license plate / rear fender assembly securing it to the arm. Torque fasteners to specification.

TORQUE
License Plate Mount Fasteners: **96 in-lbs (11 N·m)**

TAIL LIGHT REMOVAL / INSTALLATION

1. Remove seat. See **Seat Removal / Installation page 7.19**
2. Remove two fasteners ① securing tail light.



3. Disconnect the tail light electrical connection.
4. **Installation is performed by reversing the removal procedure.**

TORQUE
Tail Light Fasteners: **88 in-lbs (10 N·m)**

10

TURN SIGNAL / HAZARD SYSTEM SERVICE

TURN SIGNAL OPERATION

Turn Signal Auto Cancel Functionality

Verify function of the following components for correct turn signal operation.

- Turn Signal Switch
- Hazard Flasher Switch
- Vehicle Speed Sensor

NOTICE
FTR models have LED lights for front and rear turn signals.

The Auto Cancel Turn Signal Modes

1. NORMAL MODE - Vehicle speed above 14.9 mph (24 kmh) the auto cancel software records vehicle when turn signal is activated and equates speed with a preset distance. After the preset distance is traveled the turn signal is cancelled.
2. CONTINUOUS MODE - Vehicle speed below 14.9 mph (24 kmh) the turn signals operate indefinitely until manually cancelled. This mode overrides any previous auto cancel mode.
3. 90 - DEGREE TURN MODE - Vehicle speed below 14.9 mph (24 kmh) the turn signals operate indefinitely until speed exceeds 14.9 mph (24 kmh). If vehicle speed remains above 14.9 mph (24 kmh) for approximately two complete ON-OFF flash cycles, the turn signal cancels.
4. LANE CHANGE MODE - Vehicle speed above 14.9 mph (24 kmh) by pressing and holding the turn signal switch in the desired direction for more than one ON-OFF flash cycle the turn signals will cancel immediately once the switch is released.
5. HAZARD FLASHER MODE - At any vehicle speed the hazard flashers operate indefinitely and must be manually cancelled. This mode overrides any previous auto cancel mode.

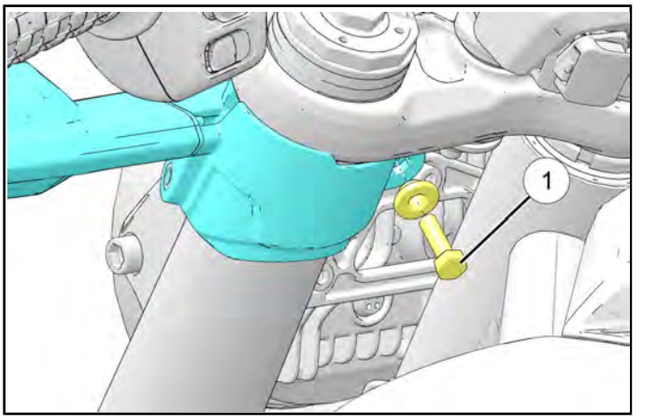
The turn signal / hazard light system does not utilize a conventional "flasher module", but instead receives a grounding signal from the ECM. Power to the turn signals is provided via the Oxygen Sensor Heater Fuse located in the main fuse box. Turn Signal INPUTS & OUTPUTS can be located in the ECM Connector Map and Fuse Application Chart.

See **ECM Connector Map page 10.44**.

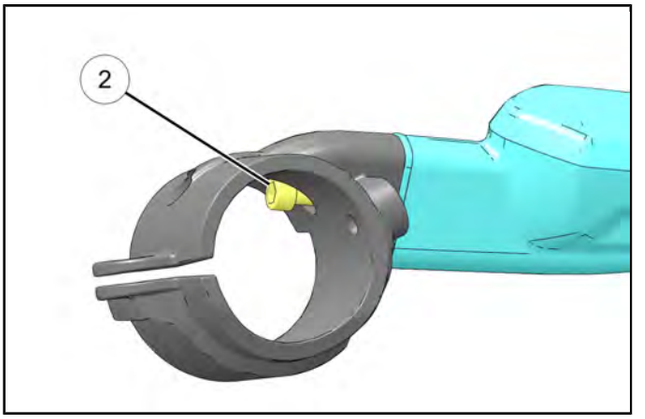
See **Fuse Application Chart page 10.68**.

TURN SIGNAL REPLACEMENT (FRONT)

1. Remove headlight cover if equipped. See **Headlight Cover Removal / Installation page 10.73**.
2. Remove turn signal mount fastener ①.



3. Remove turn signal and disconnect electrical connector.
4. Remove turn signal fastener ②.



5. **Installation is performed by reversing the removal procedure.**

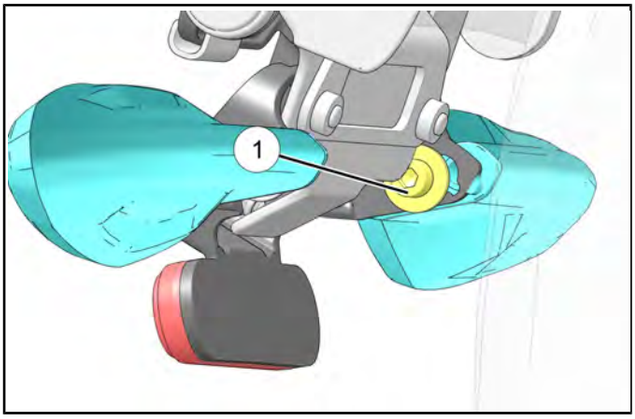
TORQUE
Turn Signal Fastener: **36 in-lbs (4 N·m)**

TORQUE
Turn Signal Mount Fastener: **36 in-lbs (4 N·m)**

TORQUE
Headlight Cover Fastener: **18 in-lbs (2 N·m)**

TURN SIGNAL REPLACEMENT (REAR)

1. Remove license plate mount. Reference **License Plate Light Replacement page 10.76**.
2. Remove turn signal fastener ①.



3. Remove turn signal and disconnect electrical connector.
4. **Installation is performed by reversing the removal procedure.**

TORQUE
Turn Signal Fastener (Rear): **48 in-lbs (5 N·m)**

INSTRUMENTATION

INSTRUMENT CLUSTER

The instrument cluster includes the speedometer, indicator lamps and Multi-Function Display (MFD).

2019–2020

2022

10

2023

	DESCRIPTION
①	Speedometer
②	Indicator Lamps
③	Multi-Function Display (MFD)

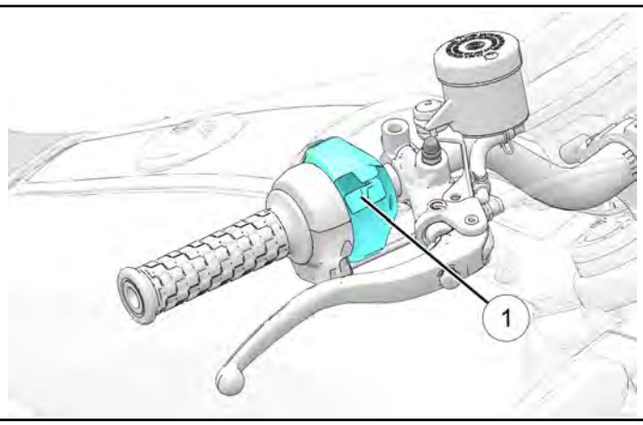
The speedometer displays forward vehicle speed in either miles per hour or kilometers per hour.

NOTICE
For detailed information regarding MODE selection and Multi-Function Display operation refer to the Owner's Manual.

INDICATOR LIGHTS

LAMP	INDICATES	CONDITION
	Chassis Fault	The alert symbol illuminates if a chassis fault occurs.
	Low Fuel	This lamp illuminates when 2.0 Liters (0.53 US gallons) of fuel remains in the tank.
	Neutral	This lamp illuminates when the transmission is in neutral.
	High Beam	The lamp illuminates when the headlight switch is set to high beam.
	Turn Signal	The turn signal indicator flashes when the left, right, or both turn signals (hazard) are active. If there is a problem in the signal system, the lamps will flash at twice the normal rate.
	ABS Not Activated	The indicator remains on until the ABS activates, which occurs when vehicle speed exceeds 6 MPH (10 km/h). When the lamp is illuminated, the anti-lock brakes will not activate, but the conventional brake system will continue to operate normally.
	Check Engine	*If this lamp illuminates while the engine is running, see your dealer promptly.* The light will remain on if the tilt sensor shuts down the engine. If abnormal sensor or engine operation is detected the light will remain on as long as the fault condition exists. Retrieve the error codes for diagnosis. If a misfire is detected, the check engine lamp will begin to flash and fuel will be cut to the affected cylinder(s). See Cylinder Misfire Detection page
 (2019–2020)	Side-stand Light (if equipped)	The side-stand light will turn on anytime the side-stand is down.
 (2022)	Engine Overheat	The engine overheat light will illuminate when the engine temperature exceeds normal operating temperature.

Multi-Function Display (MFD) The power switch must be ON to access the MFD. Use the mode switches to toggle through the modes of the MFD and to change settings in the display. The Right-Hand mode switch ① is located on the backside of the Right-Hand switch cube.



MFD INDICATORS

LAMP	INDICATES	CONDITION
	Low Oil Pressure	This lamp illuminates when oil pressure drops below a safe operating pressure while the engine is running. If this lamp illuminates while the engine is running above idle speed, turn the engine off as soon as safely possible and check the oil level. *If the oil level is correct and the lamp remains on after the engine is restarted, turn the engine off immediately. See your dealer.*
	Low Battery Voltage	This lamp illuminates if low battery voltage is detected or if there is a charging system fault. Turn non-essential accessories off to conserve power. Make sure the charging system is operating properly. See BATTERY CHARGING AND MAINTENANCE page 10.16.
MPH	Vehicle Speed	When standard mode is selected, speed displays in miles per hour.
km/h		When metric mode is selected, speed displays in kilometers per hour.
 	Cruise Control Status	*Amber Lamp:* Cruise control is enabled, but not set. When flashing, a cruise control related fault exists. *Green Lamp:* Cruise control is set to the desired speed. *Read the safety and operation procedures in the Owner's Manual before using cruise control.* .

MODES AVAILABLE	
Odometer	Engine Speed
Trip Odometer 1	Clock
Trip Odometer 2	Battery Voltage
Gear Indicator	Average Fuel Economy
Engine Coolant Temperature (2019–2020)	Instantaneous Fuel Economy
Cylinder Deactivation (2022+)	Diagnostic Functionality
Ambient Temperature (2022+)	Engine Error Codes
Misfire Detection	
Display Units (Standard / Metric)	
Over Temperature Display and Warning Indicator	

Odometer

The odometer displays total distance traveled.

Trip Odometers

The trip odometer (Trip 1 & Trip 2) displays total distance traveled since being reset. To reset, toggle to the trip odometer, then press and hold the MODE button until the trip odometer resets to zero.

Engine Speed

Engine Speed displays in revolution per minute (RPM).

Average Fuel Economy

Average Fuel Economy displays the vehicle's average fuel economy as of the last time the mode was reset. To reset, press and hold the left hand trigger while viewing the fuel economy display.

Instantaneous Fuel Economy

Instantaneous Fuel Economy displays the vehicle's current fuel economy at the moment the mode was selected.

Engine Coolant Temperature

The temperature area displays the temperature of the engine coolant.

Gear Position

Gear position will display when the transmission is in gear if the motorcycle is moving with the clutch lever released. It will also display when the transmission is in neutral.

Clock

The clock will display in 12 or 24 hour segments. Refer to the Owner's Manual to set the clock timing.

Battery Voltage

Battery voltage displays real-time, regulated charge voltage supplied to the battery. The voltage level may fluctuate depending on electrical load and engine RPM.

Misfire Detection

If a misfire is detected, the check engine indicator lamp will begin to flash and fuel will be cut to the affected cylinder(s). The check engine indicator lamp will continue to flash until the ignition switch has been moved to the off position. Restarting the engine will clear the flashing indicator and restore fuel to both cylinders. If another misfire occurs, the check engine indicator lamp will resume flashing and fuel will once again be cut to the affected cylinder(s). After the 3rd misfire, P0314 misfire fault is determined & set, the check engine light will remain on and fuel will be cut to the affected cylinder(s). If this occurs, your authorized Indian Motorcycle dealer can assist.

2022 models will have the engine shut down after 5 minutes of run time or 5 minutes of no user input after misfire detection.

Diagnostic Functionality

Certain conditions will cause the battery indicator to illuminate and an error message to display in the screen. If this occurs, please see your authorized Indian Motorcycle dealer.

Display Units

The display can be changed to display either standard or metric units of measurement. Refer to the Owner's Manual to set the display units.

Engine Error Codes

The error screen displays only when the CHECK ENGINE light is on or when it goes on and off during one ignition cycle. Error codes display only during the current ignition cycle. When the ignition switch is turned OFF, the code and message is lost, but will reappear if the fault reoccurs after restarting the engine. Refer to the Owner's Manual to retrieve the engine error codes.

Over Temperature Display and Warning Indicator

2019–2020

"HOt" displays and the CHECK ENGINE indicator lamp will illuminate.

2022

The overheat indicator lamp will illuminate.

2023

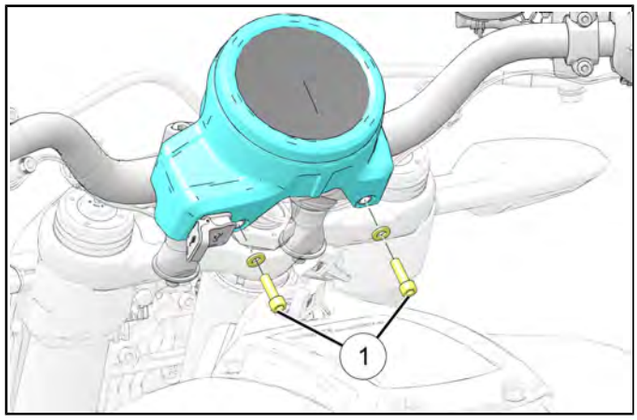
Traction Control

CONDITION	INDICATES	ACTION REQUIRED
Engine coolant temperature approaches unsafe operating condition while the engine is running.	Engine coolant temperature is above a safe operating temperature.	Stop the engine as soon as safely possible. Check the coolant level. Check the radiator for debris. Check cooling fan operation. If the warning continues to display after restarting the engine, stop the engine immediately.

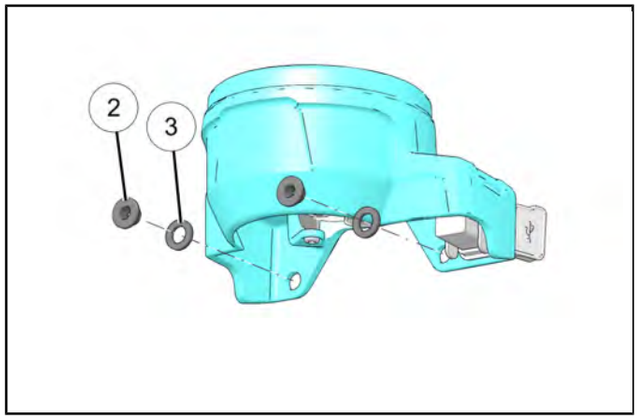
INSTRUMENT CLUSTER REMOVAL / INSTALLATION

2019–20

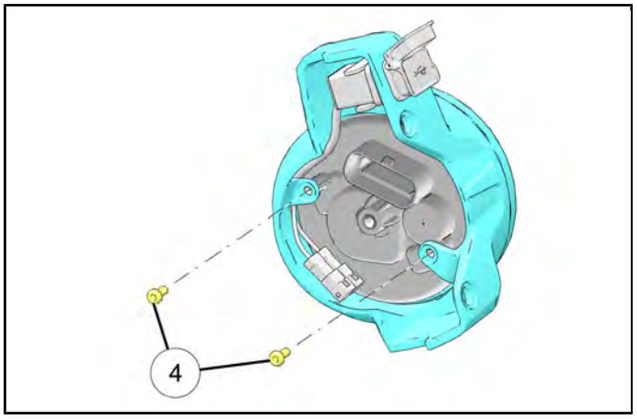
1. Disconnect battery. See **Battery Disconnect page 10.12**
2. Remove two instrument cluster housing fasteners ① and washers.



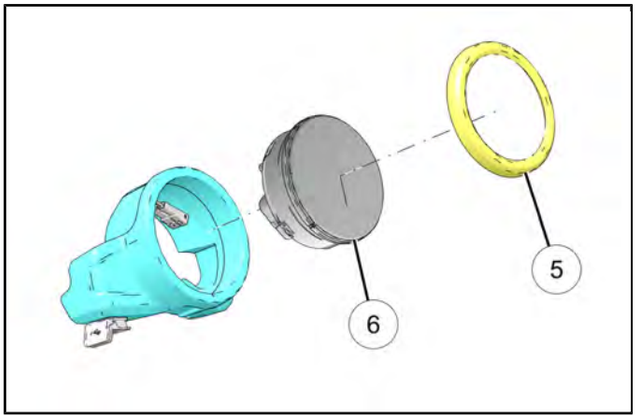
3. Remove top hats ② and rubber washers ③.



4. Remove the assembly and disconnect electrical connections.
5. Remove two speedometer screws ④.



6. Remove the speedometer cover ⑤, and speedometer ⑥.



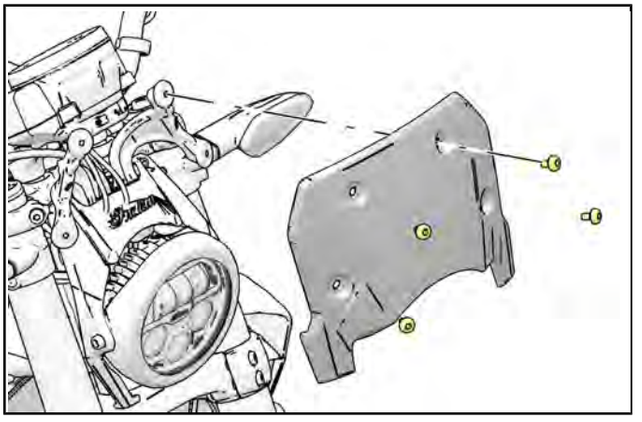
7. **Installation is performed by reversing the removal procedure.**

TORQUE
Instrument Cluster Housing Fastener: **84 in-lbs (9 N·m)**

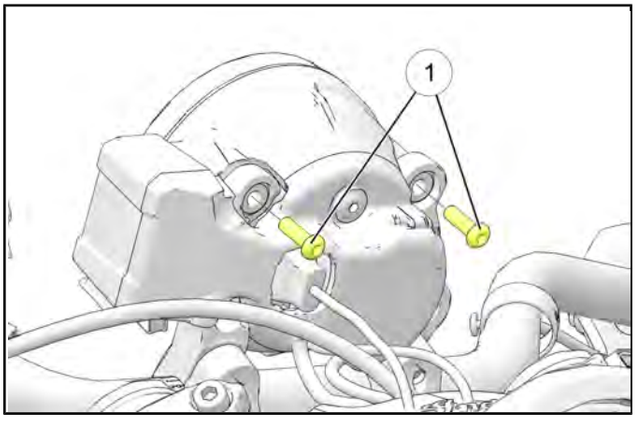
TORQUE
Speedometer (analog) Fastener: **10 in-lbs (1 N·m)**

2023 FTR Sport

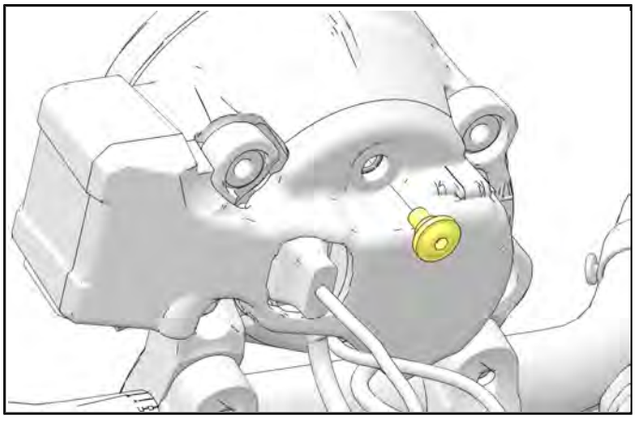
1. Disconnect battery. See **Battery Disconnect page 10.12**
2. Remove fasteners and number plate.



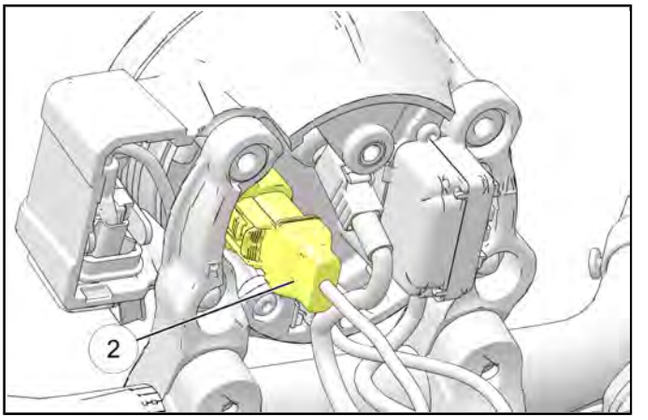
3. Remove rear display fasteners ①.



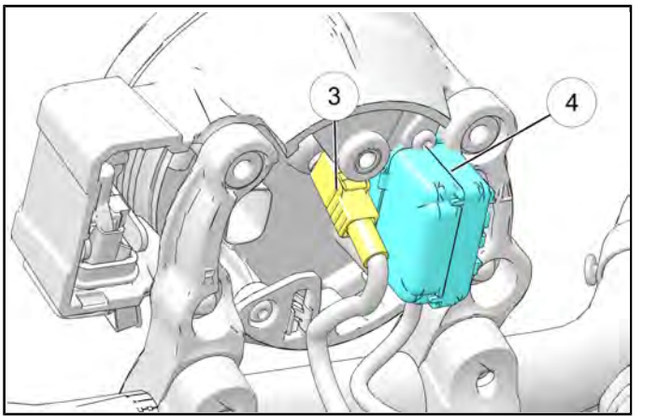
4. Remove rear middle display fastener and cover.



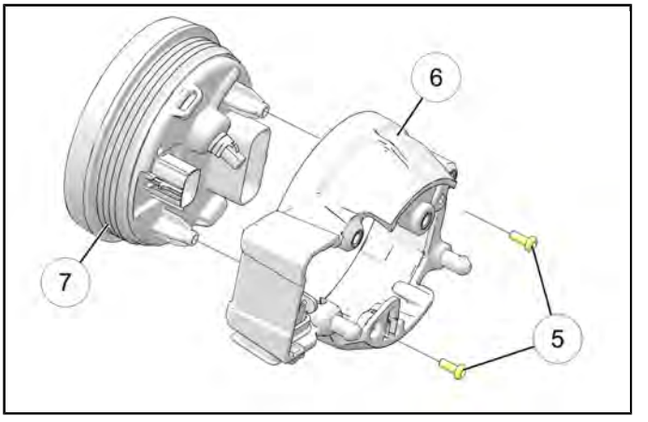
5. Lift the cluster assembly upward and disconnect cell USB ② connector.



6. Remove Antenna GPS ③, and chassis harness ④ connectors.



7. Remove instrument cluster fasteners ⑤.



8. Separate housing ⑥ and cluster ⑦.

9. **Installation is performed by reversing the removal procedure.**

TORQUE
Instrument Cluster Fasteners (2023): **9 in-lbs (1 N·m)**

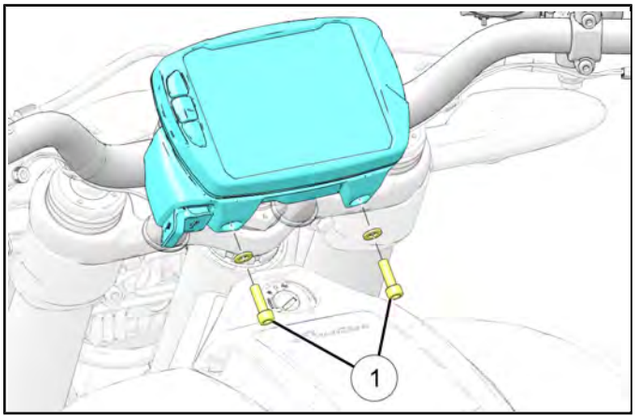
TORQUE
Center Cluster Fastener: **53 in-lbs (6 N·m)**

TORQUE
Cluster Mount Fasteners: **53 in-lbs (6 N·m)**

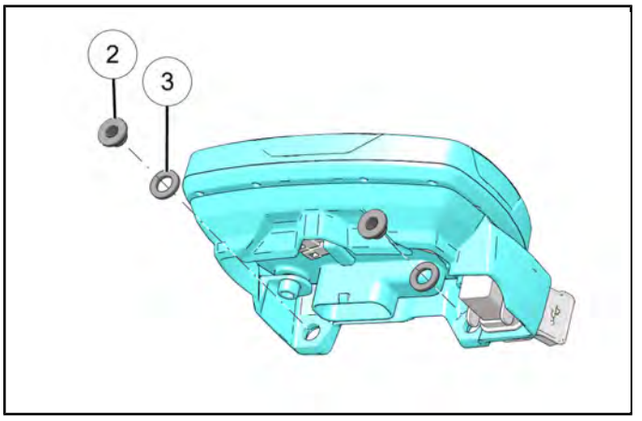
TORQUE
Number Plate Fasteners: **80 in-lbs (9 N·m)**

2019–22

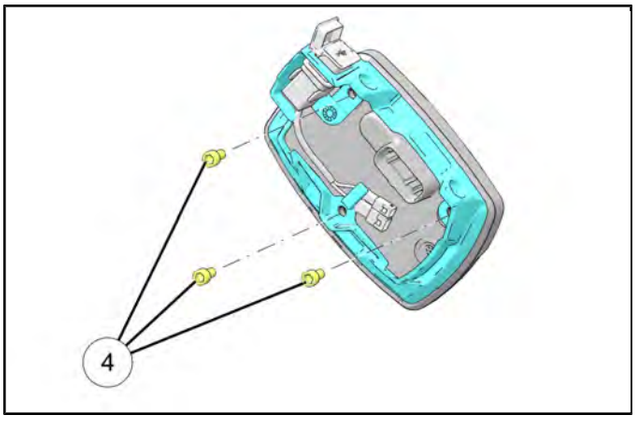
1. Disconnect battery. See **Battery Disconnect page 10.12**
2. Remove two instrument cluster housing fasteners ① and washers.



3. Remove top hats ② and rubber washers ③.



4. Remove the assembly and disconnect electrical connections.
5. Remove three display screws ④ and remove the display.



6. **Installation is performed by reversing the removal procedure.**

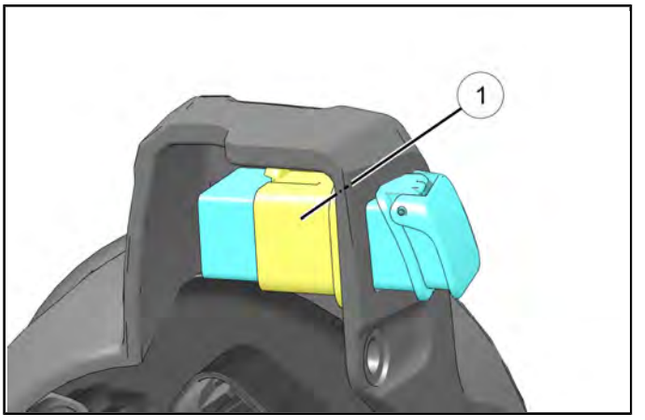
TORQUE
Instrument Cluster Housing Fastener: **84 in-lbs (9 N·m)**

TORQUE
Speedometer (touch screen) Fastener: **54 in-lbs (6 N·m)**

USB CHARGE PORT REPLACEMENT

If equipped, the USB charge port is located on the instrument cluster.

1. Remove the instrument cluster. See Instrument Cluster Removal / Installation page 10.89
2. Disconnect the USB electrical connector.
3. Disconnect the USB lock collar ①.

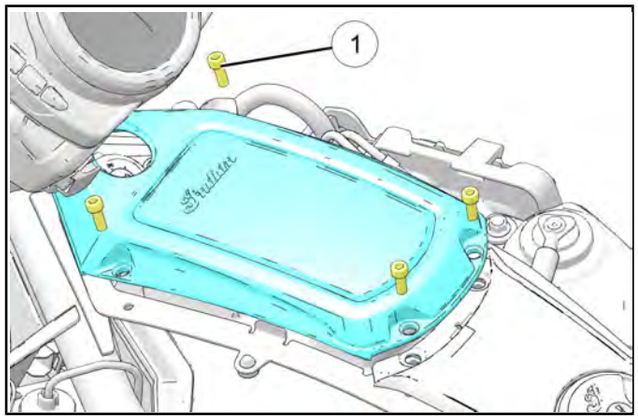


4. Remove the USB from the instrument panel
5. **Installation is performed by reversing the removal procedure.**

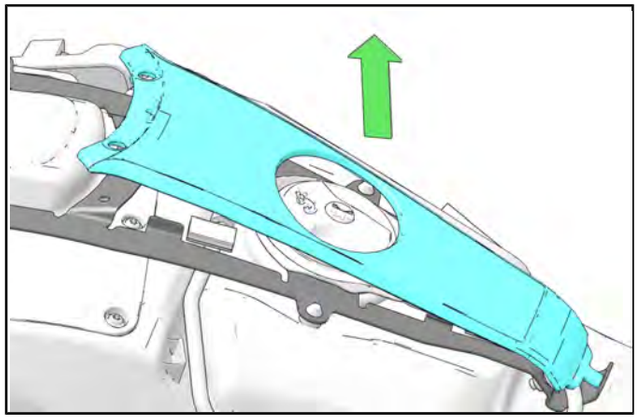
GPS PUCK SERVICE

REMOVAL

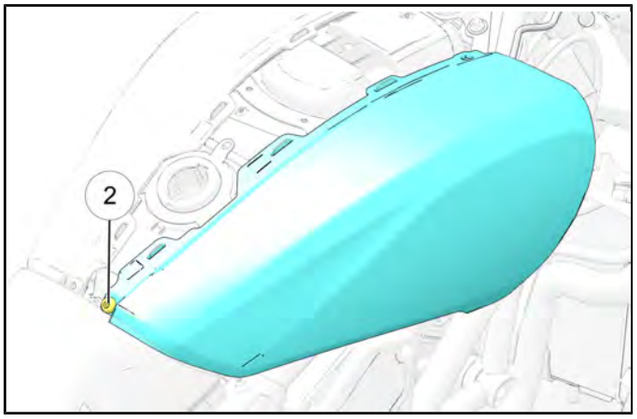
1. Remove air box bezel:
   a. Remove four fasteners ① securing air box bezel.



   b. Remove the center console cover from the alignment bracket.

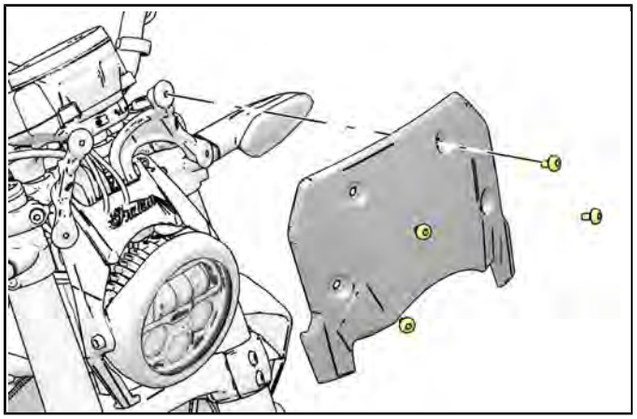


   c. Remove the gas cap and relocate to clean, safe location.
   d. Remove fastener securing the air box cover ②.

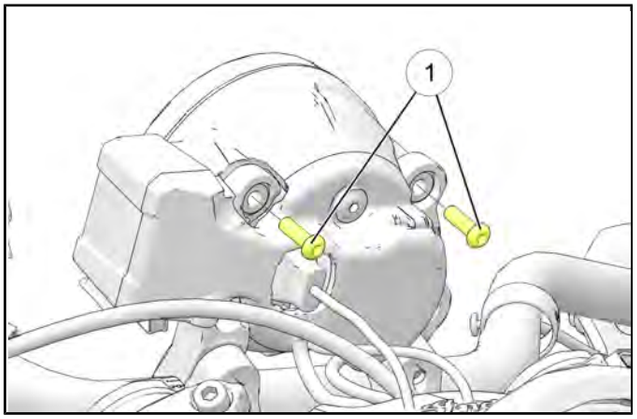


NOTICE
Pull air box cover up and out to remove.

2. Remove fasteners and number plate.

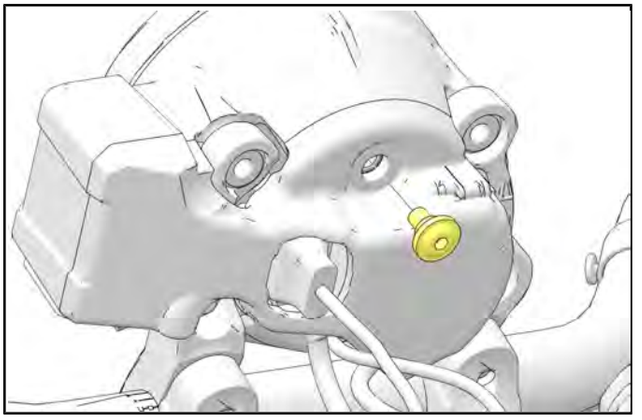


3. Remove rear display fasteners ①.

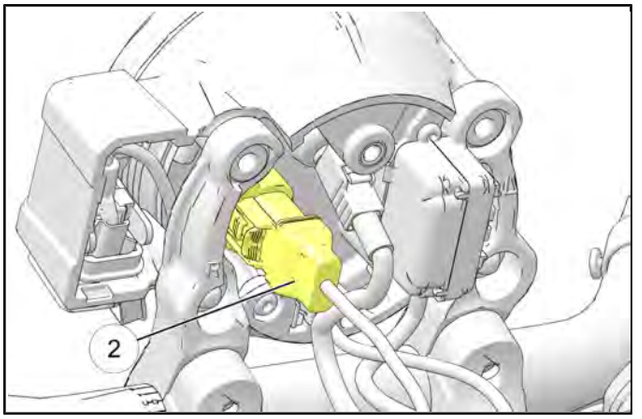


10

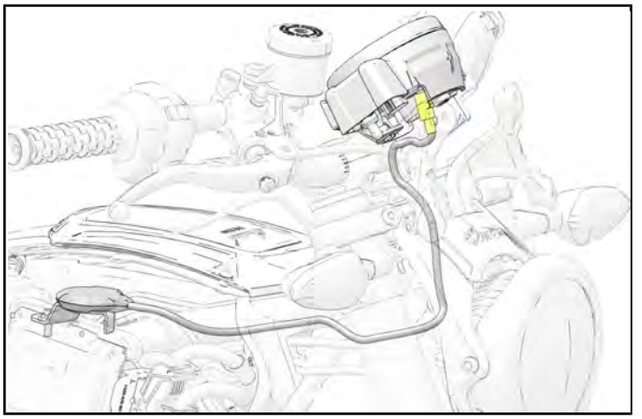
4. Remove rear center display fastener.



5. Disconnect cell USB ② connector.



6. Unplug the GSP puck from the display.



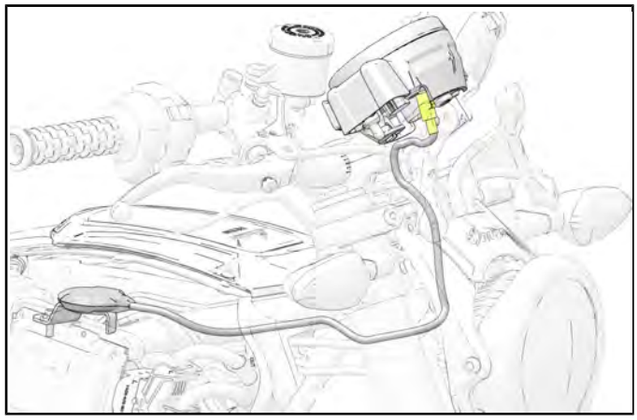
7. Plug the GPS / Cell Antenna back into the cell modem and display, making sure connectors are securely seated, and check fro functionality.

NOTICE
Must be in an area with GPS and Verizon 4G cell signal available.

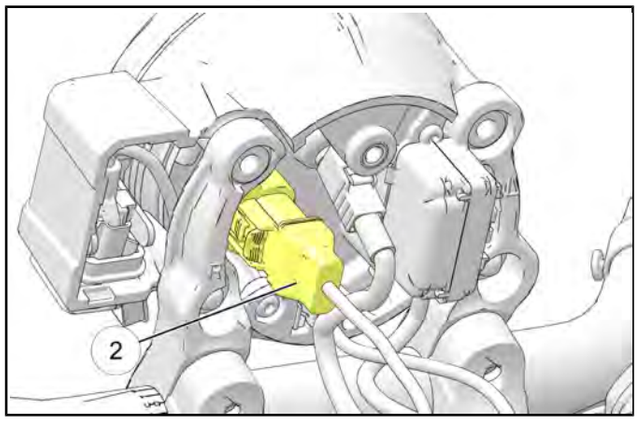
8. If GPS and or cell data is still not present, replace GPS / Cell antenna with new unit.

INSTALLATION

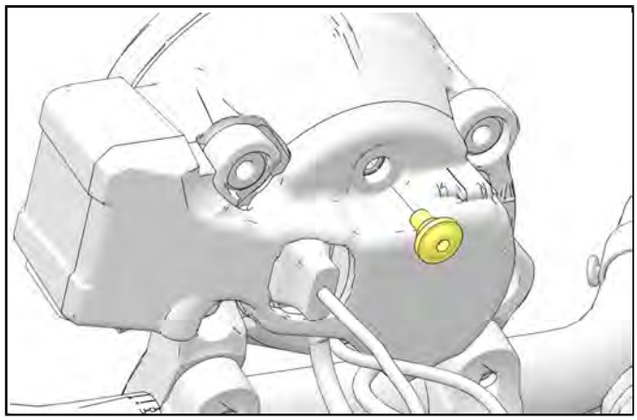
1. Plug the GSP puck into the display.



2. Connect cell USB ② connector.

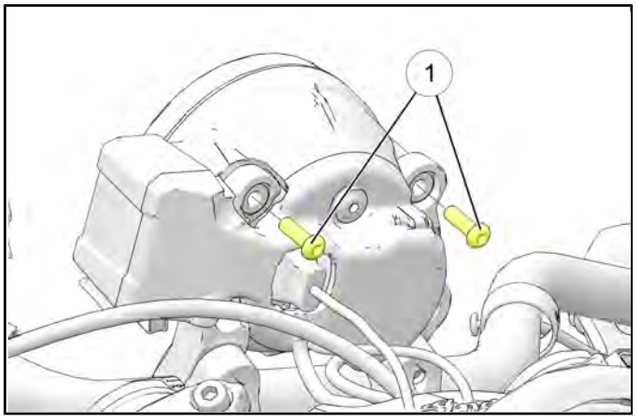


3. Install rear display cover and secure with rear center display fastener. Torque fastener to specification.



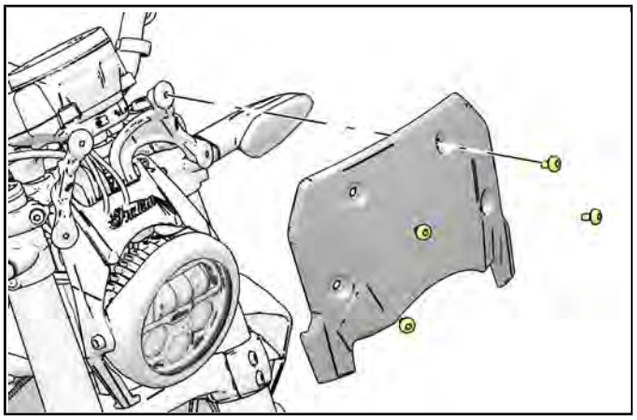
TORQUE
Center Cluster Fastener: **53 in-lbs (6 N·m)**

4. Install cluster mount fasteners ①. Torque fasteners to specification.



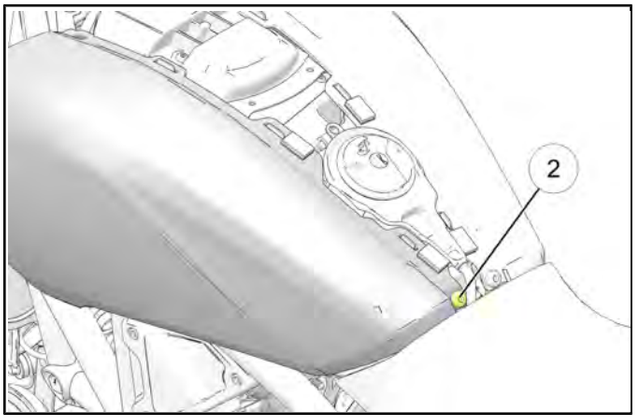
TORQUE
Cluster Mount Fasteners: **53 in-lbs (6 N·m)**

5. Install number plate and secure with fasteners. Torque fasteners to specification.



TORQUE
Number Plate Fasteners: **80 in-lbs (9 N·m)**

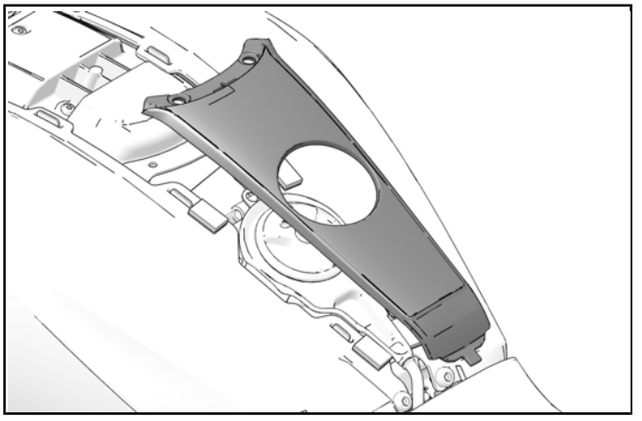
6. Install air box bezel:
   a. Lubricate air box cover grommets. Install air box cover and secure with fastener ②.



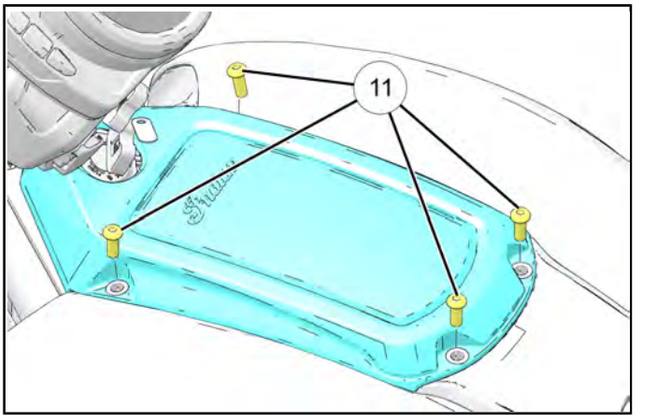
NOTICE
Use Soapy Water to help with installation. **DO NOT USE BRAKE CLEANER OR OIL BASED LUBRICANTS**

TORQUE
Air Box Cover Fastener: **36 in-lbs (4 N·m)**

   b. Install fuel tank bezel onto alignment bracket.



   c. Install four fasteners ⑪ securing air box bezel.



TORQUE
Air Box Bezel Fastener: **36 in-lbs (4 N·m)**

RIDE COMMAND SYSTEM

BLUETOOTH PAIRING

The Ride Command touchscreen display can be connected to a smart-phone and a headset simultaneously.

To pair a device, do the following:

1. From the Bluetooth Devices settings screen, the Phone screen, or the Music screen, tap on the Add Device button to bring up the pairing prompt.
2. Put your Bluetooth device into pairing mode.
3. Select the name of the device you want to pair from the touchscreen display to finish the pairing process.
4. Confirm pairing (if applicable). Depending on the device you are pairing to the display you may be prompted to confirm pairing.

UPDATE SOFTWARE

For the latest software for RIDE COMMAND™, go to https://ridecommand.indianmotorcycle.com.

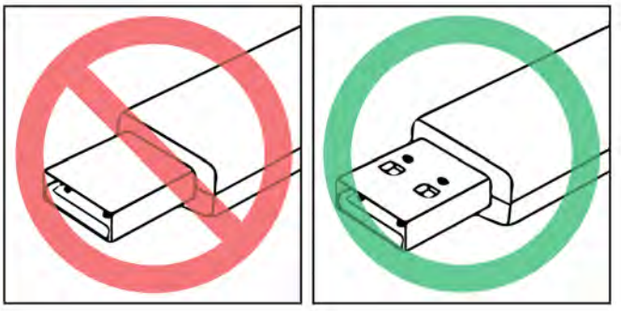
The display software can be updated by connecting a USB stick containing the latest software version to the USB port located on the bottom left of the display. The Update Software menu in Settings will list any available updates on the USB stick. Choose the correct version and wait for the update to complete before removing the USB stick. The touchscreen display will automatically restart when software is updated.

NOTICE
A USB 2.0 or USB 3.0 flash drive formatted to EX-FAT or FAT32 is required to successfully perform an update. The display will not recognize flash drives that do not meet these requirements.

IMPORTANT
Do not remove power from the display during the update process.

USB PORT

The USB Port makes it easy to power devices, such as phones, audio sources, or GPS units, in addition to allowing you to stream music through the LCD display to your Bluetooth® headset. On models equipped with a INDIAN MOTORCYCLE Ride Command display, the USB port is also used to update the display software. For the latest software, go to https://ridecommand.indianmotorcycle.com.



IMPORTANT
Due to harsh riding environments, INDIAN MOTORCYCLE recommends using a USB device with retention features.

RIDE COMMAND DIAGNOSTICS / TROUBLESHOOTING

Problem: Black Screen / Will Not Power On

STEP	ACTION	YES	NO
1	Power cycle the bike by switching ignition on and off with the key. ***Did you find and repair the condition?***	Go to Step 8	Go to Step 2
2	Check the 5 amp fuse labeled *Gauge* in the main fuse box. Refer to Fuse Box Location page 10.67 ***Is the fuse blown?***	Go to Step 9	Go to Step 3
3	Reinstall *Gauge* fuse and test screen for proper operation. ***Did you find and repair the condition?***	Go to Step 8	Go to Step 4
4	1. Turn ignition on. 2. Disconnect the display from the harness. 3. Using pin 16 (Ground) as ground reference, check for battery voltage on pins 31 (Switched Power) and 32 (Battery Power) of the display connector. ***Is there Battery Voltage at pins 31 and 32 with the ignition on?***	Go to Step 8	Go to Step 5
5	Refer to the Chassis wiring schematic in appendix and check circuits without voltage for continuity and proper operation. ***Did you find any problems in the circuit?***	Go to Step 7	Go to Step 1 and repeat diagnosis
6	Replace display with known good display. ***Did you find and repair the condition?***	Go to Step 8	Go to Step 1 and repeat diagnosis
7	Repair, replace, and check all affected power/ground circuits. Check for battery voltage at pins 31 and 32. ***Is there battery voltage at pins 31 and 32 with the ignition on?***	Go to Step 8	Go to Step 1 and repeat diagnosis

STEP	ACTION	YES	NO
8	Update display with newest software available. Refer to Update Software page 10.97 for instructions on how to update/reflash software. ***Is display working properly?***	Confirm display operation and continue use.	Go to Step 6
9	1. Test circuit for continuity and/or shorts in wiring. 2. Fix any shorts in the wiring and reinstall new fuse. ***Did you find and repair the condition?***	Go to Step 8	Go to Step 4

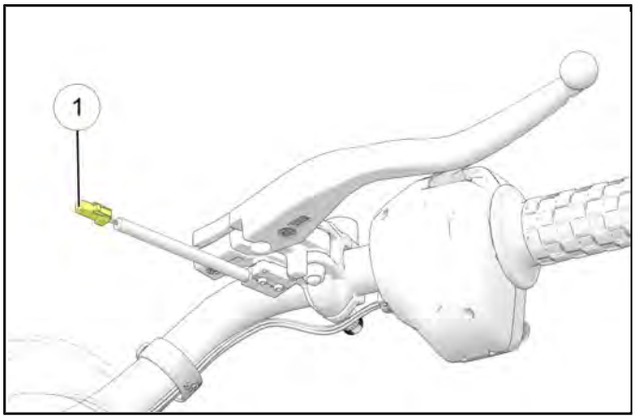
Problem: Screen missing pixels, LCD screen flaw, software glitch or problem

STEP	ACTION	YES	NO
1	Power cycle the bike by switching ignition on and off with the key. ***Did you find and repair the condition?***	Go to Step 2	Go to Step 2
2	Update display with newest software available. Refer to Update Software page 10.97 for instructions on how to update/reflash software. ***Is display working properly?***	Confirm display operation and continue use.	Go to Step 3
3	1. Remove and reinstall the 5amp fuse labeled *Gauge* in the main fuse box. Refer to Fuse Box Location page 10.67 ***Did you find and repair the condition?***	Go to Step 2	Go to Step 4
4	Replace display with known good display. ***Did you find and repair the condition?***	Go to Step 2	Repeat Diagnosis

SWITCH TESTING

CLUTCH SWITCH TEST

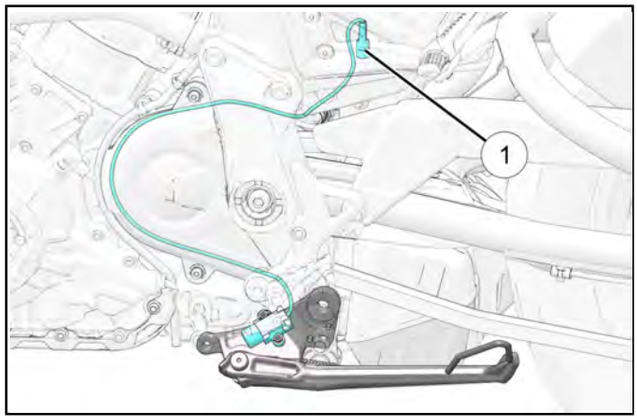
1. Disconnect clutch switch ① electrical 2 - pin connector.



2. Measure the resistance of the switch with lever pulled to handlebar (less than 1 Ohm resistance) and with lever released (OL).

SIDE-STAND SWITCH TEST

The side-stand switch is located on the left side of the unit. The electrical connection ① routes up toward the seat of the bike and resides by the ABS module.



1. Remove seat. See **Seat Removal / Installation page 7.19**.
2. Remove fuel tank. See **Fuel Tank Removal page 4.24**.
3. Inspect side-stand. Be sure that when the side stand is fully retracted (UP) that the switch plunger is extended and that when the side-stand is extended (down) the plunger is depressed.
4. Set multi meter to measure resistance and insert meter leads into appropriate jacks.
5. Place one meter lead onto each of the side-stand switch terminal pins.
6. Read resistance with the side-stand switch plunger depressed and extended.

Switch Depressed (Stand DOWN):**No Continuity (OL)** Switch Extended (Stand UP): **Continuity (Less than 1Ω)**

GEAR POSITION SENSOR TEST

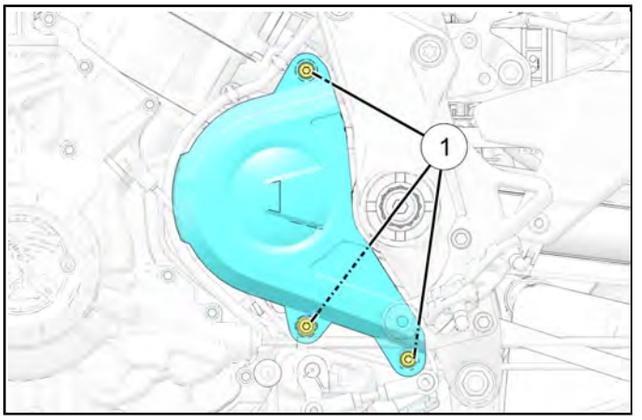
Symptoms of a faulty Gear Position sensor may include:

- Starter motor does not operate when transmission is in neutral,

but...

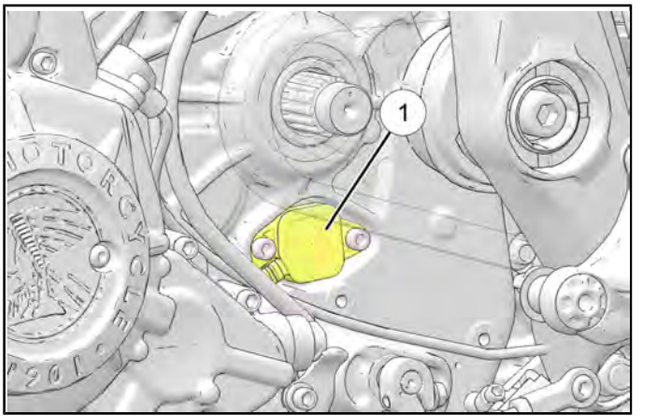
- Starter motor does operate when clutch is pulled in.

1. Remove three fasteners securing sprocket cover.



2. Place the ignition switch in the RUN position to power up the electrical system.
3. Place engine stop switch in the RUN position.
4. Shift transmission into Neutral.
5. Observe neutral indicator light.
6. If indicator is not lit with transmission in neutral:
   - Place the RUN/STOP switch in the STOP position and turn motorcycle power off.
   - Roll the motorcycle forward and back enough to verify that it is in neutral.
   - Locate the gear position sensor ① and trace the wires to the connector located near the rear of the engine.

NOTICE
Remove the seat to access the electrical connection. See Seat Removal / Installation page 7.19



Letter	Wire Color	Function
A	Red	VCC
B	Black	Ground
C	Blue	Gear

- Backprobe the connector and compare the value with the table below.

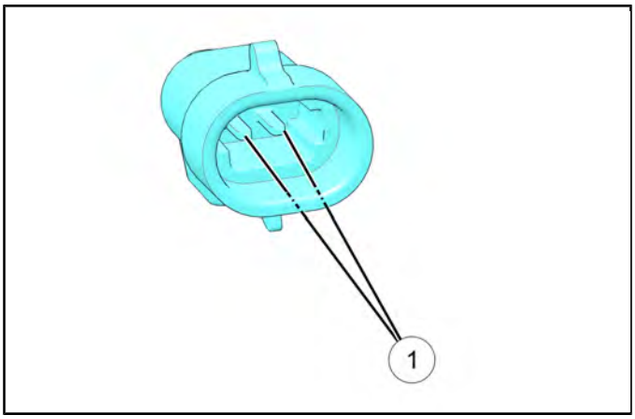
Gear	Voltage
1	.63
N	1.0
2	1.38
3	2.13
4	2.88
5	3.63
6	4.38

IMPORTANT
Voltage can also be viewed by using digital wrench.

7. If the reading is not within specified parameters, replace or repair wiring as necessary.

AMBIENT AIR TEMPERATURE SENSOR TEST

Test the resistance of two pins ① and compare with the table.

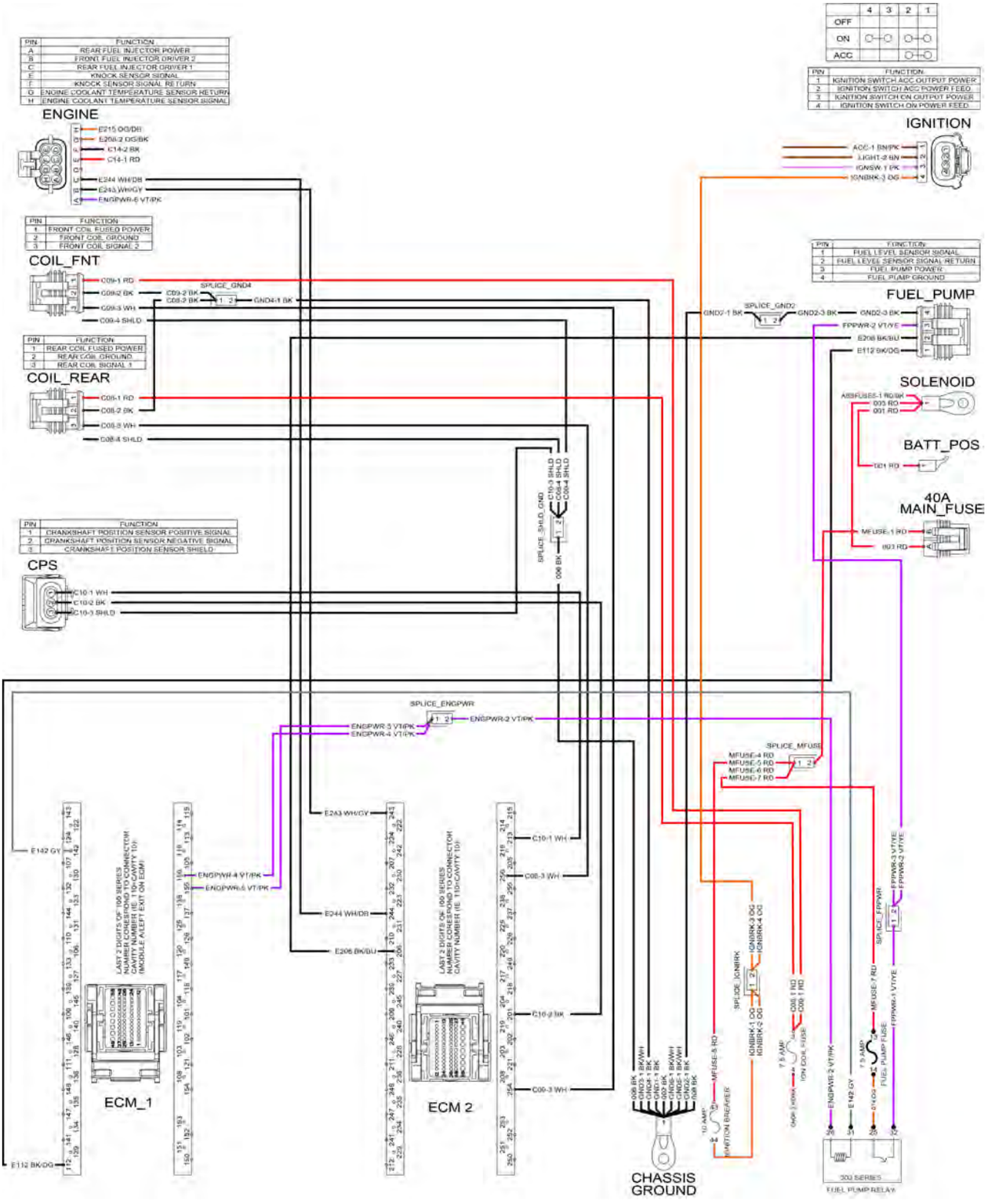


Temperature °C	Resistance (k OHMS)
-40	195.652
20	68.237
0	27.219
20	12.081
40	5.834
60	3.014
80	1.669
85	1.452

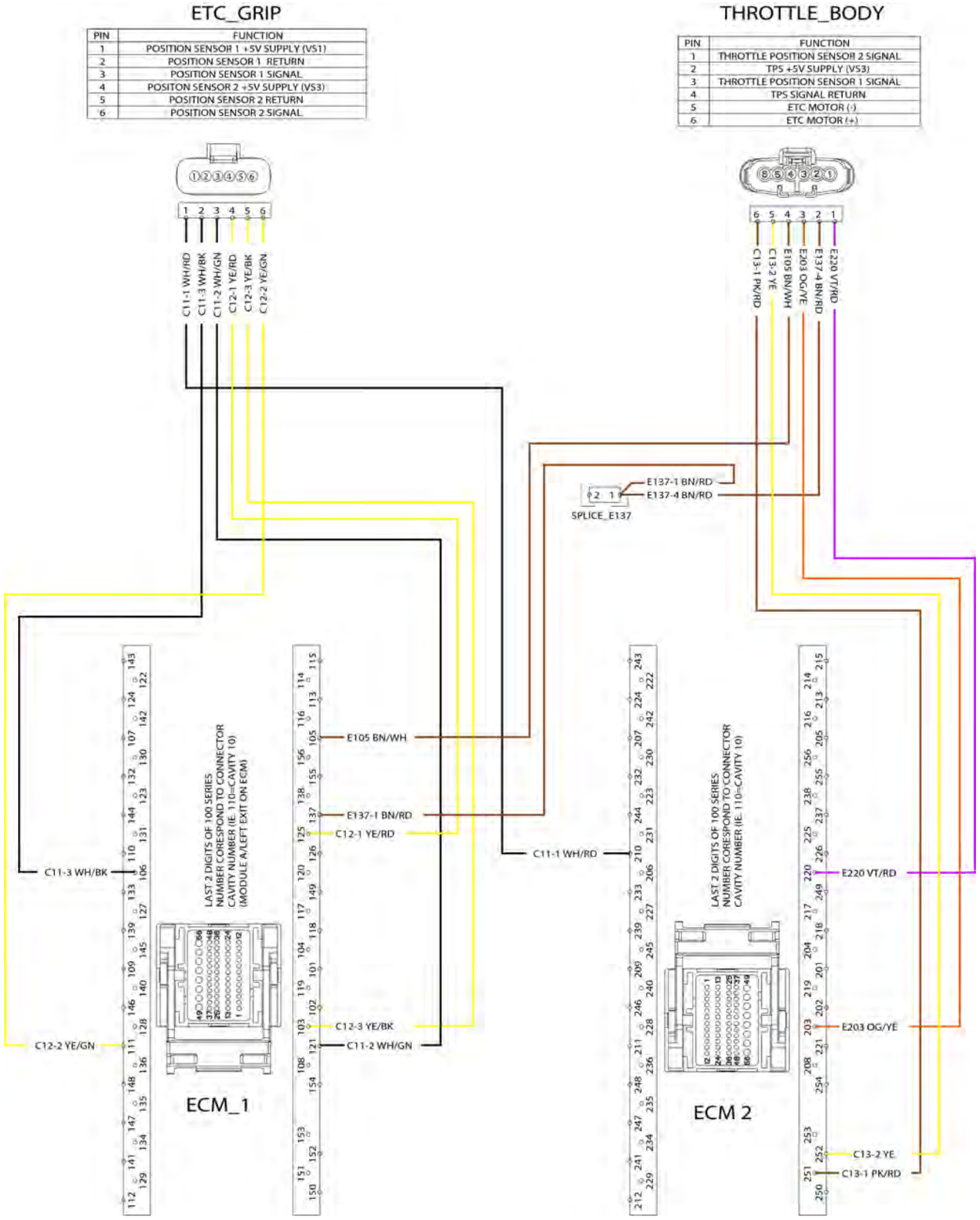
IMPORTANT
The value can also be viewed by connecting the unit to Digital Wrench.

BREAKOUT WIRING DIAGRAMS

IGNITION SYSTEM WIRING DIAGRAM



THROTTLE CONTROL WIRING DIAGRAM



ELECTRICAL DIAGNOSTICS

ELECTRICAL SERVICE NOTES

Keep the following notes in mind when diagnosing an electrical problem.

- Refer to wiring diagram for stator and electrical component resistance specifications.
- When measuring resistance of a component that has a low resistance value (under 10 Ohms), remember to subtract meter lead resistance from the reading. Connect leads together and record the resistance. The resistance of the component is equal to tested value minus the lead resistance.
- Become familiar with the operation of your meter. Be sure leads are in the proper jack for the test being performed (i.e. 10A jack for current readings). Refer to the Owner's Manual included with your meter.
- Voltage, amperage, and resistance values included in this manual are obtained with a Fluke™ 77 Digital Multimeter **(PV-43568)**. This meter is acceptable for use when diagnosing electrical problems. Readings obtained with other meters may differ.
- Pay attention to the prefix on the meter reading (K, M, etc.) and the position of the decimal point.
- For resistance readings, isolate component to be tested. Disconnect wire harness or power supply.

DIGITAL MULTI-METER (DMM) NOTES

Polaris advises to only use a high quality DMM that meets the same standards as the Fluke™ 77 (PV-43568) for electrical testing.

Unless you are very familiar with Ohm's Law, and have complete information about the circuit you are trying to diagnose, test lights are likely to provide results that would be misleading. This is especially true if any solid state component is involved, where you will almost certainly not have complete circuit information.

Polaris also specifically advises against the use of other circuit testing devices, including but not limited to:

- Short finders
- Simplified circuit testers
- Fuse piggy-back devices

Testers beside a DMM will only work in one scenario, and slight variables can provide you with misleading results. The testing practices described in this chapter are more certain and rely only on the DMM and your knowledge.

STATIC AND DYNAMIC TESTING

There are many methods for testing a DC circuit. These methods fall into one of two categories, either static or dynamic.

STATIC TESTING

The two most common forms of static testing are:

- Resistance testing (the Ohms setting on your DMM)
- Measuring voltage with the circuit open, such as when the harness connector is off a sensor you are testing. This is commonly referred to as measuring "Available Voltage".

These two tests will help you find the majority of electrical issues. If they do not, we must remember that static circuit testing does not take into account how current actually flows in that circuit. That is only accomplished with dynamic testing.

Before attempting dynamic testing (as it is intrusive on sealed connectors and damage could be done if not careful), verify the following:

- Static voltage testing advised for that circuit has been completed, and is in spec.
- All associated circuits have under 1 ohm of resistance from end to end. Testing Continuity / Resistance page 10.109
- All associated circuits have no shorts to ground. Testing For A Short To Ground page 10.109
- All associated circuits have no shorts to voltage. Testing For A Short To Voltage page 10.111

DYNAMIC TESTING

There are two types of dynamic testing we will advise to use when diagnosing electrical concerns:

- Current flow testing (Amperage) Testing Current Flow (Amperage) page 10.112. Measuring Amperage is not a common practice, as you will not typically have a spec to compare your reading to. Also, many components on this machine flow over 10 Amps, which will blow the majority of DMM fuses. The exception to this is a parasitic draw test refer to Current Draw - Key Off page 10.108.
- Measuring voltage drop. Performing this test correctly will give you understanding of how electrical pressure (voltage) varies in a circuit as current is flowing. Testing Voltage Drop page 10.113

9941004 R01 - 2019-2020, 2022-2023 FTR Service Manual

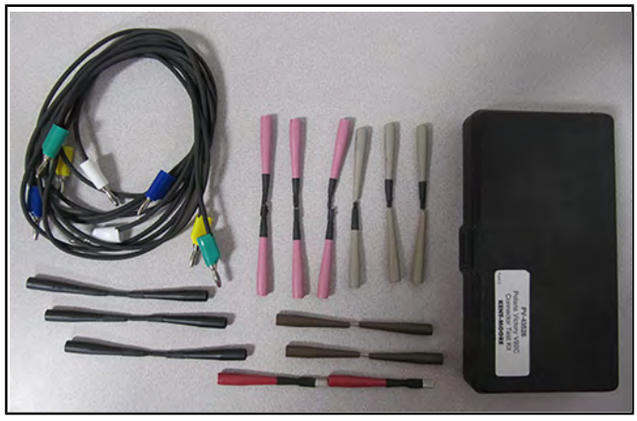
CONNECTOR PROBING GUIDELINES

FRONT PROBING

Front probing is accomplished by pulling the harness connector from the component, and then taking a measurement from the terminal face. This is the measurement taken in most situations.

The terminals in electrical connectors are small and fragile. Do not probe directly with your meter leads, as the meter leads are larger than almost all terminals. Probing with a meter lead will likely damage the terminal by spreading it beyond it's design limits, causing no tension. If there is no tension, you will have either no connection or a poor connection.

To avoid causing damage, use of the appropriate adapters is required. Most terminals used on Polaris machines can be tested using terminal test kit PV–43526. It includes male and female adapters that can be plugged into banana connectors to adapt to your meter.



PV–43526 adapters are also used as known good terminal drag testers. Insert the male tester terminal into the female connector on the harness. There should be a noticeable amount of force to install and remove the tester, and you should be able to tip the harness connector with the tester hanging from the connector, and not have the tester fall out.

If very little or no resistance is felt, or if the tester falls out when the connector is held upside down, this is an indication that the female connector in the harness has insufficient tension and will cause connection issues. You can either replace that harness, or service it by replacing the terminal or attempting to adjust/tighten the tang in the female terminal.

For a video demonstration, scan the QR code below, or right click it and select "open in new tab".

BACK PROBING

Back probing is typically not advisable on sealed connectors, as it can easily cause damage to the wire, terminal, connector body, or body to wire seal.

NOTICE
There are commercially available back probe kits. Fine, narrow needles with no coating to block current flow also work well for back probing.

If back probing must be done to see voltage drop while current is flowing in the circuit (dynamic testing), ensure it is done only on connectors that are large enough to accommodate the probe. Ensure back probing is done gently and carefully. Ensure no damage has been done after probing.

For a video demonstration, scan the QR code below, or right click it and select "open in new tab".

BREAK OUT

This is a method of front probing to achieve the goal of back probing, which is to measure the circuit while it is functioning.

You can use test probe kit PV–43526, test leads, and electrical tape to create a bridge with exposed testing areas to have everything exposed but still working.

IMPORTANT
Use electrical tape to cover the exposed conductive parts of the circuit, mainly the clamps of your test leads. If they contact each other, circuit or component damage could occur from a short.

CURRENT DRAW - KEY OFF

Parasitic draw is when there is excessive current flow with the key off.

While the most common causes of draws are improperly installed accessories (tapping into un-switched B+ instead of switched) there can be electronic component failures that can cause this as well.

IMPORTANT

Do not connect or disconnect the battery cable, or ammeter with the engine running. Damage will occur to electrical components.

IMPORTANT

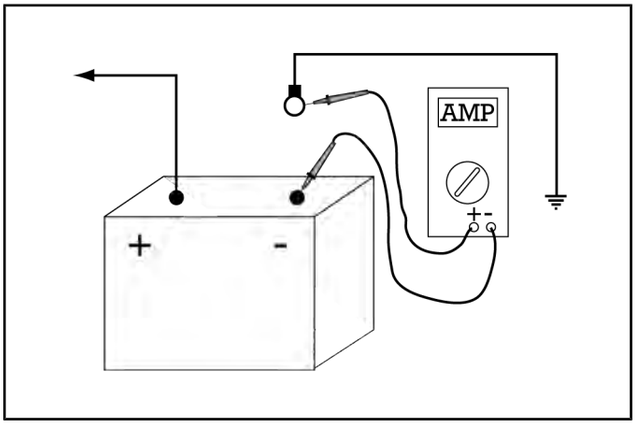
Charging system damage will occur if incompatible components are installed. Always reference the Polaris Electronic Parts Catalog for the proper part numbers.

NOTICE

Wait ten minutes with the key off for the ECU to power down. This will avoid a faulty readout while testing amperage draw.

TESTING PROCEDURE

1. Remove the negative cable from the battery.
2. Connect a jumper from the negative battery cable terminal to the negative battery post.
3. Ensure your meter leads and selector dial are set to measure amperage.
4. Connect your red lead to the battery negative cable terminal.



5. Connect your black lead to the battery negative post.
6. Momentarily key the ignition switch on, then off.

IMPORTANT

Ensure all electrical components are switched off, or damage to your jumper and/or meter will occur.

7. Wait 10 minutes before checking the value. Vehicles will vary, but electronic components will take time to fully go to sleep after switched power is removed.
8. Maximum allowable is 10 milliamps. If your meter is ranged to the 10 Amp scale, this will appear as 0.010 Amps.

Current Draw - Key Off:
Maximum of .01 DCA (10 mA)

9. If over 10 milliamps, go to the fuse block and start systematically removing one fuse at a time until the value drops, indicating the circuit that requires attention.

TESTING CONTINUITY / RESISTANCE

Testing using the Ohmmeter function of your DMM is one of the first things you will do when troubleshooting an electrical issue. It is especially convenient when the wiring diagram provides a resistance spec for the component in the circuit you are diagnosing. It can quickly give you a good idea if you simply need to replace a part, or if there might be another circuit issue.

Using the following points in conjunction with your DMM owner's manual will ensure your resistance testing is always accurate:

- Only measure resistance on an isolated part of the circuit. This means if you are testing internal resistance of a component, it cannot be connected to the harness. If you are measuring a wire (typically from the ECU to a sensor) both the sensor and ECU would need to be unplugged. Most Ohmmeters provides a precise amount of current to determine resistance. Any other sources will make your reading inaccurate.
- Ensure you are making good contact by using the proper terminal adapters. Connector Probing Guidelines page 10.107
- If you are not using a self ranging meter, double check your range setting.
- If your continuity is under 1 ohm, leave the harness disconnected and move on to Testing For A Short To Ground page 10.109 and Testing For A Short To Voltage page 10.111.

For a video demonstration, scan the QR code below, or right click it and select "open in new tab."

TESTING FOR A SHORT TO GROUND

Shorts to ground happen when the current flowing in a given circuit bypasses the load. The current flowing from B+ finds an easier way to return to ground (B-), so much more of it can flow than the circuit is designed for. This causes the circuit's protection device (either a fuse or circuit breaker) to open, protecting the circuit from damage.

There are many possible causes of a short to ground, here are some:

- The harness rubbing against a component that is grounded, such as the frame, chassis component, or engine.
- A component's internal circuitry contacting its case.
- Wire-to-wire chaffing causing contact with the conductor of a ground side circuit.
- Corrosion/moisture in a component providing a ground path.
- Moisture in a connector body providing a ground path.

NOTICE

This test is typically done right after checking continuity from sensor to ECU when diagnosing an EFI DTC. It can also be used to help diagnose concerns about blowing fuses. Ensure you are able to duplicate the concern before testing so that your results point you in the right direction.Testing for Intermittent Conditions page 10.111

TESTING PROCEDURE

1. Consult the wiring diagram. Determine which circuit you will be testing.
2. Ensure that any static voltage checks advised in relation to the DTC or concern you are diagnosing have been performed and are in spec.
3. Ensure you have checked continuity of the circuit. Testing Continuity / Resistance page 10.109
4. Ensure that neither end of the circuit is connected.
5. Set your DMM to Ohms.
6. Connect one meter lead securely to the battery negative post.
7. Connect the other lead to either end of the disconnected circuit. Ensure you are using the correct adapter.Connector Probing Guidelines page 10.107
8. If there is continuity, the harness is damaged and should be repaired or replaced.

9. If the DMM reads OL, there is no short to ground. Leave the harness disconnected on both sides, and proceed to check for a short to voltage. Testing For A Short To Voltage page 10.111

For a video demonstration, scan the QR code below, or right click it and select “open in new tab”.

TESTING FOR A SHORT TO VOLTAGE

There are three possible short to voltage causes:

1. Internal electronic component short.
2. Harness chaffing leading to contact of the circuit being diagnosed to one with B+ or a different reference voltage.
3. Moisture in a connector or component.

TESTING PROCEDURE

1. Consult the wiring diagram. Determine which circuit you will be testing.
2. Ensure that any static voltage checks advised in relation to the DTC or concern you are diagnosing have been performed and are in spec.
3. Ensure you have checked continuity of the circuit. Testing Continuity / Resistance page 10.109
4. Ensure you have checked for a short to ground. Testing For A Short To Ground page 10.109
5. Ensure that neither end of the circuit is connected.
6. Set your DMM to DC volts.
7. Connect one meter lead securely to the battery negative post.
8. Connect the other lead to either end of the disconnected circuit. Ensure you are using the correct adapter.Connector Probing Guidelines page 10.107
9. If there is voltage present, the harness is damaged and should be repaired or replaced. You may need to remove the protective tape and tubing to inspect.
10. If the DMM reads 0 volts, the concern may be in a component related to the circuit. If so, checking internal continuity of non-electronic components may reveal the concern, but diagnosis at this point may require using known good parts.

For a video demonstration, scan the QR code below, or right click it and select “open in new tab”.

TESTING FOR INTERMITTENT CONDITIONS

Intermittent conditions are very difficult to diagnose, as when you are testing the circuit, you may not have the circuit failing to indicate where the issue is. Intermittent electrical failures are almost always related to a poor connection that only goes open in specific situations, such as going over a certain kind of bump, at a certain temperature, or when the machine is torque loaded in one way.

Here is a list of possible failures that can be associated with an intermittent electrical failure:

- Loose female terminal in an electrical connector.

NOTICE

If the terminals in question are the correct size/series, always use PV–43526 to test the drag when inserting and removing the test terminal adapters. Compare the effort to the drag against the known good tester terminal for reference.

- Poor terminal to wire crimp.
- Terminal crimp that occurred at least partially on insulation instead of the conductor wire strands.
- Terminal fretting corrosion
- Contamination/moisture corrosion
- A full or partial break of the conductor wires in the insulation, with or without visible insulation damage.
- Improper routing, especially when it leads to chaffing or heat damage, especially near exhaust.

You may need to use different techniques to duplicate these concerns. These include but are not limited to:

- Moving the harness by wiggling it or flexing certain areas.
- Pulling at or near the suspected connector.
- Pushing in different directions to flex the connector body and try to isolate poor connections.
- Changing the temperature. This can be accomplished with either heat guns or cold air guns.

⚠ WARNING

Always exercise caution when using these tools, and use them for short periods of time when changing the temperature of an area. Failure to do so can lead to serious injury and/or damage to the machine.

TESTING CURRENT FLOW (AMPERAGE)

Performing a current flow test requires the meter leads be inserted into the correct cavities in the meter, and be placed in series in the circuit to be tested. Refer to your Digital Multi Meter's owner's manual for potential model specific instructions. Ensure you are using acceptable adapters to avoid damaging the connector terminals. See Connector Probing Guidelines page 10.107.

NOTICE

Amperage specs are generally not provided for circuits/components. Please only perform this test when advised in the manual.

IMPORTANT

Many circuits on this machine will exceed the 10 Amp fuse in most Digital Multi Meters in normal operation.

TESTING PARASITIC DRAW

Parasitic draw is when there is excessive current flow with the key off.

While the most common causes of draws are improperly installed accessories (tapping into un-switched B+ instead of switched) there can be electronic component failures that can cause this as well.

TESTING PROCEDURE

1. Remove the negative cable from the battery.
2. Connect a jumper from the negative battery cable terminal to the negative battery post.
3. Ensure your meter leads and selector dial are set to measure amperage.
4. Connect your red lead to the battery negative cable terminal.
5. Connect your black lead to the battery negative post.
6. Momentarily key the ignition switch on, then off.

IMPORTANT

Ensure all electrical components are switched off, or damage to your jumper and/or meter will occur.

NOTICE

Wait ten minutes with the key off for the ECU to power down to avoid a faulty readout while testing amperage draw.

7. Wait 10 minutes before checking the value. Vehicles will vary, but electronic components will take time to fully go to sleep after switched power is removed.
8. Maximum allowable is 10 milliamps. If your meter is ranged to the 10 Amp scale, this will appear as 0.010 Amps.
9. If over 10 milliamps, go to the fuse block and start systematically removing one fuse at a time until the value drops, indicating the circuit that requires attention.

TESTING VOLTAGE DROP

NOTICE

If you disconnect the connector at the load, and measure voltage with one lead on the power supply wire, and one to ground, you will be measuring available voltage. This is a static test and not dynamic voltage drop testing. Refer to Static and Dynamic Testing page 10.106.

The measurement of voltage is the **DIFFERENCE** in electrical pressure between the two points your DMM leads are touching.

Most circuits will have one load. The load is the component in the circuit that uses the current flow to do work, such as move a solenoid or light a bulb.

Voltage coming into the load should be near battery voltage with current flowing. There will be some loss from moving through electrical contacts in connectors and relays, but it will be minimal.

NOTICE

You will need to backprobe to perform this test. For information about doing this safely, refer to Connector Probing Guidelines page 10.107.

Voltage should be near fully depleted by the load. This means that when measuring on the ground side of the circuit, immediately after the load, back to battery negative, you should have near zero pressure difference (voltage).

If you do have a difference in pressure, this means there is something adding resistance to the circuit such as corrosion.

For a video demonstration, scan the QR code below, or right click it and select “open in new tab”.

NOTES

APPENDIX A WIRING DIAGRAM

Main wiring diagrams can be found tucked into the back of the printed manual.

2019, 2020 Chassis Harness: HERE

2022, 2023 Chassis Harness: HERE

2019, 2020, 2022, 2023 Rear Harness: HERE

2019, 2020, 2022, 2023 Engine Harness: HERE

NOTES

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