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DUCATI

SUPERBIKE 848 MY 2008

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0A - General

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1 - How to use this manual

This manual has been prepared for technical personnel at Ducati Authorized Service Centres with the aim of providing fundamental information on how to work in accordance with the modern concepts of "best practice" and "safety in the workplace" during the maintenance, repair or replacement of original components of the cycle parts and engine of this motorcycle.
All operations described in this manual must be carried out by experienced, skilled technicians, who are required to follow the Manufacturer's instructions in full.
Some information has been intentionally omitted, as we believe that all specialized technicians should have a basic technical background. Additional information on how to install various components is provided in the spare parts catalogue.

Important

This manual also describes the essential checks to be carried out prior to delivery of the motorcycle.

Ducati Motor Holding S.p.A. declines all liability for any technical errors or omissions in this manual and reserves the right to make changes made necessary by the technical evolution of its products without prior notice.
The information contained herein was correct at the time of going to press.

Important

Reproduction or disclosure of all or part of the contents of this manual is strictly forbidden. All rights on this manual are reserved for Ducati Motor Holding S.p.A. Applications for authorization for reproduction must be submitted in writing and must specify the reasons for such reproduction.

Ducati Motor Holding S.p.A

Layout of the manual

This manual is divided into sections (1), each identified by a letter.

Each section (1) is made up of several chapters (2), which are numbered consecutively.
The chapters (2) may be further subdivided into paragraphs (3).

The manual describes all repair operations starting from the fully assembled motorcycle.
The full procedure is described up to the point in which the motorcycle is restored to its fully assembled starting condition.

Important
Some of the sections of this manual are not included, since the motorcycle in question is not equipped with the relevant parts.

Important
The layout of the manual is designed in such a way as to be applicable to all the different models manufactured by DUCATI MOTOR HOLDING.
To facilitate consultation of the manual, the table of contents is identical for all motorcycle models.

2 - Symbols - Abbreviations - References

To allow quick and easy consultation, this manual uses graphic symbols to highlight situations in which maximum care is required, as well as practical advice or information. Pay attention to the meaning of the symbols since they serve to avoid repeating technical concepts or safety warnings throughout the text. The symbols should therefore be seen as an aid to memory. Please refer to this page whenever in doubt as to their meaning.

The terms **right-hand (RH)** and **left-hand (LH)** are used with reference to the motorcycle's direction of forward travel.

Warning

Failure to comply with these instructions may put you at risk, and could lead to severe injury or even death.

Important

Failure to follow the instructions in text marked with this symbol can lead to serious damage to the motorcycle and its components.

Notes

This symbol indicates additional useful information for the current operation.

Text references

(**X**)
References in bold type indicate a part that is not illustrated in the figures next to the text, but which can be found in the exploded views at the beginning of each chapter.

(X)
References in non-bold type indicate a part that is illustrated in the figures alongside the text.

Product specifications

Symbols in the diagram show the type of threadlocker, sealant or lubricant to be used at the points indicated. The table below shows the symbols used and the specifications of the various products.

Symbol	Specifications	Recommended product
	Engine oil (for specifications, see Sect. C 2, Fuel, lubricants and other fluids).	SHELL Advance Ultra 4
	DOT 4 special hydraulic brake fluid.	SHELL Advance Brake DOT 4
	SAE 80-90 gear oil or special products for chains with O-rings.	SHELL Advance Chain or Advance Teflon Chain

		Anti-freeze (nitride, amine and phosphate free) 30 to 40% solution in water.	SHELL Advance coolant or Glycoshell
	GREASE A	Multipurpose, medium fibre, lithium grease.	SHELL Alvania R3
	GREASE B	Molybdenum disulphide grease, high mechanical stress and high temperature resistant.	SHELL Retinax HDX2
	GREASE C	Bearing/joint grease for parts subject to prolonged mechanical stress. Temperature range: -10 to 110 ° C.	SHELL Retinax LX2
	GREASE D	Protective grease, with anti-corrosive and waterproofing properties.	SHELL Retinax HD2
	GREASE E	PANKL grease - PLB 05.	
	GREASE F	OPTIMOL grease - PASTE WHITE T.	
	LOCK 1	Low-strength threadlocker.	Loctite 222
	LOCK 2	Medium-strength threadlocker, compatible with oil.	Loctite 243
	LOCK 3	High-strength threadlocker for threaded parts.	Loctite 270
	LOCK 4	Flange sealant resistant to high mechanical stress and solvents. Resists high temperatures (up to 200 ° C) and pressures up to 350 bar; fills gaps up to 0.4 mm.	Loctite 510
	LOCK 5	Permanent adhesive for smooth or threaded cylindrical fasteners on mechanical parts. High resistance to mechanical stress and solvents. Temperature range: -55 to 175 °C.	Loctite 128455
	LOCK 6	Pipe sealant for pipes and medium to large fasteners. For water and gases (except oxygen). Maximum filling capacity: 0.40 mm diameter clearance.	Loctite 577

	LOCK 7	Speed bonder for rubber and plastics with elastomer charged ethylic base.	Loctite 480
	LOCK 8	High-strength retaining compound for threaded parts, bearings, bushes, splines and keys. Temperature range: -55 to 150 °C.	Loctite 601
	LOCK 9	Medium-strength threadlocker.	Loctite 401
	LOCK 10	Product for metal parts to seal and lock cylindrical freely sliding or threaded couplings. Resistant to high mechanical stress and high temperature, excellent resistance to solvents and chemical attack.	Loctite 128443
	LOCK 11	Instant adhesive gel offering tensile/shear strength.	Loctite 454 gel
		DUCATI liquid gasket.	942470014
		Exhaust pipe paste. Self-sealing paste, hardens when heated; resists temperatures exceeding 1000 ° C.	Holts Firegum
		Spray used to protect electrical systems. Eliminates moisture and condensation and provides excellent corrosion resistance. Water repellent.	SHELL Advance Contact Cleaner
		Dry lubricant, polymerizing on contact with air.	Molycote D321R Molycote M55 Plus

3 - Hazardous Products - Warnings

General safety rules

Carbon monoxide

When a maintenance operation must be performed with the engine running, maker sure that the working area is well-ventilated. Never run the engine in an enclosed space.

Warning

Exhaust fumes contain carbon monoxide, which is a poisonous gas that can cause unconsciousness or even death if inhaled.

Run the engine outdoors or, if working indoors, use an exhaust fume extraction system.

Fuel

Always make sure the working area is well ventilated. Keep any sources of ignition, such as cigarettes, open flames or sparks, well away from working area and fuel storage area.

Warning

Petrol is highly flammable and can explode under certain conditions. Keep away from children.

Hot parts

Warning

The engine and exhaust parts become hot when the motorcycle engine is running and will stay hot for some time after the engine has been stopped. Wear heat-resistant gloves before handling these components or allow the engine and exhaust system to cool down before proceeding.

Warning

The exhaust system might be hot even after engine is switched off; take special care not to touch the exhaust system with any part of your body and do not park the motorcycle next to inflammable material (wood, leaves, etc.).

Used engine oil

Warning

Prolonged or repeated contact with used engine oil may cause skin cancer. If working with engine oil on a daily basis, make it a rule to wash your hands thoroughly with soap immediately afterwards. Keep away from children.

Brake pad dust

Never clean the brake assemblies using compressed air or a dry brush.

Warning

Inhalation of asbestos fibres is a proven cause of respiratory illness and cancer.

Brake fluid

Warning

Avoid spilling brake fluid onto plastic, rubber or painted parts of the motorcycle to avoid the risk of damage. Protect these parts with a clean shop cloth before proceeding to service the motorcycle. Keep away from children.

Coolant

Engine coolant contains ethylene glycol, which may ignite under particular conditions, producing invisible flames. Although the flames from burning ethylene glycol are not visible, they are still capable of causing severe burns.

Warning

Take care not to spill engine coolant on the exhaust system or engine parts. These parts may be hot and ignite the coolant, which will subsequently burn with invisible flames.
Coolant (ethylene glycol) is an irritant and is poisonous when ingested. Keep away from children.
Never remove the radiator cap when the engine is hot. The coolant is under pressure and will cause severe burns if it comes into contact with the skin.

The cooling fan operates automatically: keep hands well clear and make sure your clothing does not snag on the fan.

Battery

Warning

The battery produces explosive gases; keep it away from any source of ignition such as sparks, flames and cigarettes. When charging the battery, ensure that the working area is properly ventilated.

General maintenance indications

Useful tips

Ducati recommends that you follow the instructions below in order to prevent problems and obtain the best end result:

- when diagnosing faults, primary consideration should always be given to what the customer reports about motorcycle operation since this information can highlight anomalies; your questions to the customer concerning symptoms of the fault should be aimed at clarifying the problem;
- diagnose the problem systematically and accurately before proceeding further. This manual provides the theoretical background for troubleshooting; this basis must be combined with personal experience and attendance at periodic training courses held by Ducati;
- repair work should be planned carefully in advance to prevent any unnecessary downtime, for example obtaining the required spare parts or preparing the necessary tools, etc.;
- limit the number of operations needed to access the part to be repaired. Note that the disassembly procedures in this manual describe the most efficient way to reach the part to be repaired.

General advice on repair work

- Always use top quality tools. When lifting the motorcycle, only use devices that comply fully with the relevant European directives.
- When working on the motorcycle, always keep the tools within reach, ideally in the order required, and never put them on the motorcycle or in hard-to-reach or inaccessible places.
- The workplace must be kept clean and tidy at all times.
- Always replace gaskets, seals and split pins with new parts.
- When loosening or tightening nuts and bolts, always start with the largest or start from the centre; tighten nuts and bolts to the specified torque working in a crosswise sequence.
- Always mark any parts and positions which might easily be confused at the time of reassembly.
- Use exclusively Ducati original replacement parts and the recommended brands of lubricants.
- Use special service tools where specified.
- Ducati Technical Bulletins often contain updated versions of the service procedures described in this manual. Check the latest Bulletins for details.

0B - Information about the model

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Identification data for the Superbike 848 3

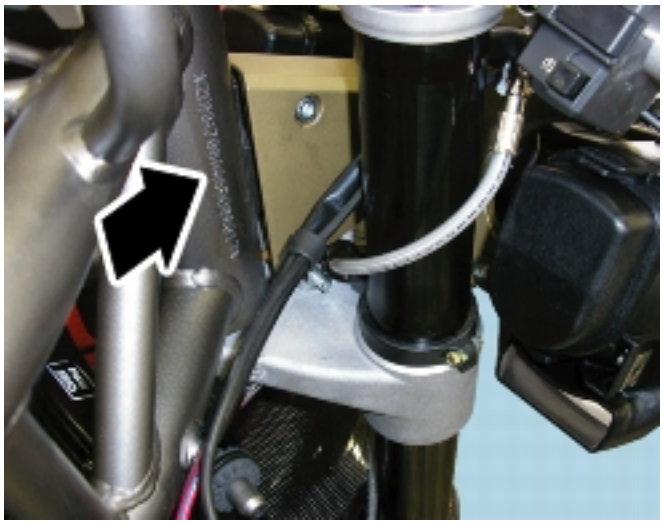
1 - Identification data

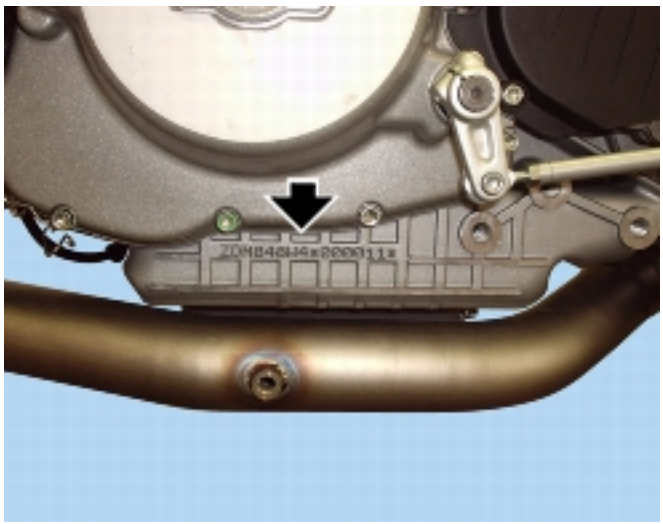
Identification data for the Superbike 848

Each Ducati motorcycle has two identification numbers - the frame number and the engine number - and an EC nameplate (A) **(not present on the US version)**.

Notes

Please quote these numbers, which identify the motorcycle model, when ordering spare parts.



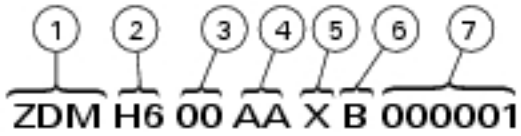


Data stamped on the frame

Europe version

1 Manufacturer: Ducati Motor Holding
2 Type, same on all 848 models
3 Variant
4 Version
5 Year of manufacture (8=2008)
6 Manufacturing facility
7 Progressive serial No.

Data stamped on the frame
EC Version

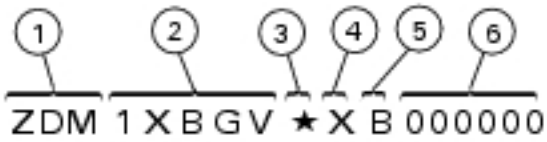


Data stamped on the frame
France version

Data stamped on the frame

US version
1 Manufacturer: Ducati Motor Holding
2 Motorcycle type
3 Variant – Numeric or X (Check digit)
4 Model year (8=2008)
5 Manufacturing facility
6 Progressive serial No.

Data stamped on the frame
US version



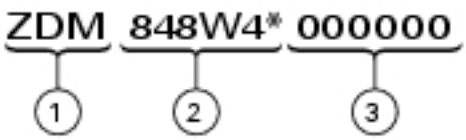
★ Variant - numeric from 0 to 9 or X (Check digit)

Data stamped on engine

Europe version

1 Manufacturer: Ducati Motor Holding
2 Engine type
3 Progressive production No.

Data stamped on engine
Europe version

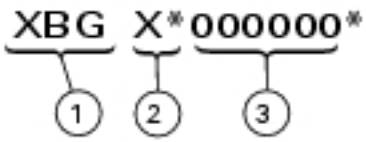


Data stamped on engine

US version

1 Engine type
2 Model year
3 Progressive production No.

Data stamped on engine
US version



0C - Technical data

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1.1 - Technical specifications

General

	Reference	Technical specifications
Motorcycle dimensions	Total length	2100 mm
	Total width	758 mm
	Total height	1100 mm
	Wheelbase	1430 mm
	Handlebar height	865 mm
	Seat height	830 mm
	Height of pillion passenger foot rest	390 mm
	Minimum ground clearance	130 mm
Frame	Type	AL450 steel tube trellis frame
Subframe	Type	AL450 steel tube trellis frame
	Steering head angle	24° 30'
	Steering angle	28° 30' RH - 28° 30' LH
	Trail	97 mm
	Front suspension	SHOWA: upside-down hydraulic fork with adjustable compression, rebound and spring preload. Fork leg dia. 43 mm, TiO treated
	Travel along leg axis:	127 mm
	Rear suspension	SHOWA: Progressive linkage with a rocker arm connecting the frame and upper pivot point of the shock absorber. The shock absorber has adjustable rebound and compression damping and spring preload. At the lower pivot point it is connected to the swingarm. The swingarm hinges on a pivot shaft that passes through the frame and engine. Wheel travel: 120 mm. Shock absorber travel: 59.5 mm.
	Front wheel	Lightweight alloy, 5Y-spokes
	Front wheel size	MT 3.50x17″
	Front tyre size	120/70 - ZR 17
	Rear wheel	Light alloy, five Y-spokes with cush drive
	Rear wheel size	MT 5.50x17″
	Rear tyre size	180/55 - ZR 17
	Type of tyre	Radial tubeless tyres
	Front brake	Hydraulic with 2 calipers
	Rear brake	Hydraulic with 1 caliper
Engine	Type	Longitudinal 90° "L" twin cylinder, four stroke
	Bore	94 mm
	Stroke	61.2 mm
	Displacement	849.4 cm^3
	Compression ratio	12±0.5:1

	Timing system	With toothed belt, double overhead camshaft, 4 valves per cylinder and 8 rocker arms
	Lubrication system	Forced lubrication by pump, with oil cooler
	Oil pump type	Gear pump
	Cooling system	Liquid cooling
	Air filter	Two filter units
	Crankshaft type	One-piece

Colours

	Description	Code no.
	Ducati Anniversary Red Transparent; Red frame with black wheels	F_473.101 (PPG); 228.880 (PPG)
	Pearl white Transparent; Grey frame with black wheels.	490019 (PPG); 228.880 (PPG)

Transmission

	Reference	Technical specifications
	Clutch	Wet multi-plate clutch
	Clutch control	Hydraulic
	Gearbox	6 speed
	Primary drive	33/61
	Final drive	15/39
	Gearbox type	With constant mesh spur gears, operated by a lever on the left side of the motorcycle
Transmission	Gear ratios	
	1^{st}	15/37
	2^{nd}	17/30
	3^{rd}	20/28
	4^{th}	22/26
	5^{th}	23/24
	6^{th}	24/23

Timing system/valves

	Reference	Adjusting clearance	Checking clearance
Timing diagram	With 1 mm valve clearance		
	Intake	Opening 20° B.T.D.C. Closing 51° A.B.D.C	
	Exhaust system	Opening 60° B.B.D.C. Closing 20° A.T.D.C.	
	Intake valve diameter Exhaust valve diameter	39.5 mm 32 mm	
Valve lift	With 0 mm valve clearance	Intake 11.6 mm Exhaust 10.7 mm	

	Opening rocker arm - intake	0.13 to 0.18 mm	0.10 to 0.25 mm
	Opening rocker arm - exhaust	0.13 to 0.18 mm	0.10 to 0.25 mm
	Closing rocker arm - intake	0.05 to 0.10 mm	0.05 to 0.25 mm
	Closing rocker arm - exhaust	0.05 to 0.10 mm	0.05 to 0.25 mm
	Reference	Assembly value (new belt)	Reset value (used belt)
Belt tensioning when cold	DDS	110±5 Hz (horizontal) 110±5 Hz (vertical)	110±5 Hz (horizontal) 110±5 Hz (vertical)
	Minimum limit value when cold	70 Hz	70 Hz

Crankshaft

	Reference	Standard value	Service limit
Crankshaft	Ovality		0.005 mm
	Taper		0.005 mm
	Main bearing journal alignment		0.01 mm on diameter

Cylinder/Piston

	Reference	Standard value	Service limit
Cylinder barrel	Max. bore ovality		0.005 mm
	Max. bore taper		0.015 mm
	Diameter Class A Class B Class C	 94.000 mm to 94.010 mm 94.010 mm to 94.020 mm 94.020 mm to 94.030 mm	
Piston-to-bore clearance		0.055 to 0.075	
Piston	Nominal diameter	94 mm	
	Diameter Class A Class B Class C	 93.935 mm to 93.945 mm 93.945 mm to 93.955 mm 93.955 mm to 93.965 mm	
Connecting rod	Connecting-rod big-end diameter	45 mm	
	Crankshaft class	Connecting rod class	Bearings colour
Big-end bearing pairings	A B A B	A A B B	Blue + Yellow Yellow + Yellow Blue + Blue Blue + Yellow
	Reference	Standard value	Service limit
Big-end bearing-to-crankpin clearance		Ø 42.014 mm/0 to 0.016 mm	
Gudgeon pin–to-piston clearance		0.015 to 0.024 mm	
	Nominal diameters	Ø 19 mm	
	Piston	Ø 19 mm/0.020 to 0.015	
	Gudgeon pin	Ø 19 mm/0 to 0.004	
Gudgeon pin-to-connecting rod clearance		0.035 to 0.049 mm	

Engine cylinder compression measured with DDS instrument	14.5 bar	12.5 bar (MIN.), difference between the two cylinders: 2 bar (MAX.)

Gearbox

	Reference	Standard value	Service limit
Gearbox shafts	Endfloat		0.05 to 0.25 mm
Selector drum	Endfloat		0.10 to 0.40 mm
Gear selector fork	Selector fork end thickness	3.90 to 4.00 mm	
	Selector fork-to-gear clearance	0.070 to 0.285 mm	0.4 mm

Cooling system

	Reference	Technical specifications
Type	Closed loop water cooling system with double-fan curved radiator and mixing thermostat	
Coolant capacity		2.3±0.5 litres

Front wheel

	Reference	Standard value	Service limit
Minimum tread depth	In the most worn part		2 mm
Tyre pressure	(Cold)	2.1 bar - 2.3 kg/cm^2	
Axle runout	On 100 mm		0.2 mm
Wheel rim runout	Radial	0.8 mm	2 mm
	Axial	0.5 mm	2 mm

Front suspension

	Reference	Technical specifications
Type		Showa: Hydraulic upside-down fork equipped with external adjusters for adjustment of rebound and compression damping and preload (for inner springs of fork legs).
Fork	Stanchion diameter:	43 mm
	Travel along leg axis:	127 mm
	Hydraulic damping standard setting. Unscrew the adjuster from fully closed position (counter clockwise)	Compression: 3/4 turn Rebound: 12 clicks
	Spring preload	18 mm (standard) corresponds to an actual preload of 9 mm. 10-25 mm (Adjustment range)
	Oil charge per leg	439 cc

Rear wheel

	Reference	Standard value	Service limit
Minimum tread depth	In the most worn part		2 mm
Tyre pressure	(Cold)	2.2 bar - 2.4 kg/cm^2	

Swingarm pivot shaft runout	On 100 mm		0.2 mm
Wheel rim runout	Radial	0.8 mm	2 mm
	Axial	0.5 mm	2 mm
Chain	Make Type	RK 525 GXW IMPROVED	
	Dimensions	5/8" x 5/16"	
	No. of links	97+1 joining link	

Rear suspension

	Reference	Technical specifications
Type		Showa: progressive monoshock with adjustable rebound, compression and spring preload
Shock absorber	Travel	59.5 mm
	Standard setting:	Compression: 2 turns Rebound: 2 turns
	Spring preload	20 mm
	Wheel travel	120 mm

Hydraulic brakes

	Reference	Standard value	Service limit
		FRONT	
Brake disc	Type	Semi-floating drilled dual disc	
	Shim	4.5±0.1 mm	4 mm (min.)
	Braking surface material	Steel	
	Flange material	Aluminium	
	Disc diameter:	320 mm	
Brake caliper	Make	Brembo	
	Type	M4-34	
	Pad friction material	TT2172	
Brake master cylinder	Type	PR 18/19	
		REAR	
Brake disc	Type	Fixed drilled disc	
	Shim	5±0.1 mm	4.5 mm (min.)
	Material	Steel	
	Diameter	245 mm	
	Braking surface	32 cm^2	
Brake caliper	Make	Brembo	
	Type	P 34 C	
	Pad friction material	FERIT I/D 450 FF	
Brake master cylinder	Type	PS11b	

Charging system/alternator

	Reference	Technical specifications
Battery	Voltage	12 V

	Capacity	10 Ah
	Type	Sealed, maintenance free
Alternator	Capacity	12 V-480 W

Injection - ignition system

	Reference	Technical specifications
Ignition	Type	Inductive electronic ignition
Starting	Type	Electric starter motor 12 V-700 W
Spark plugs	Make and type	NGK MAR10A - J
	Electrode gap	2-0.8±0.1 mm
Fuel system	Unleaded fuel	95-98 RON
	Throttle body with oval cross - section	Ø 56 mm
	Injectors per cylinder:	1
	Holes per injector:	12

Fuel system

	Make	Type
Electronic Control Unit	Marelli	5AM2

Lights/instrument panel

	Reference	Technical specifications
Headlight	Bulb type:	2 x H11 (12 V-5 W)
Side light	Bulb type:	2 x H16W (12 V-5 W)
Turn indicators:	Bulb type:	Front: A LED Rear: R10W (12 V-10 W) orange
Tail light and brake light:		A LED
Number plate light	Bulb type:	W5W (12 V-5 W)
Fuses	Regulator	30 A
Key to fusebox	Key on	10 A
	Lights	15 A
	Device	15 A
	Instrument panel	5 A
	Injection	20 A
	Engine Electronic Control Unit	5 A
	Fans	7.5 A

1.2 - Dimensions

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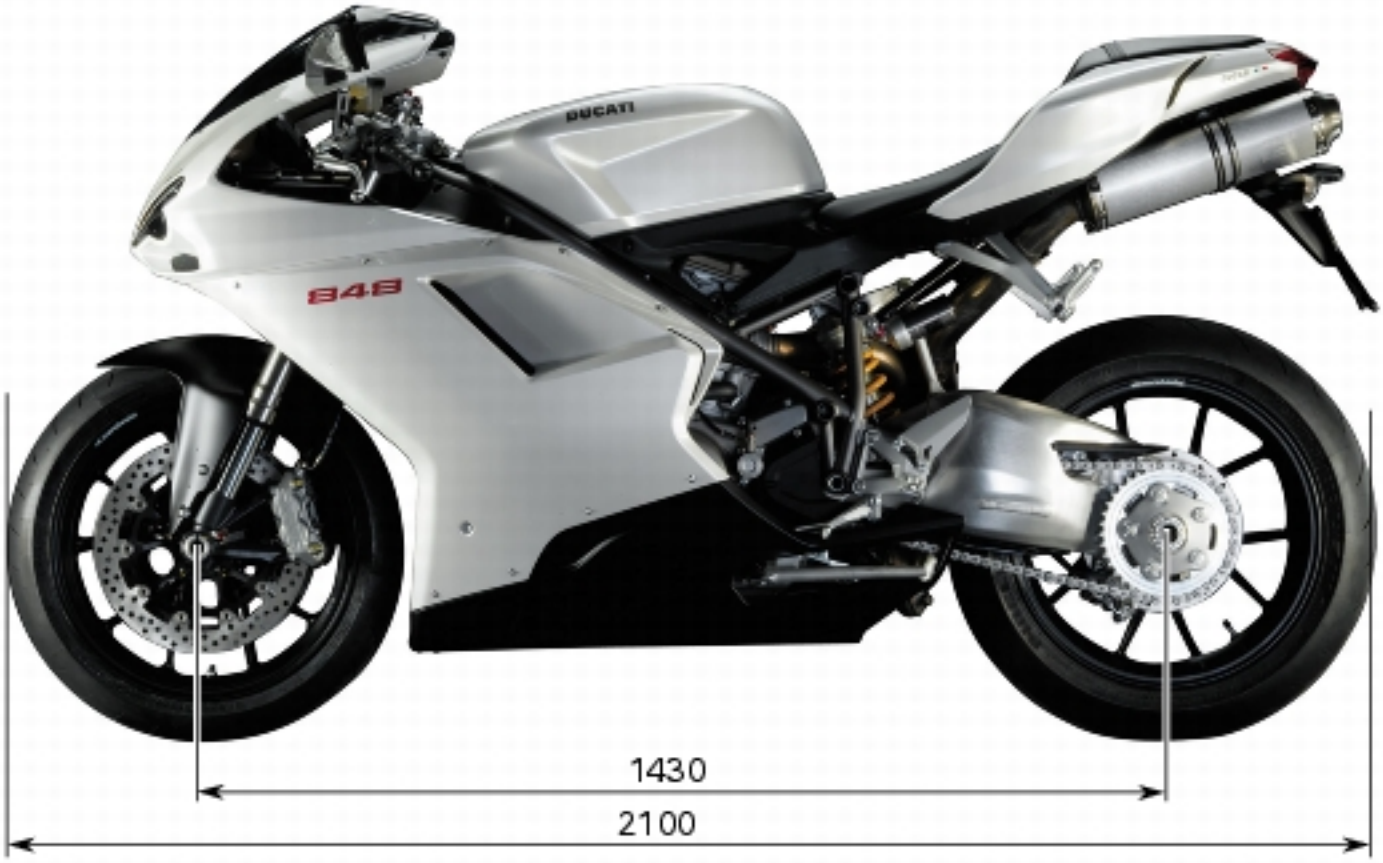
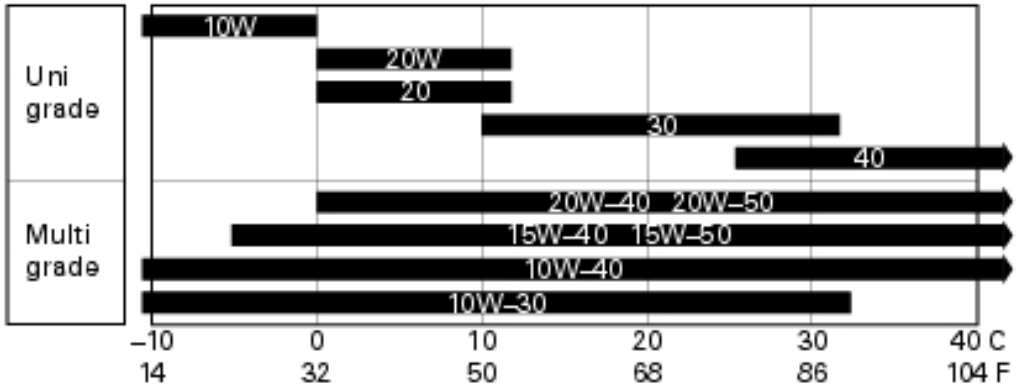


2 - Fuel, lubricants and other fluids

Fuel, lubricants and other fluids	Type	Quantity
Fuel tank, including a reserve of 4 dm^3 (litres)	Unleaded fuel with 95 fuel octane rating (at least)	15.5 dm^3 (litres)
Lubrication circuit	SHELL Advance Ultra 4	3.7 dm^3 (litres)
Front/rear brake and clutch circuits	SHELL Advance Brake DOT 4	-
Protection for electrical contacts	SHELL Advance Contact Cleaner	-
Front fork	SHELL Advance Fork 7.5 or DONAX TA	439 cc (per leg)
Cooling system	SHELL Advance Coolant or Glyco SHELL 35-40% + water	2.3 dm^3 (litres)

Important

Do not use additives in fuel or lubricants.



Engine oil

A good quality engine oil has special properties. Use only a highly detergent engine oil with certified SE, SF or SG or higher service ratings as marked on the container.

Oil viscosity

SAE 10W-40
The other viscosity grades specified in the table can be used where the average ambient temperatures are within the limits shown.

3 - Torque settings

Frame torque settings

Part	Thread (mm)	Nm ±10% tolerance	Notes
Accessories and equipment			
Reflector to bracket fastener	4x0.7	2.5	
Sidestand			
Nut securing sidestand pivot bolt	8x1.25	24.0	LOCK 10 (GREASE B on pivot bolt)
Bolt securing sidestand to crankcase	10x1.5	43.0	Solid threadlocker on bolt
Sidestand sensor bolt	6x1	5.0	Solid threadlocker on bolt
Sidestand sensor cable clamp bolt	6x1	10.0	
Front sprocket			
Front sprocket retaining nut	25x1.5	186*	GREASE B
Front sprocket cover bolt	6x1	6.0	
Lights and reflectors			
Headlight support bolt	8x1.25	25.0	LOCK 2
Lower bolt securing headlight to support	6x1	10.0	
Turn indicator retaining nut	10x1.25	5.0	LOCK 1
Tail light retaining bolt	5x0.8	3.0	Solid threadlocker on bolt
Number plate holder cover bolt	5x0.8	5.0	Solid threadlocker on bolt
Number plate holder bolt	6x1	10.0	
Number plate light bolt	4x0.7	1.5	LOCK 2
Numberplate holder plate bolt	6x1	10.0	
Rear-view mirror retaining shear bolt	5x0.8		
Instruments			
Silent-block retaining nut	5x0.8	3.0	
Front fork			
Front axle clamp bolt	8x1.25	19*	GREASE B Sequence 1-2-1
Bottom yoke clamp bolt	8x1.25	14*	GREASE B Sequence 1-2-1
Top yoke bolt	8x1.25	22*	GREASE B
Steering stem nut	35x1	30.0	GREASE B
Steering stem to bottom yoke	37x1	10.0	LOCK 8
Steering stop bolt locknut	6x1	10.0	LOCK 2 (on nut thread only)
Steering damper eye bolt	6x1	10.0	LOCK 1
Steering damper clamp bolt	6x1	8.0	LOCK 2
Bolt securing steering damper to top yoke	6x1	10.0	LOCK 1
Steering damper rod eye	8x1.25	10.0	LOCK 8
Adjustment grub screw for OHLINS steering damper	4x0.7	1.0	LOCK 1
Electrical/electronic system			
Bolt securing ECU to battery support	6x1	10.0	
Lights relay plate retaining bolt	5x0.8	2.5	LOCK 1
Bolt securing fusebox to frame	6x1	6.0	Solid threadlocker on bolt

Nut securing contactor cable + starter motor	6x1	5.0	GREASE only on starter motor nut
Bolt securing horn to frame	8x1.25	22.0	Solid threadlocker on bolt
Voltage regulator retaining bolt	6x1	10.0	
Lambda sensor	18x1.5	45.0	
Battery support bolt	6x1	10.0	
Battery cover retaining bolt	6x1	6.0	
Speed sensor retaining bolt	6x1	10.0	
Rear brake switch on master cylinder mounting bracket	8x1	5.0	
Nut securing horn to bracket	13x0.5	15.0	
Bolt securing earth cable to starter motor	6x1	10.0	
Front brake			
Front brake caliper retaining bolt	10x1.5	45*	GREASE B
Rear brake bleed valve fitting on caliper	8x1.25	10.0	
Front/rear brake bleed fitting	10x1	25.0	
Bolt securing brake master cylinder to handlebar	6x1	10.0	Sequence: 1-2-1
Front brake hose clamp retaining bolt	5x0.8	0.8	
Front brake hose fitting on caliper	10x1	25.0	
Front brake fluid reservoir bracket bolt on master cylinder	6x1	10.0	
Nut securing front brake fluid reservoir to bracket	5x0.8	5.0	
Front brake bleed valve fitting on master cylinder	10x1	14.0	
Front brake lever retaining nut	6x1	6.0	
Rear swingarm			
Swingarm pivot bolt nut	15x1.25	72*	
Rear brake caliper plate centring pin	12x1.25	33*	LOCK 8
Bolt securing chain sliders to swingarm	6x1	8.0	Solid threadlocker on bolt
Rear wheel hub retaining bolt	12x1.25	35*	GREASE B Sequence 1-2-1
Rear bolt securing chain sliders to swingarm	6x1	8.0	Solid threadlocker on bolt
Rear brake			
Rear brake master cylinder plate bolt	10x1.5	43.0	LOCK 5
Rear brake caliper bolt	8x1.25	25*	GREASE B
Rear brake master cylinder bolt	6x1	10.0	
Rear brake reservoir retaining bolt	6x1	2.0	
Rear brake linkage locknut	6x1	7.5	
Rear brake hose fitting on caliper and on master cyclinder	10x1	25.0	
Rear brake bleed valve fitting on caliper	10x1	14.0	
Handlebars - Clutch control			
Handlebar hose clamp retaining bolt	6x1	10.0	
Clamp bolt securing handlebar to fork leg	8x1.25	22*	GREASE B
Throttle twistgrip housing bolt	6x1	10.0	
Bolt securing clutch master cylinder clamp to handlebar	6x1	10.0	Sequence: 1-2-1
Clutch hose connector	10x1	25.0	
Clutch piston retaining bolt	6x1	10.0	Sequence: 1-2-3-1

Bolt securing clutch fluid reservoir bracket to master cylinder	6x1	10.0	
Nut securing clutch fluid reservoir to bracket	5x0.8	2.0	
Clutch bleed valve fitting on actuator	6x1	7.0	
Clutch bleed valve fitting on master cylinder	10x1	14.0	
Clutch lever retaining nut	6x1	6.0	
Clutch hose fitting on actuator	10x1	25.0	
Handlebar switch housing bolts	...	0.8	
Rear shock absorber			
Nut securing rear suspension rocker arm pivot bolt	10x1.25	42*	GREASE B
Bolt securing shock absorber to rocker arm	10x1.25	42*	GREASE B
Bolt securing tie-rod to rocker arm	10x1.25	42*	GREASE B
Bolt securing shock absorber and tie-rod to swingarm	10x1.25	42*	GREASE B
Front mudguard			
Front mudguard fastener	6x1	5.0	
Liquid Cooling			
Radiator pack retaining bolt	6x1	10.0	
Radiator orientation bolt	6x1	6.0	LOCK 2
STAR 16-27 water cooling hose guide fastener	...	2.5	
STAR 20-32 water cooling hose guide fastener	...	2.5	
Coolant (bleed) hose guide clamp on horizontal cylinder	...	2.5	
Radiator hose to expansion tank fastener	...	1.0	
Coolant drain plug on pump cover	10x1	18.0	
Expansion tank to bracket fastener	6x1	10.0	
Bolt securing expansion tank bracket to cylinder head	6x1	10.0	
Radiator-expansion tank and drainage hose guide clamp	...	1.0	
Footrests and levers			
Bolt securing footrest to frame	8x1.25	24.0	LOCK 2
Bolt securing heel plate to footrest bracket	5x0.8	5.0	LOCK 2
Gearchange lever tie-rod locknut	6x1	10.0	
Gearchange lever clamp retaining bolt	6x1	10.0	LOCK 1
Gearchange rod to lever retaining nut	6x1	10.0	
Brake/gearchange lever pivot bolt	8x1.25	23.0	GREASE A on bush + LOCK 2 on thread
Locknut for rear brake pedal adjuster screw	6x1	2.5	
Rear brake linkage to brake lever pivot bolt	6x1	5.0	LOCK 2
Front wheel			
Front wheel axle nut	25x1.25	63*	GREASE B (apply to axle thread and underside of nut)
Rear wheel			
Rear wheel cush drive retaining nut	10x1	44.0	LOCK 2
Rear wheel pack retaining nut (both sides)	48x1.5	230*	GREASE B (apply to axle thread and underside of nut)
Rear wheel drive pin retaining bolt	8x1	27*	LOCK 2
Fuel tank			

Fuel tank centring plates retaining bolt	6x1	6.0	LOCK 2
Bolt securing flange to fuel tank	5x0.8	6.0	LOCK 2
Bolt securing deformation bracket to subframe	6x1	10.0	
Unions for fuel tank breather and drain hoses	7x1	2.0	
Bolt securing fuel tank to deformation bracket	8x1.25	22.0	
Bolt securing side panel brackets to fuel tank	5x0.8	2.5	LOCK 1
Fuel hose containment plate fastener	5x0.8	2.5	LOCK 1
Bolt securing fuel cap to fuel tank flange	5x0.8	5.0	
Exhaust system			
Nut securing manifold to cylinder head	6x1	10.0	
Vertical manifold heat shield retaining nut	6x1	10.0	
CO plug	10x1.25	25.0	
Nut securing exhaust to frame	6x1	10.0	
Nut securing silencer support/number plate holder to frame	6x1	8.0	
Bolt securing silencers to support	8x1.25	20.0	
Silencer rear retaining nut	5x0.8	5.0	
Nut securing Bowden cables to exhaust valve	5x0.8	5.0	
Exhaust valve actuator retaining bolt	6x1	10.0	
Rider heat shield retaining bolt	5x0.8	5.0	
Nut securing Bowden cables to exhaust hose guide	5x0.8	5.0	Solid threadlocker on bolt
Seat			
Bolt securing rider's seat to frame	5x0.8	5.0	
Nut securing hooks to pillion seat	6x1	10.0	
Frame			
Nut securing frame pack/engine	12x1.25	60*	GREASE B
Nut securing subframe to frame	8x1.25	25*	Class 8.8 steel bolt
Ignition switch retaining bolt	6x1	>12	Shear head bolt solid threadlocker on bolt
Ignition switch cover retaining nut	6x1	10.0	
Nut securing lock cable end fitting to seat cowling	22x1.5	3.0	
Bolt securing seat lock latch to frame	6x1	5.0	
Oil cooler			
Oil cooler nipple on crankcase	14x1.5	32.0	LOCK 8
Cooler oil hose connector on crankcase nipple	16x1.5	25*	Lubricate with engine oil
Oil hose union on oil cooler	16x1.5	18*	Lubricate with engine oil
Bolt securing oil cooler bracket to cylinder head	6x1	10.0	
Bolt securing oil cooler pack to bracket	6x1	10.0	
Air intake - oil breather			
Bolt securing intake funnels to base of airbox	5x0.8	5.0	LOCK 1
Bolt securing throttle cable guide to airbox	4x0.7	2.0	LOCK 1
Bolt securing air ducts to airbox	6x1	3.5	
Bolt securing air ducts to headlight	6x1	4.0	
Clamp securing blow-by hose to crankcase	...	1.5	
Fuel system - EVAP canister			
Clamp securing throttle body to intake manifold	...	2.5	
Bolt securing intake funnels to throttle body	5x0.8	2.5	Solid threadlocker on bolt

Bolt securing fuel hose guide to airbox	4x0.7	2.5	Solid threadlocker on bolt
Bolt securing fuel hose guide to base of airbox	5x0.8	4.0	
Bolt securing EVAP filter bracket to timing belt cover	6x1	10.0	LOCK 2
Nut securing EVAP plate to bracket	6x1	10.0	
Fairings			
Bolt securing windshield to headlight shell	4x0.7	0.2	
Upper bolt securing headlight shell to support	6x1	5.0	
Lower bolt securing headlight shell to support	6x1	5.0	
Bolt securing upper fairing panels to headlight shell	5x0.8	0.33	
Bolt securing right-hand fairing panel	5x0.8	0.33	
Bolt securing left-hand fairing panel	5x0.8	0.33	
Bolt securing left-hand fairing panel to frame	5x0.8	2.5	
Bolt securing right-hand fairing panel to frame	5x0.8	2.5	
Lower bolt securing RH and LH fairing panels	5x0.8	2.5	Solid threadlocker on bolt
Bolt securing shield to radiator	5x0.8	2.5	
Bolt securing splashguard to headlight support	5x0.8	0.33	
Bolt securing side panels to fairing panels	5x0.8	0.33	
Bolt securing air duct cover to air duct	5x0.8	0.33	
Bolt securing air duct cover to frame/headlight shell	5x0.8	2.5	
Front lower bolt securing fairing panels to frame	5x0.8	2.5	
Rear lower bolt securing fairing panels to frame	5x0.8	2.5	
Bolt securing side panels to fuel tank/frame	5x0.8	2.5	
Bolt securing side panels to seat cowling	5x0.8	0.33	
Bolt securing side panels to heat shield	5x0.8	0.33	
Front bolt securing seat cowling/side panels to frame	5x0.8	2.5	
Intermediate bolt securing seat cowling to frame	5x0.8	5.0	
Front bolt securing seat cowling heat shield to frame	5x0.8	2.5	
Bolt securing fairing bracket to engine	6x1	10.0	
Bolt securing fairing bracket to engine	10x1.5	20.0	LOCK 5

* dynamic safety-critical point; tightening torque must be within Nm ±5%.

Notes

For product specifications and symbols, see paragraph "Product specifications" (Sect. A 2).

Engine torque settings

Part	Thread (mm)	Nm	Min.	Max.	Notes
Idler and tensioner pulley bolts	M20x1	50	45	55	LOCK 2 or TB1324
Camshaft pulley retaining nut	M17x1	71	64	78	GREASE A
Rocker arm shaft covers	M12x1.25	15	14	16	LOCK 2 or TB1324
Coolant temperature sensor on coolant outlet union	M12x1.5	23	20	26	LOCK 4 – Restrain the insert when tightening

Cylinder head nut: Stage 1 Stage 1 Stage 2	M10x1.5	 20 40 60	 38 57	 42 63	Apply GREASE C to the underside of the nut and the thread of the stud
Cam cap bolt: Stage 1 Stage 2	M8x1.25	 10 22.5	 9 21	 11 25	Engine oil
Coil retaining bolt	M6x1	10	9	11	
Pulley flange retaining bolts	M6x1	10	9	11	
Cylinder head cover bolt	M6x1	10	9	11	
Exhaust manifold stud	M6x1	10	9	11	LOCK 5 or TB1375B
Vacuum gauge connection screw on cylinder head (EU only)	M6x1	5	4	6	LOCK 2 or TB1324
Evaporative emissions canister fitting on cylinder head (California only)	M6x1	5	4	6	LOCK 2 or TB1324
Air breather blanking screw on vertical cylinder head	M6x1	3	2	4	LOCK 2 or TB1324
Air breather fitting on horizontal cylinder head	M6x1	10	9	11	LOCK 6
Intake manifold bolt	M6x1	10	9	4	
Bolts securing coolant unions to cylinder head	M5x1	8	7	9	pre-applied Tecnologic 150 threadlocker
Oil cartridge	M16x1.5	11	10	12	Engine oil on gasket
Oil cartridge nipple	M16x1.5	42	38	46	LOCK 2 or TB1324
Oil pick-up pipe plug	M14x1.5	24	21	27	LOCK 5 or TB1375B
Oil cooler nipple	M14x1.5	27	24	30	LOCK 5 or TB1325B
Oil drain plug	M12x1.5	20	18	22	
Clutch cover oilway blanking plug	M10x1.5	15	13	17	LOCK 5 or TB1375B
Neutral sensor	M10x1.25	10	9	11	
Oil pump adapter bolt	M10x1				LOCK 5 or TB1375B
Clutch cover inner oilway screw	M10x1.5	15	13	17	LOCK 5
Cylinder head/barrel stud	M10x1.5	30	28	32	LOCK 2 or TB1324
Vertical cylinder zone crankcase bolt: Stage 1 Stage 2	M8x1.25	 19 25	 22 22	 28 28	GREASE B or Agip GR SM on thread
Central crankcase bolt + swingarm pivot bolt: Stage 1 Stage 2	M8x1.25	 19 25	 22 22	 28 28	GREASE B or Agip GR SM on thread
Gear stop lever bolt	M8x1.25	18	16	20	LOCK 2 or TB1324
Blow-by valve bolt	M6x1	10	9	11	
Chain side secondary bearing retaining bolt	M6x1	10	9	11	LOCK 2 or TB1324
Clutch side primary bearing retaining bolt	M6x1	10	9	11	LOCK 2 or TB1324
Crankcase bolt – idler area	M6x1	10	9	11	
Outer crankcase bolt	M6x1	10	9	11	
Oil pick-up gauze filter bolt	M6x1	10	9	11	
Bosch sensor bolt	M6x1	10	9	11	
Chain cover oil circuit blanking screw	M6x1	8	7	9	LOCK 2 or TB1324
FCC clutch bolt	M6x1	6	5	7	
Under-piston oil jet retaining screw	M5x0.8	8	7	9	LOCK 2 or TB1324
Starter motor mounting bolt	M6x1	10	9	11	Pre-applied Loctite 516
Starter motor rear bolt	M6x1	10	9	11	Pre-applied Loctite 516

Idler gear shaft retaining bolt	M6x1	10	9	11	LOCK 2 or TB1324
Flywheel retaining nut	M24x1	330	313	346	LOCK 5 or TB1375B
Nut securing front sprocket oil clutch	M22x1	190	171	209	GREASE B
Connecting rod cap bolts: Tighten at 50 rpm Pause for 2 sec. then back off by 360° at 30 rpm Stage 2 at 30 rpm Stage 3 at 10 rpm Stage 4, tighten through 65° ± 1° at 14 rpm Torque check	M10x1	 35 20 35 70 to 103			Apply GREASE B to thread
Crankshaft grub screw	M8x1.25	13	11	15	LOCK 5 or TB1375B
Drilled crankshaft grub screw	M8x1.25	13	11	15	LOCK 5 or TB1375B
Selector drum locating screw	M16x1.5	30	27	33	
Gear stop lever screw	M8x1.25	18	16	20	LOCK 2 or TB1324
Selector claw bolt	M8x1.25	25	22	28	
Selector claw locator nut	M6x1	10	9	11	
Selector claw bolt	M6x1	9	8.5	9.5	Loctite 516 pre-applied to thread
Idler and tensioner pulley bolts	M20x1	50	45	55	LOCK 2 or TB1324
Camshaft pulley retaining nut	M15x1	71	64	78	GREASE A
Timing belt driveshaft gear nut	M14x1	55	50	60	GREASE A
Idler and tensioner pulley nut	M8x1.25	25	22	28	GREASE A
Timing belt cover bolt	M6x1	10	9	11	Loctite 516 pre-applied to thread
Self-tapping screw for timing belt cover filter	M3.5				
Oil filler plug	M22x1.5	5	5	6	
Wet clutch centre nut	M20x1	120	115	125	GREASE B
Oil pressure sensor	M10x1.5	18	16	19	
Oilway blanking plug	M10x1	20	18	22	LOCK 5 or TB1375B
Clutch cover bolt	M6x1	10	9	11	Pre-applied Tecnologic 150 threadlocker
Clutch-side crankcase cover bolt	M6x1	10	9	11	
Coolant inlet union	M30x1.5	25	23	27	LOCK 5 or TB1375B
Coolant outlet union	M22x1.5	25	23	27	LOCK 5 or TB1375B
Pick-up sensor inspection screw	M12x1	15	13	17	LOCK 2 or TB1324
Water pump cover plug	M10x1	20	18	22	
Spark plug	M10x1	12	11	13	
Coolant pump bearing stop screw	M6x1	10	9	11	LOCK 2 or TB1324
Stator wiring clamp bracket bolt	M6x1	10	9	11	LOCK 2 or TB1324
Water pump cover plug	M6x1	10	9	11	
Alternator-side crankcase cover bolt	M6x1	10	9	11	
Alternator-side crankcase cover + water pump bolt	M6x1	10	9	11	
Inspection cover bolt	M6x1	4.5	4.5	6	
Alternator rotor/flywheel bolt	M6x1	13	11	15	LOCK 5 or TB1375B
Alternator-side crankcase cover bolt	M6x1	10	9	11	
By-pass pump cap	M15x1	25	22	28	LOCK 2 or TB1324
Oil pump retaining bolt	M6x1	10	9	11	

Oil pump retaining bolt	M8x1.25	26	23	29	
Coolant outlet union	M22x1.5	25	23	27	LOCK 5 or TB1375B
Coolant circuit hose clamps		2.5	2	3	

* dynamic safety-critical point; tightening torque must be within Nm ±5%.

Notes

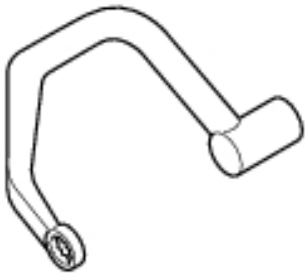
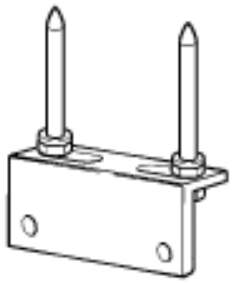
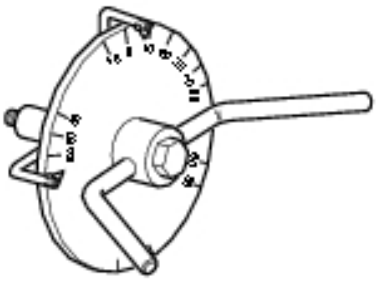
For product specifications and symbols, see paragraph "Product specifications" (Sect. A 2).

4 - Service tools

Parts catalogue

WORKSHOP SERVICE TOOLS
WORKSHOP SERVICE TOOLS

Specific tools for the engine

Code No.	Designation	
88713.2011	Tool to lock crankshaft at Top Dead Centre	
88713.2676	Wrench for tightening cylinder head nuts	
88713.2103	Stand for cylinder head assembly	
88765.1523	Timing check tool	

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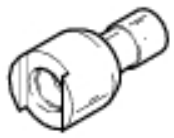
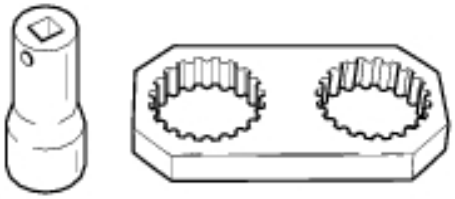
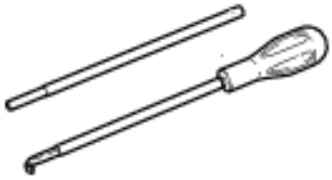
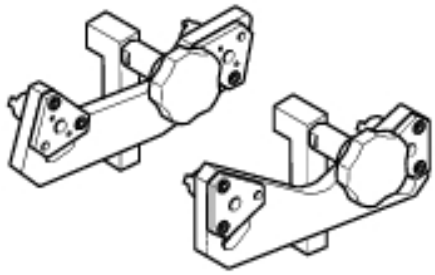
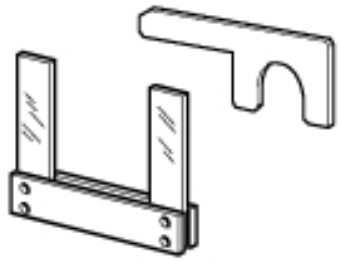
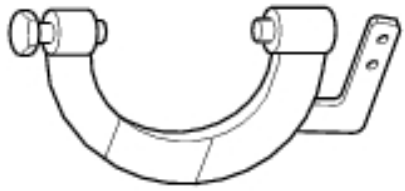
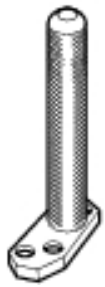
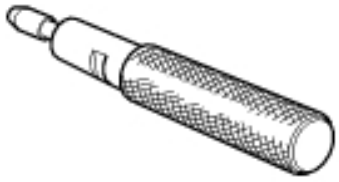
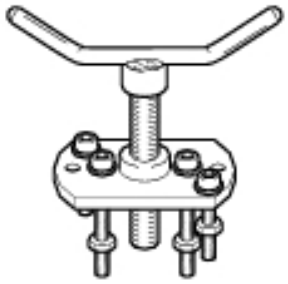
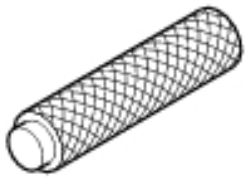
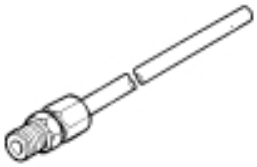
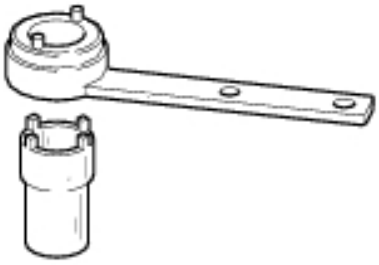
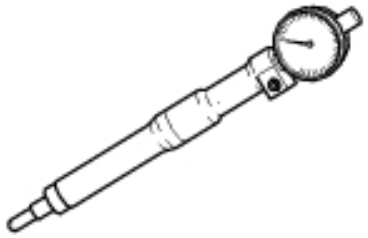
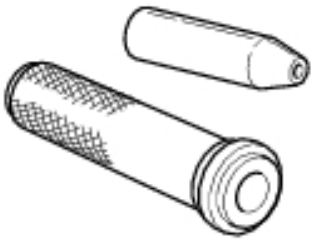
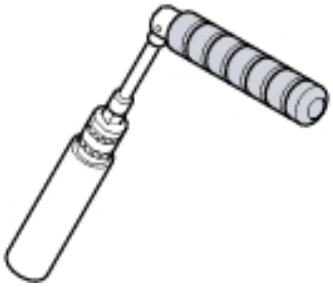
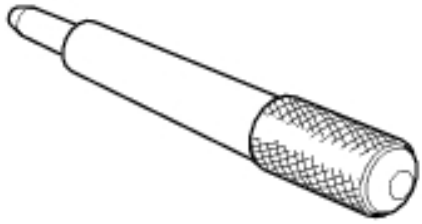
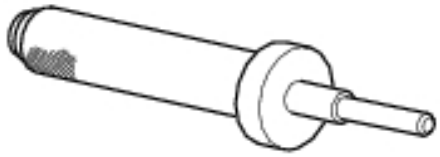
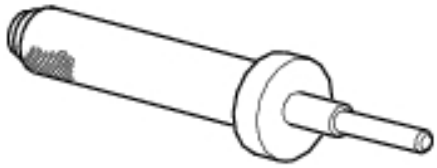
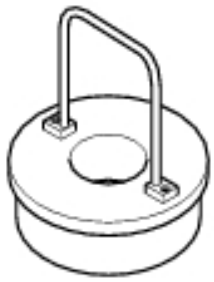
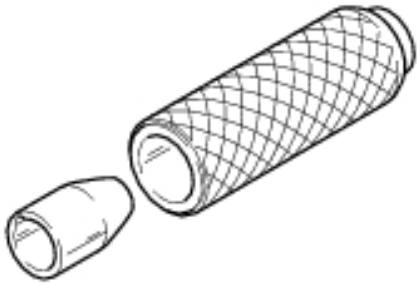
88713.1821	Wrench for tightening timing belt tensioner pulley shafts	
88713.2861	Camshaft oil seal installer	
88713.2060	Gearbox output shaft oil seal installer	
88713.1806	Tool for tightening Z=20 camshaft pulley	
88713.2069	Rocker spring tensioning kit	

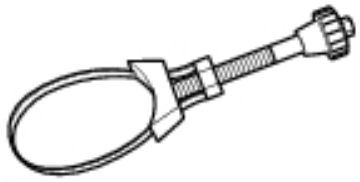
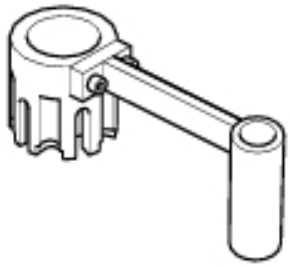
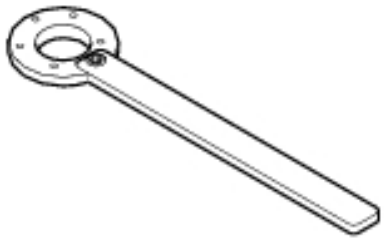
97900.0215	DDS (Ducati Diagnostic System) + cylinder vacuum gauge kit	
88765.1524	Timing belt pulley timing tools	
88765.1518	Valve lift gauge	
88713.2878	Fork-type feeler gauge 0.1 mm, 0.2 mm, 0.3 mm	
88713.2874	Alternator holding tool for tightening nut	

88713.1920	Tool for installing O-rings on crankcase studs	
88713.2827	Plate for gear selector fork positioning	
88713.2442	Tool for installing valve guide seals	
88713.1749	Puller for drive pulley and cover	
88713.1832	Engine repair bench	

88713.1904	Punch for fitting half-rings	
88713.1980	Punch for installing caps on shafts	
88713.1886	Engine cover sheet	
88713.1010	Exhaust gases pick-up connector	
88713.1805	Tool for tightening timing belt driveshaft pulley	

88765.1188	Top Dead Centre test gauge	
88713.0869	Water pump front seal installer	
88713.0870	Installation tool for counter plate for water pump front seal	
88700.5749	Crankcase assembly cap	
88713.2877	Sparkplug wrench	

88713.2842	Inlet/exhaust valve guide installer	
88713.2846	Exhaust valve seat installer	
88713.2847	Inlet valve seat installer	
88713.2870	Connecting rod guide tool	
88713.2834	Punch and sleeve for installing camshaft circlip	

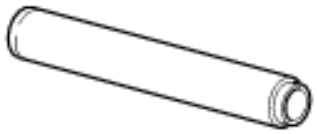
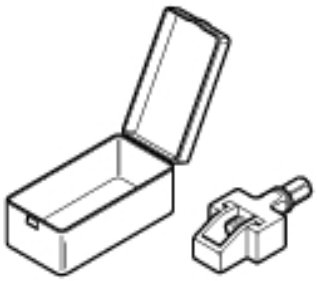
88713.2832	Timing belt tensioner pulley wrench	
88713.2669	Tool for installing needle roller bearings on primary shaft	
88713.2906	Oil filter cartridge wrench	
88713.2651	Wet FCC clutch drum holding tool	
88713.2423	Reaction wrench	

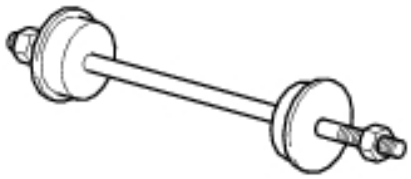
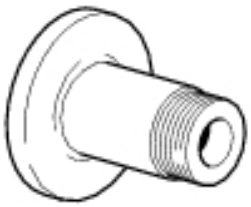
88713.2422	Wrench for tightening primary sprocket nut	

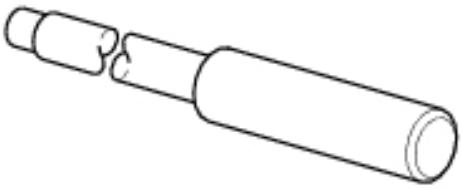
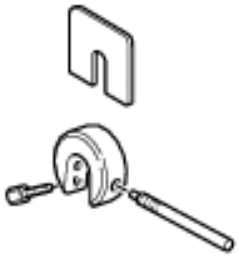
Parts catalogue

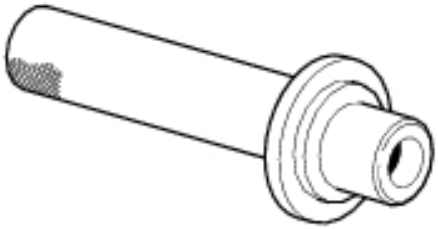
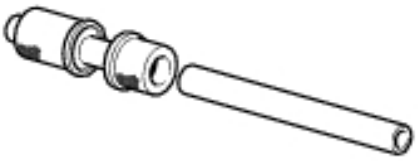
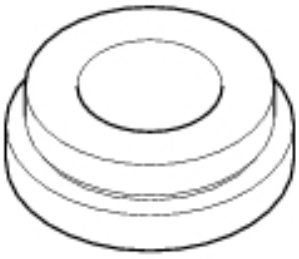
WORKSHOP SERVICE TOOLS

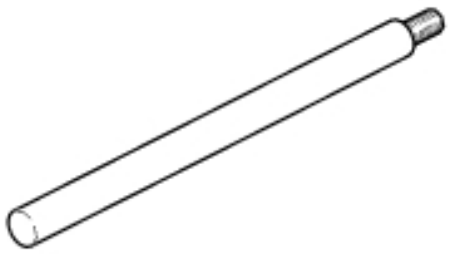
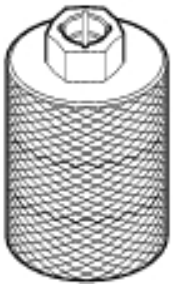
Specific tools for the frame

Code No.	Designation	
88713.1072	Drift to install half bearing in bottom yoke	
88713.2562	Chain assembly tool	
8000.70139	Front wheel axle wrench	

88713.1515	Engine/frame support	
88713.1058	Wrench for steering stem nut	
88713.1062	Tool for installing steering head bearings	
88713.1071	Drift to drive rocker arm needle rollers	
88713.2951	Rear wheel balancing tool	

88713.1038	Wrench for adjustment of the eccentric hub	
88713.1096	Tool for overhauling SHOWA forks/fitting oil seals	
677.4.003.1A	Chain joining link	
88713.1074	Swingarm pivot bolt removal tool	
88713.0957	SHOWA fork spacer holder	

88713.1057	Steering damper bearing installer	
88713.1077	Seat lock nut wrench	
88713.1068	Tool for installation of swingarm roller bearings	
88713.2409	Swingarm bearing installer	
88713.2856	Rod guide tool	

88713.2857	Tool for disassembly of sliding bushes	
88713.2858	Tool for disassembly of sliding bushes	
88713.2855	Bush support bar	
88713.2854	Fork plug installation/removal bush	

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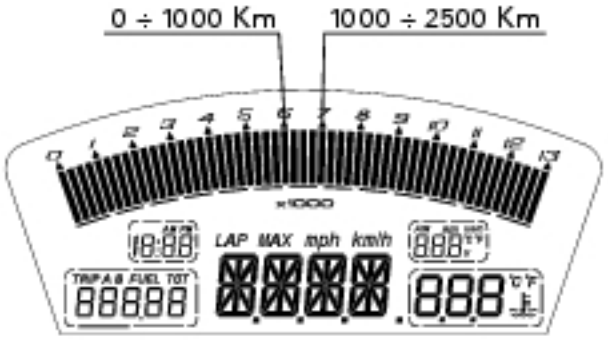
1 - Preliminary checks

Running-in precautions

Maximum engine speed

Rpm limits to be observed during the running-in period and in normal use:
1 Up to **1000** km;
2 from **1000** to **2500** km.



Maximum engine speed up to 1000 km

During the first **1000** km keep an eye on the rev counter. The indicator must not exceed **5500-6000** rpm. During the first hours of riding, it is advisable to continuously vary the load on the engine and the rpm, though still keeping within the above limits.
For this reason, roads with numerous bends and hilly areas are ideal for running in the engine, brakes and suspension. For the first 100 km, use the brakes gently. Do not brake violently or keep brake applied for too long. This will enable a correct break-in of friction material on brake pads against brake discs. To allow all the mechanical moving parts of the motorcycle to adapt to one another and above all to avoid adversely affecting the life of basic engine parts, it is advisable to avoid harsh acceleration and not to run the engine at high rpm for too long, especially uphill. It is also advisable to check the drive chain frequently and ensure that it is lubricated as required.

Maximum engine speed from 1000 to 2500 km

You may now ask more from the engine, but be careful never to exceed **7000** rpm for the first **2500** km of riding. Keeping strictly to these recommendations will extend the life of your engine and reduce the likelihood of overhauls or tune-ups.

Important

Throughout the running-in period, be careful to stick to the recommended maintenance schedule and periodic service intervals indicated in the warranty booklet. Failure to follow these instructions releases Ducati Motor Holding S.p.A. from any liability whatsoever for any engine damage or shorter engine life.

Pre-ride checks

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Warning

Failure to carry out these checks before riding may result in damage to the motorcycle and serious injury to the rider.

Before starting, check the following points:

Fuel level in the tank

Check the fuel level in the tank. Fill the tank if needed (Sect. C 2, Fuel, lubricants and other fluids).

Engine oil level

Check the oil level in the sump through the sight glass. Top up with recommended oil if necessary (Sect. C 2, Fuel, lubricants and other fluids).

Brake and clutch fluid

Check the fluid levels in the respective reservoirs.

Coolant

Check coolant level in the expansion reservoir. Top up if necessary (Sect. C 2, Fuel, lubricants and other fluids).

Tyres

Check tyre pressure and condition (Sect. C 1.1, Front wheel/Rear wheel).

Controls

Operate the brake, clutch, throttle and gear change controls (levers, pedals and twistgrip) to check that they function correctly.

Lights and indicators

Make sure the lights, indicators and horn work properly. Replace any burnt-out bulbs with new bulbs having the same rating (Sect. C 1.1, Lights/instrument panel).

Key locks

Check that the fuel filler cap and the seat are locked.

Sidestand

Make sure the sidestand operates smoothly (Sect. P 6, Protection and safety devices) and is in the correct position (Sect. H 5, Sidestands).

2 - Starting - Engine warmup

Starting the engine

This motorcycle is equipped with an automatic starter (stepper motor). This allows automation of the engine warmup procedure.
For information on the operation of the stepper motor, see Sect. M 3, Stepper motor.
Turn the ignition switch to ON. Make sure both the green light and the red light on the instrument panel come on (Sect. P 7, Instrument panel).
Allow the engine to start on its own, without turning the throttle twistgrip.

Important

The oil pressure warning light should go out a few seconds after the engine has started. If the light stays on, stop the engine and check the oil level (Sect. P 7, Instrument panel).
Never start the engine when the oil pressure is too low.

Important

Do not run the engine at high speed when cold. Allow some time for the oil to warm up and reach all points that need lubricating.

Warning

The engine can be started with the sidestand down and the gearbox in neutral. When starting the engine with a gear engaged, pull in the clutch lever (in this case the sidestand must be in the raised position).

3 - Routine maintenance table

Programmed maintenance plan: operations to be carried out by the dealer

List of operations with frequency (distance or time interval*)	km x1000	1	12	24	36	48	60
	miles x1000	0.6	7.5	15	22.5	30	37.5
	Months	6	12	24	36	48	60
Change the engine oil		•	•	•	•	•	•
Change the engine oil filter		•	•	•	•	•	•
Clean the engine oil pick-up filter					•		
Check the engine oil pressure				•		•	
Check/adjust the valve clearances (**1**)			•	•	•	•	•
Check the tension of the timing belts (**1**)			•		•		•
Renew the timing belts				•		•	
Check and clean the spark plugs. Renew if necessary				•		•	
Check and clean the air filter (**1**)			•		•		•
Change the air filter				•		•	
Check throttle body synchronisation and idle speed setting (**1**)			•	•	•	•	•
Check the brake and clutch fluid levels		•	•	•	•	•	•
Change the clutch and brake fluid					•		
Check and adjust the brake and clutch control cables			•	•	•	•	•
Check/lubricate the throttle/choke cables			•	•	•	•	•
Check tyre pressure and wear		•	•	•	•	•	•
Check the brake pads. Renew if necessary		•	•	•	•	•	•
Check the steering head bearings				•		•	
Check the drive chain tension, alignment and lubrication		•	•	•	•	•	•
Check the clutch disc pack. Renew if necessary (**1**)			•	•	•	•	•
Checking the coolant level			•	•	•	•	•
Change the coolant					•		
Check operation of electric fans and sealing of coolant circuit			•	•	•	•	•
Check the rear wheel cush drive				•		•	
Check the wheel hub bearings				•		•	
Check the indicators and lighting			•	•	•	•	•
Check tightness of nuts and bolts securing the engine to the frame			•	•	•	•	•
Check the sidestand			•	•	•	•	•
Check tightness of the front wheel axle nut			•	•	•	•	•
Check tightness of the rear wheel axle nut			•	•	•	•	•
Check the external fuel hoses			•	•	•	•	•
Change the front fork oil					•		
Check the forks and rear shock absorber for oil leaks			•	•	•	•	•
Check the front sprocket retaining bolts			•	•	•	•	•
General lubrication and greasing			•	•	•	•	•
Check and recharge the battery			•	•	•	•	•
Road test the motorcycle		•	•	•	•	•	•
General cleaning			•	•	•	•	•

* Service operation to be carried out in accordance with the specified distance or time intervals (km, miles or months), whichever occurs first.
(1) Operation to be carried out only at the specified distance intervals.

Programmed maintenance plan: operations to be carried out by the client

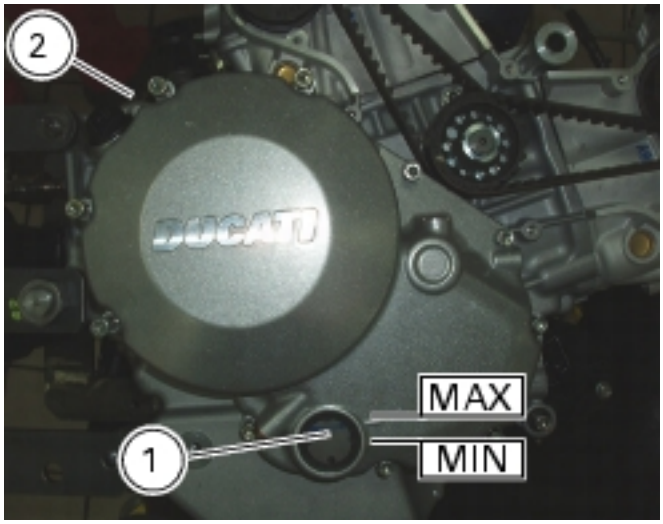
List of operations with frequency (distance or time interval*)		
	km x1000	1
	miles x1000	0.6
	Months	6
Checking the engine oil level		•
Check the brake and clutch fluid levels		•
Check tyre pressure and wear		•
Check the drive chain tension and lubrication		•
Check the brake pads. If necessary, contact your dealer to renew pads		•

* Service operation to be carried out in accordance with the specified distance or time intervals (km, miles or months), whichever occurs first.

4 - Maintenance operations

Checking the engine oil level

Check the engine oil level in the sight glass (1) on the right-hand side of the oil sump.
Stop the engine and allow a few minutes for the oil to settle to a steady level.
Check the level with the motorcycle perfectly vertical and with the engine warm (but not running).
The oil must be between the MIN and MAX marks. If the oil level is low, remove the right-hand side fairing (Sect. E 2, Removal of the side fairings) and top up.
Remove the filler cap (2) and top up with the recommended oil.
Refit the filler plug and all previously removed parts.



Changing the engine oil and filter cartridge

Notes

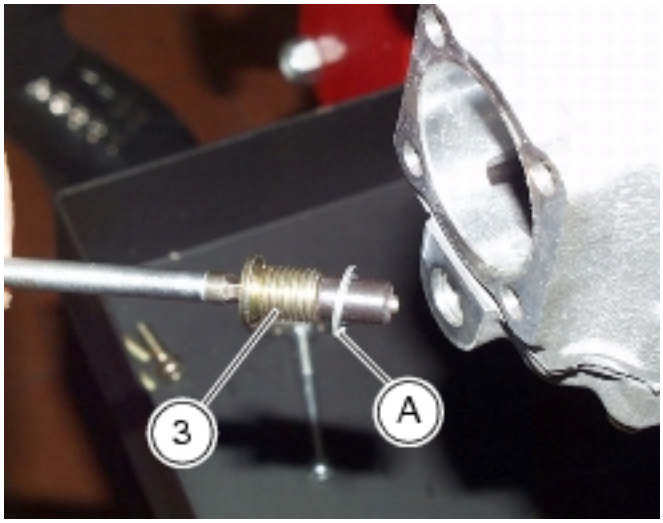
Change the oil when the engine is warm (but with the engine stopped). In these conditions the oil is more fluid and will drain more rapidly and completely.

Remove the fairings (Sect. E 2, Removal of the side fairings).
Remove the drain plug (3) with seal (A) from the oil sump and allow the oil to drain off.

Warning

Dispose of oil and/or filter cartridges in compliance with environmental protection regulations.

Remove any metallic deposits from the end of the magnetic drain plug (3). Clean the threasds of the plug; apply THREE BOND TB1215 to the threads. Refit the drain plug complete with gasket (A) to the sump.

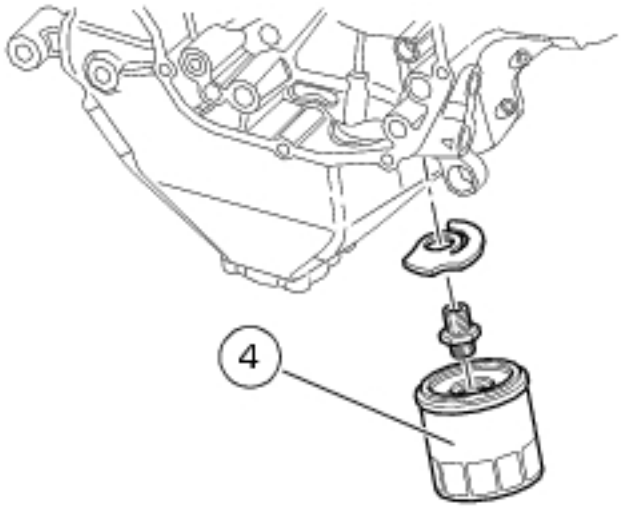


Tighten to the specified torque (Sect. C 3, Engine torque settings).
Remove the filter cartridge (4) from the sump using a standard filter wrench.

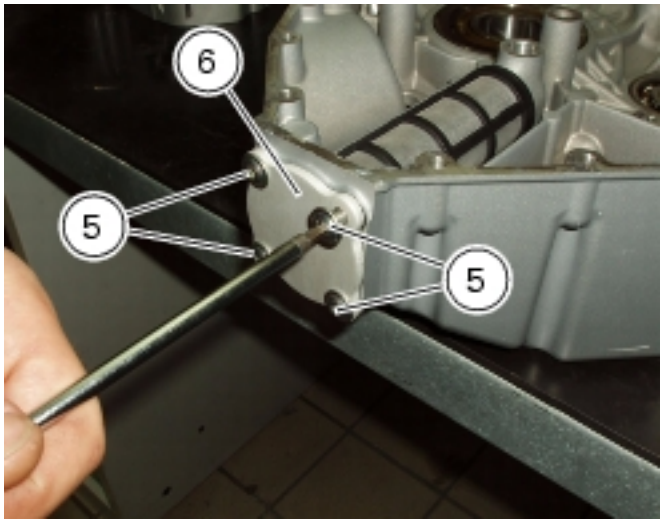
Important
Dispose of the used cartridge, do not attempt to reutilise it.

Lubricate the rubber seal of the new filter (4) with engine oil before installing it.
Screw the cartridge into place and tighten to the specified torque (Sect. C 3, Engine torque settings).

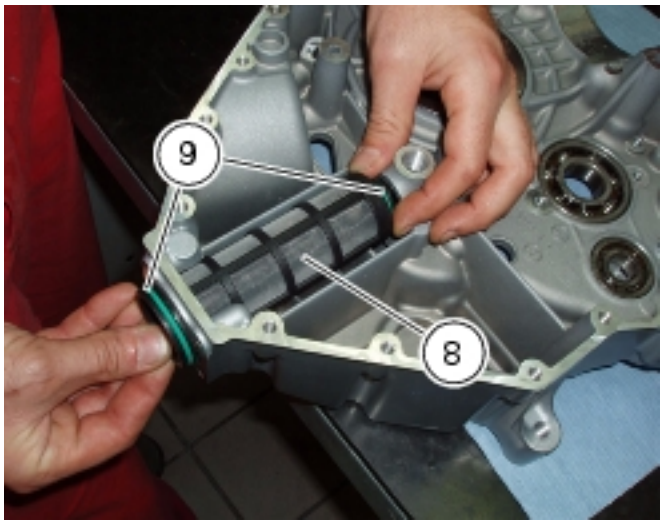
Notes
It is advisable to fill the filter cartridge (4) with engine oil before installing it: this enables the recommended oil level to be maintained without topping up.



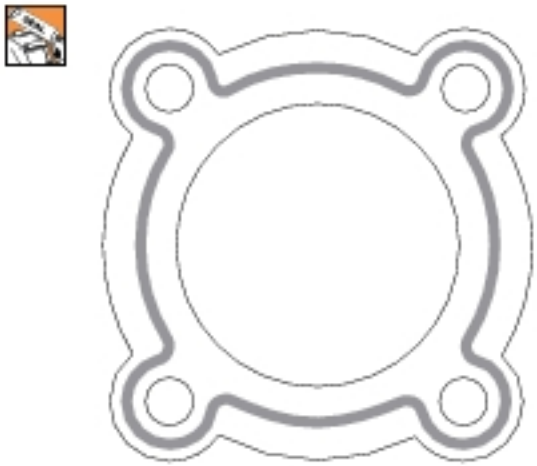
Every two oil changes, clean the oil pickup gauze filter.
Undo the four bolts (5) securing the outer cap (6) and remove the cap.



Take out the filter element (8), check the O-rings (9) and replace if necessary.

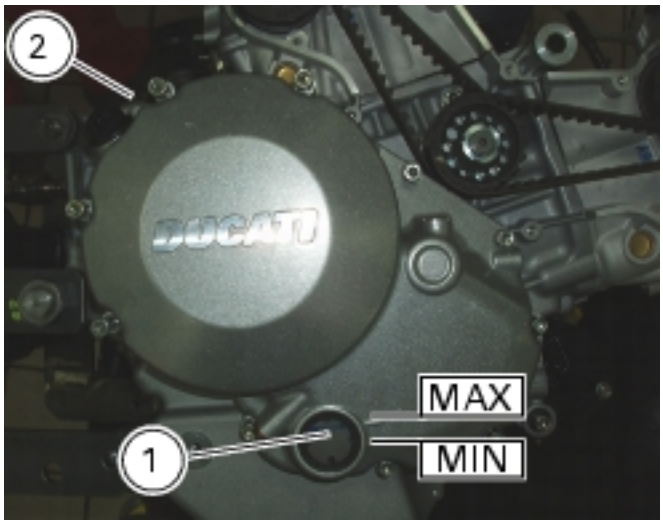


Clean the filter with petrol and compressed air. Take care not to damage the gauze.
Refit the gauze filter (8) with the O-rings (9).
Apply a bead of liquid gasket to the seating of the cap (6) on the crankcase cover as shown in the figure.



Refit the cap (6) and tighten the bolts (5).
Tighten the bolts (5) to the specified torque (Sect. C 3, Engine torque settings).
Remove the filler cap (2) and fill with oil of the recommended type (Sect. C 2, Fuel, lubricants and

other fluids) up to the MAX line in the sight glass (1).
Refit the filler cap (2). Run the engine at idle speed for a few minutes.

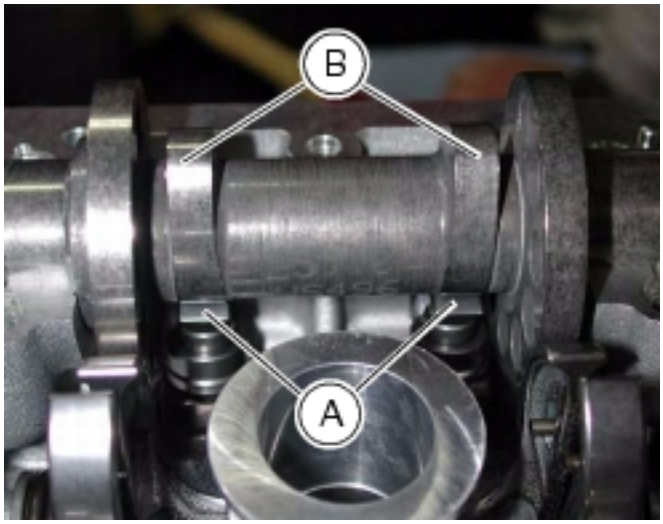


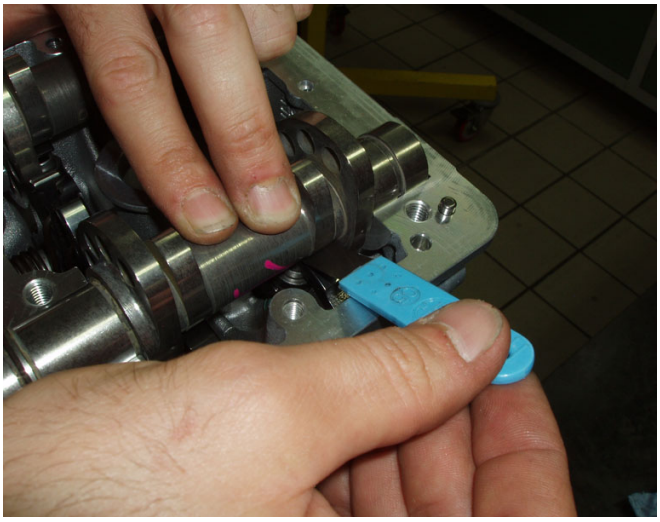
Check for oil leaks. Check that the oil pressure light on the instrument panel switches off a few seconds after the engine starts. If not, switch off the engine and trace the fault.
After a few minutes, check the oil level again and top up to the MAX level line, if necessary.
Refit all parts removed.

Checking valve clearances

Proceed as described in Sect. N 4.1, Checking and adjusting the valve clearances.
With the valve in the rest position, slide a feeler gauge between rocker arm (A) and the lowest side of the cam (B) to measure the clearance.
The clearances must be within the specified limits:

Opening rocker arm	
Intake:	
Operation	0.13 to 0.18 mm
Checking clearance	0.10 to 0.25 mm
Exhaust:	
Operation	0.13 to 0.18 mm
Checking clearance	0.10 to 0.25 mm

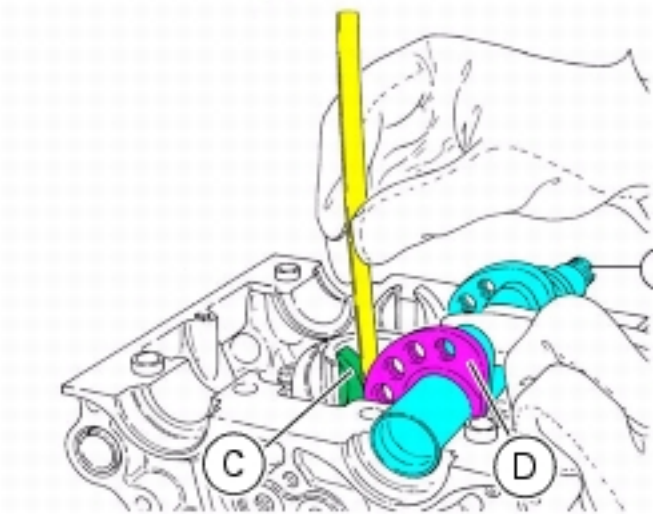


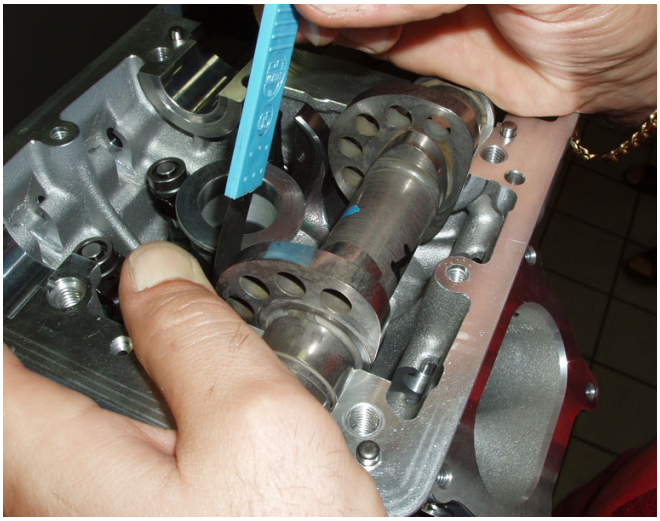


With the valve in the rest position, slide a feeler gauge between closing rocker arm (C) and the highest side of the cam (D) to measure the clearance.

Closing rocker arm	
Intake:	
Operation	0.05 to 0.10 mm
Checking clearance	0.05 to 0.25 mm
Exhaust:	
Operation	0.05 to 0.10 mm
Checking clearance	0.05 to 0.25 mm

If the clearances measured are outside the specified limits, measure the value and adjust as required (Sect. N 4.1, Checking and adjusting the valve clearances).



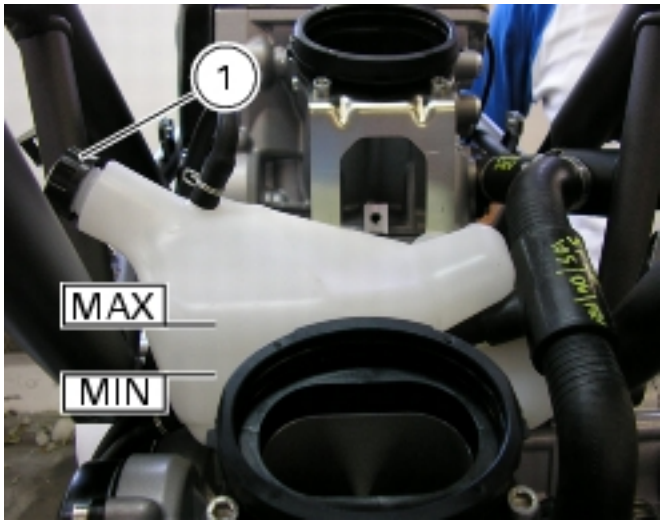


Adjusting the valve clearances

Proceed as described in Sect. N 4.1, Checking and adjusting the valve clearances.

Checking the coolant level

At the intervals specified in the "Routine maintenance table" chart (Sect. D 3), check the coolant level in the expansion tank, located on the right-hand side of the motorcycle.
The coolant level must be between the MAX and MIN marks on the tank.
If the level is low, top up with the recommended coolant.
Remove the right-hand side fairing (Sect. E 2, Removal of the side fairings).
Remove the filler cap (1) and top up to the specified level.
Refit the cap (1) and replace any parts removed.



For optimal operating conditions (coolant mixture starting to freeze at -20 °C), the recommended liquid antifreeze should be mixed with water in the following percentages:
ANTIFREEZE: **35-40**% of volume;
WATER: **60-65**% of volume.

Important

Very hard water with a high mineral salt content can damage the engine.
Increase the amount of coolant to up to **55**% volume in the case of very cold climates.

Important

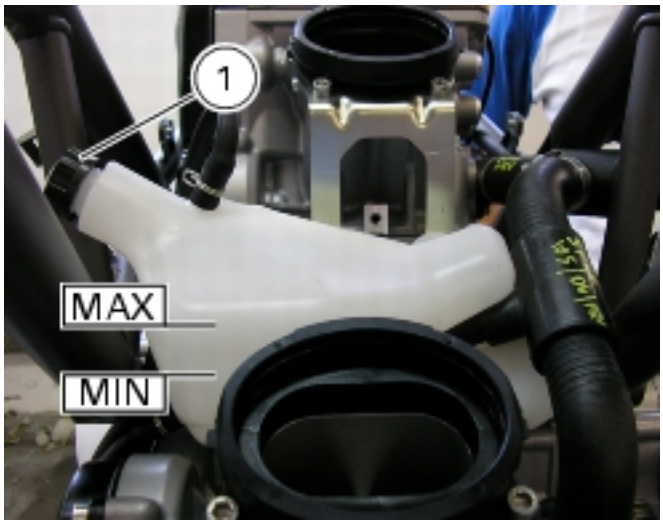
Solutions with less than **30**% of coolant will not provide sufficient protection against corrosion.

Changing the coolant

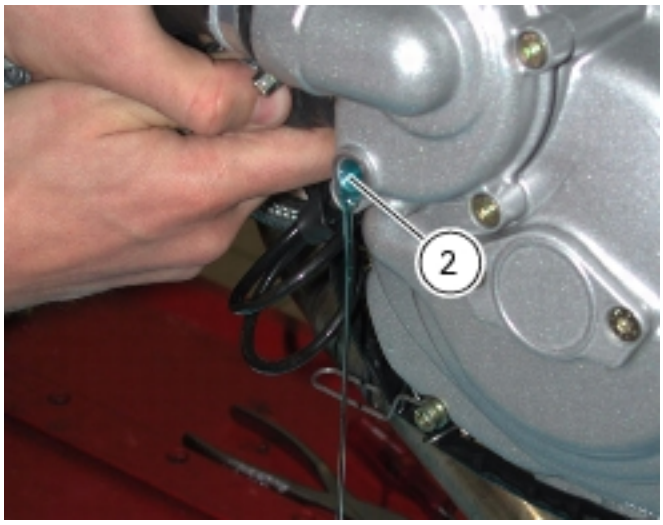
Warning

This operation must only be carried out when the engine is cold. Attempting to change the coolant with the engine hot could lead to burns from hot coolant or scalding steam.

Remove the right-hand fairing (Sect. E 2, Removal of the side fairings).
Remove the expansion tank filler cap (1).



Place a container under the engine and place the motorcycle on its sidestand.
Unscrew the plug from the drain hole (2) located on the pump cover.
Allow the coolant to drain off completely.
Refit the cap to the drain hole (2) along with a new gasket.



Fill the circuit by removing the cap (1) and pouring new coolant of the recommended type into the expansion tank.
Allow several minutes for the coolant to fill all the internal passages.
Completely fill the expansion tank and replace the cap (1).
Start the engine and allow the coolant to reach **110** °C; run the engine for around **10** minutes.

Stop the engine and allow it to cool down so that all the air is expelled from the cooling circuit.

Warning

Keep your hands, clothing and tools well clear of the radiator fan at all times; this fan starts automatically without warning and could cause serious injury or damage.

Important

Check the cooling circuit for possible leaks.

Top up the coolant through the expansion tank filler to bring the level up to the **MAX** mark.
Refit and tighten the expansion tank cap (1) and refit all parts previously removed.

Changing and cleaning the air filters

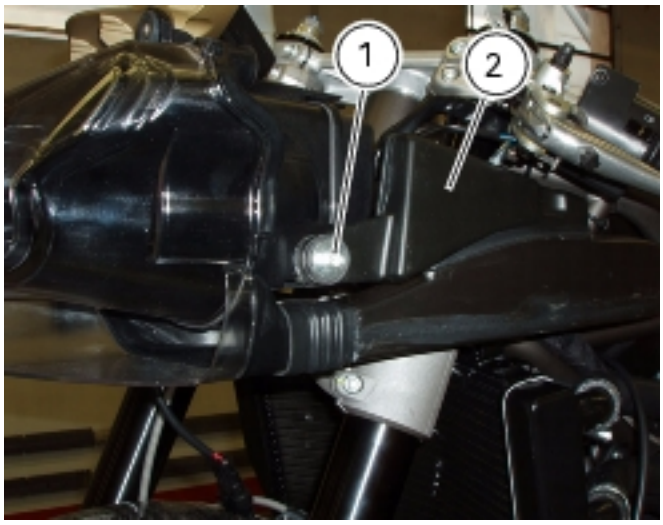
The air filter must be renewed at the intervals indicated in the "Routine maintenance table" (Sect. D 3).

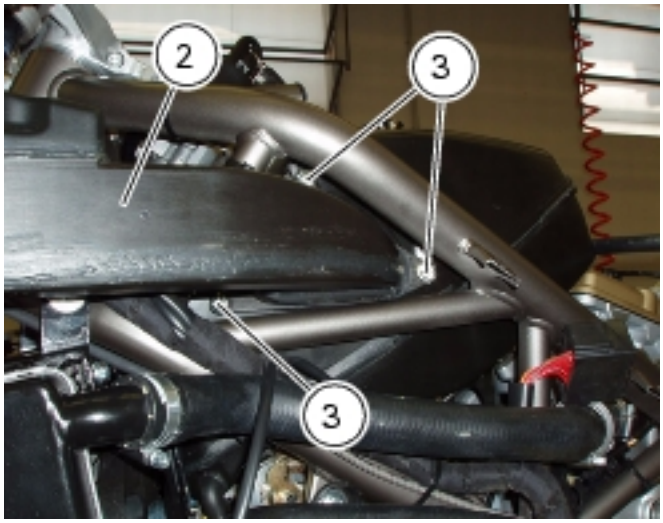
Operation	Section reference
Remove the side fairings	E 2, Removal of the side fairings
Remove the air duct covers and the headlight shell	E 1, Removal of the headlight shell

Notes

The images show the motorcycle without the fuel tank: the operation described may also be carried out with the fuel tank fitted.

Unscrew the bolt (1) securing the air intake duct (2) to the headlight support and the bolts (3) securing it to the filter housing.
Remove the air intake duct (2).





Extract the filter cartridges (4) from the housings in the airbox.

The filter cartridge can be cleaned with a jet of compressed air or renewed as necessary.

Important

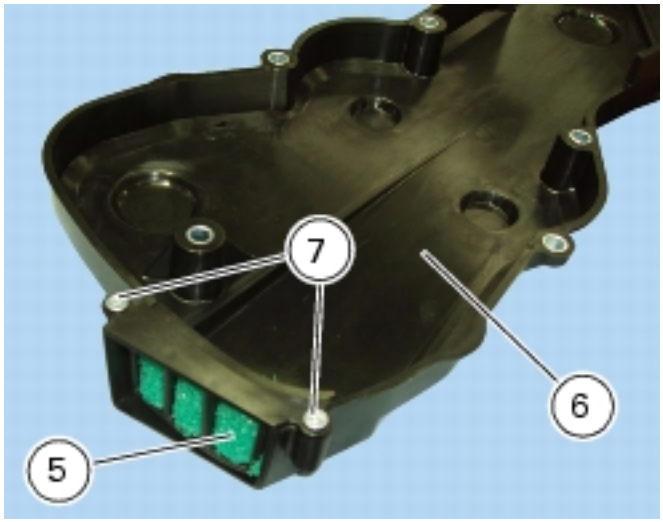
A clogged air filter will reduce air intake and engine power, increase fuel consumption and cause a build up of deposits on the spark plugs. Do not use the motorcycle without a filter, as impurities in the air could get into the engine and cause damage.

Reinstall the filter cartridge in its seat in the filter housing and refit all removed parts and structures.

Important

If the motorcycle is used in very damp or dusty conditions, the air filter cartridge must be changed more frequently.

Check the air filter (5) located in the horizontal cylinder timing belt cover (6): to remove the filter, remove the cover (Sect. N 4.2, Removal of the timing belt covers) and remove the bolts (7).
After inspection, refit the filter (5), tighten the bolts (7) and replace the horizontal cylinder timing belt cover (6) (Sect. N 4.2, Refitting the timing belt covers).



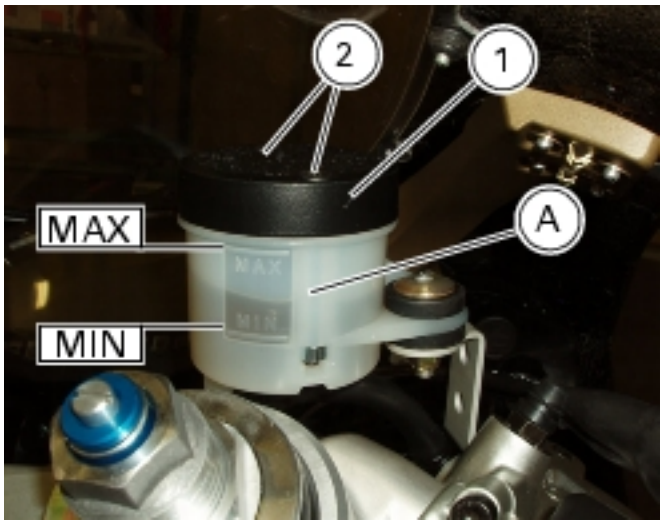
Changing the brake fluid

Warning

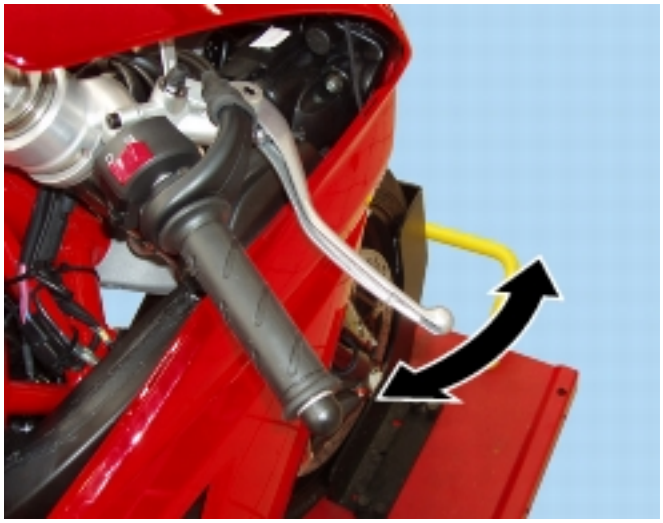
Brake fluid will damage painted surfaces if spilled on them. In addition, it is very harmful in contact with the skin or with the eyes; in the event of accidental contact wash the affected area with abundant running water.

Changing the fluid in the front brake circuit

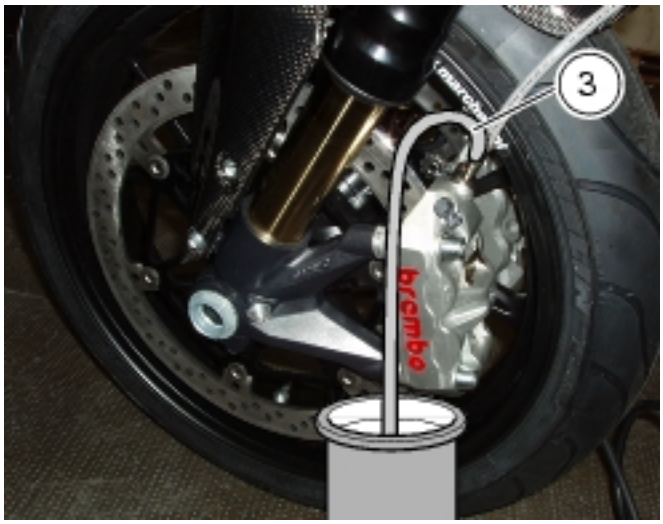
Unscrew the screws (2) and remove the cap (1) and membrane from the front brake fluid reservoir.
Siphon the brake fluid from the reservoir (A).
Fill the reservoir (A) with new brake fluid up to the **MAX** mark.



Operate the clutch lever two or three times until the circuit is pressurized.
Hold the lever pulled in towards the handgrip.



Attach a length of transparent plastic tubing to the bleed valve (3) and insert the other end of the tubing in a container placed on the floor.
Loosen the bleed valve (3) to allow fluid to escape.

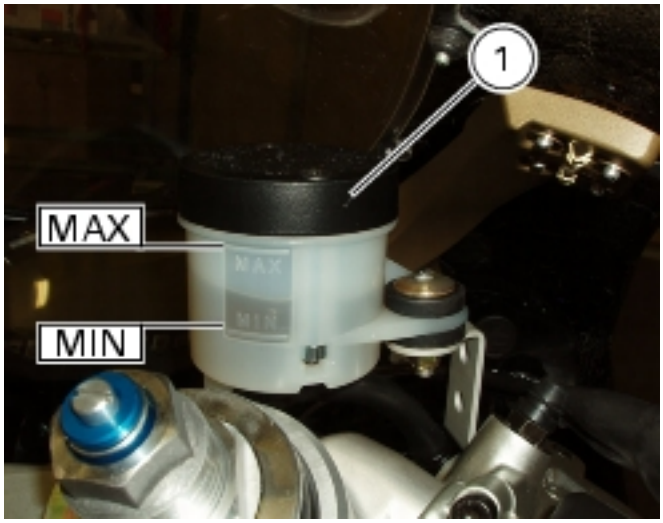


Warning
While filling the system, always keep the fluid level above the **MIN** mark to prevent the formation of air bubbles in the circuit.

Allow the fluid to flow from the bleed valve (3) until it changes colour.
Tighten the bleed valve (3) and restore the correct fluid level in the reservoir.

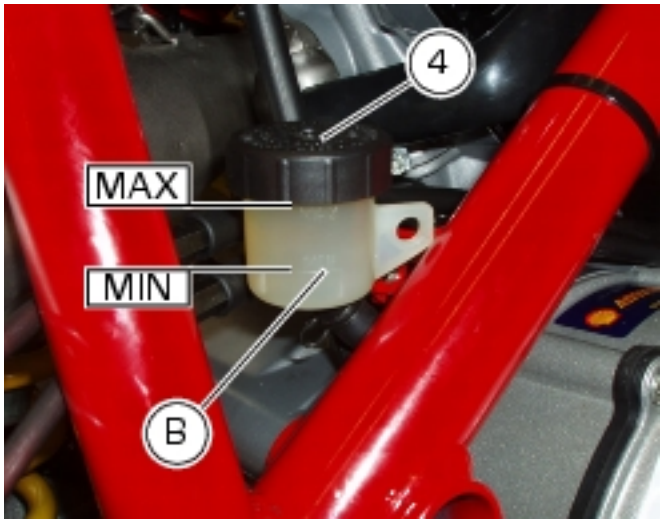
Notes
Repeat this operation on each brake caliper.

Refit the cap (1), carrying out the removal operations in reverse order.

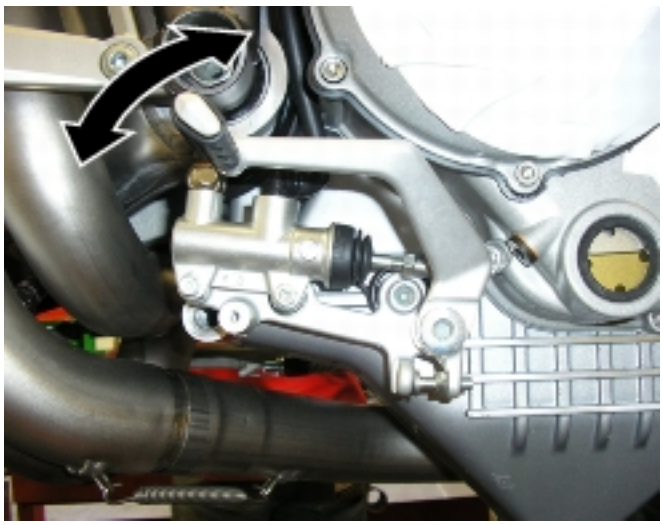


Changing the rear brake circuit fluid

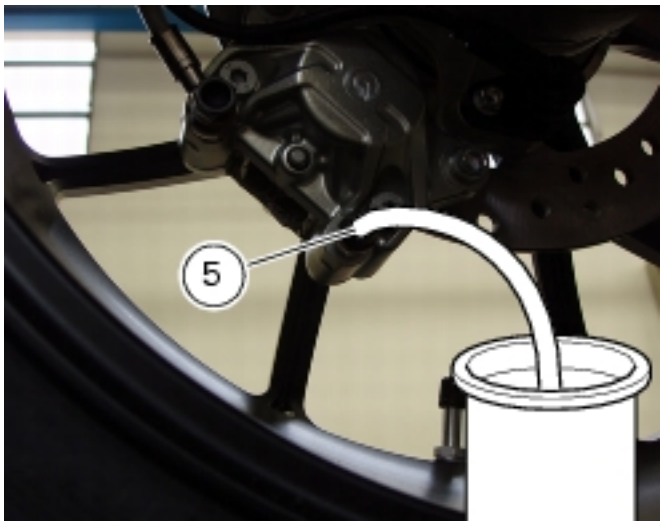
Unscrew the cap (4) of the rear brake fluid reservoir (B).
Siphon the brake fluid from the reservoir (B).
Fill the reservoir (B) with new brake fluid up to the **MAX** mark.



Operate the brake pedal two or three times to pressurize the circuit.
Hold the pedal pressed down.



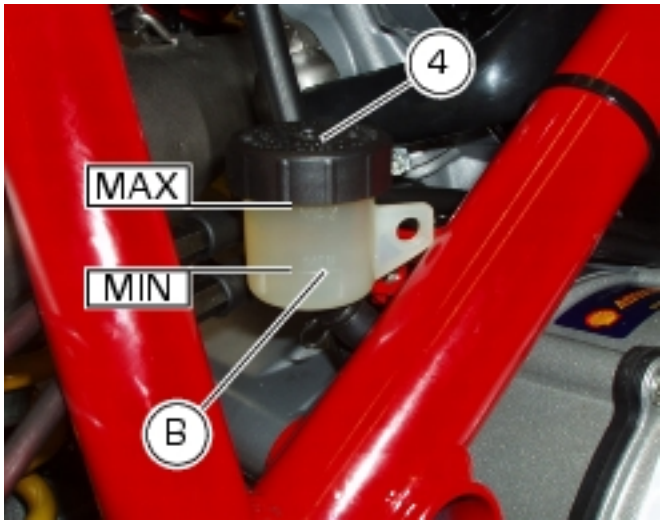
Attach a length of transparent plastic tubing to the bleed valve (5) and insert the other end of the tubing in a container placed on the floor.



Warning

While filling the system, always keep the fluid level above the **MIN** mark to prevent the formation of air bubbles in the circuit.

Allow the fluid to flow from the bleed valve (5) until it changes colour.
Tighten the bleed valve (5) and restore the correct fluid level in the reservoir.
Replace the cap (4), screwing it firmly on to the reservoir (B).

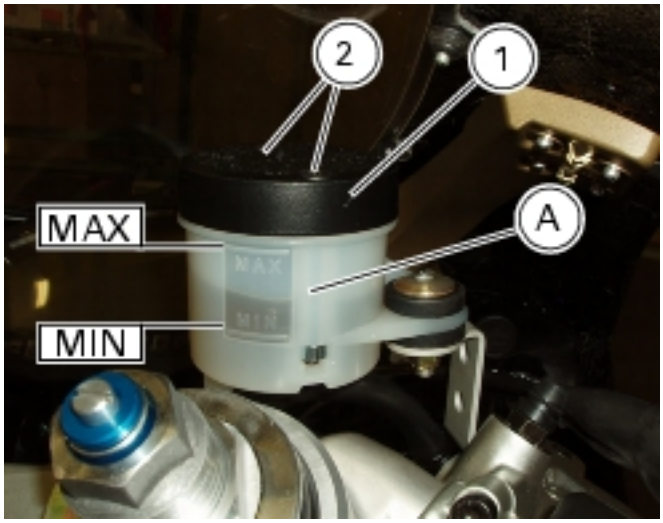


Draining the brake circuit

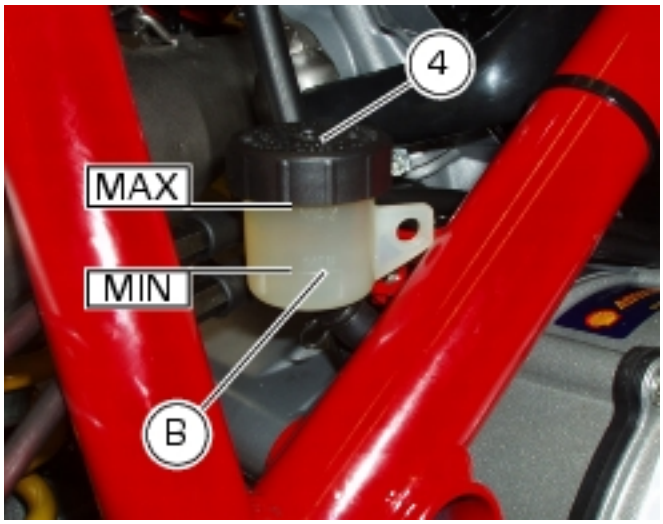
Warning

Brake fluid will damage painted surfaces if spilled on them. In addition, it is very harmful in contact with the skin or with the eyes; in the event of accidental contact wash the affected area with abundant running water.

Undo the screws (2) and remove the cap (1) and membrane from the front brake fluid reservoir (A).



Unscrew the cap (4) of the rear brake fluid reservoir (B).

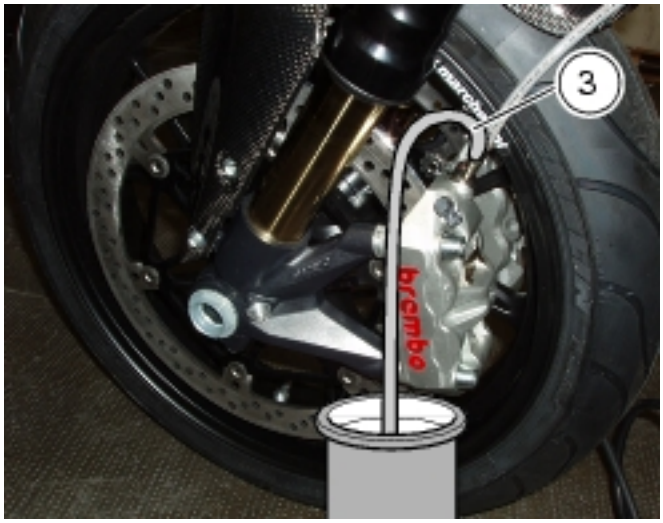


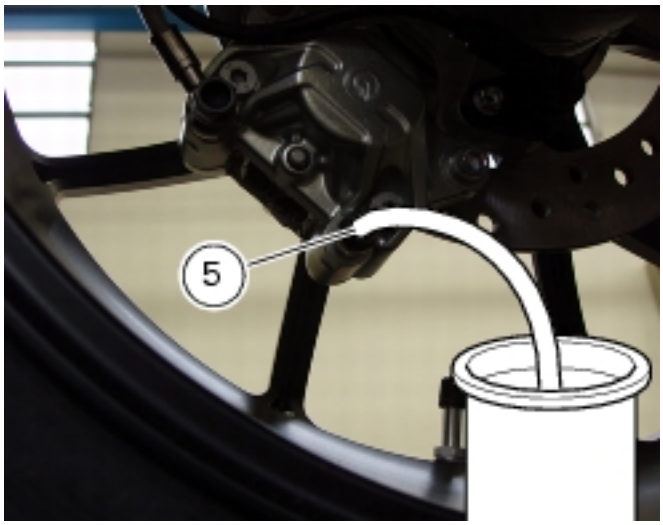
Connect a commercially available brake bleeder to the bleed valve (3) or (5).
Open the bleed valve (3) or (5) and pump with the bleeder until no more fluid emerges.

Notes

Follow the manufacturer's instructions when using a commercial brake bleeding tool.

If you do not have a bleeder available, attach a length of transparent plastic tubing to the bleed valve (3) or (5) and insert the other end of the tubing in a container of old brake fluid placed on the floor.





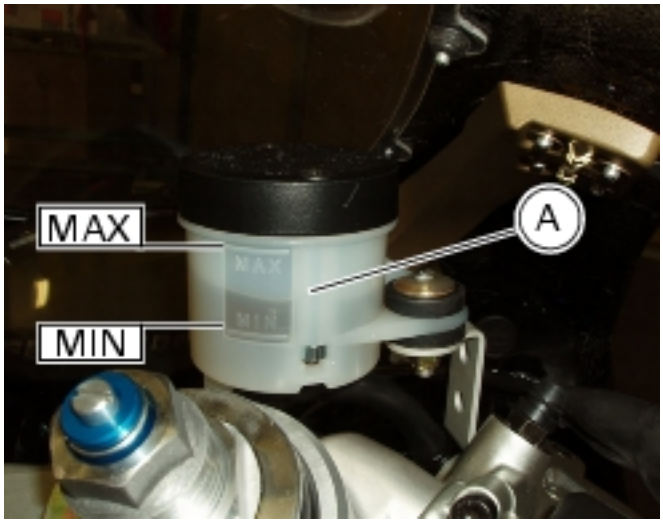
Unscrew the bleed valve by a **1 / 4** turn.
Operate the brake lever (or pedal) until all the fluid has drained out.
Repeat this operation for each brake caliper.

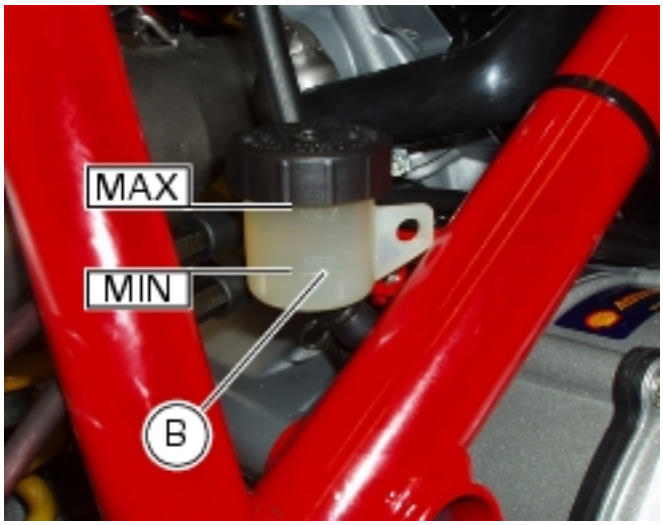
Filling the brake system with fluid

Warning

Brake fluid will damage painted surfaces if spilled on them. In addition, it is very harmful in contact with the skin or with the eyes; in the event of accidental contact wash the affected area with abundant running water.

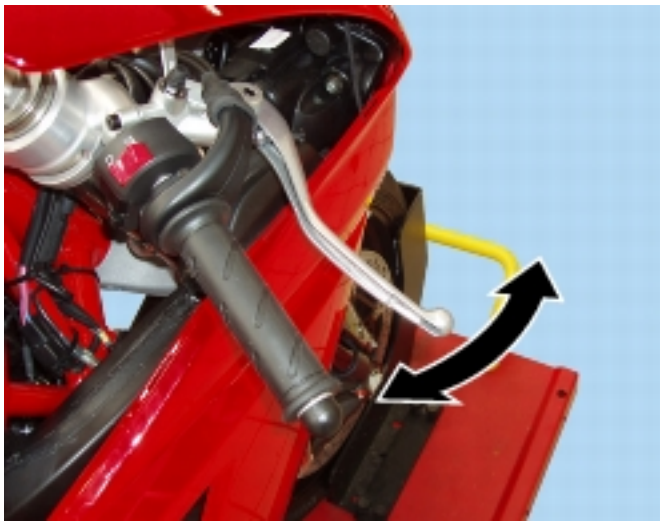
Fill the reservoir (A) or (B) with the recommended fluid taken from a previously unopened container.

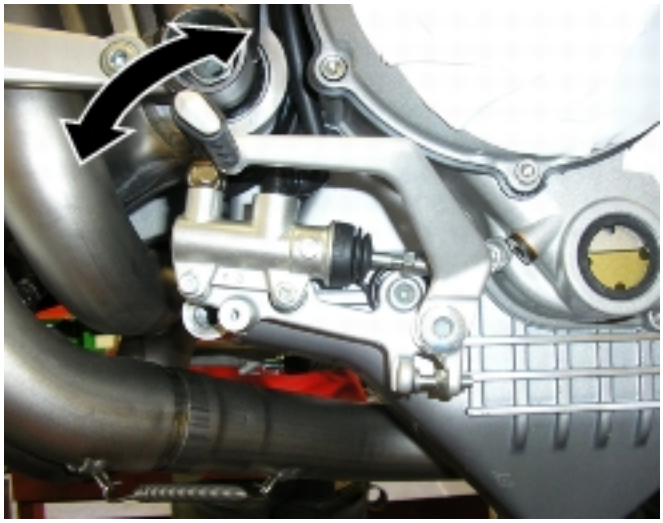




Important

During the following operation, the fluid level must remain topped up at all times. The end of the transparent plastic tubing must remain immersed in the discharged fluid at all times.
Operate the brake lever (or pedal) several times to allow the fluid to reach all points of the circuit and expel any air.



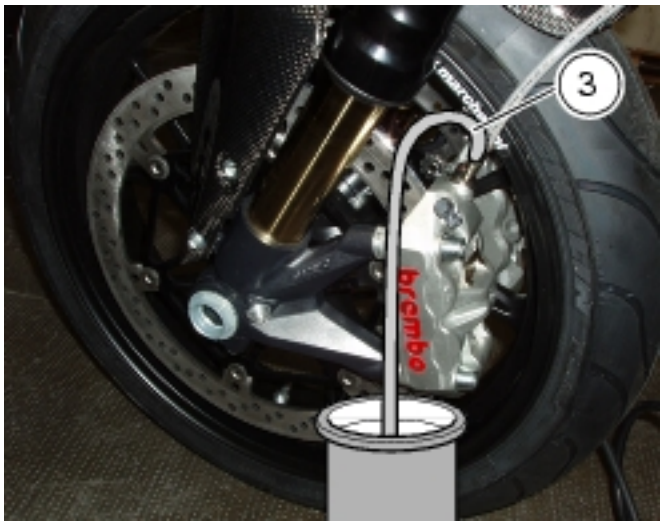


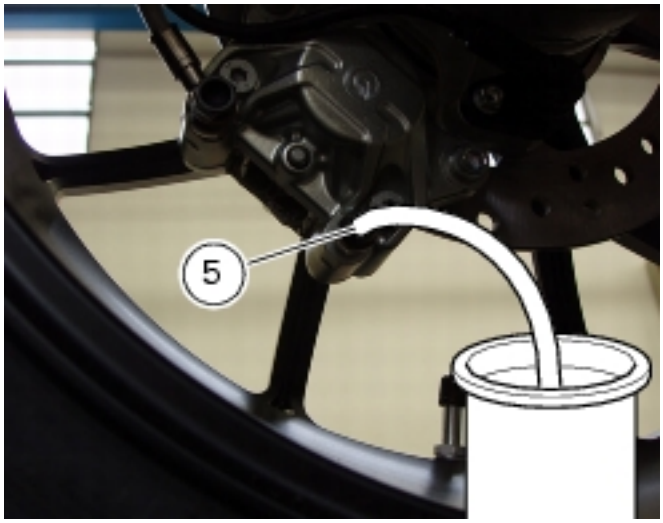
Connect the bleed tool to bleed valve (3) or (5).

Notes

Follow the manufacturer's instructions when using a commercial brake bleeding tool.

Open the bleed valve (3) or (5) and pump with the bleeder. Make sure that the reservoir level does not fall below the **MIN** mark.
Repeat the bleeding operation until the fluid flowing from the tube is completely free of air bubbles.
Tighten the bleed screw (3) or (5) to the specified torque (Sect. C 3, Frame torque settings).
If you do not have a brake bleeding tool available, connect a length of transparent plastic tubing to the bleed valve (3) or (5) as described in the draining procedure.

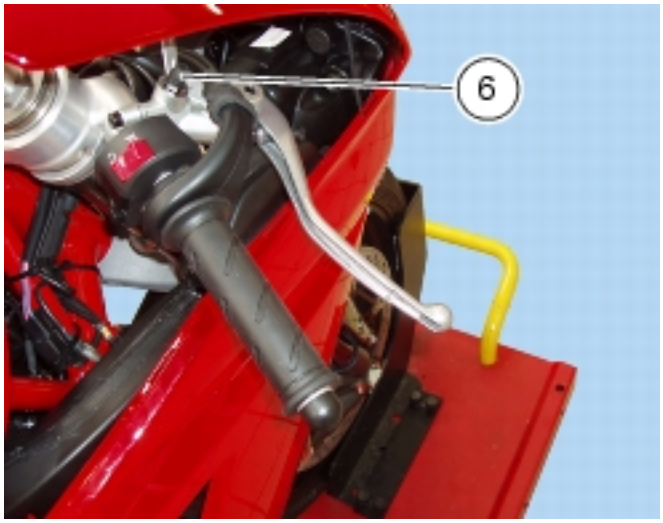




Open the bleed valve (3) or (5) by a **1 / 4** turn and operate the brake lever (or pedal) several times until the fluid starts coming out of the bleed valve. Pull the lever fully in and open the bleed valve by at least a **1 / 4** of a turn.
Wait a few seconds, then release the lever gradually while simultaneously closing the bleed valve (3) or (5).

Important
Do not release the brake lever (or pedal) until the bleed valve has been fully tightened.

Repeat the bleeding operation until the fluid emerging from the plastic tube is free of air bubbles.
Bleed air from the bleed valves one at a time.
Tighten the bleed valve (3) or (5) to the specified torque (Sect. C 3, Frame torque settings). Replace the dust cap.
To completely eliminate any air that might remain at the top of the front brake master cylinder, repeat the same procedure for the bleed valve (6).
Top the fluid up to the correct level and tighten the screws (2) on reservoir (A) and replace cap (4) on reservoir (B).

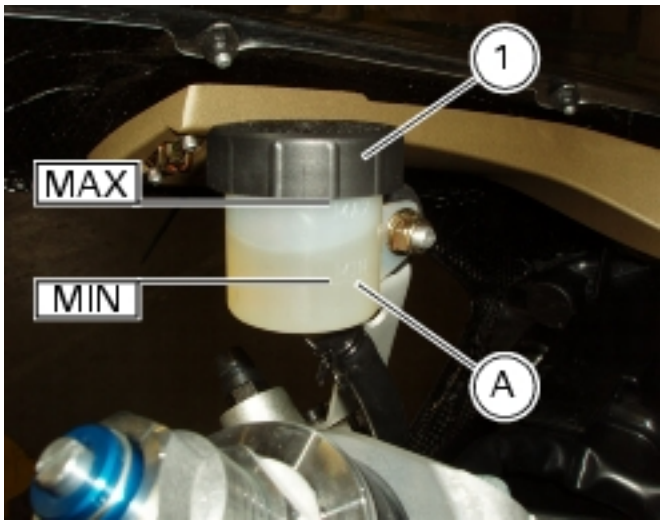


Changing the clutch fluid

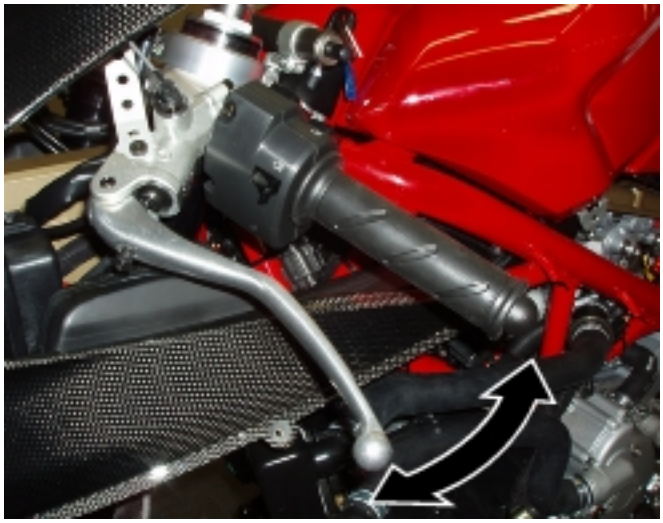
Warning

Clutch fluid will damage painted surfaces if spilled on them. In addition, it is very harmful in contact with the skin or with the eyes; in the event of accidental contact wash the affected area with abundant running water.

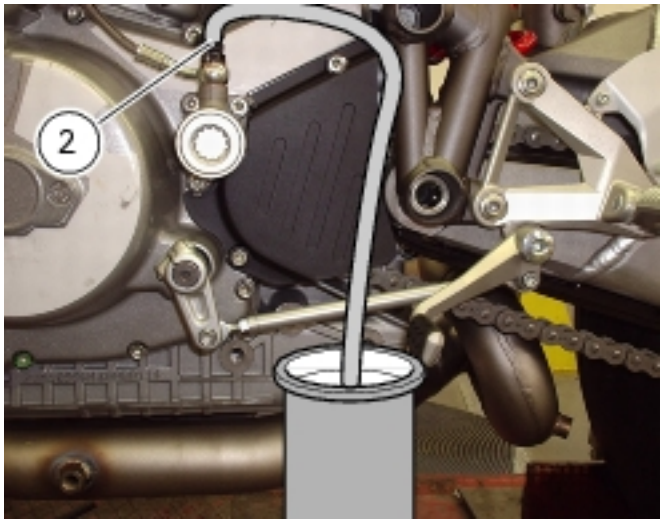
Remove the cap (1) and membrane from the clutch fluid reservoir (A).
Siphon the brake fluid from the reservoir (A).
Fill the reservoir (A) with new clutch fluid up to the **MAX** mark.



Operate the clutch lever two or three times until the circuit is pressurized.
Hold the lever pulled in towards the handgrip.



Attach a length of transparent plastic tubing to the bleed valve (2) and insert the other end of the tubing in a container placed on the floor.
Open the bleed valve (2) to allow fluid to escape.



Warning
During the filling operation, always keep the fluid level above the **MIN** mark to prevent the formation of air bubbles in the circuit.

Allow the fluid to flow from the bleed valve (2) until it changes colour. Tighten the bleed valve (2) to the specified torque (Sect. C 3, Frame torque settings) and top up the reservoir fluid level.

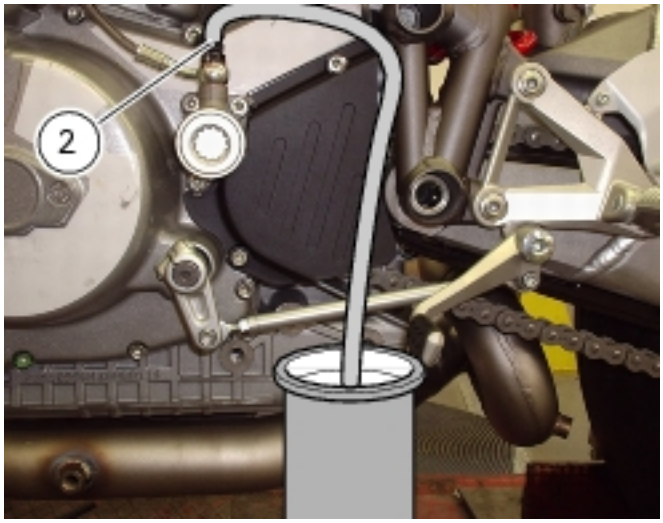
Draining the clutch hydraulic circuit

Warning
Clutch fluid will damage painted surfaces if spilled on them. It is also very harmful if it comes into contact with the skin or with the eyes; in the event of accidental contact, wash the affected area with abundant running water.

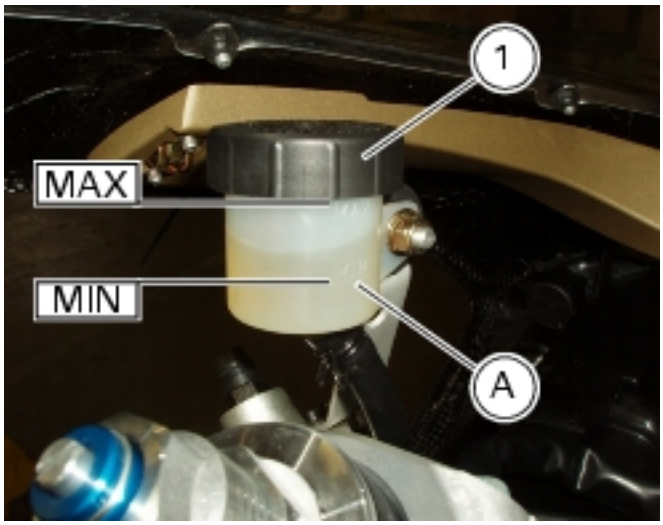
Remove the dust cap to expose the bleed valve (2).
Connect a clutch circuit bleeding tool to the clutch slave cylinder bleed valve (2).

Notes
Follow the manufacturer's instructions when using a commercial clutch bleeding tool.

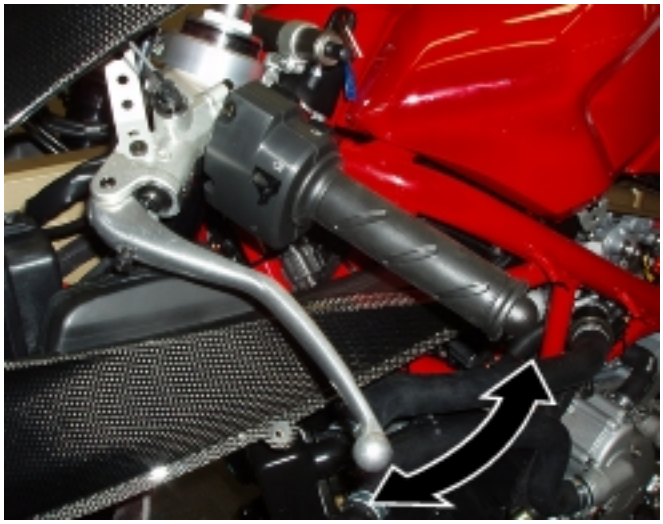
Open the bleed valve and pump with the bleeding tool until no more fluid emerges.
If you do not have a bleeding tool available, attach a length of transparent plastic tubing to the bleed valve (2) and insert the other end of the tubing in a container of old clutch fluid placed on the floor.



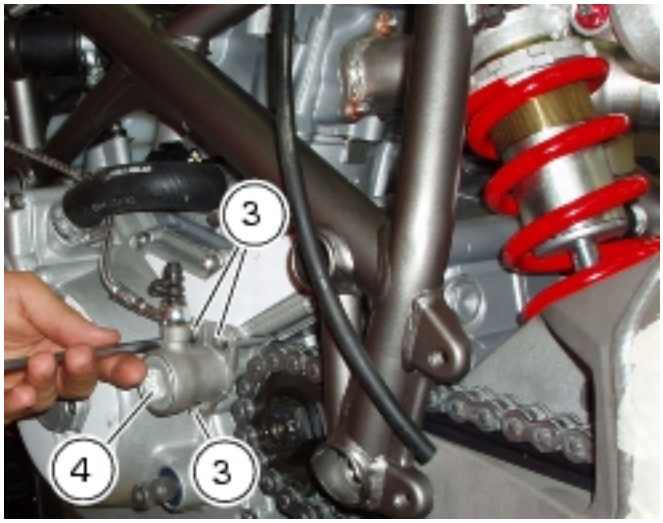
Unscrew the bleed valve by a **1 / 4** turn.
Remove the cap (1) and membrane from the clutch fluid reservoir (A).



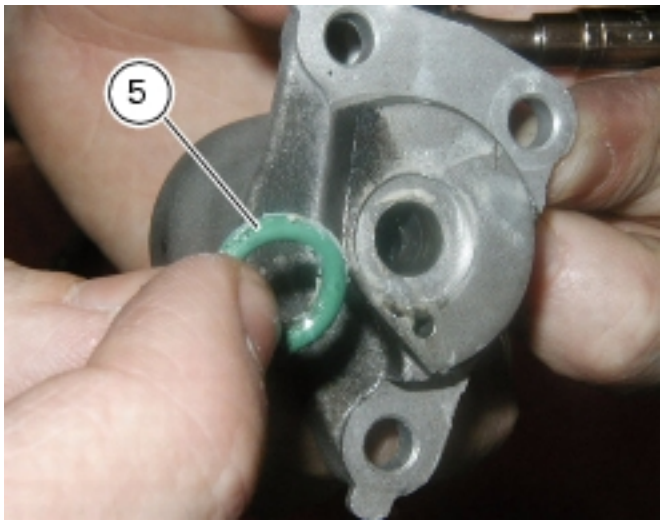
Operate the clutch lever until all the fluid has been expelled.



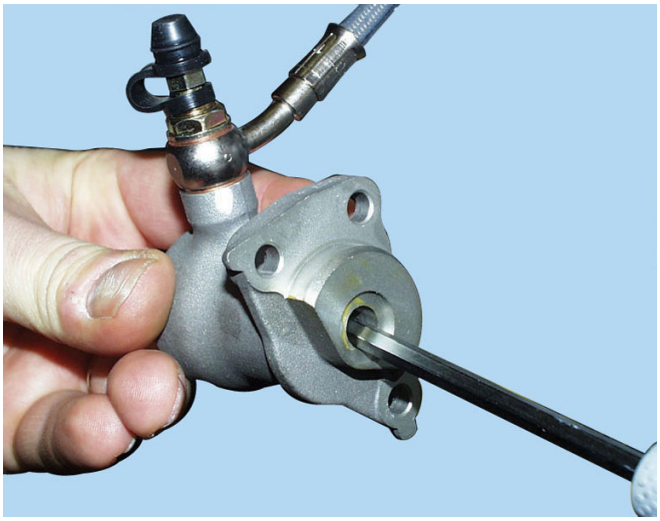
To help drain the circuit fully, unscrew the three retaining bolts (3) and remove the slave cylinder cap from the engine.



Remove the clutch slave cylinder (4) taking care not to damage the internal O-ring (5).



Push in the internal piston to force out all the fluid from inside the cap.



Refit the slave cylinder cap and tighten retaining screws (3) to the specified torque (Sect. C 3, Frame torque settings).
Tighten the bleed valve to the specified torque (Sect. C 3, Frame torque settings).

Filling the clutch circuit

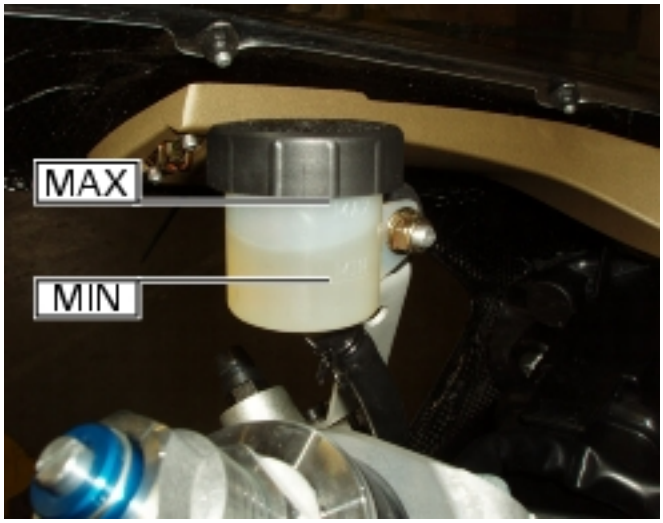
Warning

Clutch fluid will damage painted surfaces if spilled on them. It is also very harmful if it comes into contact with the skin or with the eyes; in the event of accidental contact, wash the affected area with abundant running water.

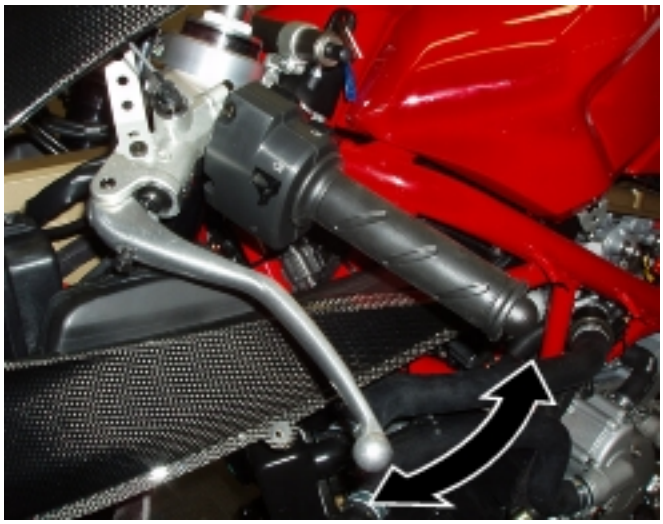
Fill the reservoir with the recommended fluid (Sect. C 2, Fuel, lubricants and other fluids) from a previously unopened container.

Important

During the following operation, the fluid level must remain topped up at all times. The end of the transparent plastic tubing must remain immersed in the discharged fluid at all times.



Operate the clutch lever and keep it pulled to fill the circuit and expel any air.



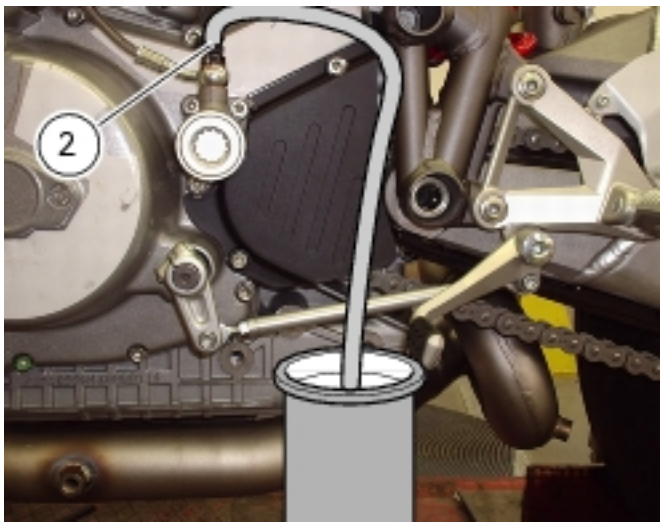
Connect the bleed tool to the bleed valve (2).

Notes

Follow the manufacturer's instructions when using a commercial clutch bleeding tool.

Open the bleed valve (2) and pump with the bleeding tool. Make sure that the reservoir level does not fall below the **MIN** mark.

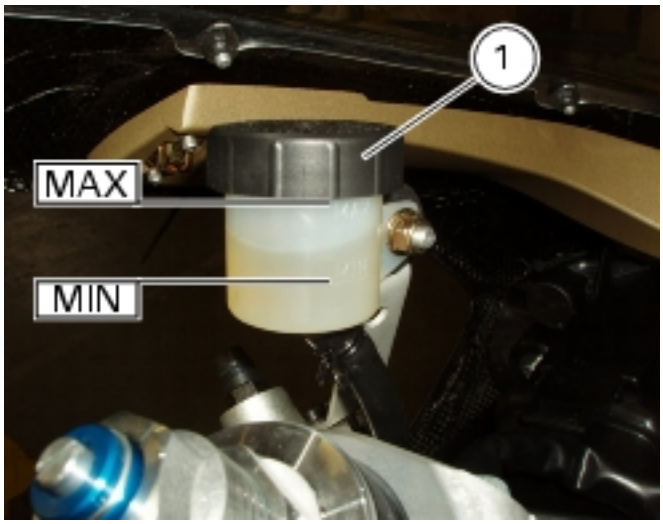
Repeat the bleeding operation until the fluid flowing from the tube is completely free of air bubbles.
If you do not have a bleeding tool available, connect a length of transparent plastic tubing to the bleed valve (2) as outlined in the draining procedure.



Open the bleed valve by a **1/4** turn and operate the clutch lever several times until the fluid starts to emerge from the bleed valve (2).
Pull the lever fully in and then slacken off the bleed valve by at least a **1/4** turn.
Wait for a few seconds, then release the lever gradually while simultaneously closing the bleed valve (2).

Important
Do not release the clutch lever until the bleed valve has been fully tightened.

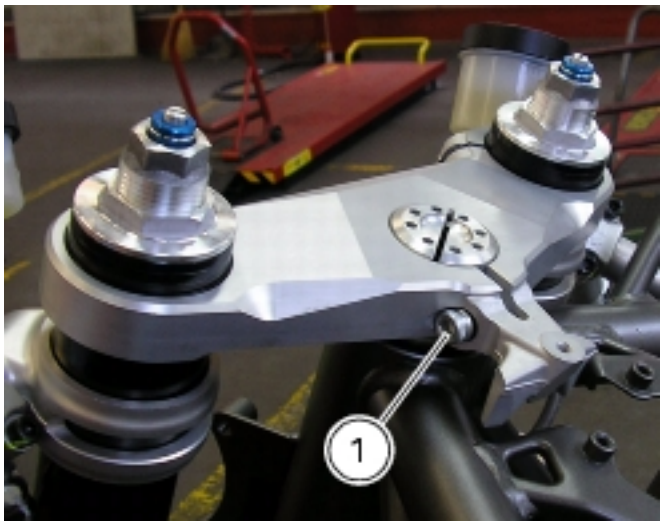
Repeat the bleeding operation until the fluid emerging from the plastic tube is free of air bubbles.
Tighten the bleed valve (2) to the specified torque (Sect. C 3, Frame torque settings) and replace the dust cap.
Top up the fluid level to approximately **3** mm above the **MIN** mark on the reservoir.
Replace the cap (1) with the membrane.



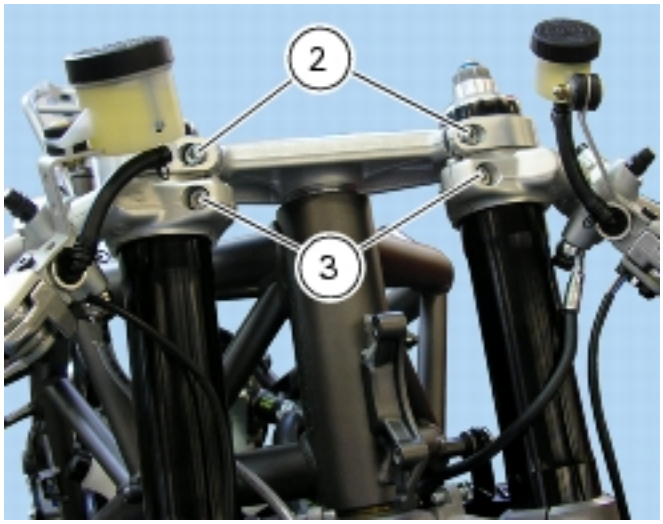
Adjusting the steering head bearings

Excessive handlebar play or the forks shaking in the steering head indicate that the play in the steering head bearings requires adjustment. Proceed as follows:

Loosen the clamp bolt (1) that holds the steering tube to the top yoke.

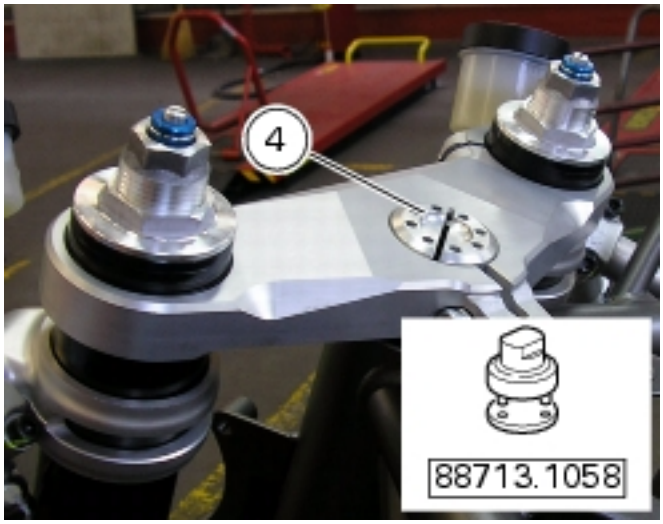


Loosen the clamp bolts (2) securing the top yoke to the fork legs and loosen the handlebar bolts (3).



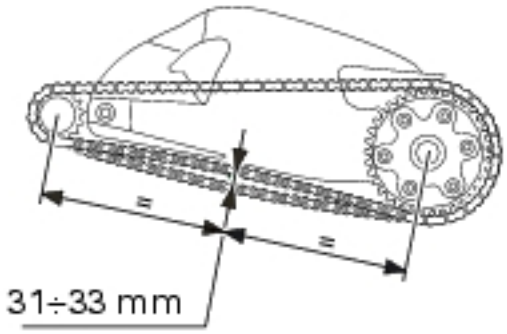
Using the special wrench **88713.1058**, tighten the adjuster nut (4) to the specified torque (Sect. C 3, Frame torque settings).

Push the steering head against the nut (4) and tighten the previously loosened bolts to the specified torque (Sect. C 3, Frame torque settings).

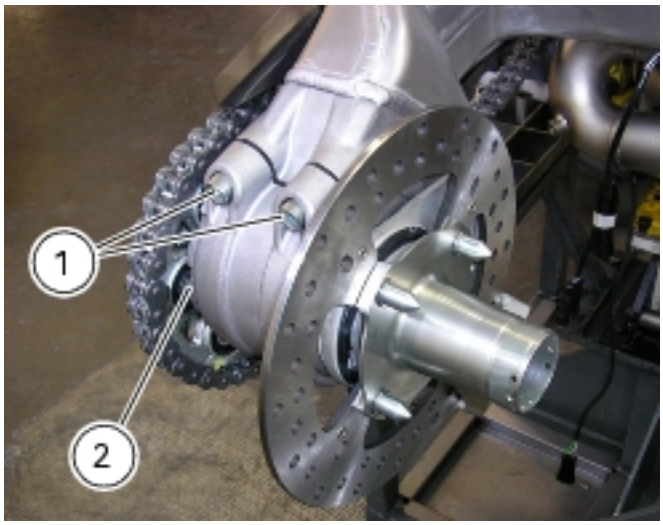


Adjusting the chain tension

Move the motorcycle slowly until you find the point at which the upper section of the chain is most taut.
Place the motorcycle on its sidestand.
Push the chain upwards with a finger in correspondence with the centre of the swingarm (see adhesive label).
The bottom run of the chain must be able to deflect **31** to **33** mm.

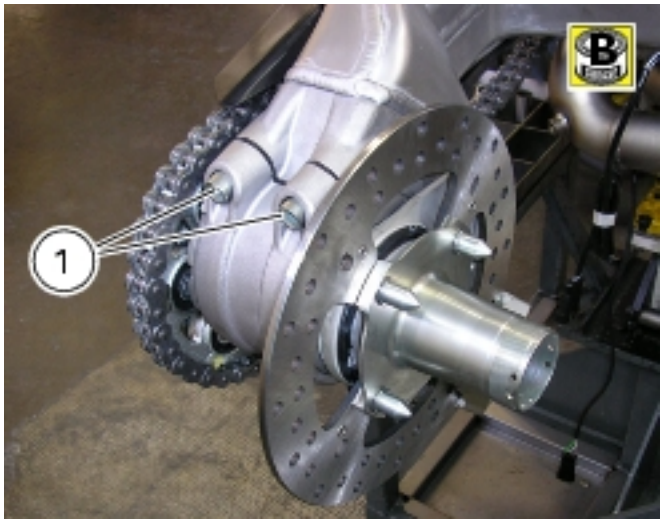


To adjust the tension, proceed as follows:
Slacken off the two clamp bolts (1) that secure the rear wheel hub to the swingarm.
Fit service tool no. **88713.1038** inserting its tooth in the eccentric hub (2).
Rotate the eccentric hub (2) to obtain the correct chain tension.
Rotate the hub anti-clockwise to tighten the chain or clockwise to slacken it (as viewed from chain side of the bike).



Important
An incorrectly tensioned chain will lead to accelerated wear of the transmission components.
If the clamp bolts (1) are removed, lubricate the threads and the underside of the head of each bolt, then tighten the bolts (1) to the specified torque in the sequence 1-2-1.

Warning
For the safety of the rider and passenger, it is essential that the eccentric hub clamp bolts are correctly tightened (Sect. C 3, Frame torque settings).



Checking brake pad wear and changing brake pads

Warning

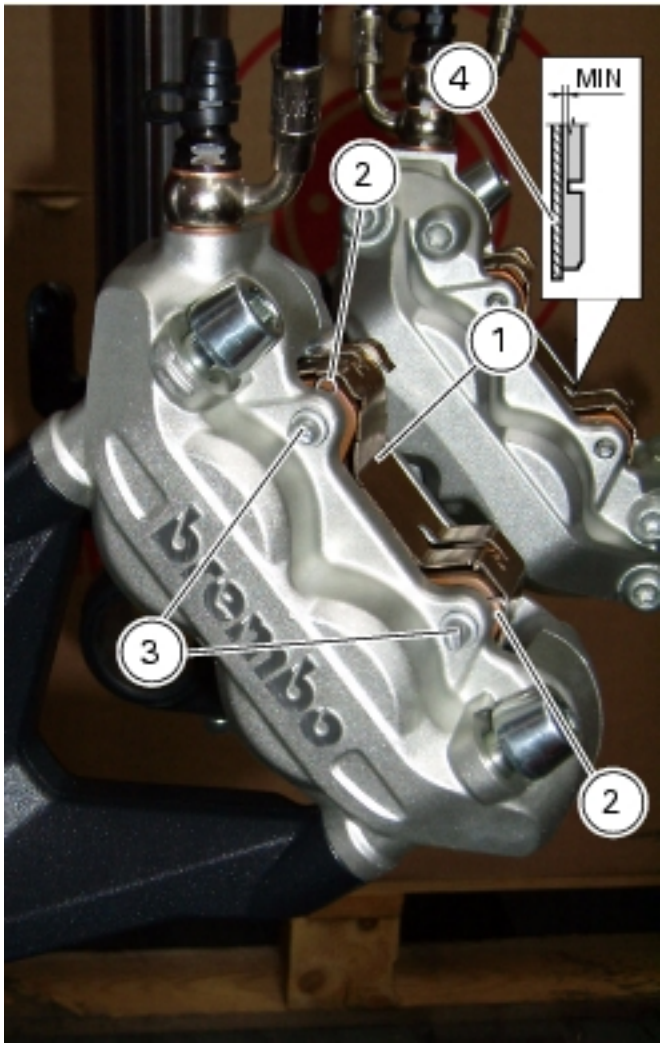
Brake fluid will damage painted surfaces if spilled on them. It can also be very harmful if it comes into contact with the skin or with the eyes; in the event of accidental contact, wash the affected area with abundant running water.

Important

On handing over the motorcycle after changing the brake pads, inform the customer that the front brake must be used gently for the first 100 km to allow the pads to bed in completely.

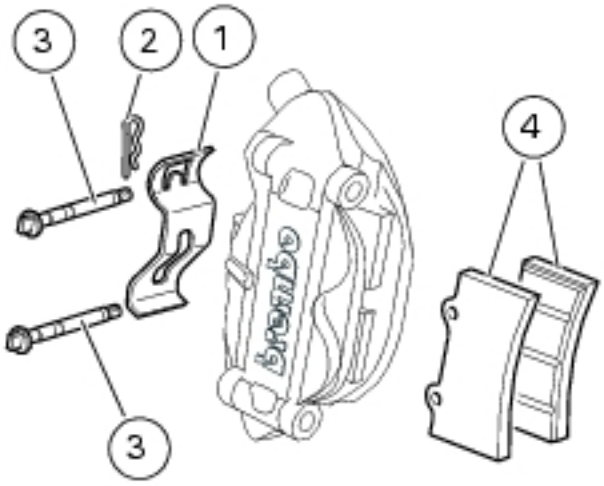
Checking front brake pad wear

Look through the slot in the caliper clip (1) to make sure the groove in the brake pad friction material (4) is still visible.



Important

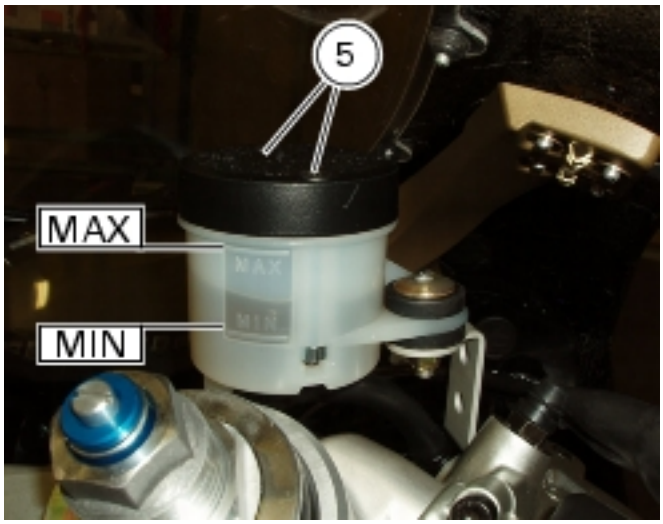
If either of the pads is worn, both pads must be renewed as a set.
Change the brake pads as follows.
Remove the cotter pin (2) from the pad retaining pins.
Withdraw the pad retaining pins (3) from the outside.
Remove the clip (1) from between the two caliper halves.
Force the caliper pistons back into their bores by forcing the old brake pads apart.
Withdraw the used pads (4) from the calipers.



Notes

Change pads that have a shiny or "vitrified" appearance.
Insert the new pads and clip (1).
Insert the retaining pins (3) from the exterior of the caliper and secure them with the cotter pins (2).

Operate the brake lever repeatedly so that the pads are firmly bedded in against the disc by the force of the brake fluid.
Check that the brake fluid level in the master cylinder reservoir is above the **MIN** mark. If necessary, top up as follows. Turn the handlebar so that the reservoir is level.
Unscrew the screws (5) and remove the reservoir cover.
Remove the inner membrane from the reservoir.
Top up to the MAX level with the specified brake fluid.
Refit all previously removed components.

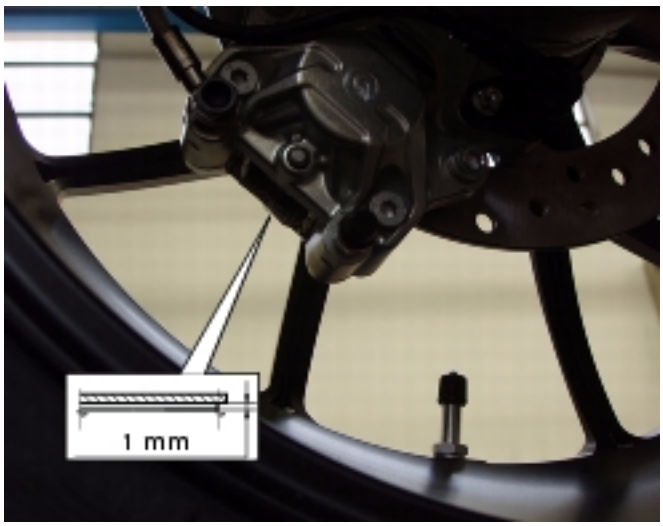


Checking rear brake pad wear

Check through the slot between the two caliper halves that there is at least **1** mm of friction material on the pads.

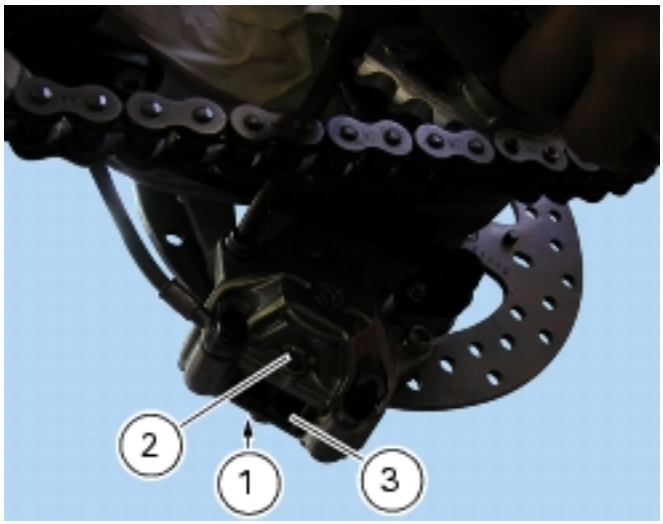
Important

If either of the pads is worn, both pads must be renewed as a set.

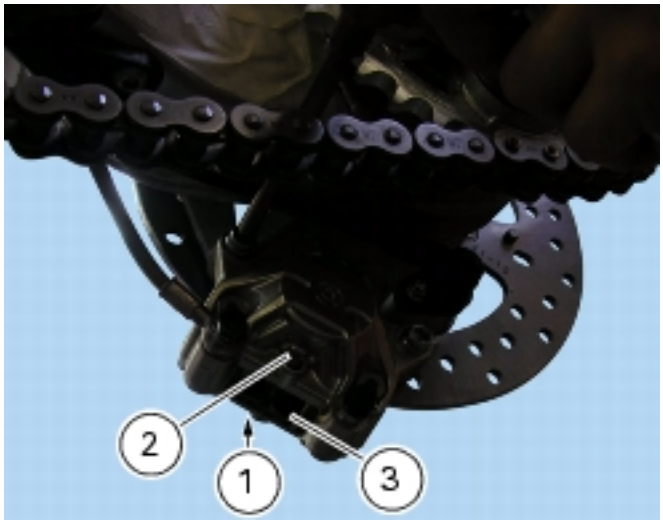


Change the brake pads as follows:
Remove the cotter pin (1) (on the inner side of the caliper) from the pad retaining pin.
Force the caliper pistons back into their bores by forcing the brake pads apart.
Withdraw the pad retaining pin (2) towards the outside.
Remove the clip (3) from between the two caliper halves.
Remove the worn pads.

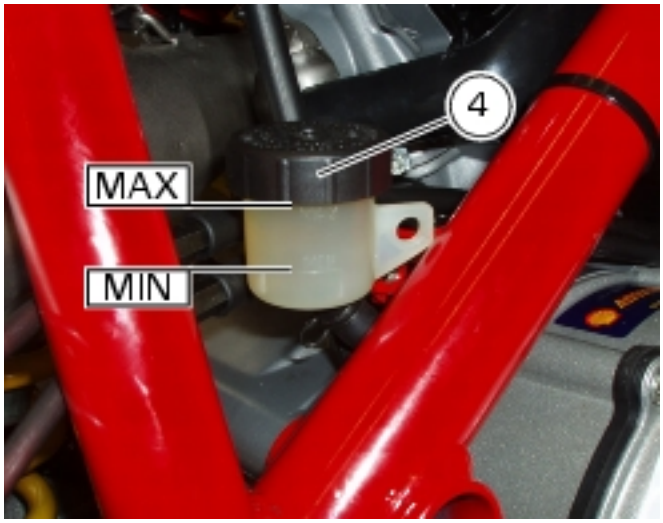
Notes
Change pads that have a shiny or "vitrified" appearance.



Insert the new pads and clip (3). Slide in the pad retaining pin (2) and secure it in position with the cotter pin (1).



Operate the brake pedal repeatedly so that the pads are bedded in against the disc by the force of the brake fluid.
Check that the brake fluid level in the master cylinder reservoir is between the **MIN** and **MAX** marks.
If not, unscrew the reservoir cover (4) and top up with the recommended brake fluid.



Notes

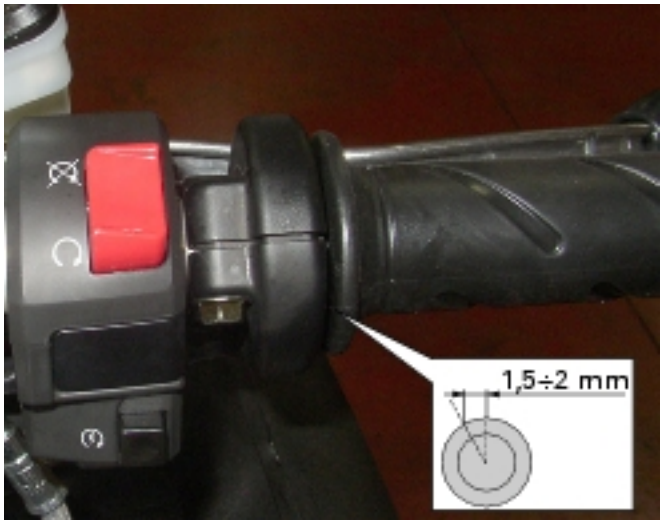
If it proves difficult to change the brake pads, first remove the caliper from the motorcycle (Sect. G 6, Removal of the rear brake caliper).

Warning

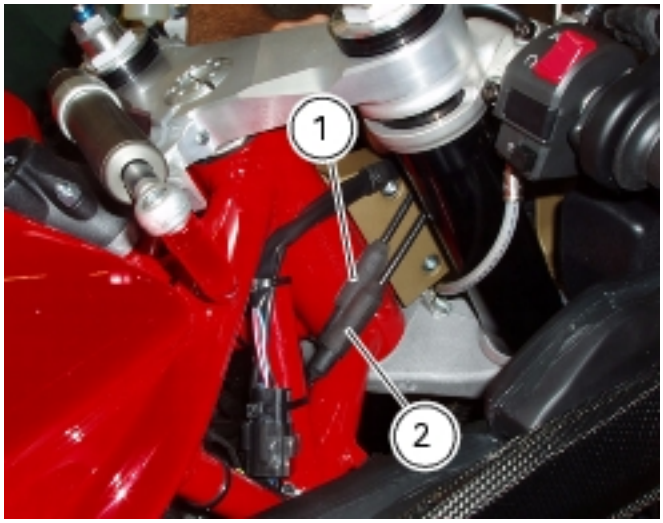
As the brake calipers are components of vital importance to the safety of the motorcycle, refer to the instructions in Sect. G 3, Hydraulic front brake, Sect. G 6, Hydraulic rear brake, and in particular, on reassembly, take care to tighten the caliper bolts to the specified torque (Sect. C 3, Frame torque settings).

Adjusting the throttle cable

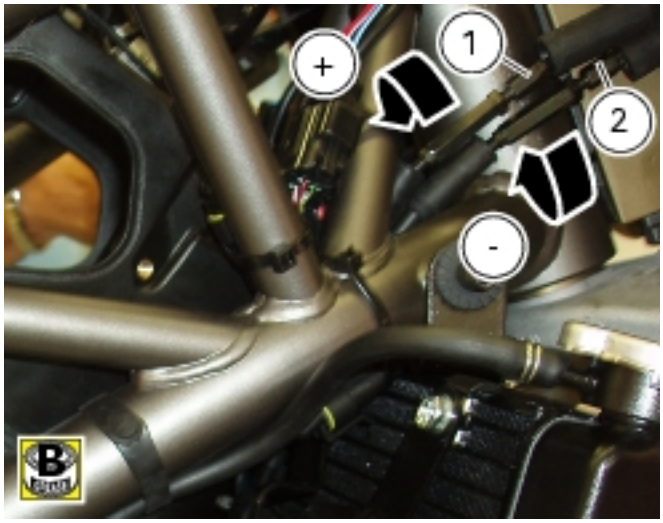
The throttle cable should have freeplay of **1.5** to **2.0** mm (measured in terms of rotation of the twistgrip) in all steering positions.



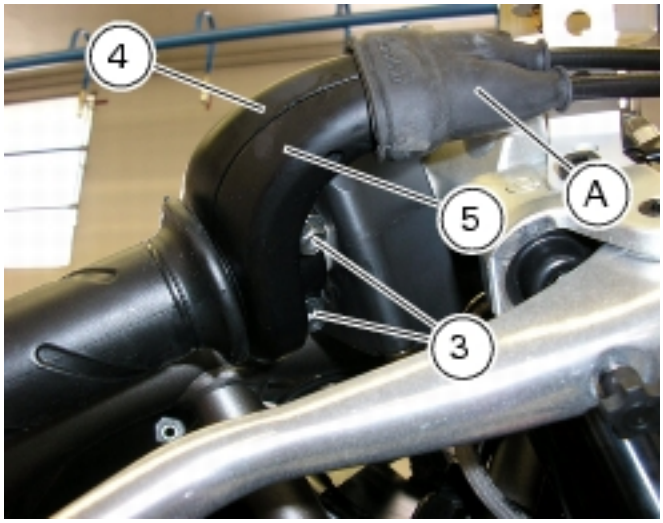
If necessary, adjust using the adjusters (1) and (2) located on the steering tube on the left side of the motorcycle.
Adjuster (1) adjusts the throttle opening control, while adjuster (2) adjusts the throttle closing control.



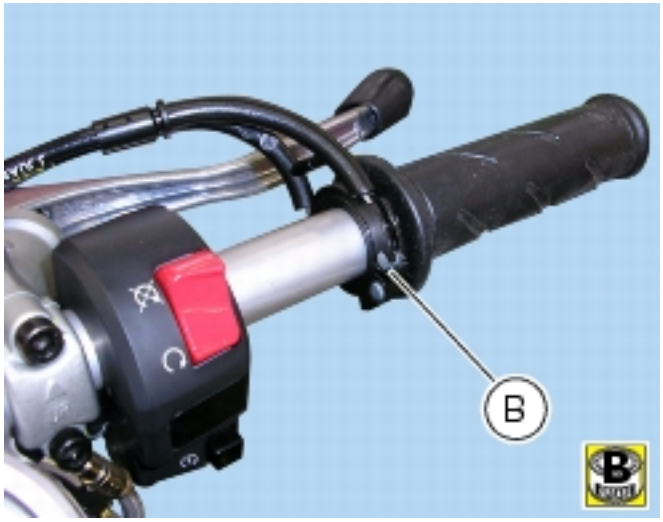
Peel back the sleeves to access the adjusters and slacken the locknuts.
Adjust both adjusters by the same amount: turn clockwise to increase free play and anti-clockwise to reduce free play. When finished, tighten the locknuts and replace the sleeves.
Periodically check the condition of the outer cables of the throttle opening (1) and closing cables (2). The plastic covering should show no signs of pinching or cracking.
Lubricate the ends of the inner cables with the prescribed grease periodically to ensure they run freely.



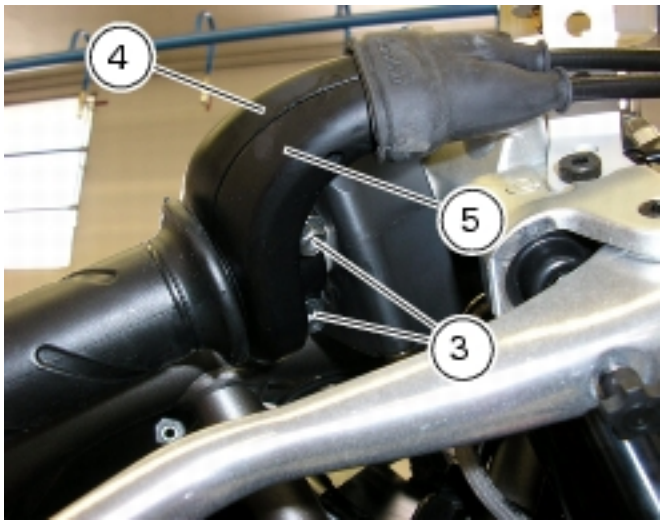
Operate the throttle to make sure the inner cable slides smoothly inside the outer cable. If you feel excessive resistance or stiffness, renew the cable.
To lubricate the throttle twistgrip, peel back the rubber sleeve (A), unscrew the screws (3) and remove the twistgrip housings (4) and (5).

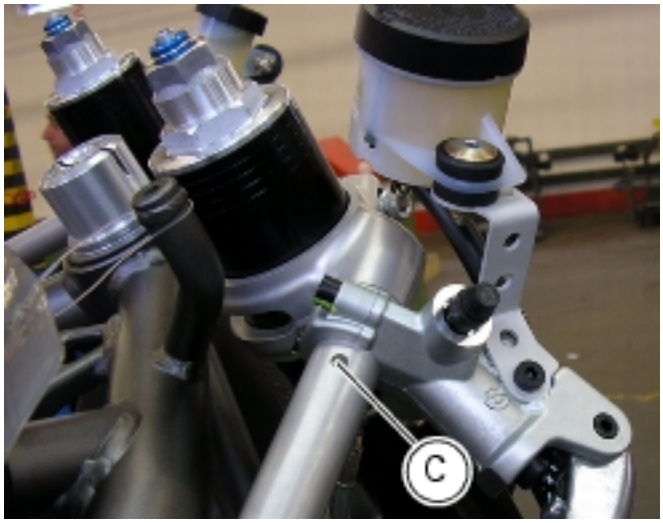


Lubricate the ends of the cable and the race (B) with the recommended grease.
When refitting the cover, make sure that the cables are correctly positioned in the race (B).



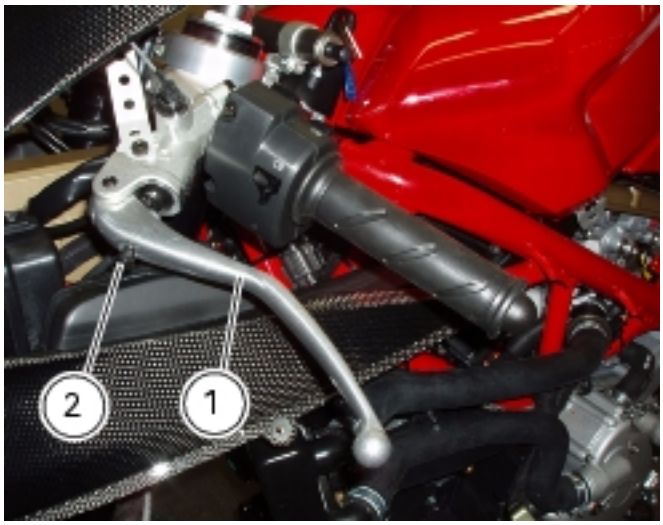
Locate the housings (4) and (5) in the handlebar hole (C).
Secure the housings (4) and (5) with screws (3) tightened to the specified torque (Sect. C 3, Frame torque settings).



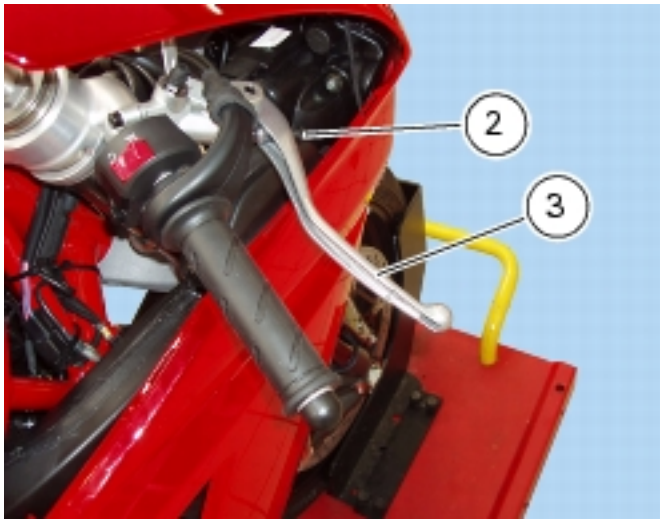


Adjusting the clutch lever and front brake lever

The lever (1) disengages the clutch. The span adjuster (2) serves to alter the distance of the lever from the handlebar.
The lever distance can be adjusted through 10 clicks of the knob (2). Turn the knob clockwise to move the lever away from twistgrip, or anti-clockwise to move it closer.



When the clutch lever (1) is operated, drive from the engine to the gearbox and the rear wheel is disengaged. Correct use of the clutch lever is very important in all riding situations, especially when moving off.
The position of the front brake lever (3) can be adjusted in the same way.



Warning

Any adjustment of clutch and brake levers must only be carried out when motorcycle is stationary.

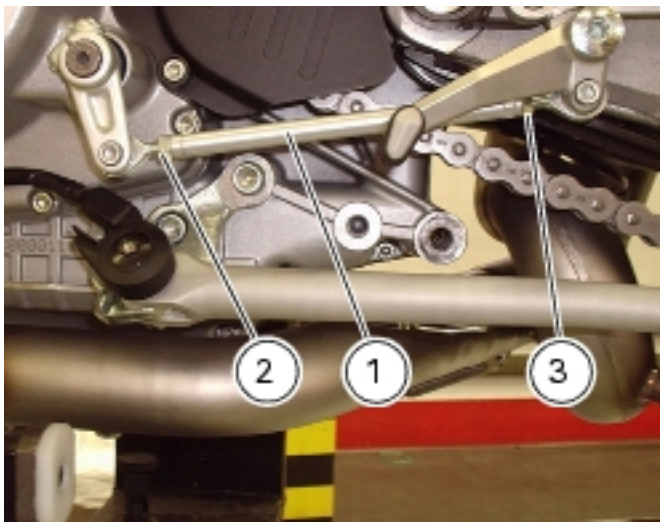
Adjusting the position of the gearchange and rear brake pedals

The position of the gearchange and rear brake pedals in relation to the footrests can be adjusted to suit the preferred riding position.
To adjust the position of the gearchange pedal, proceed as follows:
Restrain the tie-rod (1) and slacken the locknuts (2) and (3).

Notes

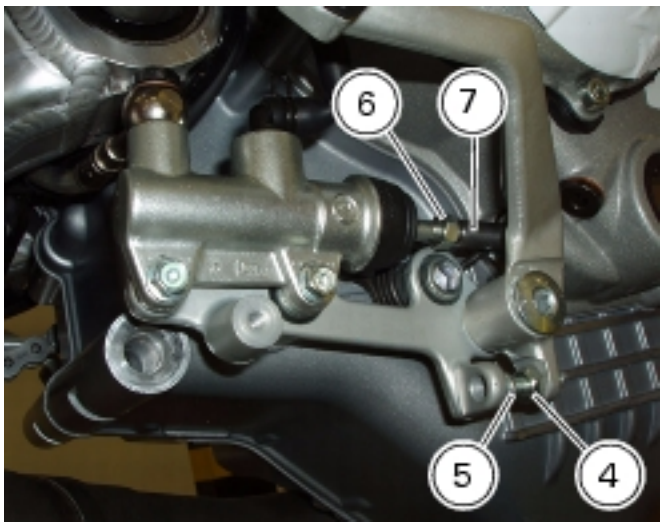
The locknut (2) has a left-hand thread.

Turn the tie-rod (1) using an open-ended wrench on the flats to move the gearchange pedal to the required position.
Tighten both lock nuts onto the rod.



To adjust the position of the rear brake pedal, proceed as follows.
Loosen the locknut (4).
Turn the pedal travel adjustment bolt (5) until the pedal is in the desired position.
Tighten the lock nuts (4) to the specified torque (Sect. C 3, Frame torque settings).

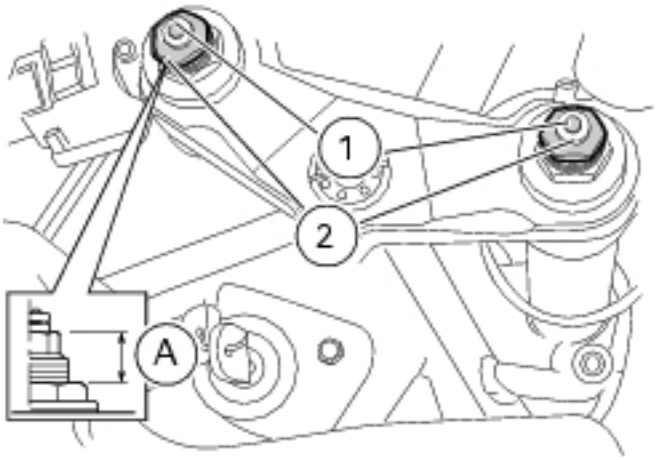
Operate the pedal by hand to make sure it has **1.5** to **2** mm of free play before the brake begins to bite.
If not, adjust the length of the master cylinder pushrod as follows.
Slacken off the locknut (7) on the pushrod.
Screw the rod into the clevis (6) to increase play, or unscrew it to reduce play.
Tighten the lock nut (7) to the specified torque (Sect. C 3, Frame torque settings) and re-check the free play.



Adjusting the front fork

The front fork can be adjusted for rebound, compression and spring preload.
The settings are adjusted by way of external adjuster screws:
1) to adjust rebound damping;
2) to adjust spring preload;
3) to adjust compression damping.

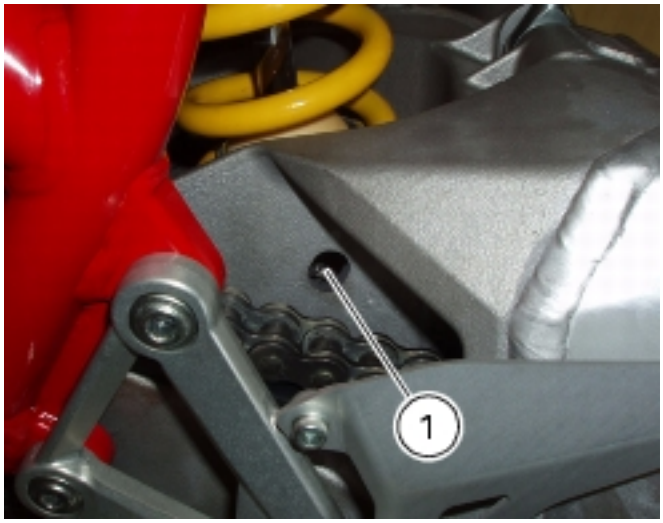
Place the motorcycle in an upright position and ensure that it is stable.
To adjust the rebound damping setting, turn the adjuster (1) on the top of each fork leg with a flat screwdriver.
Turn the adjuster (3) on the bottom of each fork leg with a flat-blade screwdriver to adjust the compression damping setting.
As you turn the adjusters (1) and (3), you will hear them click. Each click corresponds to different damping setting. The stiffest damping setting is obtained with the adjuster turned fully clockwise to the "0" position. Start with this position and turn counterclockwise. Count the clicks, which correspond to position 1, 2 and so forth.
To change the spring preload for each fork leg, turn the adjuster (2) with a 22 mm hex wrench.



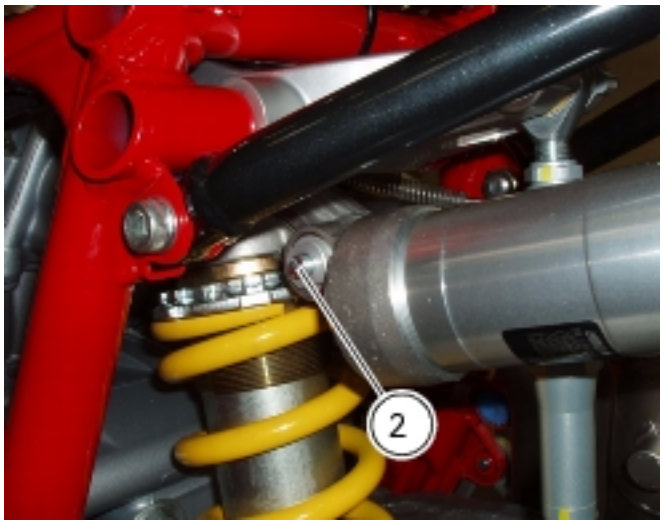
The STANDARD factory settings are as follows:
compression: 3/4 turn;
rebound: 12 clicks;
spring preload (A): 18 mm.

Adjusting the rear shock absorber

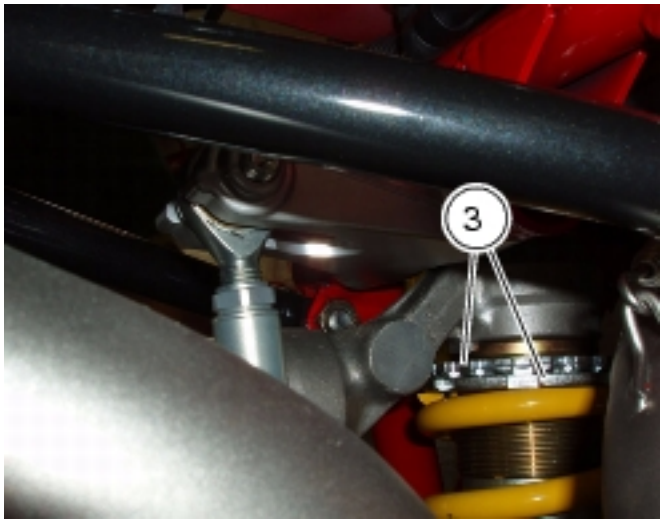
The shock absorber has external adjusters that enable you to adapt the rear suspension to suit the load conditions. Adjuster (1), located on the left-hand side at the point at which the shock absorber is fixed to the swingarm, controls rebound damping.



The adjuster (2) located on the rear shock absorber reservoir is used to adjust compression damping.
Turn the adjusters (1) and (2) clockwise to increase damping, or anti-clockwise to reduce damping.



STANDARD setting:
from the fully closed position (turned fully clockwise), unscrew:
rebound adjuster (1): 2 turns;
compression adjuster (2): 2 turns;
spring preload: 20 mm.
The two nuts (3) on the upper part of the shock absorber serve to adjust the preload on the outer spring. To adjust the spring preload, unscrew the upper adjuster nut using a pin wrench.
Screw the lower nut in or out to increase or reduce the preload.
Once the desired spring preload has been set, tighten down the upper ring nut.



Warning

To turn the preload adjuster ring nuts, use only a specific tool and take care, otherwise the wrench pins may suddenly slip out of the ring nut. This could injure your hands.
Never use a wrench with a too small pin or with a too short handle.

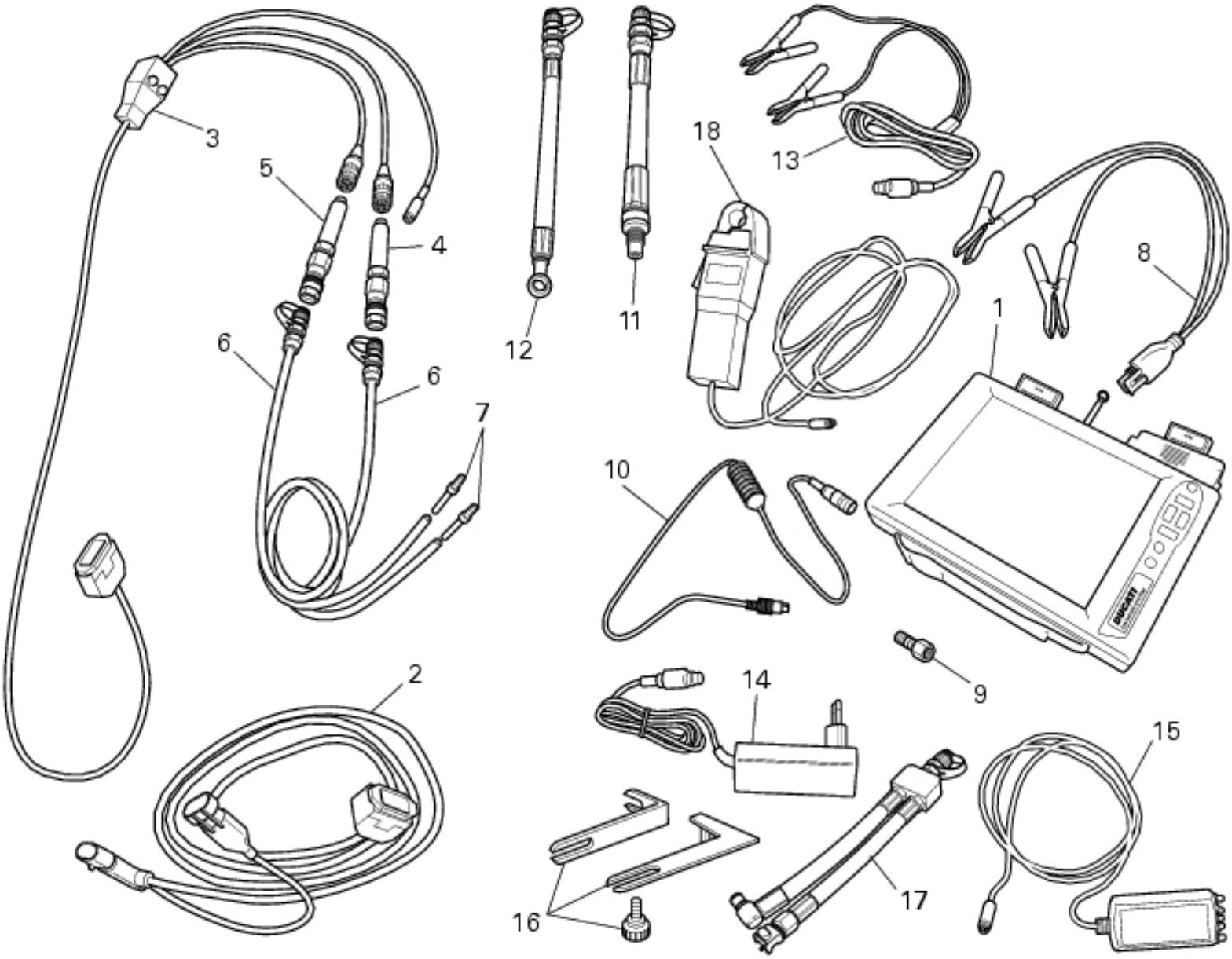
Warning

The shock absorber is filled with high-pressure gas and can cause injuries if inexpertly dismantled.

Important

If the motorcycle is to be ridden with a pillion rider and luggage, we recommend setting the rear shock absorber spring preload to the maximum to ensure the best handling and proper ground clearance at all times. It may also be necessary to adjust the rebound damping accordingly.

5 - Diagnostic instruments



1 97900.0211 Basic DDS (Ducati Diagnosis System)
2 97900.0227 Power and diagnostic cable D607
3 97900.0222 Power and diagnostic cable 1060838 (Measurement Module)
4 97900.0218 Vacuum sensor
5 552.1.039.1A Pressure sensor
6 97900.0220 Pressure/vacuum pipe
7 97900.0221 Pipe fitting
8 97900.0228 Battery socket adapter
9 814.1.114.1A Oil pressure connector
10 514.1.032.1A Auxiliary test cable
11 552.1.038.1A Cylinder compression cable with M10 connector
12 875.1.065.1A Oil pressure pipe
13 97900.0230 Mains power adapter
14 97900.0224 Mains power adapter
15 88765.1371 Belt tensioning sensor
16 88765.1374 Bracket for belt tensioning sensor
17 590.1.189.1A Fuel pressure test pipe
18 97900.0234 Ammeter clamp

Parts catalogue

DDS tester

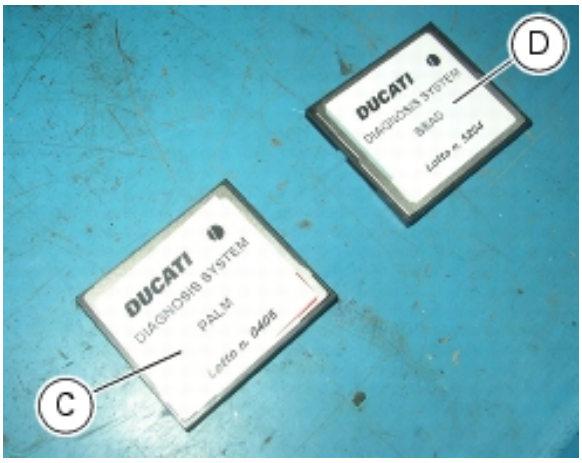
WORKSHOP SERVICE TOOLS

Important

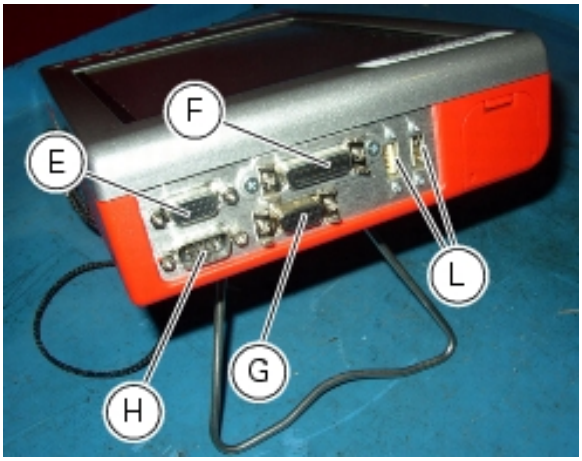
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Description of the Ducati Diagnostic System instrument

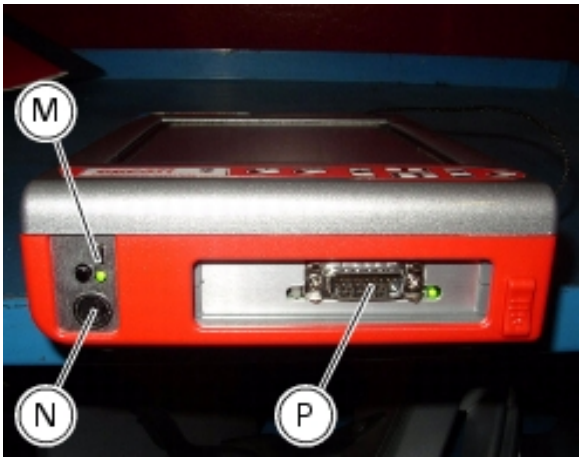
The Ducati Diagnostic System (DDS) is used for diagnosis of the injection-ignition system via a serial connection. The system is also equipped with functions to test various devices on the motorcycle. The DDS tester can be used to measure current and voltage on any electrical device, to perform tests on individual components and to measure pressure and temperature values.
The DDS tester (1) is comprised of a palmtop display unit (A), a BBAD self-diagnosis module (B), a display memory card (C) and a BBAD memory card (D).



The touch-screen display unit (A) serves for both data display and input, using the stylus housed on the side of the unit.
The self-diagnosis module (B) enables communication between the DDS tester (1) and the motorcycle's on-board electronic control unit (ECU).
The user interface software resides in the display memory card (C) which is housed in the palm-top display unit (A).
The software that enables communication with DUCATI ECUs resides in the BBAD memory card (D), which is housed in the BBAD self-diagnosis module (B).
The display unit is equipped with two connection panels: one at the top of the instrument and one at the bottom.
The top connection panel has 6 connection sockets with the following functions:
- one VGA output (E);
- one port for connection of the measurement module (F);
- one RS232 serial port for connection of peripheral devices (COM1) (G);
- a second RS232 serial port for connection of peripheral devices (COM2) (H);
- two generic USB ports (USB1 and USB2) (L).



The bottom connection panel has 3 connection sockets with the following functions:
- one USB port (M);
- one power connection socket (N);
- one diagnostics connection socket (P).



You can connect a printer to the DDS tester (1) to print test reports: connect the printer to the serial port (COM1) (G) located on the top connection panel of the tester (1).

Technical data

Power supply:
- from the mains - 220 V;
- from the motorcycle battery - 12 V.

Components supplied with the DDS tester

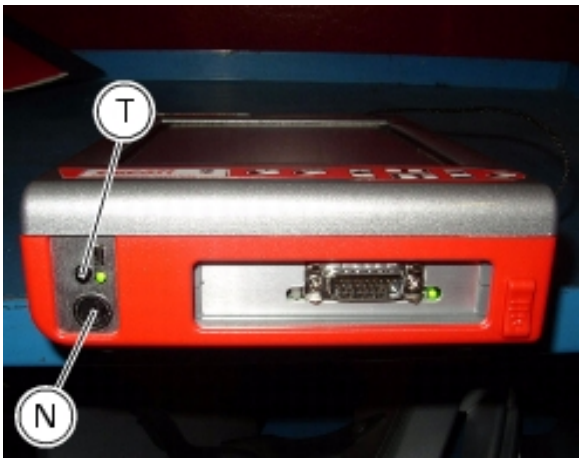
The DDS tester (1) is supplied in a kit together with the following items:
- Rechargeable DDS battery
- Battery charger
- Mains power adapter
- USB memory card reader
- Power and diagnostic cable complete with fuse
- CD containing DDS installation software for PC
- USB cable
- Belt tension sensor.

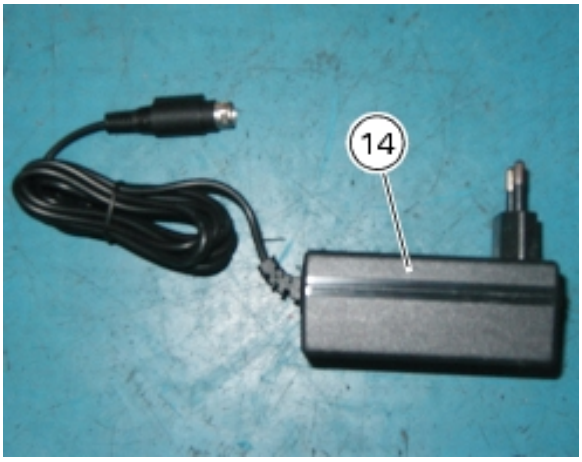
Tester power supply

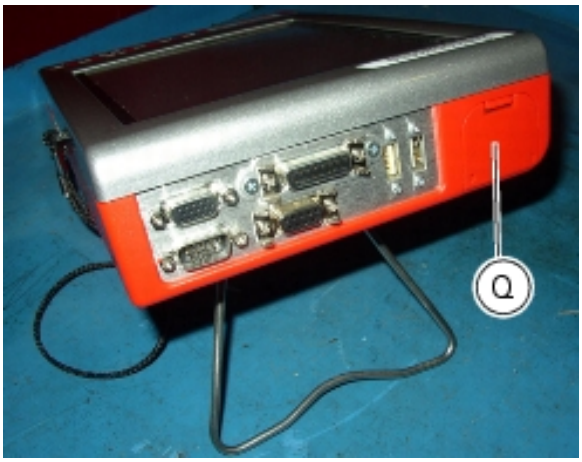
The DDS tester (1) may be powered in any one of the following ways:

- from the mains power supply by connecting the mains adapter (14) to the power connection socket (N);
- from the motorcycle by connecting the specific cables (see paragraph "Connection to motorcycle");
- from the tester's internal battery: the battery (Q) is housed in the top part of the tester. To operate the tester (1) using the internal battery and to recharge the battery, refer to the "User Manual" supplied with the DDS tester.

To switch on the display, press the button (T).

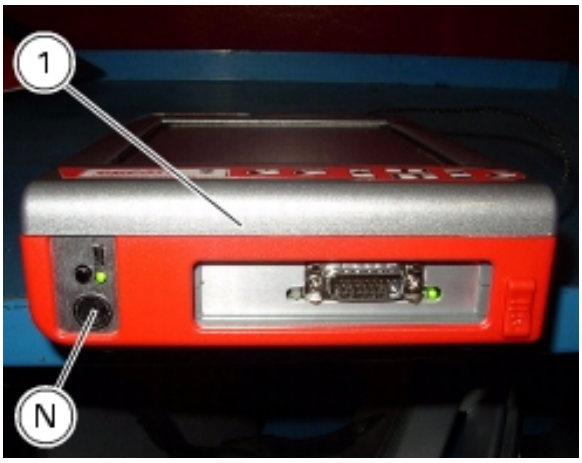




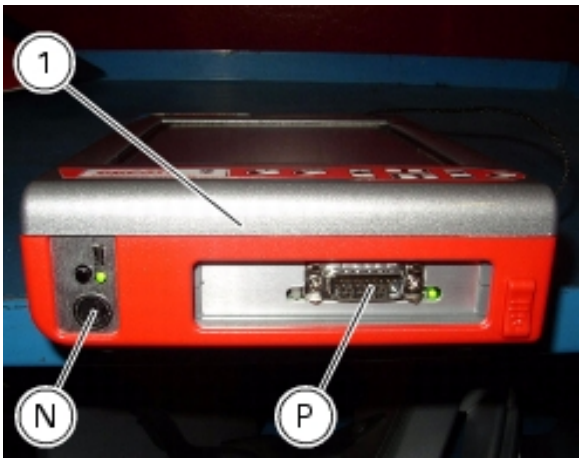


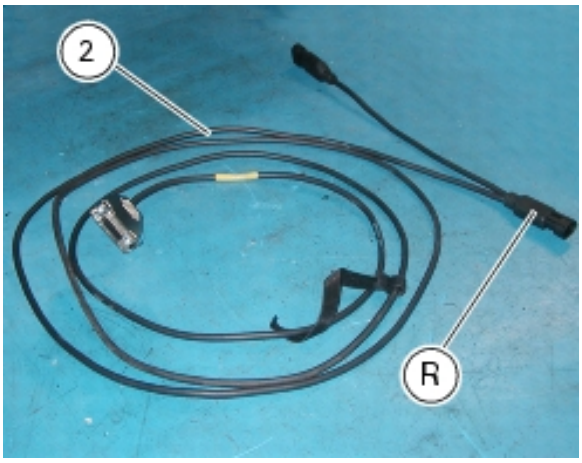
Connection to motorcycle

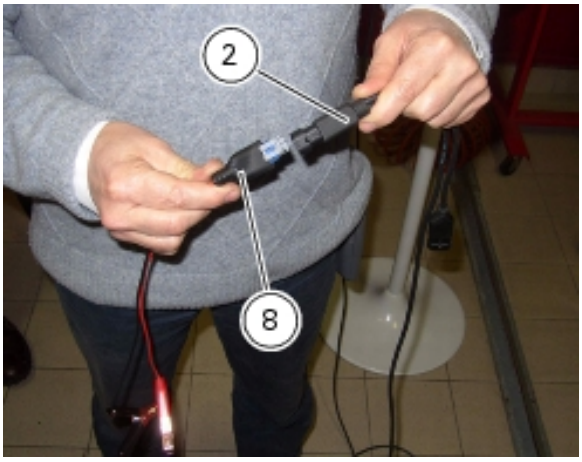
The tester requires a power supply of between **9** and **16** Volts DC.
When using the tester, take care never to allow the power supply to fall below the minimum voltage: this situation could occur during engine starting and idling on motorcycles in which the battery is not in perfect working order. If the tester detects a power supply voltage of less than **9** Volts, the current procedures will be aborted; when the voltage returns to within the acceptable tolerance limits the procedure must initiated again from the beginning.
The DDS tester (1) may be powered from the motorcycle in any one of the following ways:
- connect the battery power adapter (13) to the power connection socket (N) on the tester and to the motorcycle battery;



- connect the power and diagnostic cable (2) to the diagnostic connection socket (P) on the tester; then connect the battery socket adapter (8) to the connection socket (R) on the power and diagnostics cable (2) and to the motorcycle battery.







Notes

For connection of the various devices required for self-diagnostic procedures, consult the instruction handbook supplied with the tester.

DDS tester

The main functions of the DDS tester can be summarised as follows:

- retrieval of errors (faults) of the ignition - injection system stored in the engine control unit memory and their subsequent deletion, if required;
- reading of engine parameters (rpm, coolant and air temperature, atmospheric pressure, throttle opening, battery voltage, injection times and ignition advance, etc.);
- active diagnostics. Activation of ignition - injection system transducers to test functionality and control signals (fuel pump, ignition coils, rev counter, injectors, etc.). With this function it is also possible to enter the code to override the immobilizer;
- road test. Allows the technician to store engine parameters recorded within a previously specified engine speed range interval. The resulting parameters can then be analysed and displayed once they have been acquired;
- with specific sensors connected, the DDS tester can read electrical voltages, current, temperature, timing belt tension, and pressure values (lubrication and fuel supply circuits for example).

Checking and adjusting timing belt tension

Notes

The on-screen icons used during this procedure are explained in a table at the end of this section.

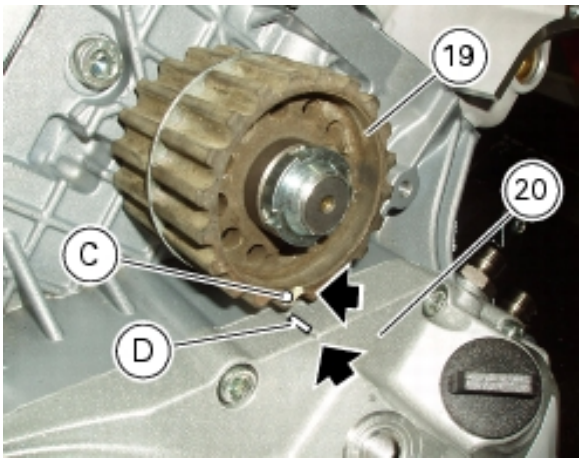
Notes

This operation, which is performed using the DDS tester, has the advantage that it can be carried out on both timing belts with the engine still installed on the frame. An optical reader is connected to the DDS. The optical reader has a

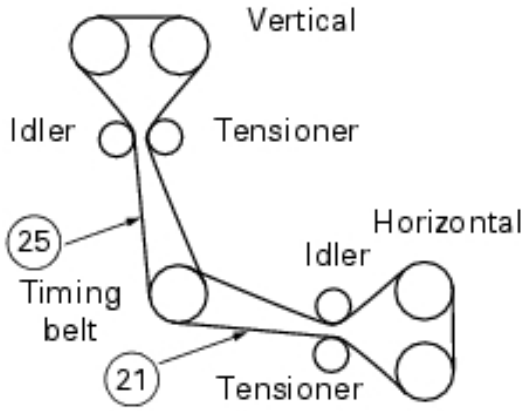
green LED that serves to determine that the reader is correctly positioned in front of the belt to be tested. It is also equipped with an infrared transmitter (A) and receiver (B) designed to detect oscillations of the belt when caused to vibrate with the flick of a finger.

Operation	Section reference
Remove the right-hand side fairing	E 2, Removal of the side fairings
Remove the timing belt covers	N 4.2, Removal of the timing belt covers

Remove the spark plugs.
Position the crankshaft so that the piston of the horizontal cylinder is at TDC of its power stroke.
This is achieved by aligning the timing mark (C) on the timing driveshaft pulley (19) with the reference notch (D) on the clutch cover (20).



Take the measurement on section (21) of the horizontal belt as described in the paragraph "Measuring timing belt tension".
Turn the crankshaft through 270° in the direction of rotation of the engine (so that the piston of the vertical cylinder is at TDC of the power stroke) and repeat the procedure used for the horizontal cylinder, measuring the tension on section (25) of the vertical cylinder timing belt.

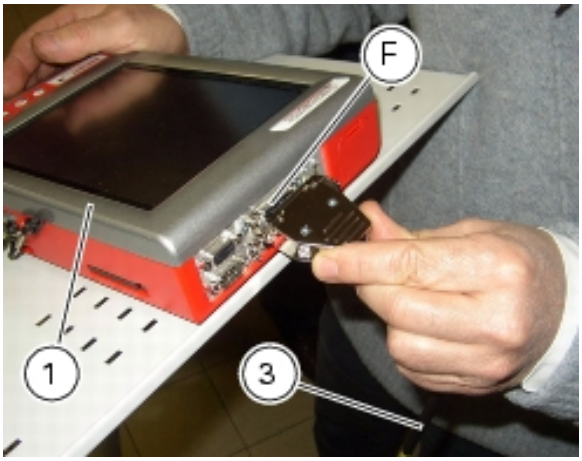


Remove the belt tension sensor and disconnect the DDS tester from the motorcycle.

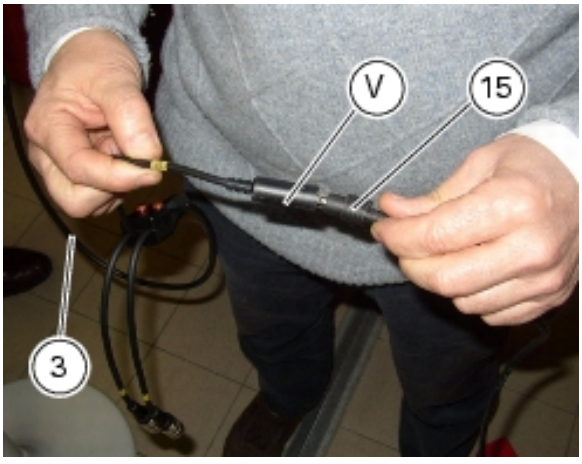
Operation	Section reference
Refit the timing belt covers	N 4.2, Refitting the timing belt covers
Refit the right-hand side fairing	E 2, Refitting the side fairings

Measuring timing belt tension

Switch on the DDS tester (1); see paragraph entitled "Tester power supply".
Connect the power and diagnostics cable (Measurement Module) (3) to the measurement module connector (F) on the DDS tester (1).

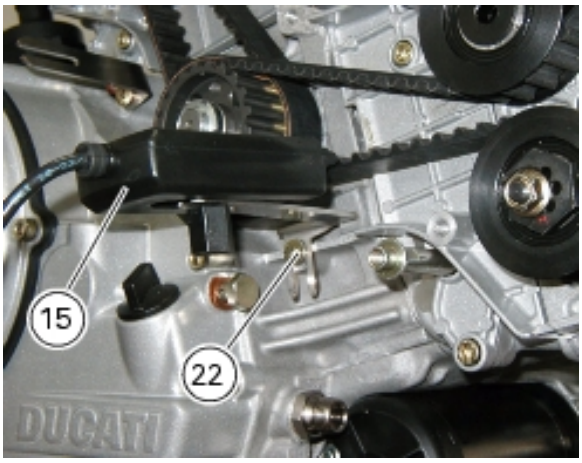


Connect the belt tension sensor (15) to the connector (V) of the power and diagnostics cable (Measurement Module) (3).

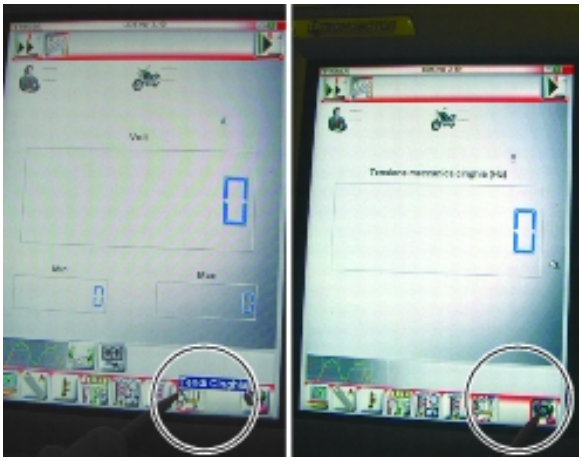


Fix the mounting bracket of the belt tension sensor (15) using the timing belt cover bolt (22).

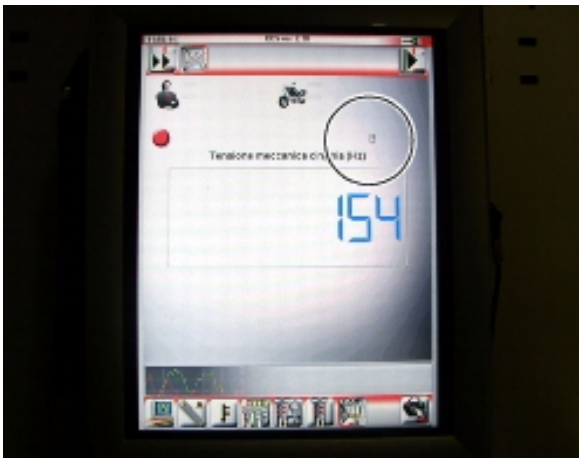
Aim the central green LED of the sensor (15) at the mid-point of the belt run, with the reader parallel to the belt and at a distance of about **1** to **1.5** cm from it.

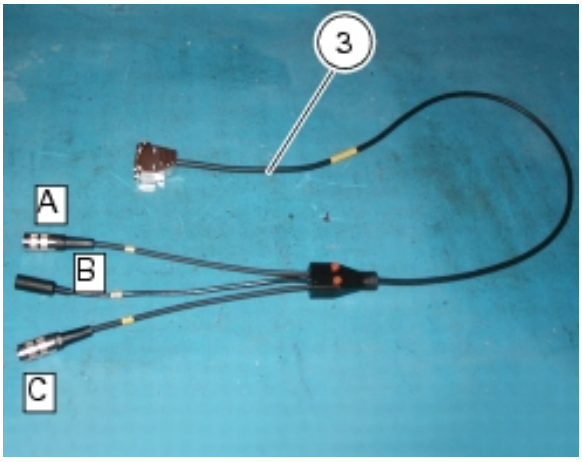


On the DDS tester (1), select the "Measurement module" function by pressing the corresponding icon; then press the "Belt Tension" icon followed by the "Start" icon to access the "Mechanical belt tension" screen.



The socket to which the cable (Measurement Module) (3) is to be connected is indicated on the screen with a capital letter: A, B or C.





Flick the belt lightly with your finger and read the frequency value (Hz) on the DDS tester.

Notes

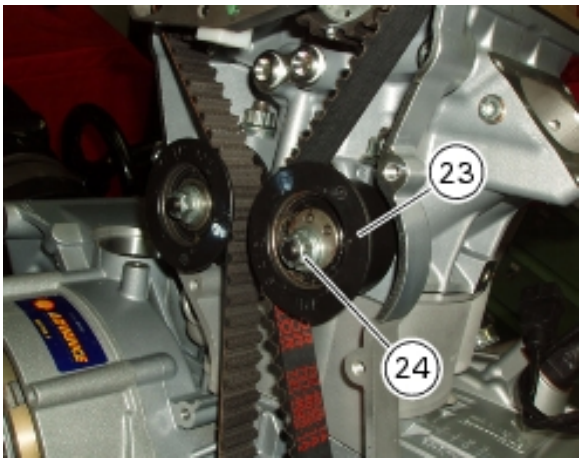
Do not flick the belt several times repeatedly, as the minimum time necessary for the DDS tester to take a reading is **1** second.

Correct tension values are as shown in Sect. C 1.1, Timing system/valves and must be checked with the engine cold: apply the installation values when fitting a new belt, and the reset values when belt tension reaches 70 Hz.

Warning

The timing belts can become slack during normal operation. When checking belt tension, if the reading is less than 70 Hz, restore to the specified reset values (Sect. C 1.1, Timing system/valves).

If the tension is incorrect, increase or reduce belt tension by loosening the nut (24) and moving the adjustable tensioner pulley (23).
Tighten the nut (24) securing the tensioner pulley.
Re-check the timing belt tension.
Repeat the above procedure until the correct belt tension is obtained.
Once finished, tighten the nut (24) of the tensioner pulley (23) to the specified torque (Sect. C 3, Engine torque settings).



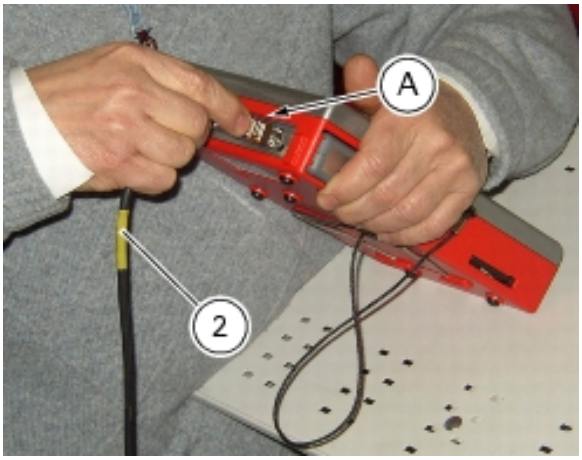
Resetting the throttle position sensor (TPS)

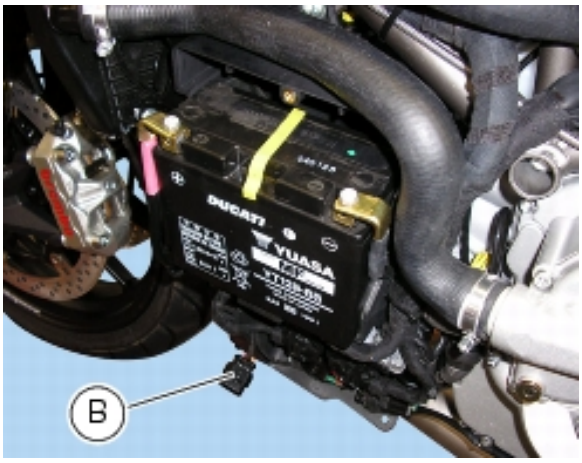
The linear throttle potentiometer has no facility for positioning adjustment: to ensure that the system functions correctly, proceed as follows:

Warning

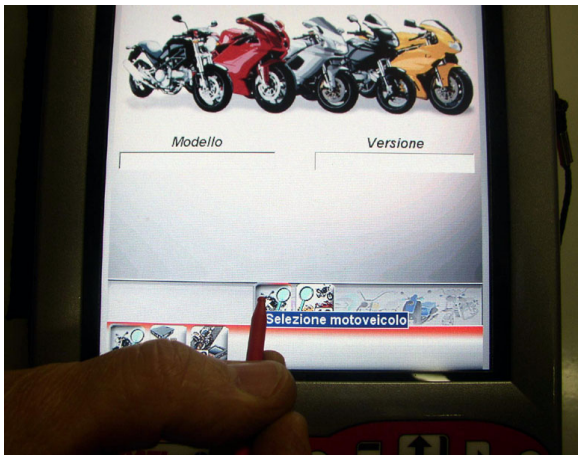
This procedure must precede the first start-up of the vehicle after replacement of the throttle body, the ECU or the wiring.

Make sure the butterfly valve is seated against the stop (throttle twistgrip fully closed).
In this position you can teach the ECU the angle of the position sensor. To do this, use the DDS tester and follow the procedure described below.
Lift the fuel tank (Sect. L 2, Removal of the fuel tank).
Switch on the DDS tester (1); see paragraph entitled "Tester power supply".
Connect the power and diagnostics cable (2) to the diagnostics connector (A) on the tester and to the diagnostics socket (B) on the motorcycle.



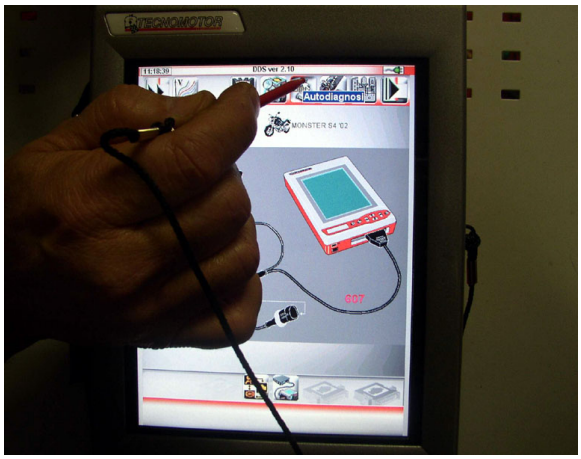


Enter the general functions menu by pressing the icon "Menu 1" (C).
Press the "Select vehicle" icon and, on the next screen, press the "Select motorcycle" icon; select the motorcycle model and confirm, then select the version and confirm.



Press the icon "Select system" to display a list of the bike's systems that can be analysed.

Select "Engine electronics" and press the "Confirm" icon (D). Next, press the "Self-diagnosis" icon to access the corresponding function.

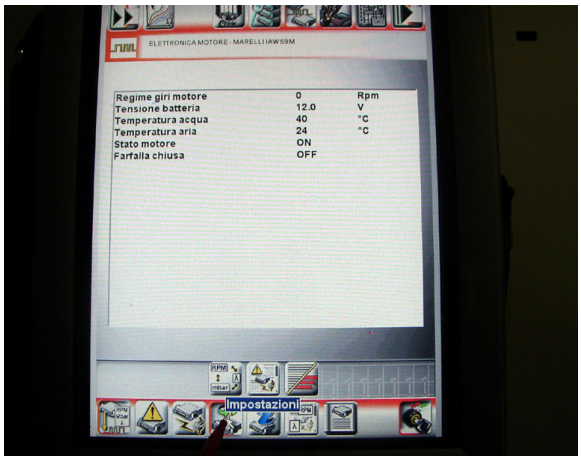


The DDS tester will interrogate the electronic control unit and display the parameters analysed with their relative values.

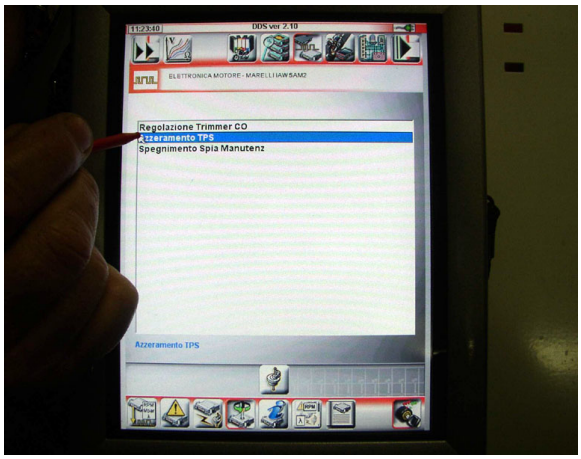
Notes

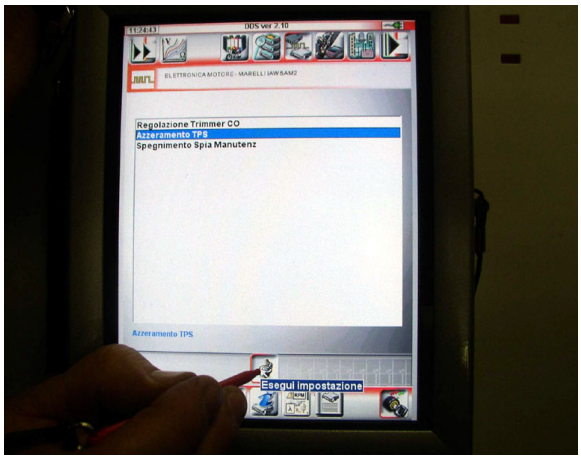
Make all connections with the motorcycle ignition key in the OFF position.

Press the "Settings" icon to display the special parameters.

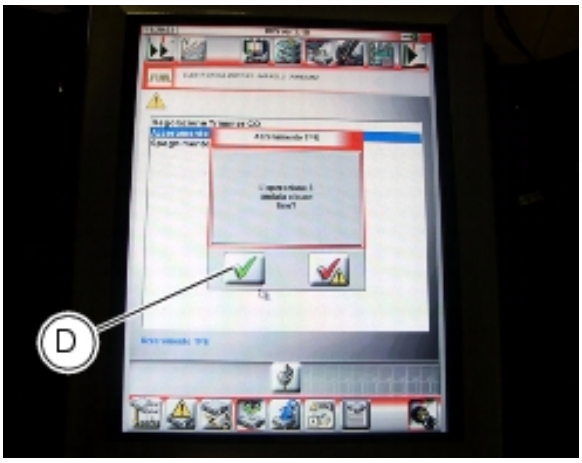


Select the option "Reset TPS" and then press the icon "Apply".





On completion of the operation, the message "Was the operation was completed successfully?" will appear; press "Confirm" (D).



If any problems were encountered during the operation, the tester will display the relative error messages: each message must be confirmed, (by pressing the "Confirm" icon (D)), or rejected (by pressing the "Exit" icon (E)).

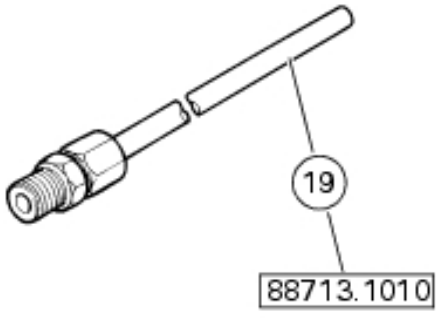
Once the reset has been performed, the ECU will be associated with the motorcycle's throttle body. Replacement of the throttle body, the ECU or the wiring must always be immediately followed by a new reset procedure.

Adjusting the idle speed

Notes

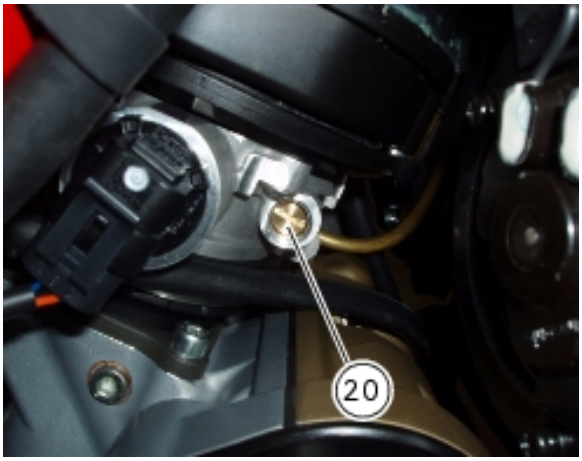
a Check that the motorcycle is fitted with a genuine Ducati ECU, intake system and exhaust system; if not, fit genuine components.
b This adjustment should be carried out in an ambient temperature greater than 16 °C.

Connect the inserts of the exhaust gas analyser code **88713.1010** to the outlets on the exhaust pipes using the fittings (19).



Make sure that the butterfly valve race is seated against the stop screw when the throttle twistgrip is fully closed.

Make sure that the throttle cable freeplay is correctly adjusted.
Reset the TPS to zero as described in the paragraph "Resetting the throttle position sensor (TPS)" in this section.
Screw in fully both bypass screws (20) and (21) and then screw them out by 3/4 of a turn.
Check:
- that the throttle angle value read by the DDS tester with the engine switched off is 2.6° ± 0.1°; if not, repeat the procedure "Resetting the throttle position sensor (TPS)";
- that the engine idling state is recognised, i.e. that the "butterfly valve closed" parameter on the DDS is ON.

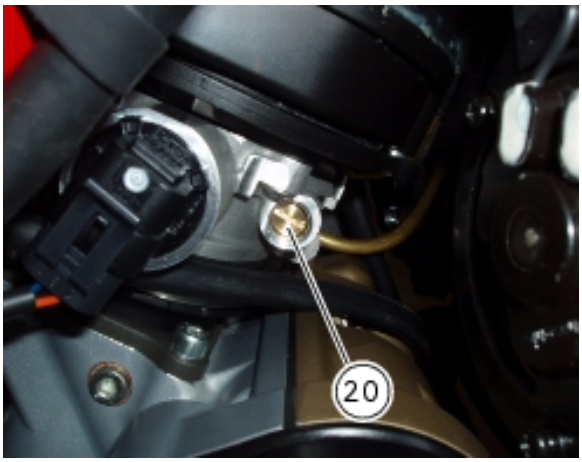


Start the engine and wait for the coolant temperature to reach 75 °C.
When the coolant temperature exceeds 75 °C, start the adjustment operations described below, bearing in mind that on completion of the adjustment, the coolant temperature must not exceed 90 °C.

Warning
If the engine is shut off, before proceeding with adjustment of the CO level, wait a minute after restarting for the enrichment phase to finish (Crank time).
Check the CO level of the vertical cylinder:
a if the average CO level of the VERTICAL cylinder is greater than or equal to 0.7%, check the rotation speed;
b if the average CO level of the VERTICAL cylinder is less than 0.7% (weak mixture), close the VERTICAL by-pass (21) by 1/4 of a turn at a time, waiting about 20 seconds for the exhaust gases to reach the analyser, until the CO level of the VERTICAL cylinder exceeds 0.7%. If after completely closing the bypass screw on the VERTICAL cylinder, the VERTICAL CO level is still less than 0.7%, open the bypass screw of the HORIZONTAL cylinder (20) by 1/4 a turn at a time until the electronic engine management system brings the VERTICAL cylinder to a CO level greater than 0.7% (note that adjusting the by-pass of the horizontal cylinder also adjusts the combustion of the vertical cylinder).
Checking the average rpm read by the DDS:
a if the average reading is between 1300 and 1400 rpm (1350 ±50 rpm), the adjustment is correct;
b if the average reading falls outside the above range, repeat the entire adjustment procedure, after which, if the average is less than 1300 rpm, open both bypass screws (20) and (21) by 1/8 of a turn at a time, until it falls within the above range. Conversely, if the average is more than 1400 rpm, close both bypass screws (20) and (21) by 1/8 of a turn at a time, until it falls within the specified range.

Warning

In any event, the bypass screws of the two cylinders must not be opened by more than 2.5 turns from the fully closed position.



Actions to be taken if the idle speed adjustment procedure is not successful.

1 Repeat the entire idle speed adjustment procedure.
2 Check the CO level of the horizontal cylinder:
   - the CO level of the horizontal cylinder should be kept within the range 0.4%-1.4% automatically by the electronic engine management system;
   - if this does not occur, renew the lambda probe and/or check the valve clearances, timing, seals, etc.;
   - repeat the entire idle speed adjustment procedure.
3 Check the vacuum pressures downstream of the butterfly valve (carry out this check only after completing the steps described above).

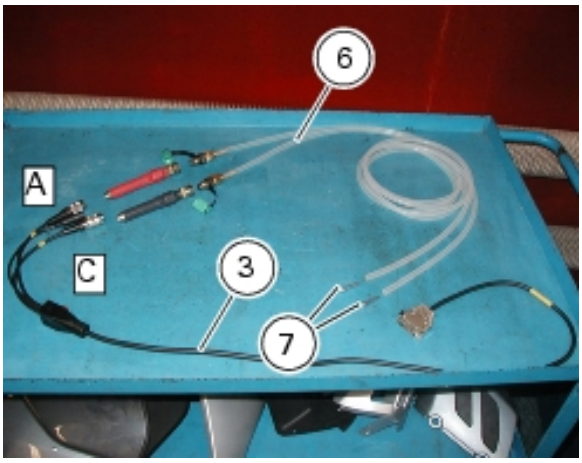
Warning

Idle speed adjustment takes priority over balancing the vacuum pressures downstream of the butterfly valve. Differences in pressure between the horizontal and vertical cylinder are therefore acceptable, provided that the idle speed is adjusted correctly.

- If you are unable to obtain the desired idle speed setting, try reducing the vacuum differential downstream of the butterfly valve as described in the following paragraph "Throttle body balancing";
- repeat the entire idle speed adjustment procedure.

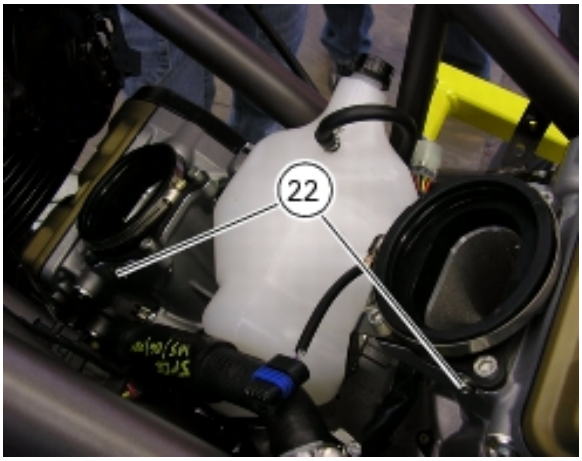
Throttle body balancing

Connect the Measurement Module cable (3) to the Measurement Module connector on the DDS (see paragraph "Description of the Ducati Diagnostic System instrument").
Connect the vacuum/pressure pipes (6) to the connectors (A) and (C) of cable (3) and connect the fittings (7) to the pipes.

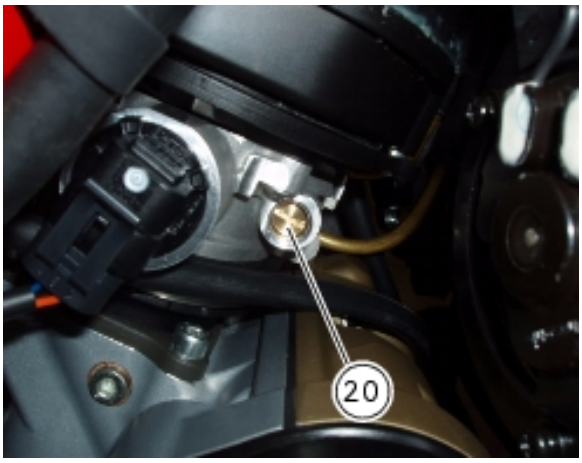


Switch on the DDS tester; see the paragraph "Tester Power Supply".
Enter the "Measurement module" function. Press the "Cylinder synchronisation" icon.

The socket to which the Measurement Module cable (3) is to be connected is indicated on the screen with a capital letter: A, B or C. Remove the screws (22) from the cylinder heads and install the fittings (7) in their place.



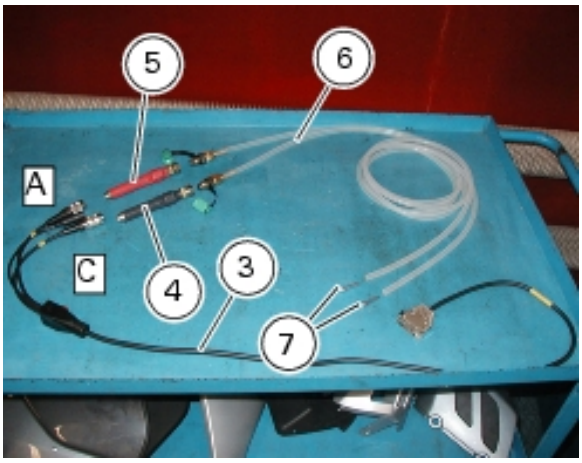
Open both bypass screws (20) and (21) by one turn from the fully closed position.

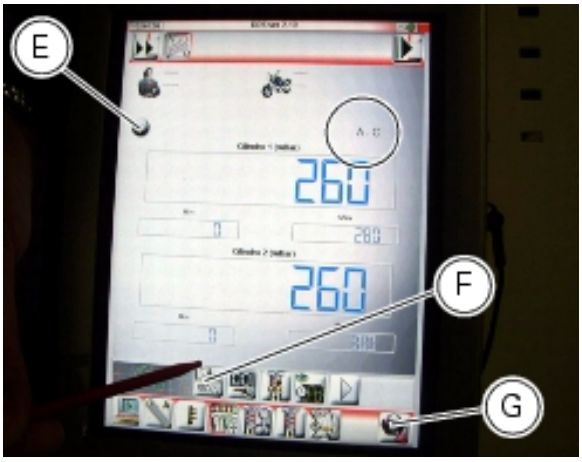


Warning

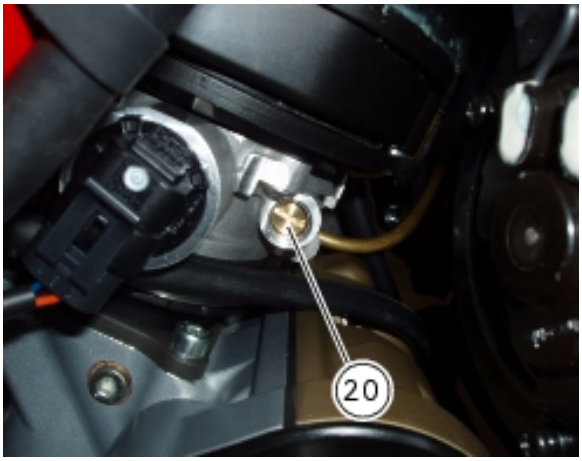
Press the "Reset" icon (G), then connect the sensors (4) and (5) to connectors (A) and (C) of the cable (3) and to the vacuum/pressure pipes (6).

Press the "Start" icon to begin the cylinder pressure measurement procedure.
The onscreen indicator light (E) will turn red when the function is active.
Start the engine.
The values may be displayed in two different ways: in numerical form or in graphic form; to select the desired display type, press the "Value display" icon (F).
The values can be reset by pressing the "Reset" icon (G).





To adjust the balance, turn the bypass screws (20) and (21) until the two lines on the graph coincide, if in graphic mode, or until identical numerical values are displayed, if in numerical mode.
Correct balancing is obtained when the two lines of the graph are superimposed or when the two numerical values indicated are equal.

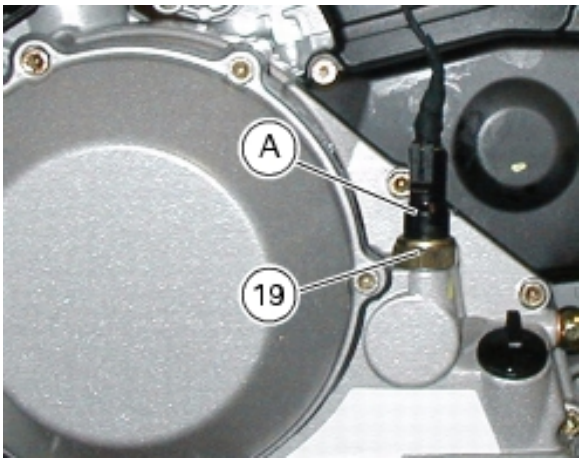


Checking the engine oil pressure

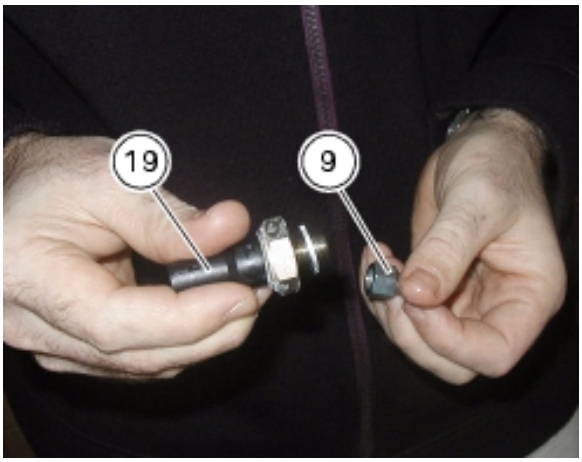
Notes

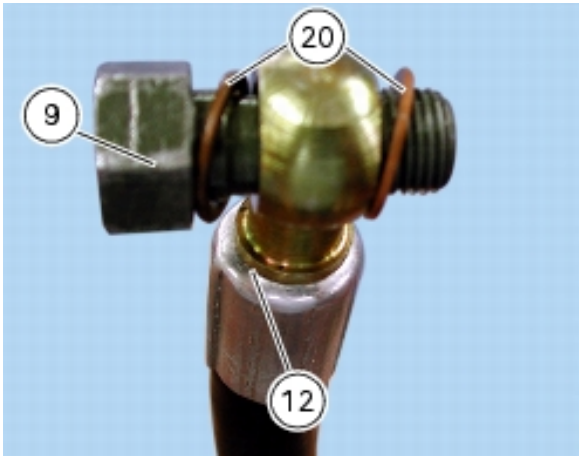
The on-screen icons used during this procedure are explained in a table at the end of this section.

To measure the pressure of the lubrication circuit, use the engine oil pressure test point (19) as follows:
Remove the right-hand side fairing (Sect. E 2, Removal of the side fairings).
Disconnect the wiring connector (A) and remove the pressure switch (19), taking care to recover the seal.

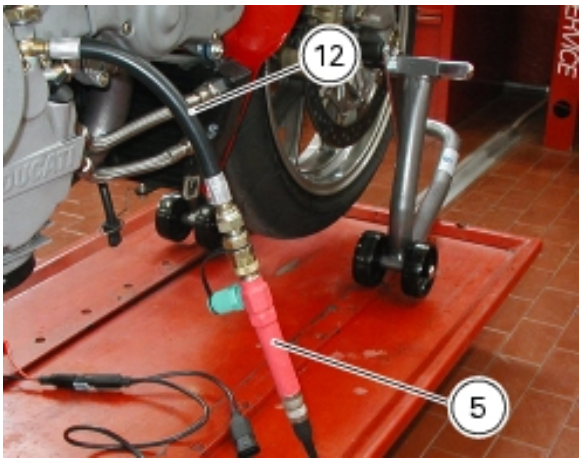


Insert the fitting (9) into the connection on the hose (12), interposing the two copper sealing washers (20). Insert the fitting (9) of the pipe (12) in the threaded hole (M10x1 mm) of the right crankcase cover and screw it fully home. Refit the pressure switch (19) on the fitting (9) along with its seal, and reconnect the wiring connector (A).

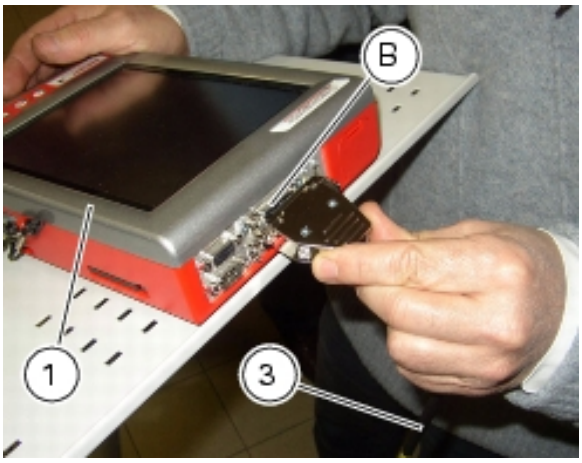




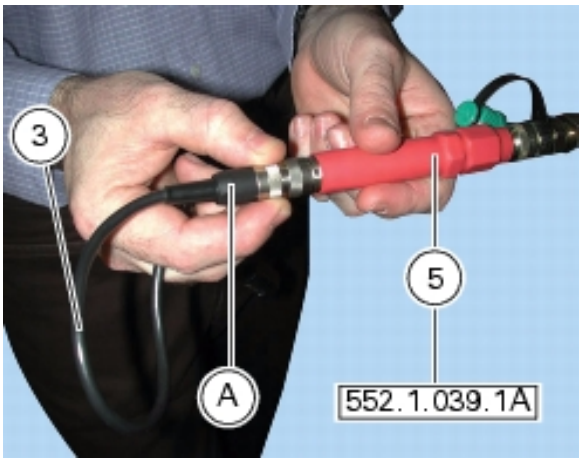
Connect the pressure sensor (5) to the pipe (12) to transform the pressure signal into an electrical signal.

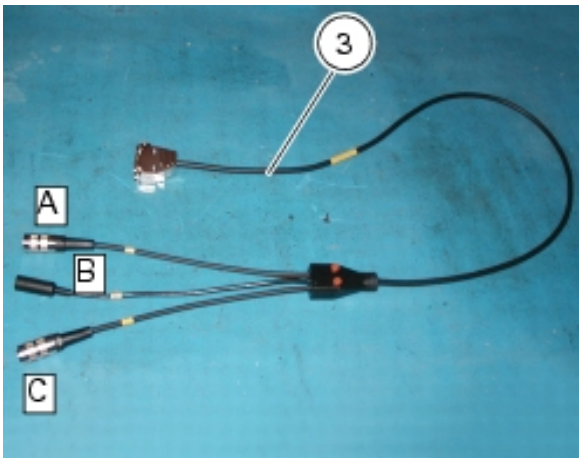


Switch on the DDS tester (1); see paragraph entitled "Tester power supply".
Connect the power and diagnostics cable (Measurement Module) (3) to the measurement module connector (B) on the DDS tester (1).

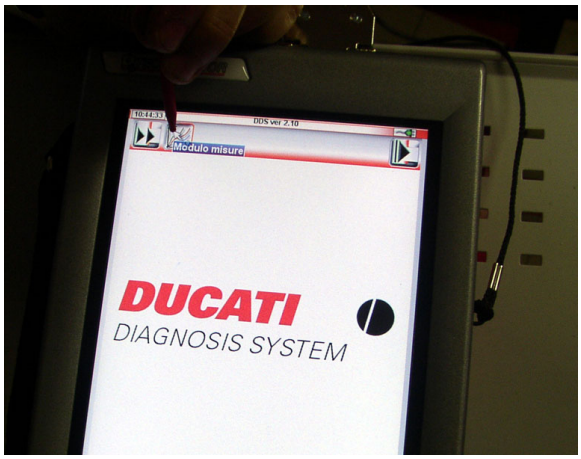


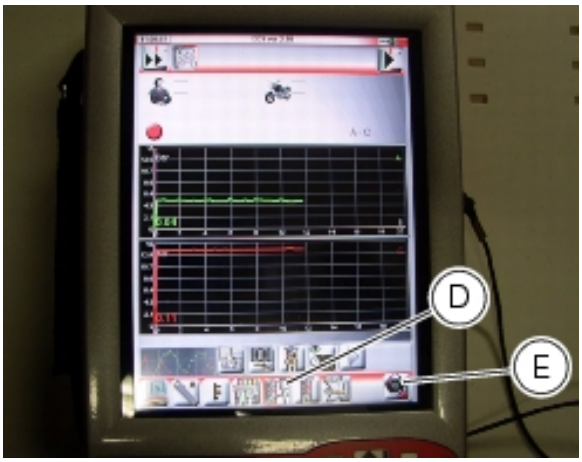
Connect the pressure sensor (5) to socket (A) or (C) of the cable (3).





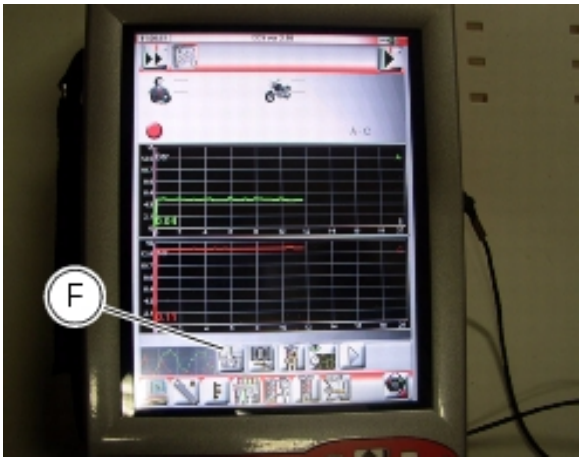
On the DDS tester (1), select the "Measurement module" function by pressing the corresponding icon; then press the "Pressure Test" icon (D) followed by the "Start" icon (E).





The socket to which the cable (Measurement Module) (3) is to be connected is indicated on the screen with a capital letter: A, B or C.

Start the engine.
The values may be displayed in three different ways: one numeric format and two graphic formats; to select the desired display type, press the "Value display" icon (F).



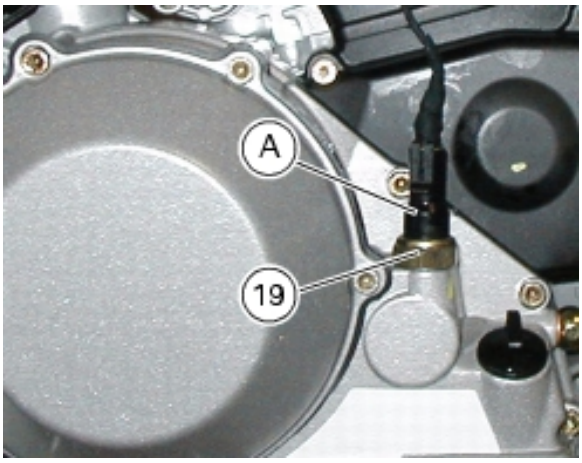
The measured value is indicated alongside the letter (A) or (C) identifying the cable used for the measurement: i.e. if you used connector (A) of the cable (3), the measured value will be displayed next to the letter (A) on the screen.

Oil pressure test values:

Warm engine
(Minimum oil temperature = **80** °C)
1100 to **1300** rpm
greater than **0.8** bar
3500 to **4000** rpm
greater than **4** bar

Important
The maximum pressure must never exceed **6.0** bar.

Excessively high pressure may indicate that the relief valve is stuck. Excessively low pressure, on the other hand, may be caused by the relief valve being stuck in the open position, the relief valve spring being too weak, or a faulty oil pump. Other causes are excessively worn seals and gaskets or a badly worn engine.
Remove the tool and refit the pressure switch (19) along with its seal. Tighten the pressure switch to the specified torque (Sect. C 3, Engine torque settings).
Reconnect the electrical system connector (A) to the pressure switch.



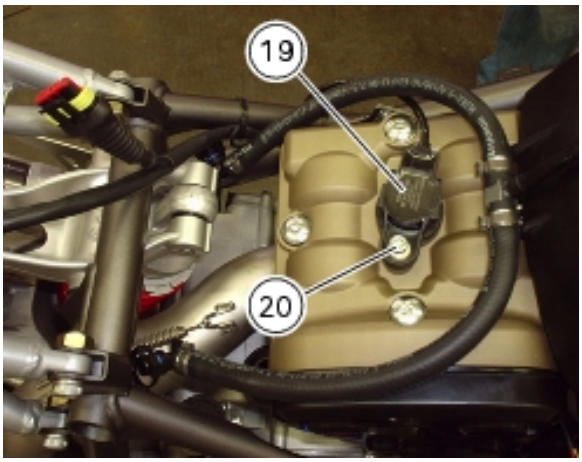
Disconnect the DDS tester
Refit the RH side fairing (Sect. E 2, Engine torque settings).

Cylinder compression test

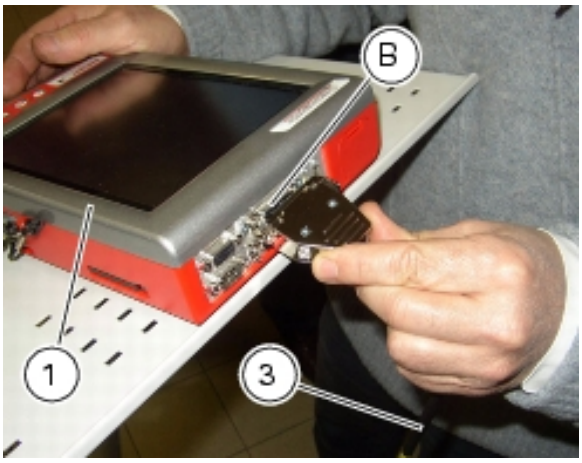
Notes

The on-screen icons used during this procedure are explained in a table at the end of this section.

Engine performance is directly correlated to the pressure that can be measured in the combustion chambers of the two cylinders. Excessive or insufficient pressure, or an excessive difference between the two cylinders, will result in a reduction in engine performance and can lead to component failure.
Run the engine so that it warms up to the point that the fan is tripped at least once.
Remove the engine outer structures.
Open the throttles completely.
Remove the HT leads (19), unscrewing the nuts (20) of both spark plugs.
Remove the spark plug from the cylinder to be tested.



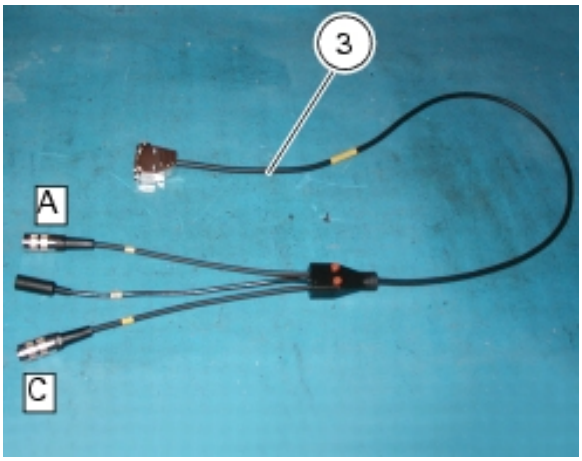
Connect the HT lead to earth to prevent sparking.
Screw the cylinder compression fitting (**11**) into the spark plug bore.
Connect the pressure sensor (**5**) to the cable (**11**).
Switch on the DDS tester (1); see paragraph entitled "Connection to motorcycle".
Connect the power and diagnostics cable (Measurement Module) (3) to the measurement module connector (B) on the DDS tester (1).



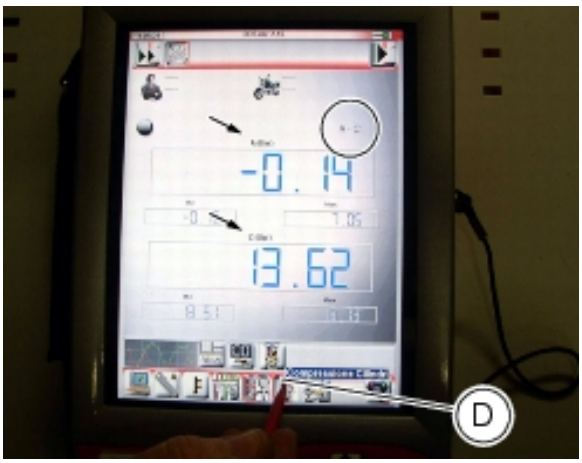
Connect the pressure sensor (**5**) to socket (A) or (C) of the cable (3).

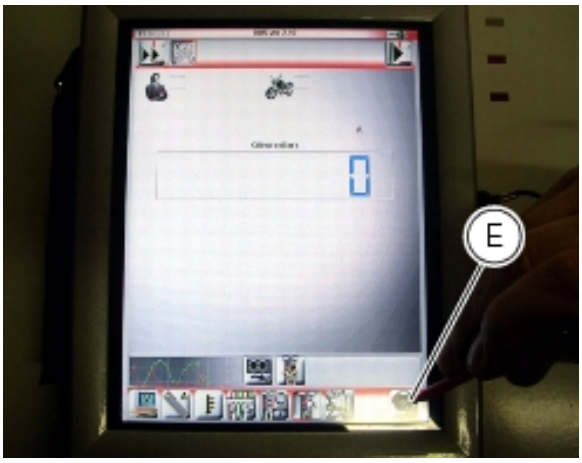
Notes

Measure the compression on one cylinder at a time.



On the DDS tester (1), select the "Measurement module" function by pressing the corresponding icon; then press the "Cylinder Compression" icon (D) followed by the "Start" icon (E).



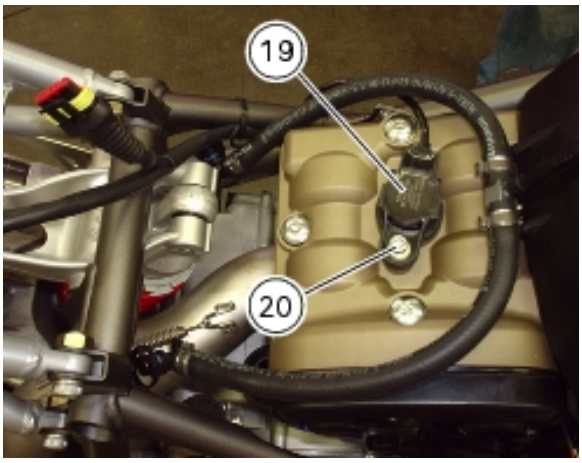


The socket to which the cable (Measurement Module) (3) is to be connected is indicated on the screen with a capital letter: A, B or C.
Turn over the engine with the starter motor until the pressure stops rising.
Check the pressure in each cylinder:
- standard value: **14.5** bar;
- minimum value: **12.5** bar;
- maximum permissible difference between cylinders: **2** bar.

An excessively high pressure value can be caused by:
- build up of deposits in the combustion chamber.

An excessively low pressure value can be caused by:
- gas escaping between the cylinder head and the barrel;
- worn valve seats;
- bent valve stems;
- incorrect valve clearances;
- worn cylinder or piston rings.

Refit the sparkplugs, position the HT leads (19) in their respective housings and tighten the nuts (20) to the specified torque (Sect. C 3, Frame torque settings).
When the check has been completed, refit the outer structures.

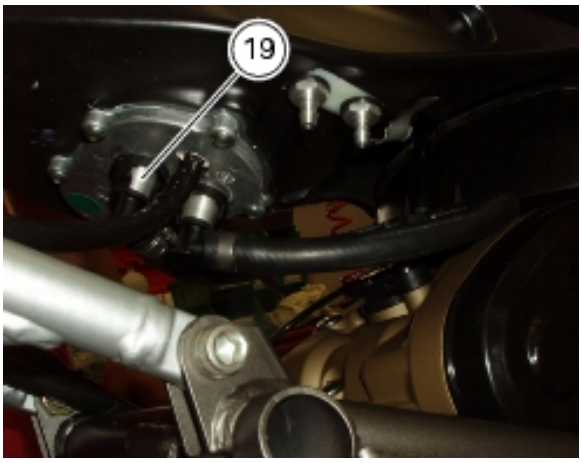


Fuel pressure test

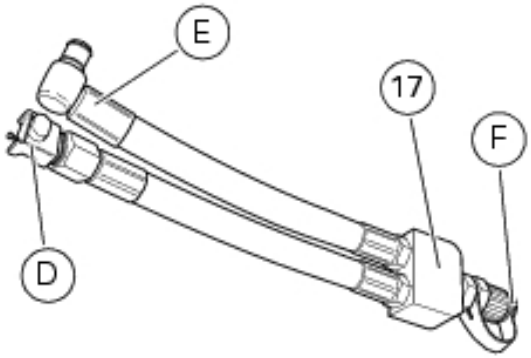
Notes

The on-screen icons used during this procedure are explained in a table at the end of this section.

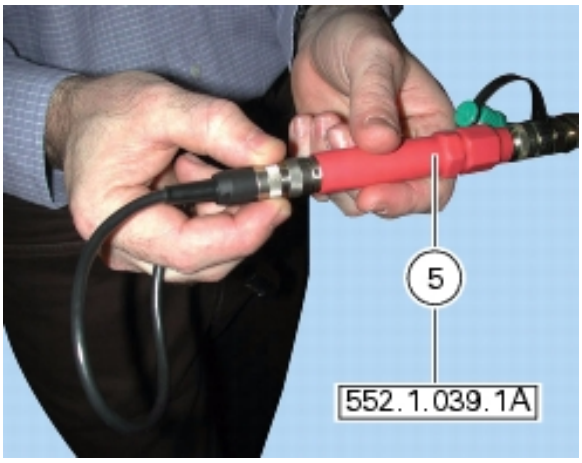
Before doing this check, detach the fuel tank (Sect. L 2, Removal of the fuel tank) from the bike, without removing it. Slightly raise the fuel tank and place a pad underneath it so as to be able to access the fittings on the flange. Remove the fuel feed hose (19).



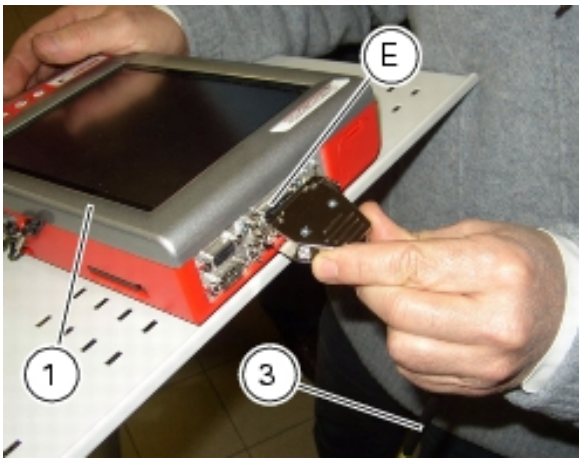
Take the fuel pressure pipe test (17) and connect one end (D) to the outlet fitting on the tank and the other end (E) to the fuel feed hose (19) in this way, the fuel pressure can be measured at the test outlet (F).



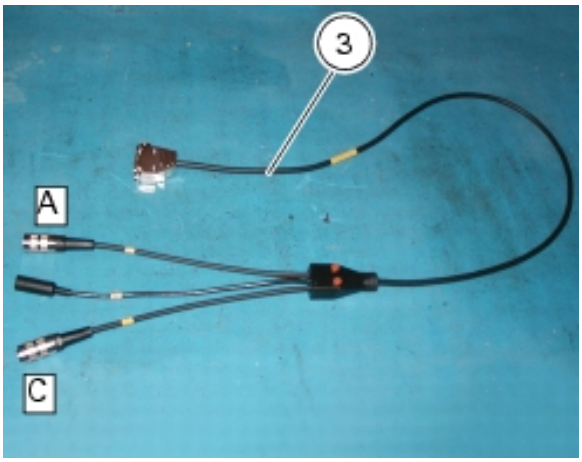
Connect the pressure sensor (5) to the test outlet (F) of the pipe (17) to transform the pressure signal into an electrical signal.



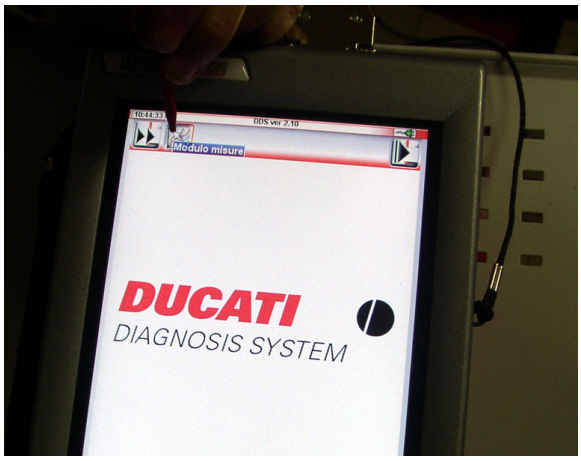
Switch on the DDS tester (1); see paragraph entitled "Tester power supply".
Connect the power and diagnostics cable (Measurement Module) (3) to the measurement module connector (E) on the DDS tester (1).



Connect the pressure sensor (5) to socket (A) or (C) of the cable (3).

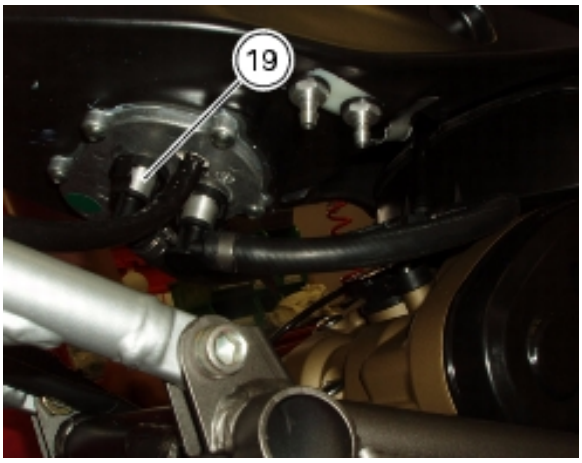


On the DDS tester (1), select the "Measurement module" function by pressing the corresponding icon; then press the "Pressure Test" icon (F) followed by the "Start" icon (G).



The socket to which the cable (Measurement Module) (3) is to be connected is indicated on the screen with a capital letter: A, B or C.
The values may be displayed in three different ways: in one numeric form and in two graphic forms; to select the desired display type, press the "Value display" icon (H).

The measured value is indicated alongside the letter (A) or (C) identifying the cable used for the measurement: i.e. if you used connector (A) of the cable (3), the measured value will be displayed next to the letter (A) on the screen.
The maximum pressure must be **3** bar (nominal).
On completion of the test, remove all the components of the test instrument and refit the fuel feed hose (19).
Refit the fuel tank (Sect. L 2, Refitting the fuel tank).

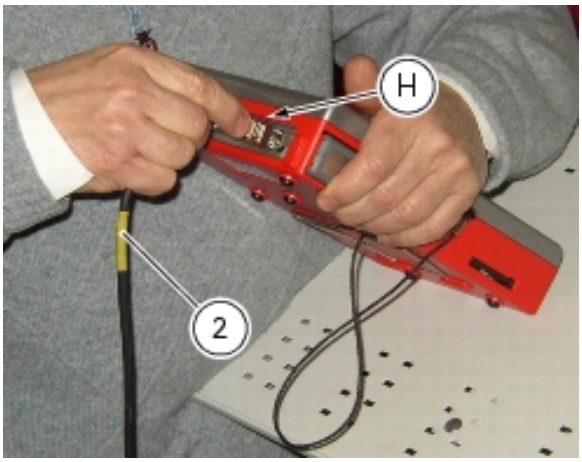


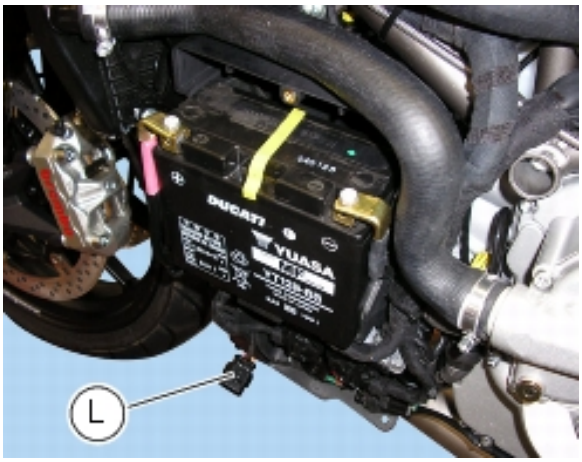
Immobilizer override procedure

Notes

The on-screen icons used during this procedure are explained in a table at the end of this section.

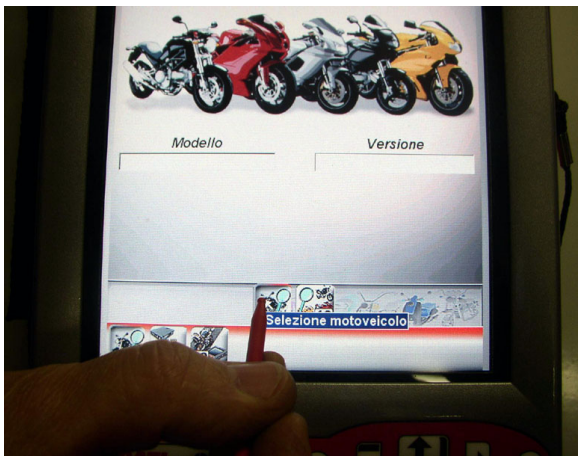
If the immobilizer system does not work, there is an emergency procedure for starting the engine, by entering the secret code with the aid of the DDS tester.
Switch on the DDS tester (1); see paragraph entitled "Tester power supply".
Connect the power and diagnostics cable (2) to the diagnostics connector (H) on the tester and to the diagnostics socket (L) on the motorcycle.



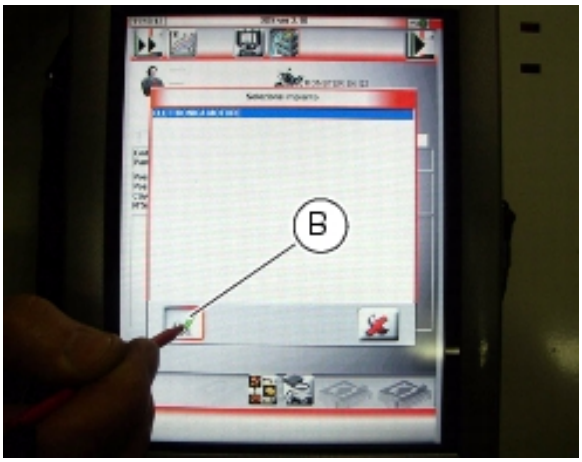


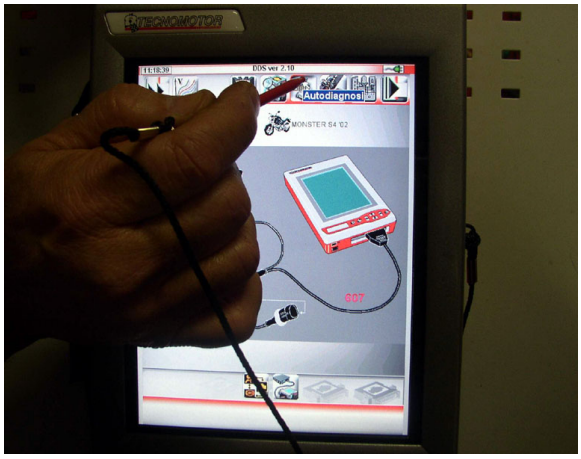
Enter the general functions menu by pressing the icon "Menu 1" (A).

Press the "Select vehicle" icon and, on the next screen, press the "Select motorcycle" icon; select the motorcycle model and confirm, then select the version and confirm.



Press the icon "Select system" to display a list of the bike's systems that can be analysed.
Select "Engine electronics" and press the "Confirm" icon (B). Next, press the "Self-diagnosis" icon to access the corresponding function.



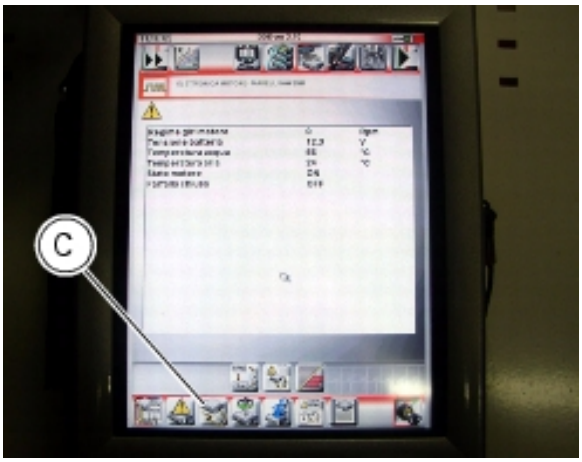


The DDS tester will interrogate the electronic control unit and display the parameters analysed with their relative values.

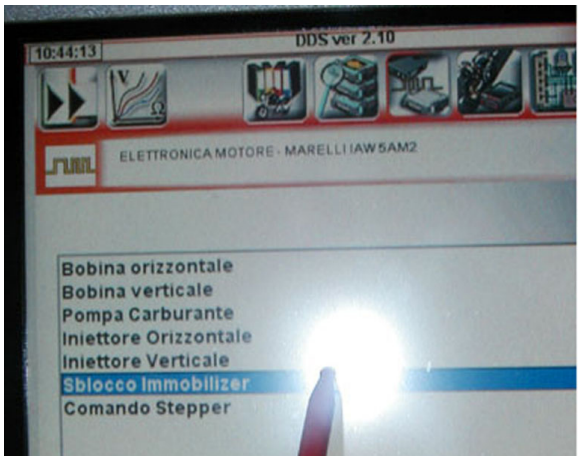
Notes

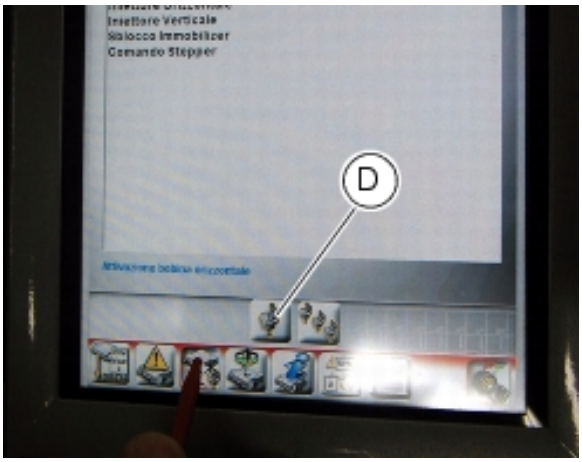
Make all connections with the motorcycle ignition key in the OFF position.

Press the "Actuators" icon (C) to display the actuators and other components connected to the ECU.

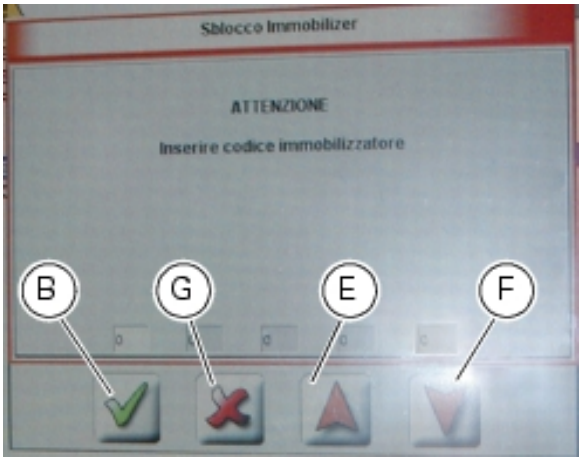


Select the option "Immobilizer Override" and then press the icon "Apply" (D).





A screen will appear in which you can enter the 5 digit secret code. Use the red arrows (E) and (F) to enter each digit: after entering each digit, press the "Confirm" icon (B).
One the entire code has been entered, press the "Confirm" icon (B) again.
On completion of the operation, the message "Was the operation completed successfully?" will appear; press "Confirm".
If any problems were encountered during the operation, the tester will display the relative error messages: each message must be confirmed by pressing the "Confirm" icon, or rejected by pressing the "Exit" icon (G).



Disconnect the tester.

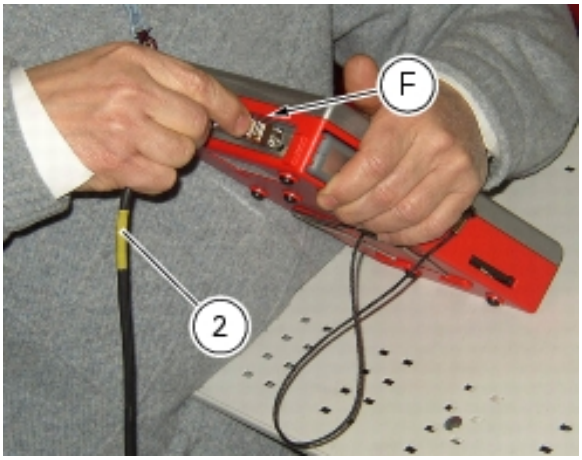
Guided diagnosis

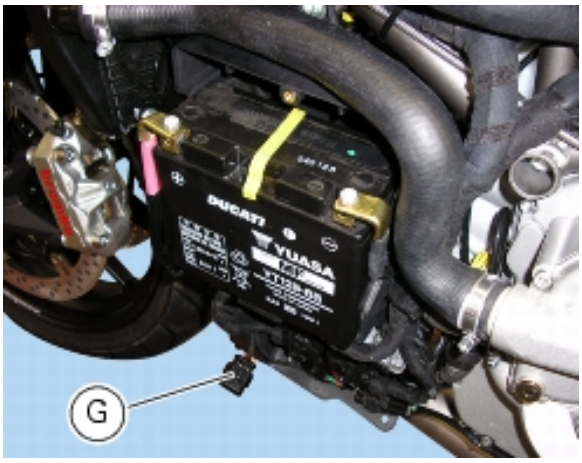
Notes

The on-screen icons used during this procedure are explained in a table at the end of this section.

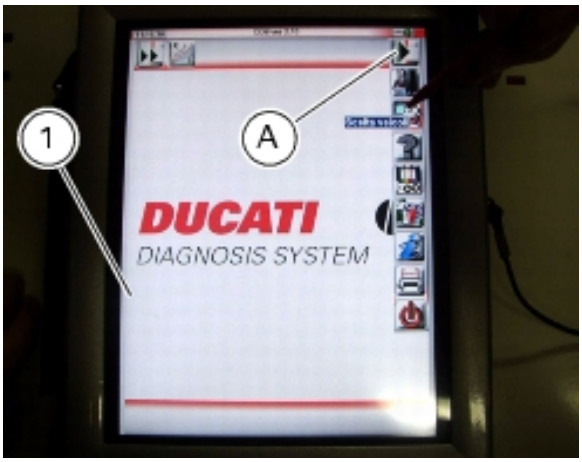
The DDS tester guides the operator step-by-step through the various diagnostic procedures, providing descriptions

and documentation for motorcycle components, wiring diagrams for the electronic systems and information on the locations of specific components.
Switch on the DDS tester (1); see paragraph entitled "Tester power supply".
Connect the power and diagnostics cable (2) to the diagnostics connector (F) on the tester and to the diagnostics socket (G) on the motorcycle.

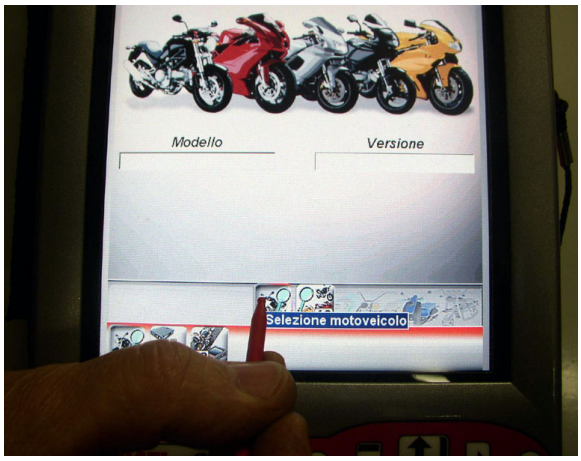




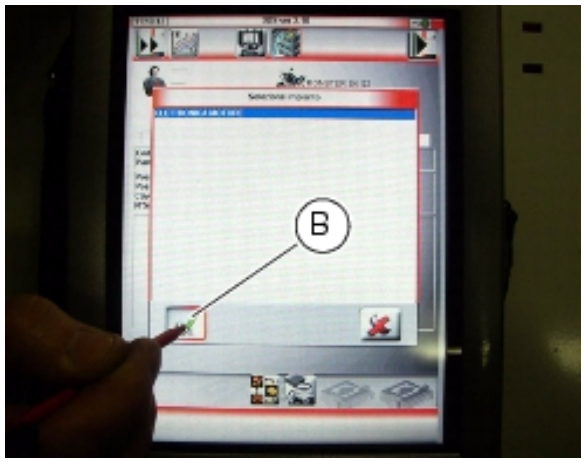
Enter the general functions menu by pressing the icon "Menu 1" (A).



Press the "Select vehicle" icon and, on the next screen, press the "Select motorcycle" icon; select the motorcycle model and confirm, then select the version and confirm.
Press the icon "Select system" to display a list of the bike's systems that can be analysed.

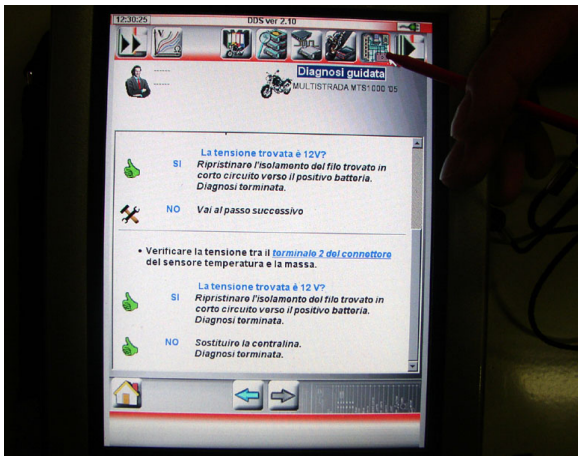


Select "Engine electronics" and press the "Confirm" icon (B).

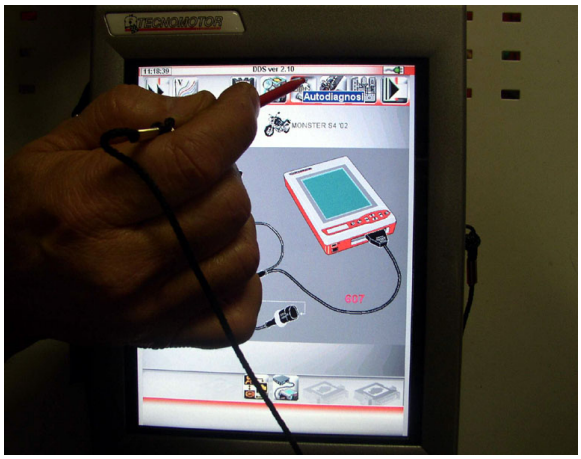


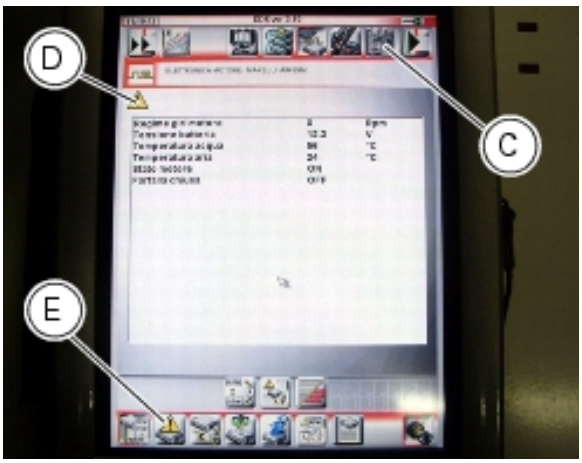
Press the "Guided diagnosis" icon (C) to access the corresponding function.

A series of screens are displayed indicating the operations required for correct diagnosis.



To determine whether the system has any internal problems, you can access the "Self-diagnosis" function by pressing the corresponding icon. If any errors are present, the symbol (D) will be displayed. To determine the type of errors present, press the "Errors" icon (E). Once errors have been detected, you can then resolve them through the guided diagnosis procedure; press the "Guided Diagnosis" (C) icon.





The DDS tester will interrogate the electronic control unit and display the parameters analysed with their relative values.

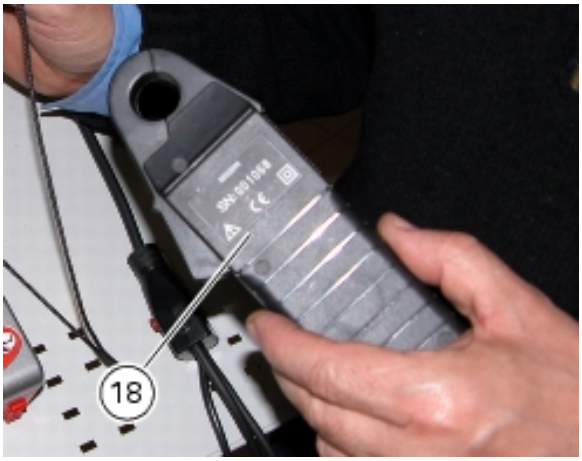
Testing the battery charging system

Notes

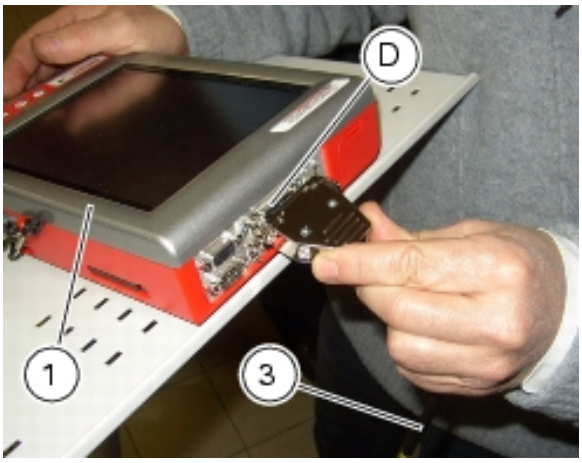
The on-screen icons used during this procedure are explained in a table at the end of this section.

You can determine the engine rpm required for the alternator to produce sufficient current to charge battery, power the injection/ignition system and all the electrical equipment on the motorcycle. When applied to a cable, the

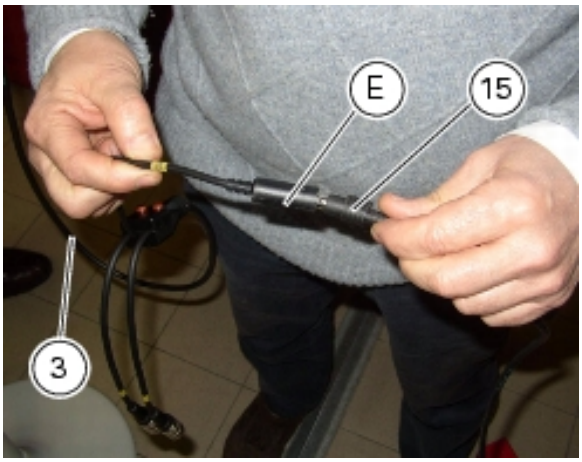
ammeter clamp (18) detects the magnetic field generated by the current passing through that cable.



Remove the right-hand fairing (Sect. E 2, Removal of the side fairings).
Switch on the DDS tester (1); see heading "Tester Power Supply".
Connect the power and diagnostics cable (Measurement Module) (3) to the measurement module connector (D) on the DDS tester (1).



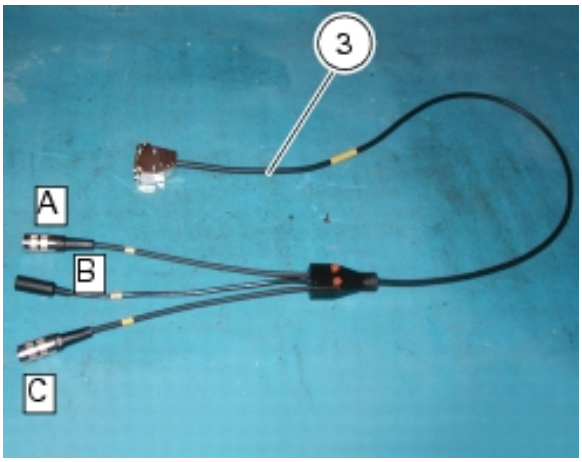
Connect the ammeter clamp to the connector (E) of the power and diagnostics cable (Measurement Module) (3).



Warning
The ammeter clamp must not be connected to wires through which electrical current is flowing.

Apply the ammeter clamp to the battery positive terminal lead with the arrow on the clamp pointing towards the battery positive terminal (+).
On the DDS tester (1), select the "Measurement module" function by pressing the corresponding icon; then press the "Ammeter" icon (F) followed by the "Start" icon.

The socket to which the cable (Measurement Module) (3) is to be connected is indicated on the screen with a capital letter: A, B or C.



If the measured current is a positive quantity, this means that alternator is powering all the electrical loads and charging battery at the same time. If the current has a negative sign, this means that the charging system is not able to power the electrical loads and a significant amount of the current required must be supplied by the battery, which is therefore discharging.

Important

If polarity is reversed when clamping the ammeter onto the cable, the sign of the readings will also be reversed, giving rise to incorrect diagnosis.

Deactivating the “service” indication on the instrument panel

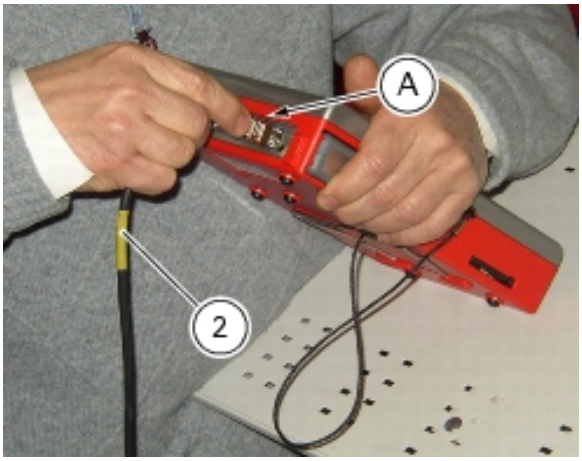
The message "SERV" is displayed on the instrument panel, indicating that the motorcycle should be serviced in accordance with the programmed maintenance plan. This indication is activated after the first **1000** km and thereafter at intervals of **12000** km.

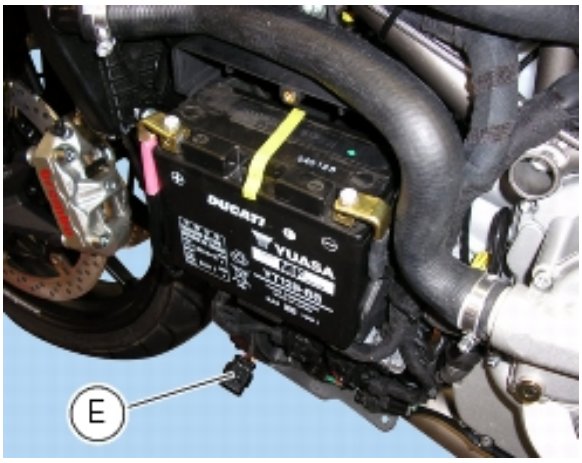
After the scheduled service has been carried out, the indication must be switched off as follows:

Notes

The on-screen icons used during this procedure are explained in a table at the end of this section.

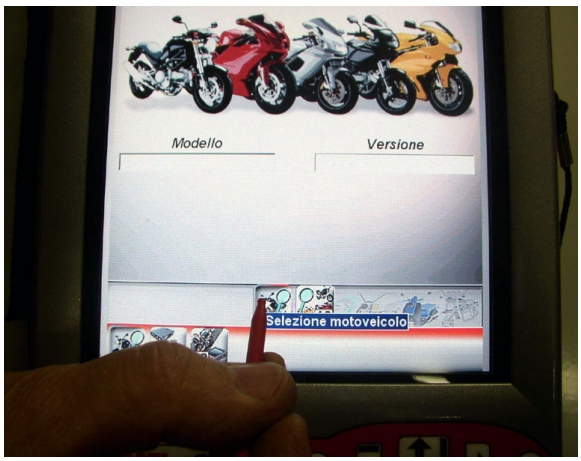
Switch on the DDS tester; see the paragraph "Tester Power Supply".
Connect the power and diagnostics cable (2) to the diagnostics connector (A) on the tester and to the diagnostics socket (E) on the motorcycle.





Enter the general functions menu by pressing the "Menu 1" icon (B).

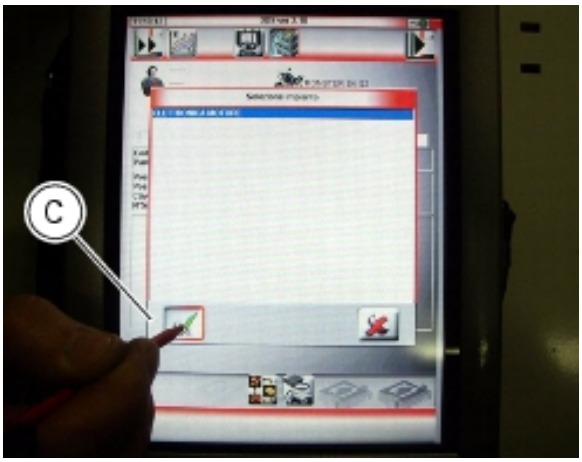
Press the "Select vehicle" icon and, on the next screen, press the "Select motorcycle" icon; select the motorcycle model and confirm, then select the version and confirm.



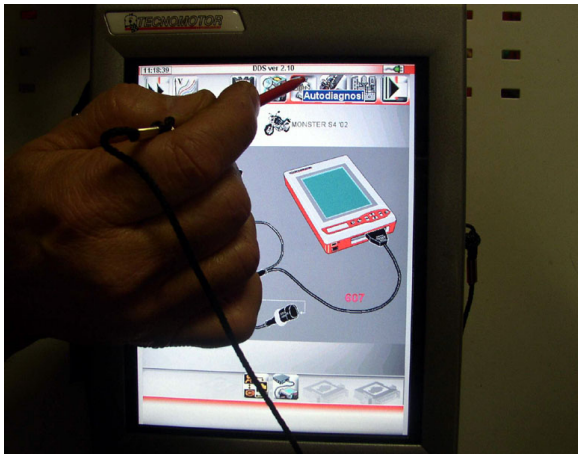
Press the "Select system" icon.
A list of the motorcycle's systems that can be analysed will appear on the display.

Select "Engine electronics".

Press the "Confirm" icon (C). Next, press the "Self-diagnosis" icon to access the corresponding function.

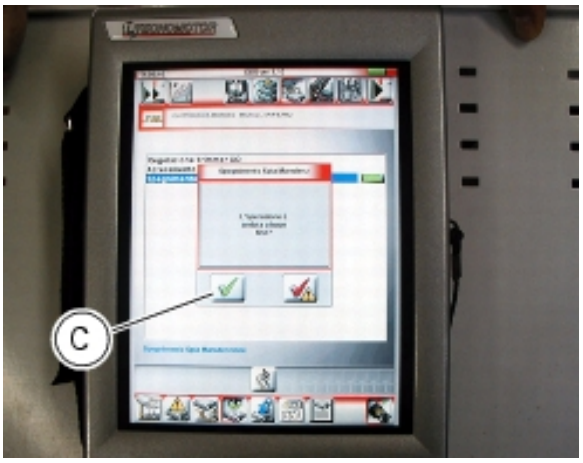


The DDS tester will interrogate the electronic control unit and display the parameters analysed with their relative values.
Press the "Settings" icon to display the special parameters.



Select the option "Service light OFF" and then press the "Apply" icon.

On completion of the operation, the message “Was the operation was completed successfully?” will appear; press “Confirm” (C).



If any problems were encountered during the operation, the tester will display the relative error messages: each message must be confirmed, (by pressing the "Confirm" icon (C)), or rejected (by pressing the "Exit" icon (D)).

Notes

Once the "service" indication has been reset with the DDS tester, set the ignition switch to OFF and wait for at least **30** seconds before switching it ON again.

Icons table

Symbol	Designation

	Confirm
	Exit
	Measurement module
	Belt tension
	Start/stop
	Menu 1
	Select vehicle
	Select motorcycle
	Self-diagnosis
	Settings
	Apply
	Cylinder synchronisation
	Value display
	Reset
	Pressure test
	Cylinder compression
	Actuators
	Guided diagnosis

Select system

Errors

Ammeter clamp

0E - Fairings

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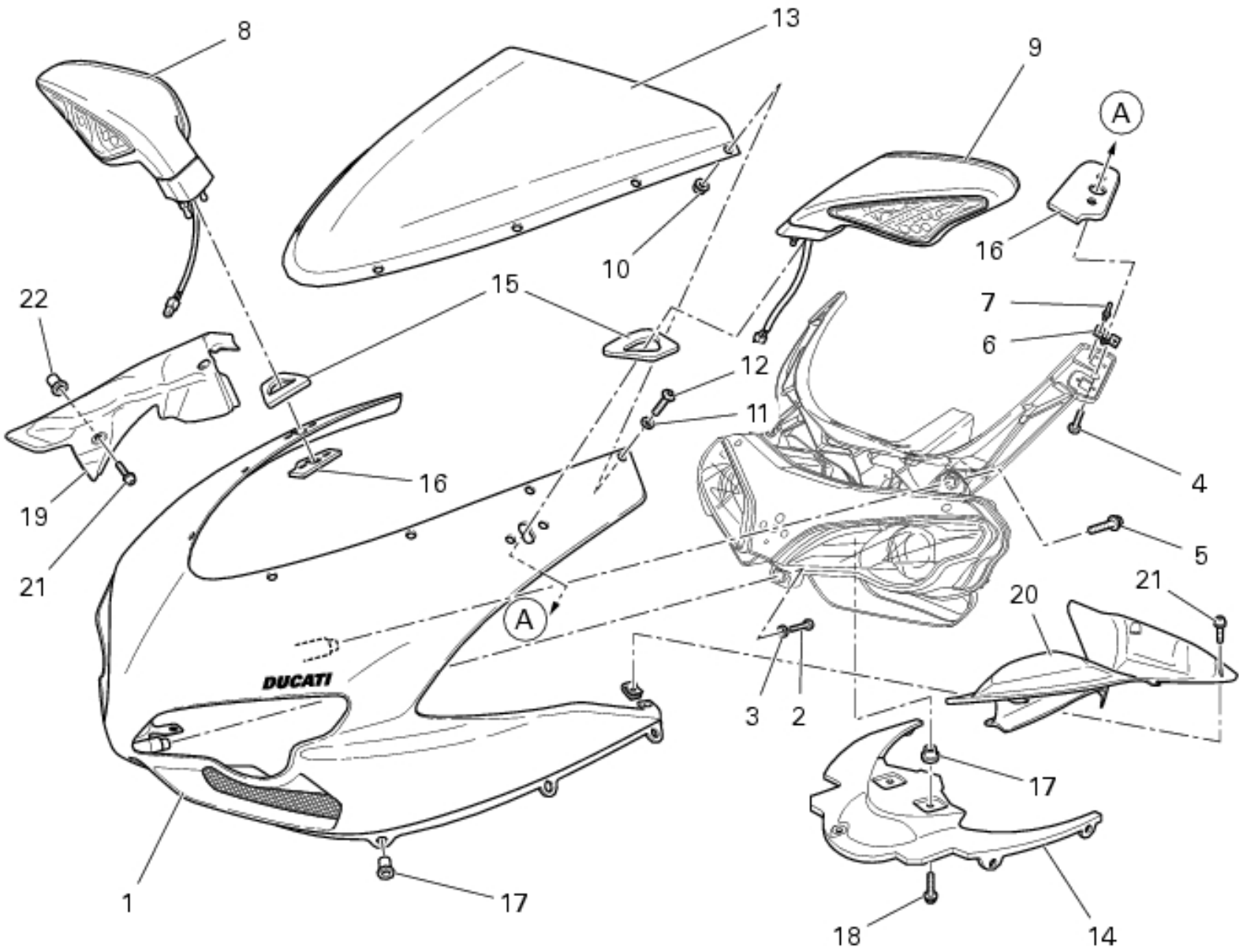
1 - Headlight shell - rear-view mirrors



1 Headlight shell
2 Bolt
3 Washer
4 Bolt
5 Bolt
6 Clip
7 Rivet
8 RH rear-view mirror
9 LH rear-view mirror
10 Nut
11 Nylon washer
12 Special bolt
13 Windshield
14 Splashguard
15 Upper gasket
16 Lower gasket
17 Threaded insert
18 Bolt

19 Right heel plate
20 Left heel plate
21 Special bolt
22 Insert

Parts catalogue

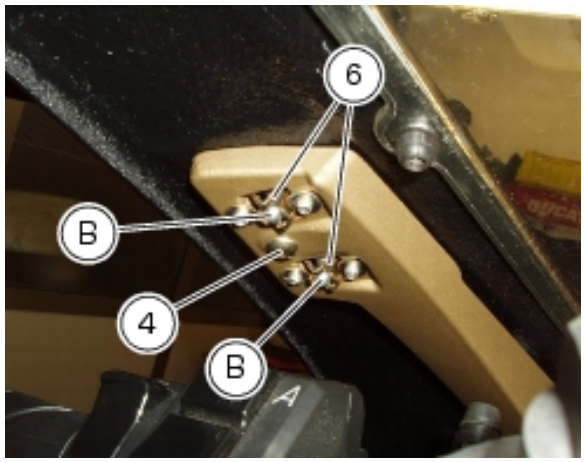
HEADLIGHT FAIRING

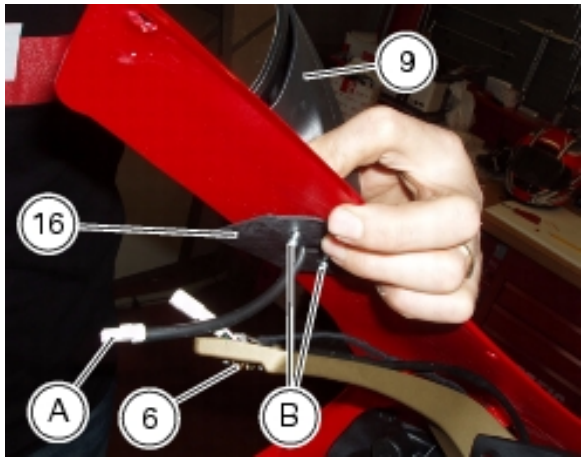
Important

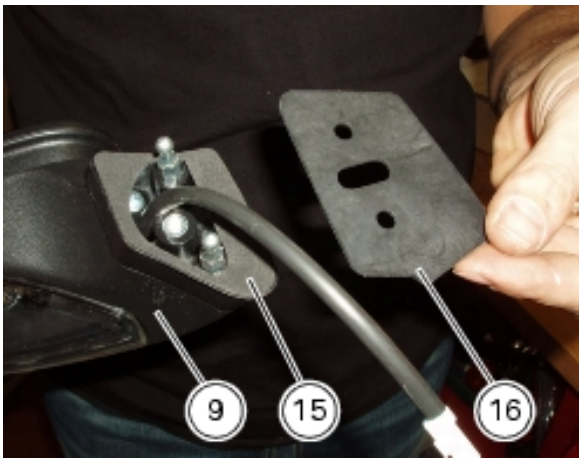
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the rear-view mirrors

Unscrew the rear-view mirror (9) retaining bolt (4).
Release the rear-view mirror (9) by disengaging the pins (B) from the clips (6).
Remove the lower rubber gasket (16) and disconnect the turn indicator wiring connector (A) from the wiring loom.
During removal, take care not to lose or damage the gasket (16).
Repeat the process for the other rear-view mirror.
Wrap the mirrors in protective material to avoid damaging them.

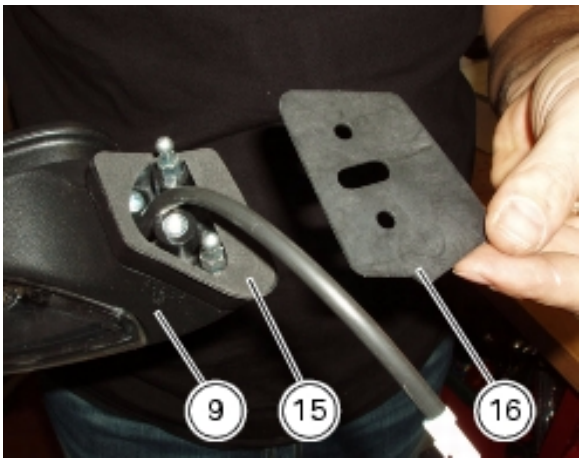


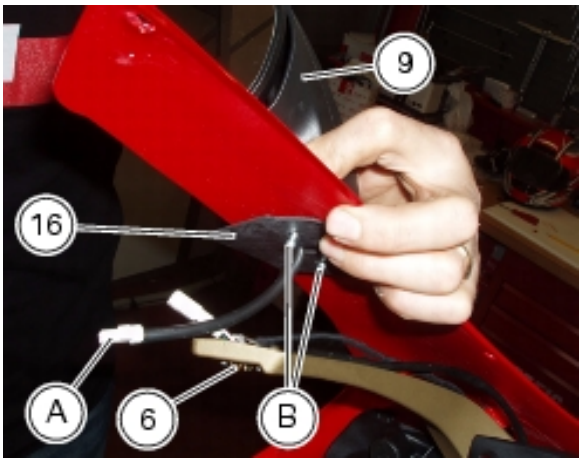


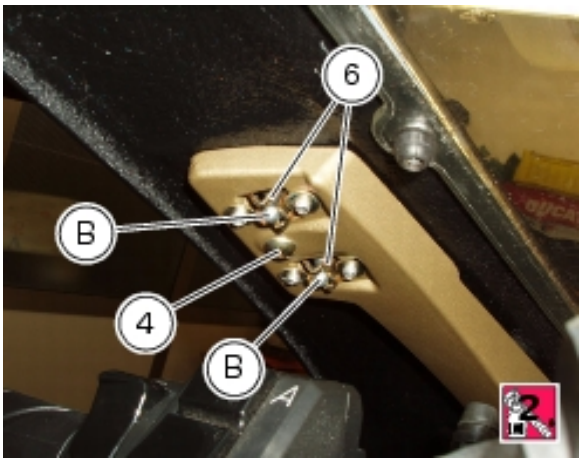


Refitting the rear-view mirrors

Locate the rear-view mirror on the headlight shell, routing the turn indicator wiring through the appropriate hole.
Check that the upper gasket (15) is in place on the mirror.
Refit the lower gasket (16).
Engage the pins (B) in the clips (6) on the headlight shell.
Connect the front turn indicator wiring connector (A) to the wiring loom.
Apply the recommended threadlocker and tighten the safety bolt (4) to the specified torque (Sect. C 3, Frame torque settings).
Repeat the process to refit the other rear-view mirror.

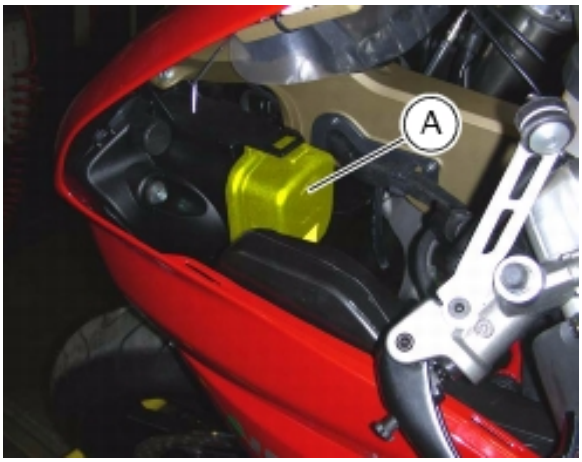




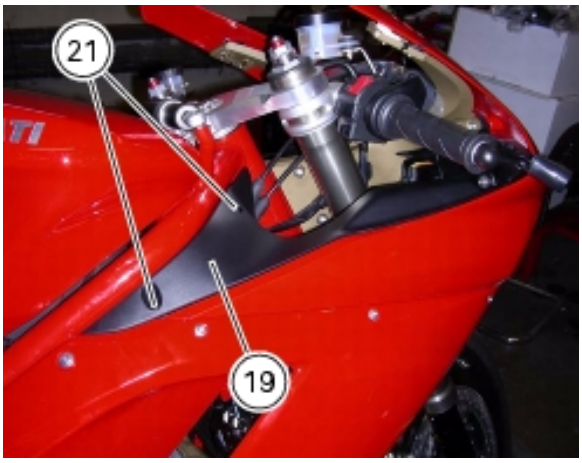


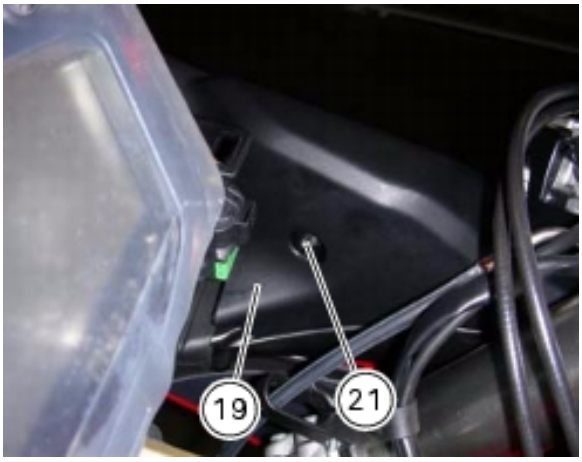
Removal of the air scoop covers

Remove the LH (A) and RH (B) bulb covers on the headlight.

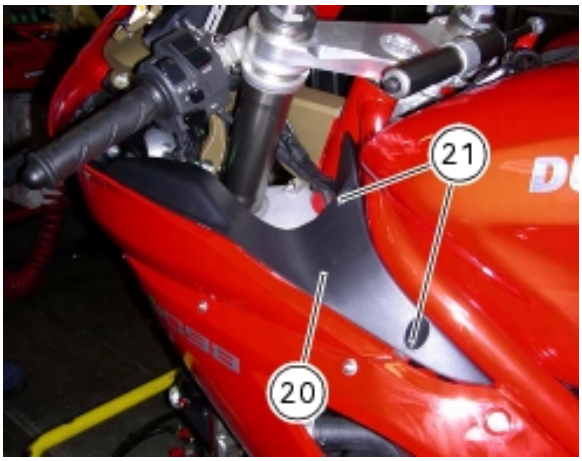


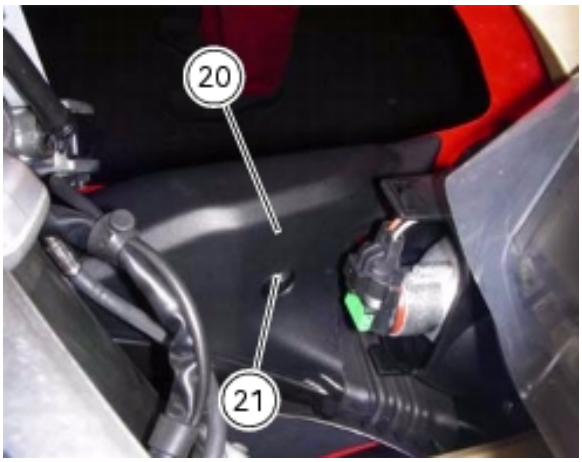
Undo the three bolts (21) securing the RH air scoop cover (19).





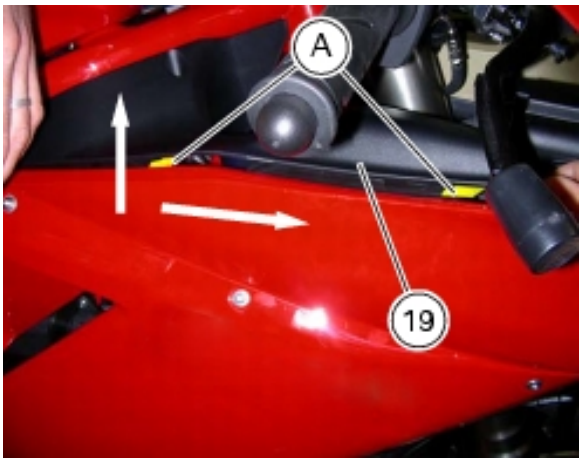
Unscrew the three bolts (21) securing the LH air scoop cover (20).

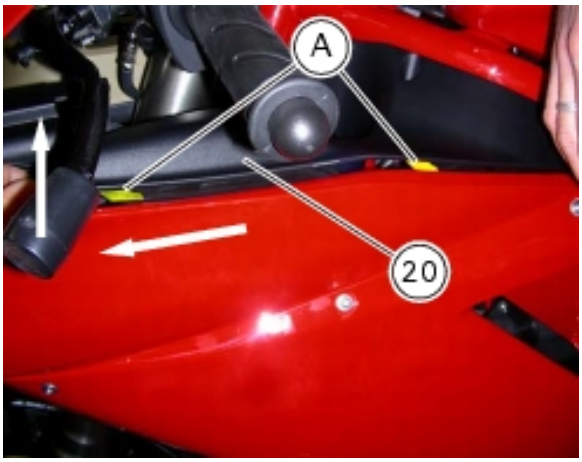




Slide the air scoop covers (19) and (20) towards the front of the motorcycle and when the fittings (A) are clear of the

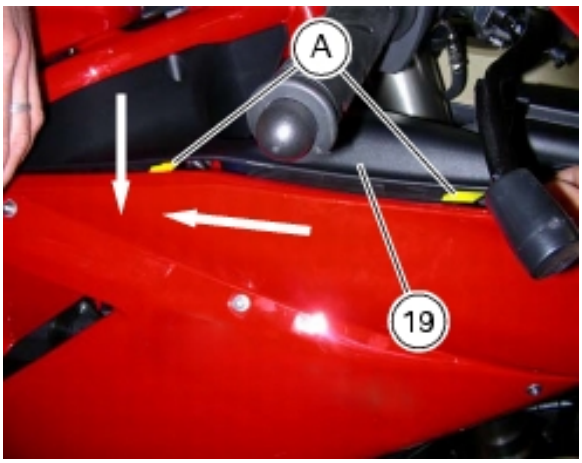
fairing, lift.

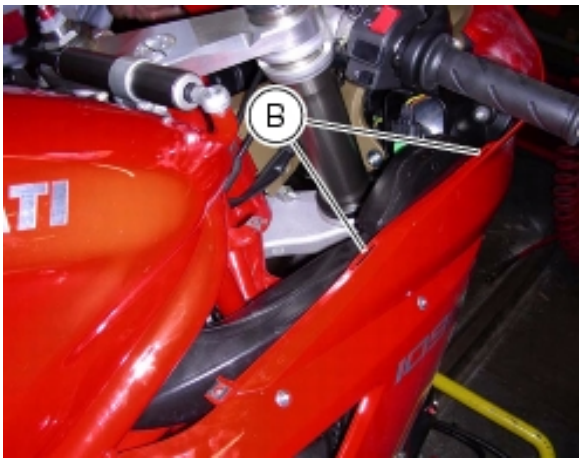


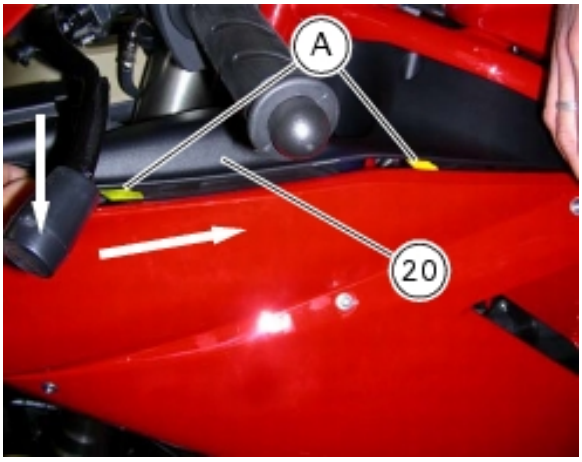


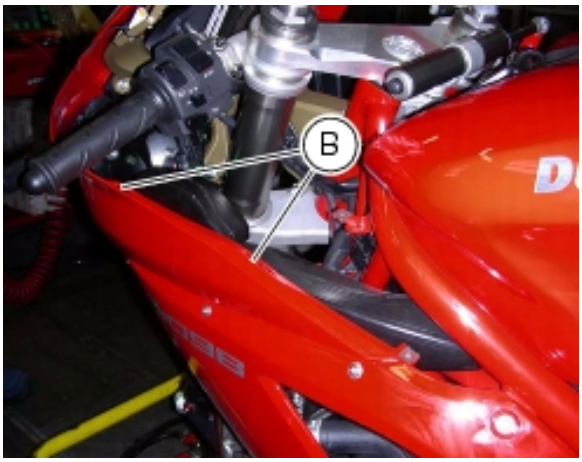
Refitting the air scoop covers

Refit the air scoop covers (19) and (20), taking care not to mark the fuel tank or break the bulb.
Insert the fittings (A) in the slots (B) in the LH and RH fairing panels and slide them towards the fuel tank.

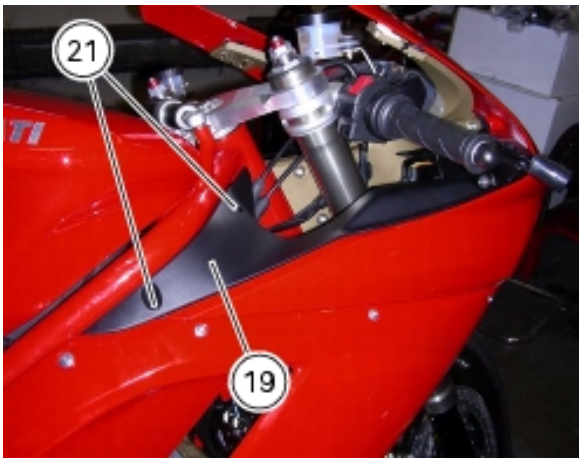


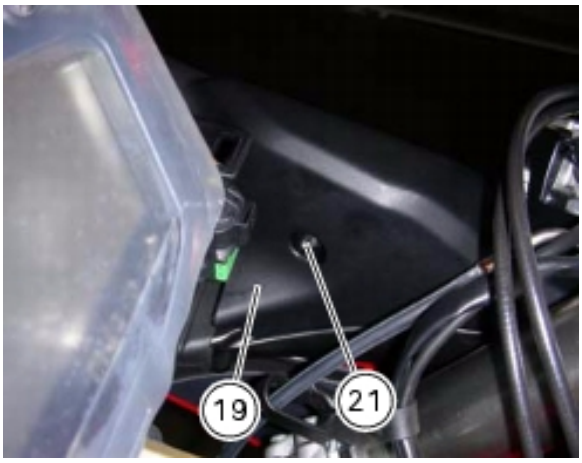


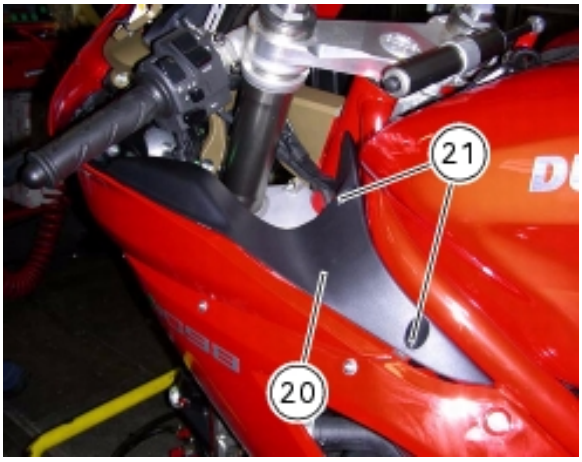


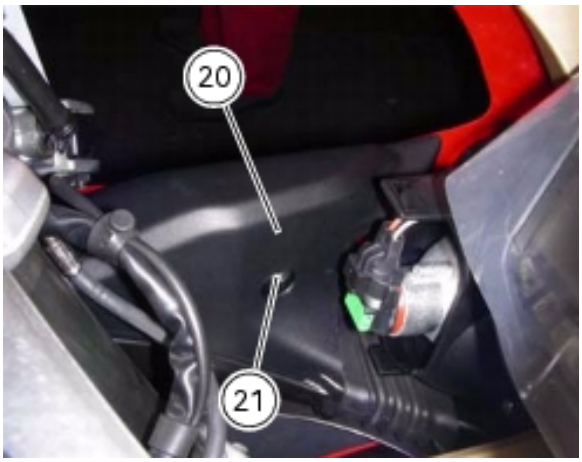


Fit the six bolts (21) securing the RH (19) and LH (20) air scoop covers. Tighten the bolts to the specified torque (Sect. C 3, Frame torque settings).

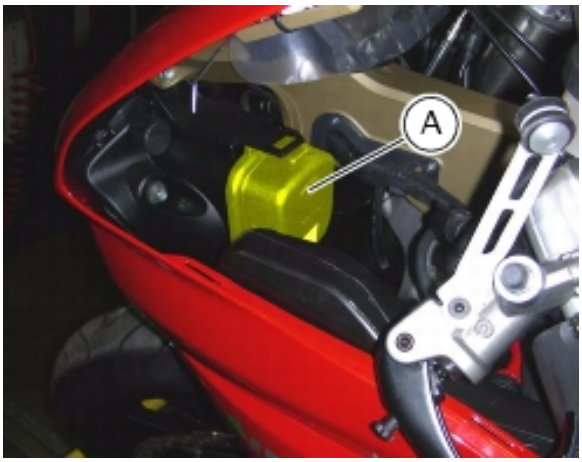








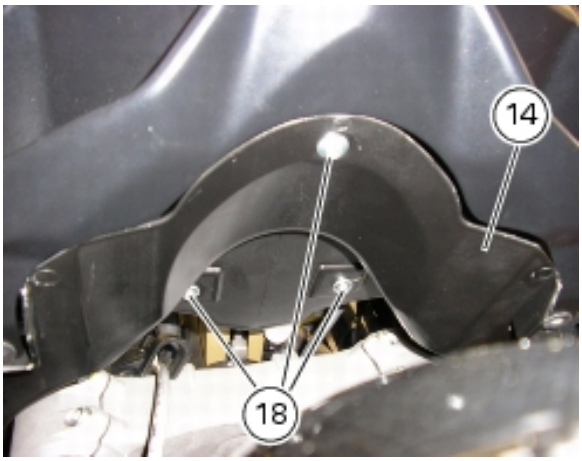
Refit the LH (A) and RH (B) bulb covers on the headlight.



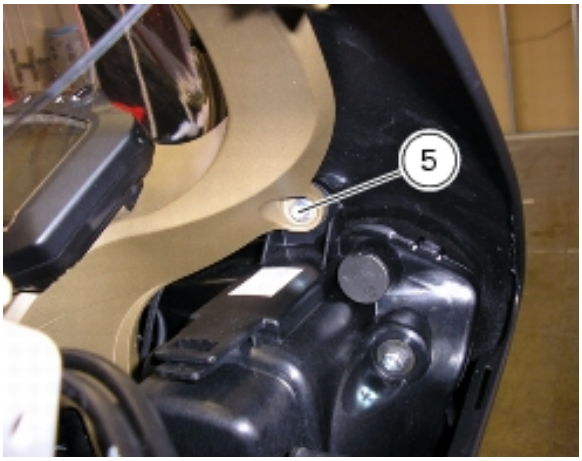
Removal of the headlight shell

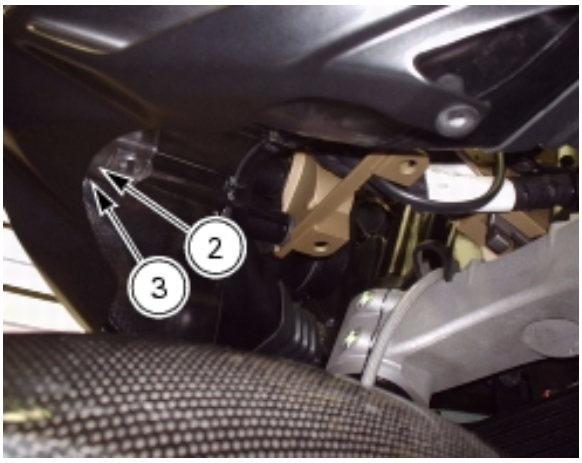
Operation	Section reference
Remove the side fairings	E 2, Removal of the side fairings

To remove the headlight shell, you must first remove the rear-view mirrors and air scoop covers as described above. Unscrew the bolts (18) and remove the splash guard (14).



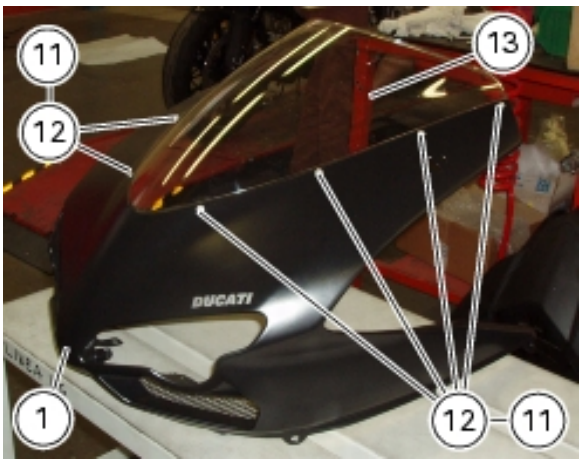
Unscrew the bolts (5) (on both sides of the headlight support frame) and the bolt (2) with washer (3) under the light assembly.

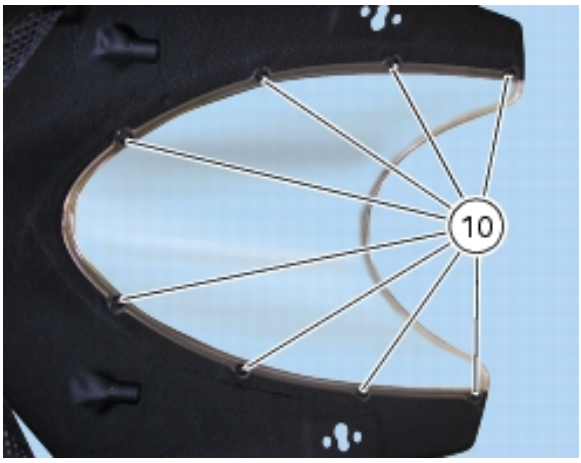




Slide the headlight shell (1) forward, releasing it from the rubber mountings of the lights assembly.

If the windshield (13) is to be replaced, unscrew the bolts (12) with washers (11) and remove the windshield (13), recovering the inserts (10).



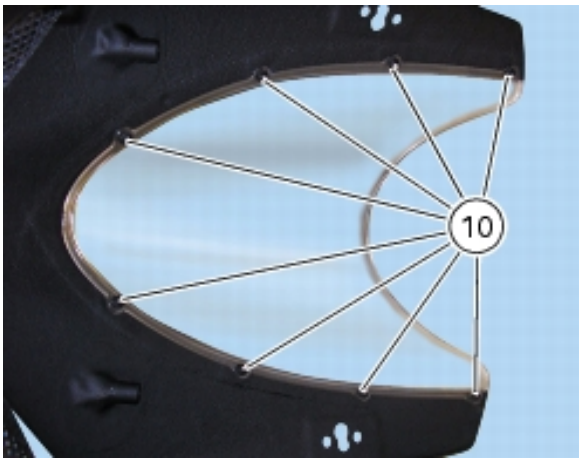


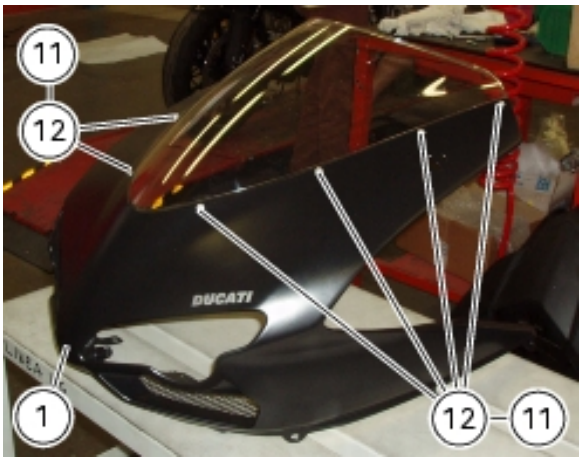
Refitting the headlight shell

Important

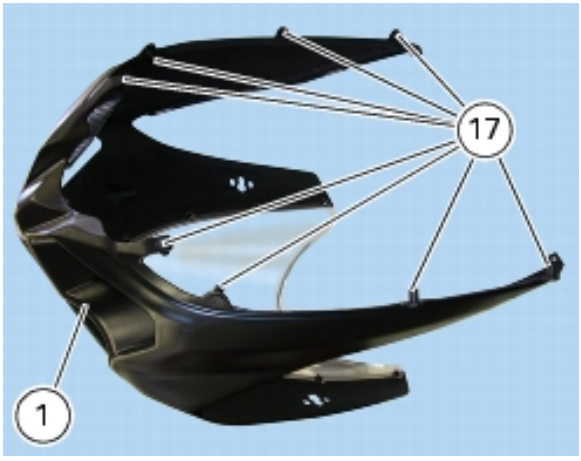
On refitting the headlight shell, always refit the nylon washers (11) in correspondence with the retaining bolts to avoid damaging the painted parts and the Plexiglas windshield.

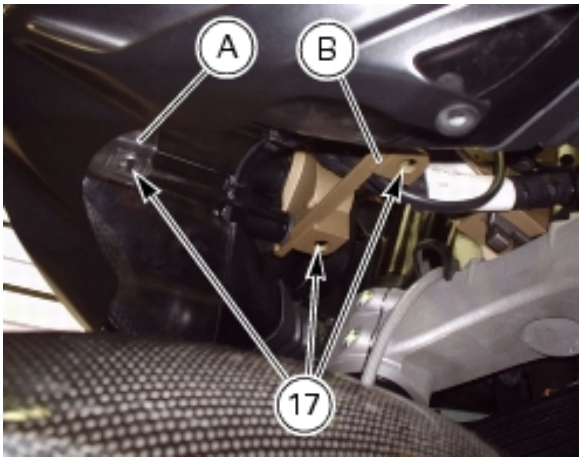
During reassembly, make sure that the threaded inserts (10) are correctly positioned on the headlight shell.
To prevent the bolts (12) and washers (11) from moving while fitting them, hold the inserts (10) pressed against the headlight shell (1).





Check that the threaded inserts (17) are present on the headlight shell (1) and on the lower part of the lights assembly (A) and its support (B).

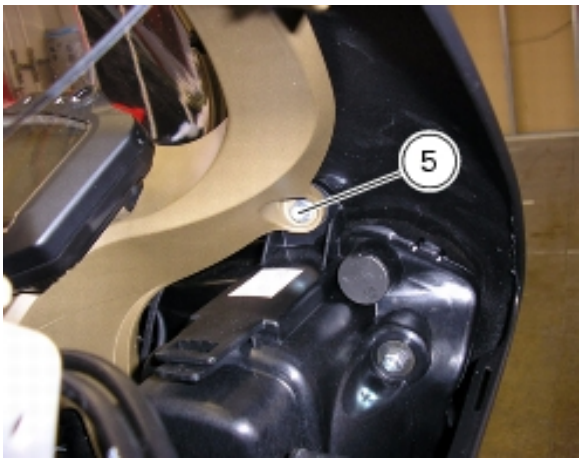


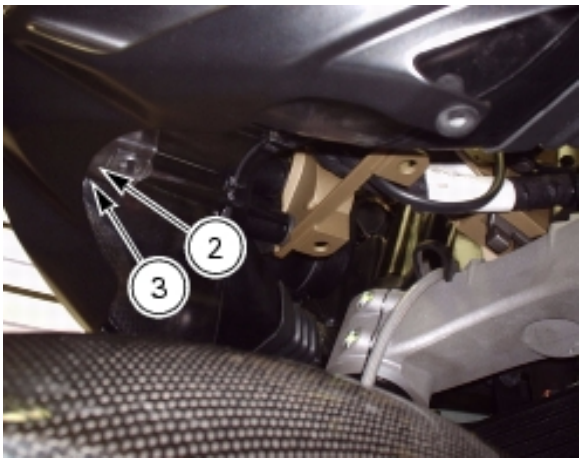


Make sure the turn indicator wiring is correctly routed in the grooves inside the headlight shell supports.
Bring the headlight shell up to the lights assembly and locate the pins of the headlight shell in the rubber grommets (C).

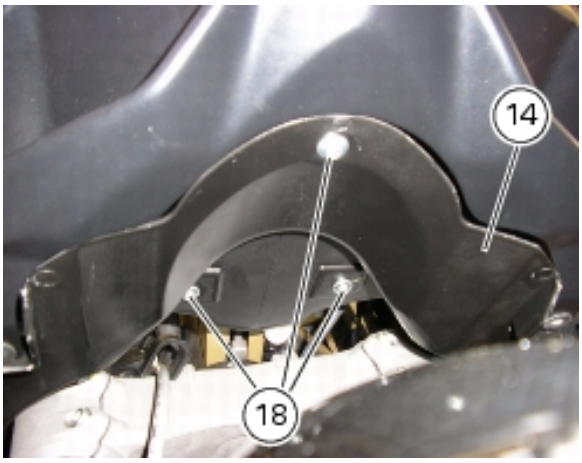
Push the headlight shell (1) into place on the lights assembly.

Refit the bolts (5) (on both sides of the headlight support frame) and the bolt (2) with washer (3) under the light assembly. Tighten the bolts (5) and (2) to the specified torque (Sect. C 3, Frame torque settings).





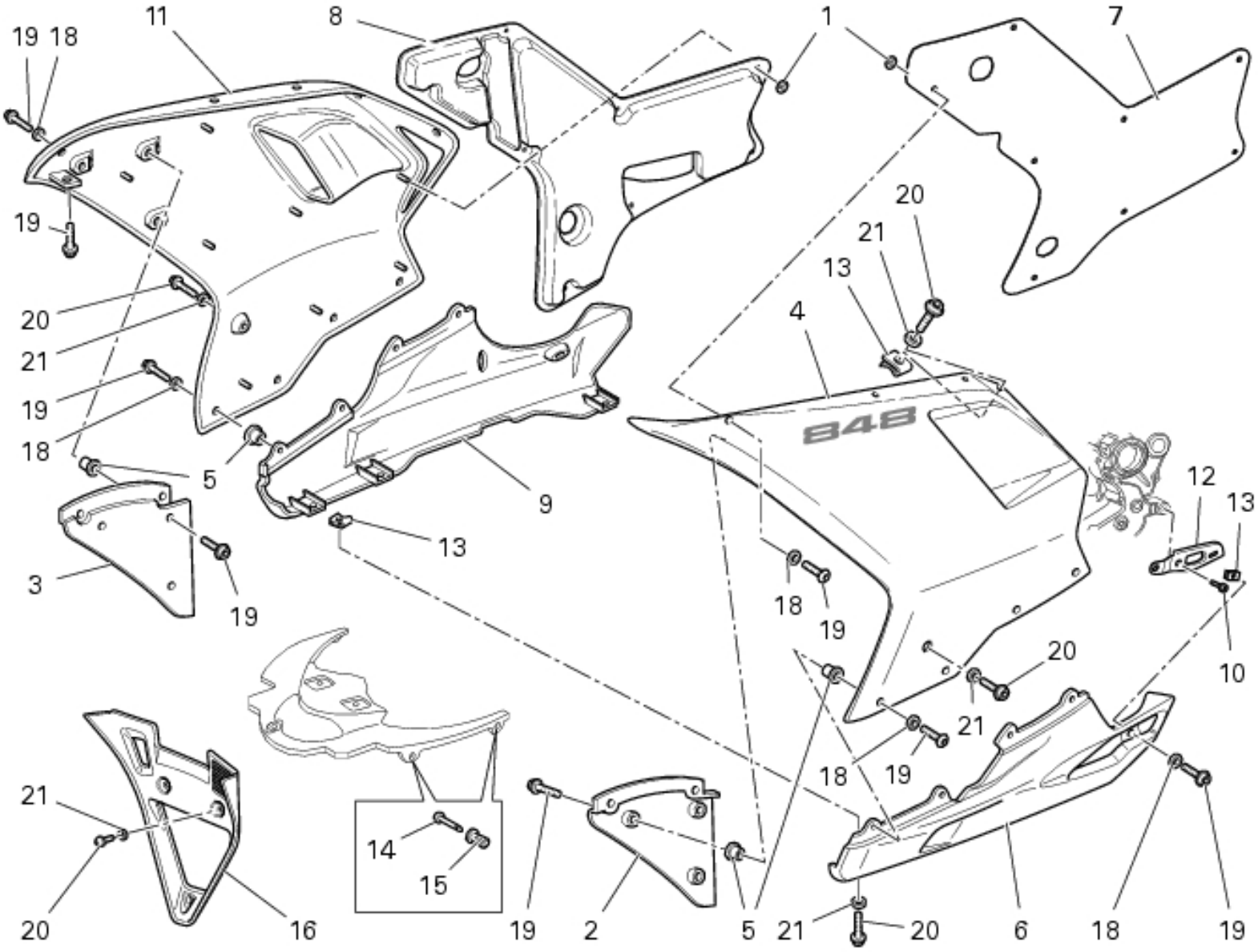
Refit the windshield (14) and tighten the bolts (18) to the specified torque (Sect. C 3, Frame torque settings).



Refit the rear-view mirrors and air scoop covers as previously described.

Operation	Section reference
Refit the side fairings	E 2, Refitting the side fairings

2 - Fairing panels



1 Clip
2 Panel (left)
3 Panel (right)
4 Left upper fairing
5 Threaded insert
6 Left lower fairing
7 Left side panel
8 Right side panel
9 Right lower fairing
10 Bolt
11 Right upper fairing
12 Bracket
13 Clip
14 Pin
15 Bush
16 Front air scoop
17 Bush
18 Nylon washer

19 Bolt
20 Bolt
21 Nylon washer

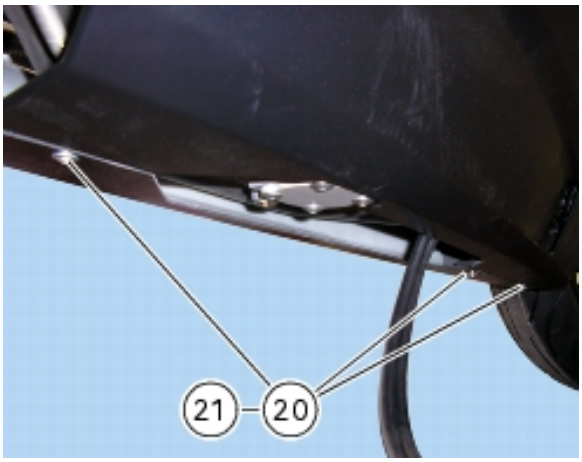
Parts catalogue

FAIRING

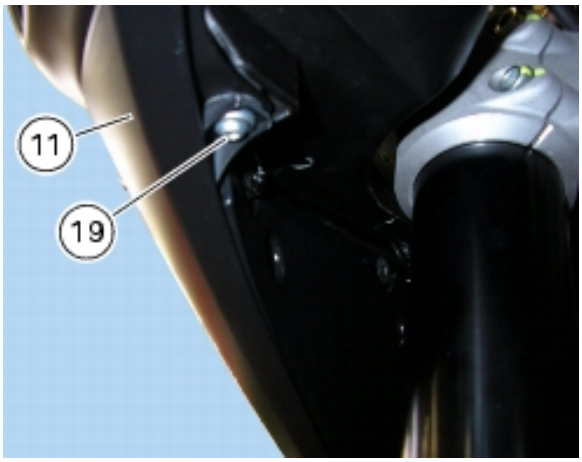
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the side fairings

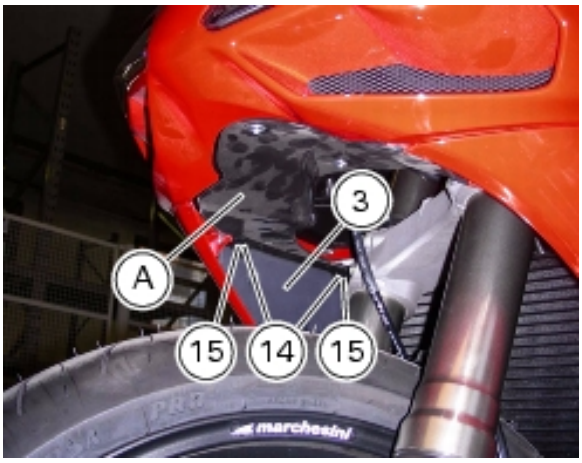
Unscrew the screws (20) securing the bottom of the fairing panels, recovering the washers (21).



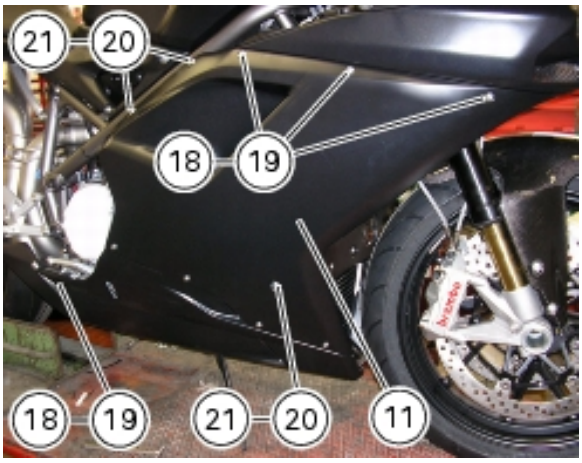
Unscrew the inner screw (19) securing the front of the right upper fairing (11).



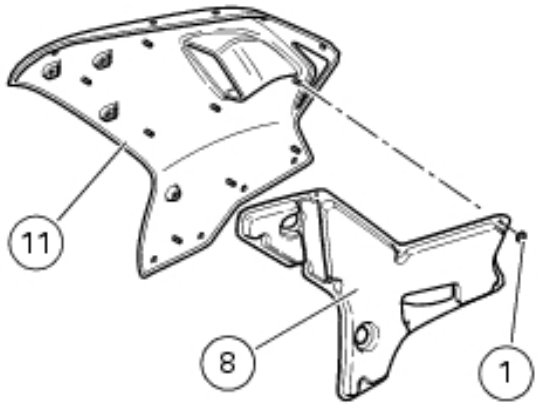
Remove the bolts (14) and bushes (15) securing the splashguard (A) to the inner panel (3).



Unscrew the screws (20) and (19) securing the right upper fairing (11) to the bike, recovering the washers (21) and (18).

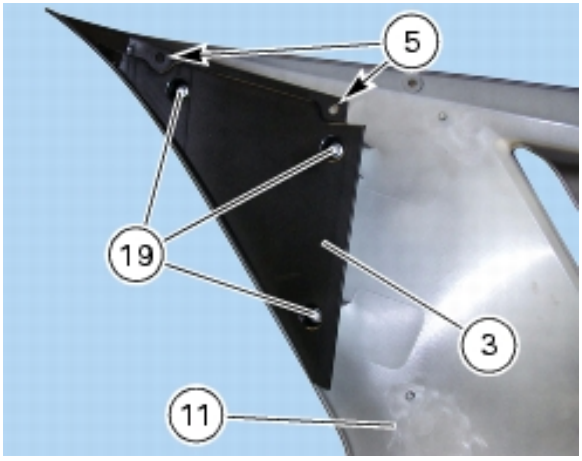


Remove the right side fairing assembly from the motorcycle.
Proceed in the same way with the left side fairing, withdrawing the sidestand through the aperture in the fairing.
To remove the soundproofing panels (**7**) and (8), remove the clips (1).

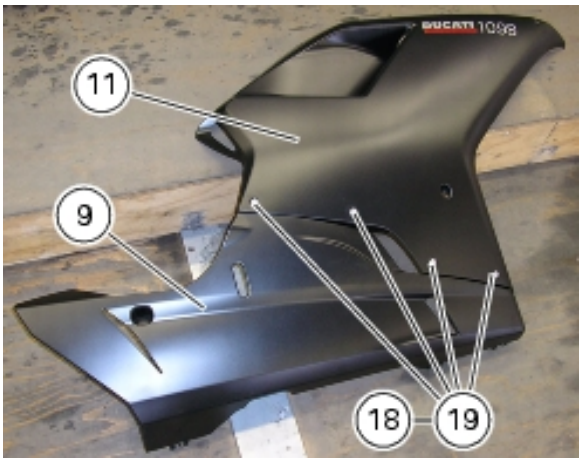


Disassembly and reassembly of the fairing

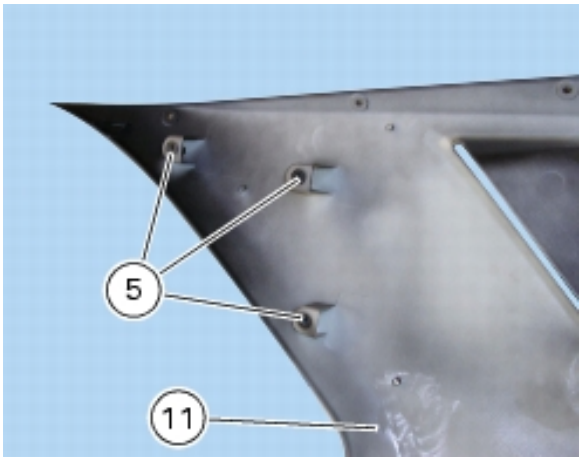
Remove the screws (19) securing the panel (3) and remove it from the upper fairing (11).



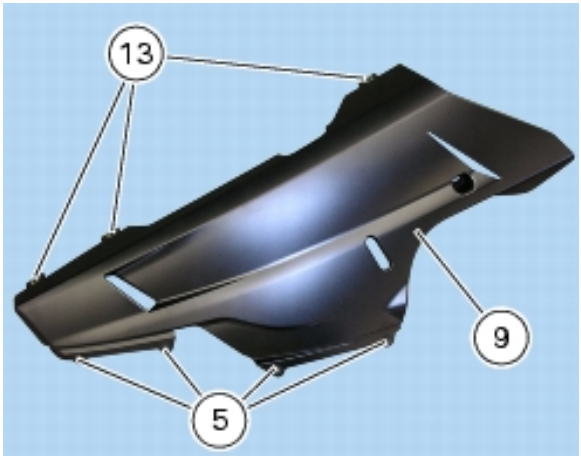
Undo the screws (19) securing the upper fairing (11) to the lower (9), recovering the washers (18).



Repeat the above steps to disassemble the left-hand side fairing.
To reassemble the fairing panels, carry out the steps of the disassembly procedure in reverse order, making sure that the inserts (5) are fitted to the upper fairing (11) and the panel (3).



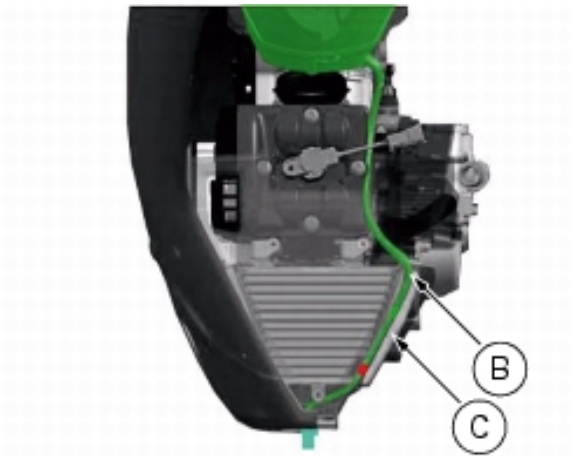
Make sure that the inserts (5) and clips (13) are fitted to the lower fairing (9).



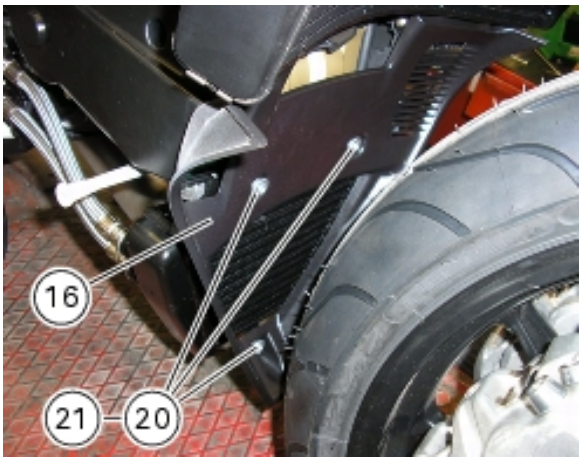
Tighten all the screws to the specified torque (Sect. C 3, Frame torque settings).

Removal of the front shield

Remove the fairing panels as previously described.
Withdraw the drain tube (B) from the guide (C) in the shield.



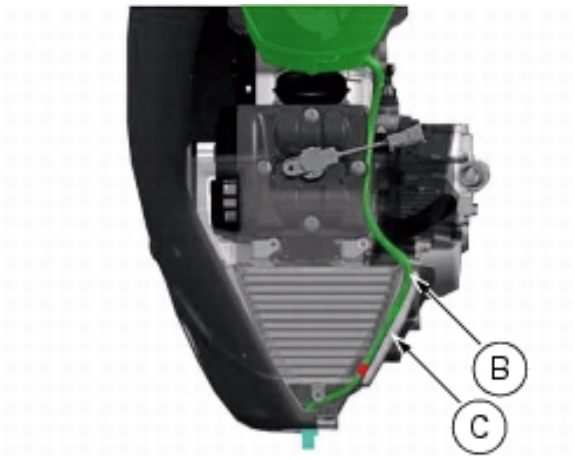
Undo the screws (20) securing the front shield (16) to the oil cooler support bracket.
Remove the front shield (16) from its seating and recover the washers (**21**).



Refitting the front shield

Tighten the screws (20) to the specified torque (Sect. C 3, Frame torque settings).

Insert the drain tube (B) in the guide (C) in the shield.

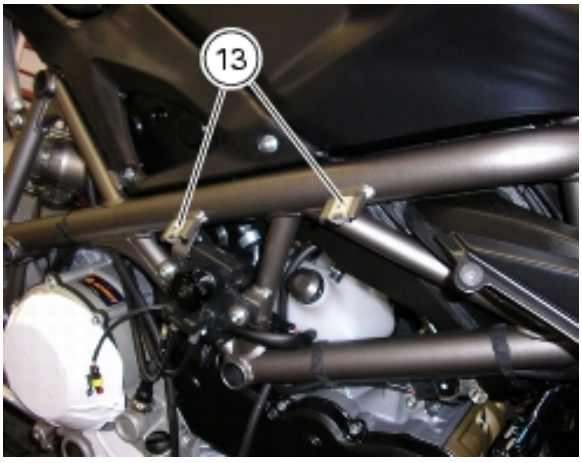


Refitting the side fairings

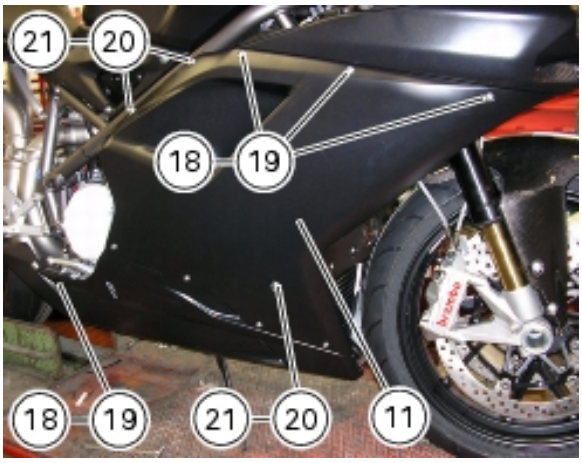
Warning
If parts that have been removed are not refitted correctly they may become loose suddenly while riding and cause you to lose control of your motorcycle.

Important
To avoid damage to painted parts, always fit the nylon washers (21) and (18) in correspondence with the fixing screws.

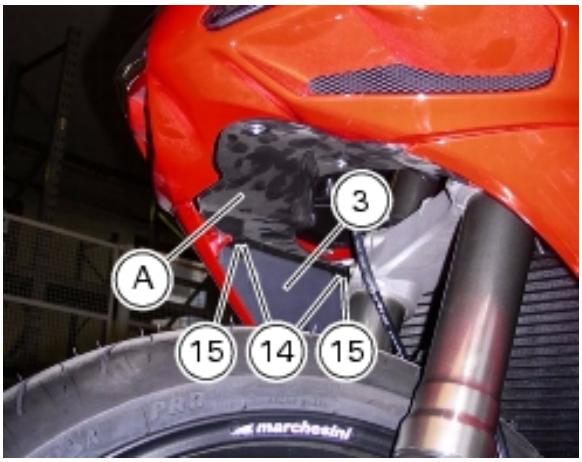
Make sure that the clips (13) are fitted to the frame on both sides of the motorcycle.



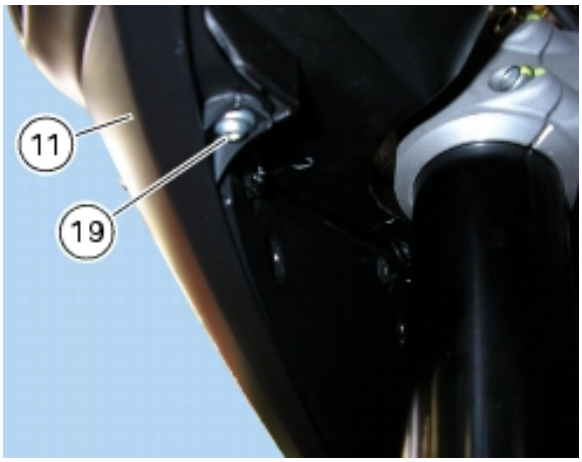
Fit the screws (20) and (19) securing the right upper fairing (11) to the bike, interposing the washers (21) and (18).



Insert the screws (14) and bushes (15) securing the splashguard (A) to the inner panel (3).

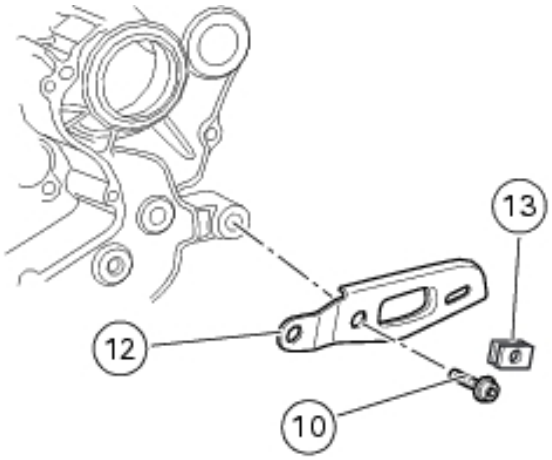


Fit the inner screw (19) securing the front of the right upper fairing (11).



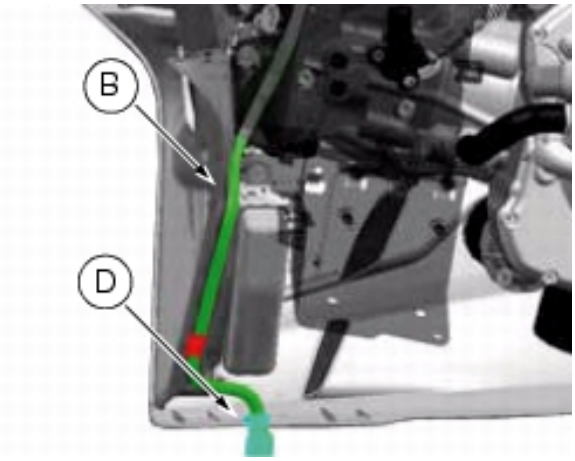
Left fairing mounting bracket

If the bracket (12) was removed, refit it and insert the screw (10). Tighten the screw (10) to the specified torque (Sect. C 3, Frame torque settings). Make sure that the clip (13) is fitted.

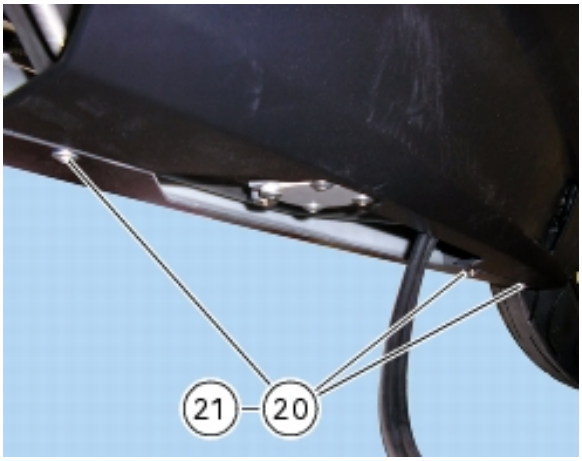


In the same way, refit the left fairing (**4**), taking care when inserting the sidestand through the aperture provided in the fairing panel (6).
Fit the left fairing, attaching it to the front shield and to the right fairing at the bottom.

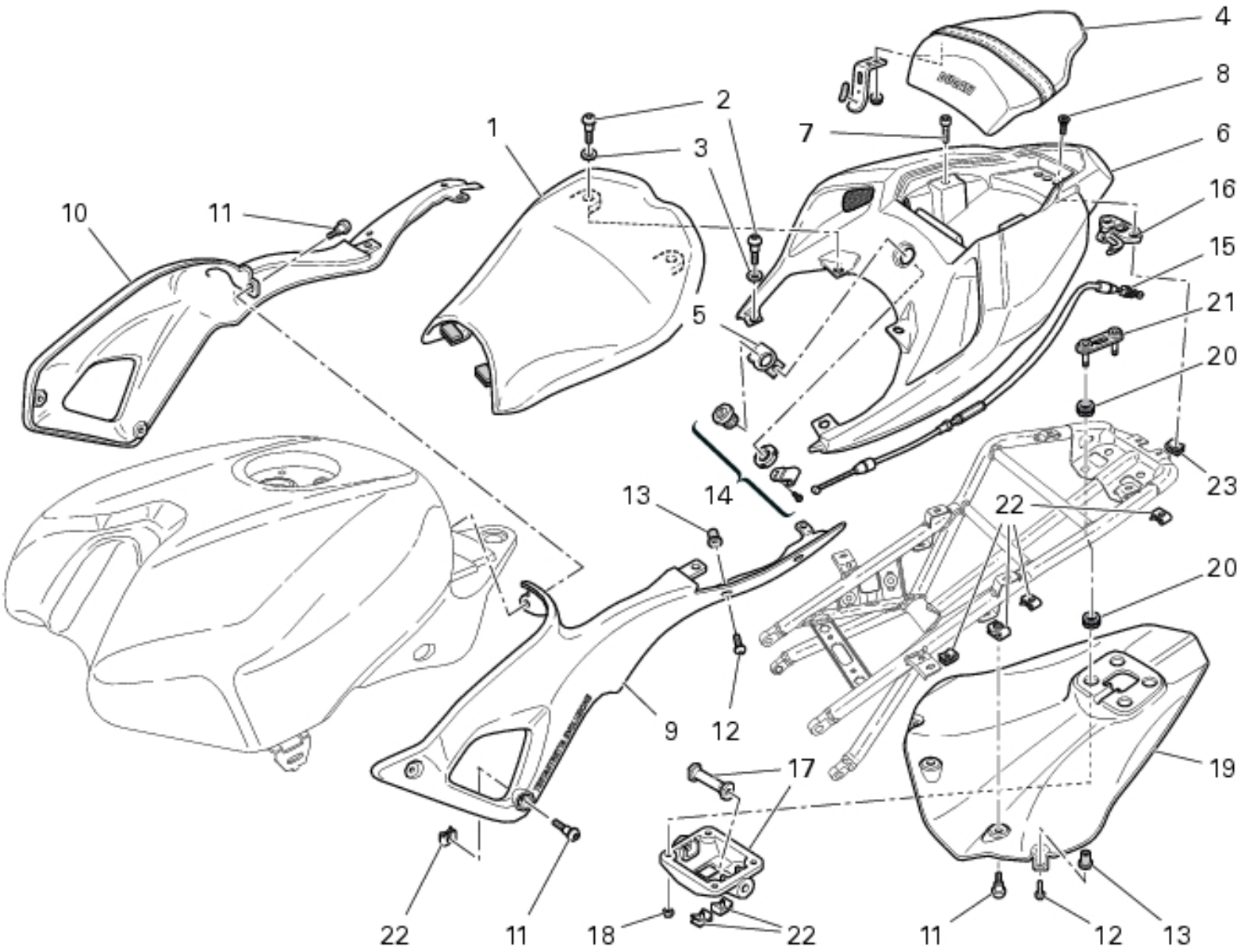
Notes
The rubber (D) on the lower end of the airbox drain tube (B), must be inserted in the hole provided in the fairing.



Fit the screws (20) securing the bottom of the fairing panels, interposing the washers (21).
Tighten all the fairing retaining screws mentioned above to the specified torque (Sect. C 3, Frame torque settings).



3 - Seat – seat cowling and side panels



1 Seat
2 Bolt
3 Washer
4 Pillion seat
5 Bracket
6 Dual seat cowling
7 Bolt
8 Bolt
9 Left side panel
10 Right side panel
11 Bolt
12 Bolt
13 Threaded insert
14 Seat lock
15 Control cable
16 Seat catch
17 Support
18 Nut

19 Undertail heat shield
20 Rubber
21 Flange
22 M5 clip
23 M6 clip

Parts catalogue

Seat

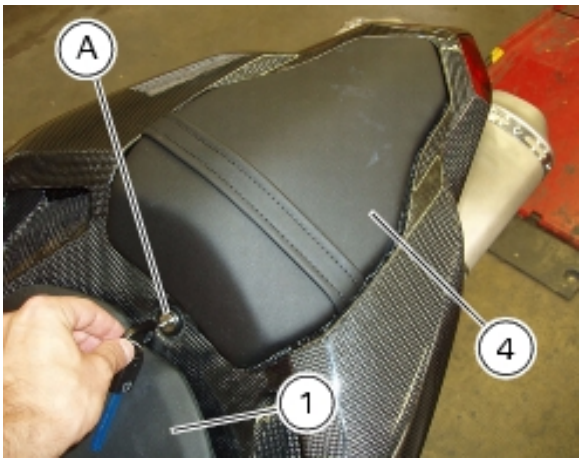
Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the seats

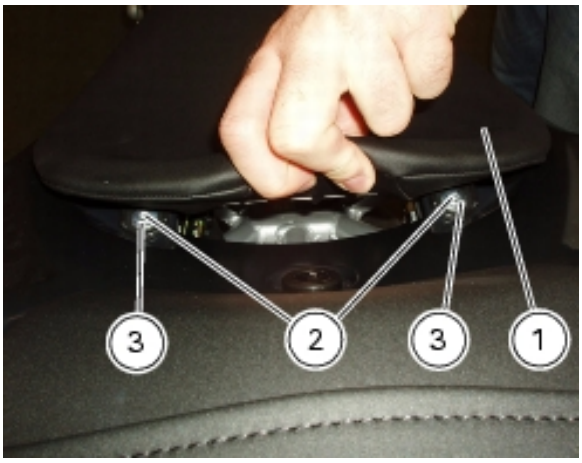
Removal of the pillion seat

Release the pillion seat (4) by opening the lock (A) at the rear of the rider seat (1).
Remove the pillion seat (4) from the bike by pulling it backwards slightly and lifting.



Removal of the rider seat

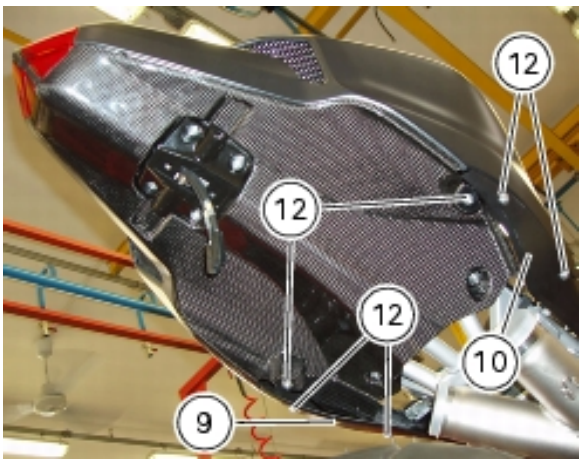
Undo the bolts (2) securing the seat to the subframe and recover the washers (3).
Remove the rider seat (1) from the bike by pulling it backwards slightly and lifting.



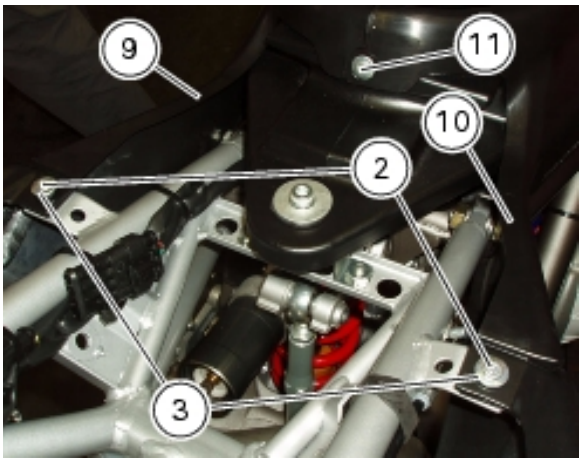
Removal of the side panels and seat cowling

Removal of the side panels

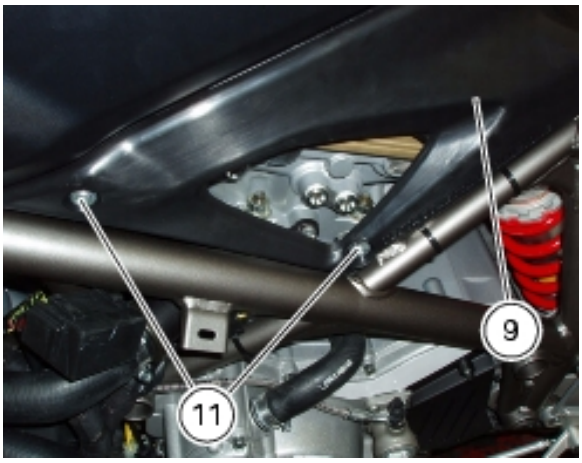
In order to remove the side panels, you first need to remove the seats as described previously.
Unscrew the two bolts (12) securing the rear of the right (10) and left (9) side panels to the rear subframe. Unscrew the four lateral rear retaining bolts (12).



Undo the bolt (11) securing the front of the right (10) and left (9) side panel to the fuel tank. Unscrew the two central retaining bolts (2) of the right (10) and left (9) side panels, recovering the washers (3).

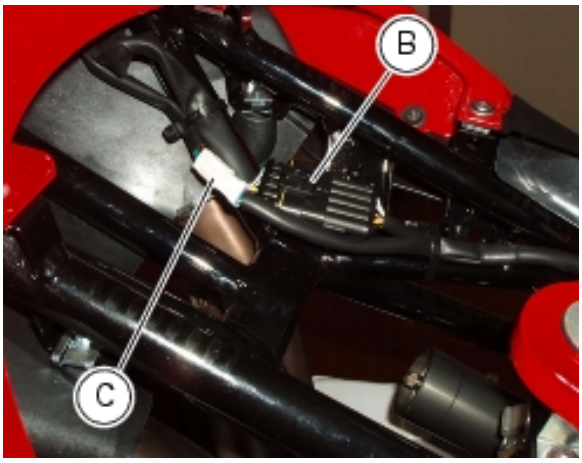


Unscrew the two front retaining bolts (11) of the right (10) and left (9) side panels. Remove the two side panels from the bike.

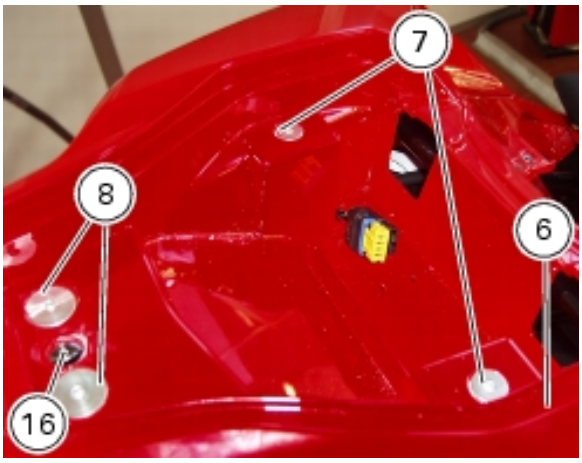


Removal of the seat cowling

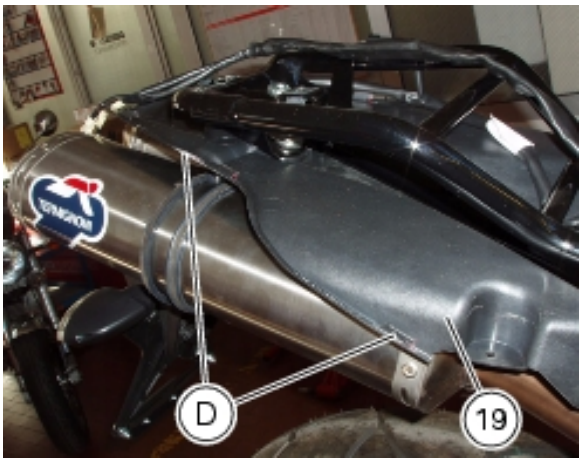
In order to remove the seat cowling, you first need to remove the seats and side panels as described previously. Disconnect the wiring connectors (B) of the rear wiring loom and the connector (C) of the data acquisition wiring.



Unscrew the two upper bolts (7) securing the seat cowling (6). Unscrew the two bolts (8) securing the catch for the lock (16).

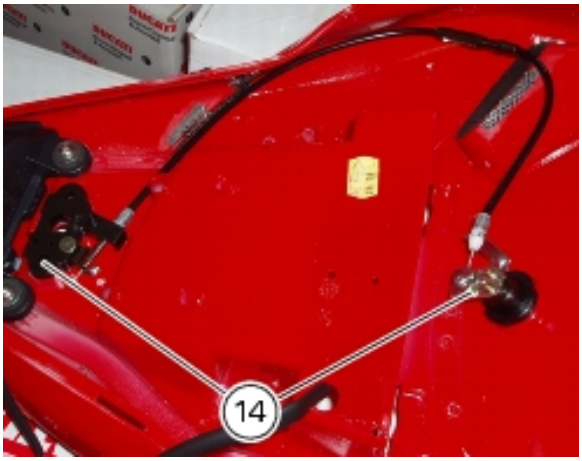


Remove the seat cowling (6) from the heat shield (19), pushing the cowling towards the front of the bike while simultaneously lifting it to disengage the catches (D) on the heat shield (19) from the corresponding locations on the seat cowling (6).

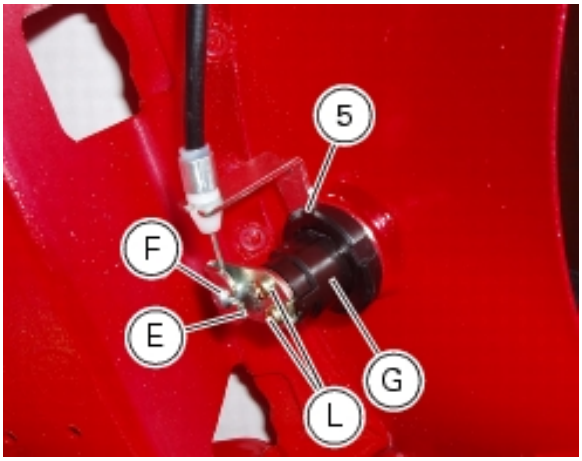


Removal of the seat release mechanism

The seat release mechanism (14) is located under the seat cowling.



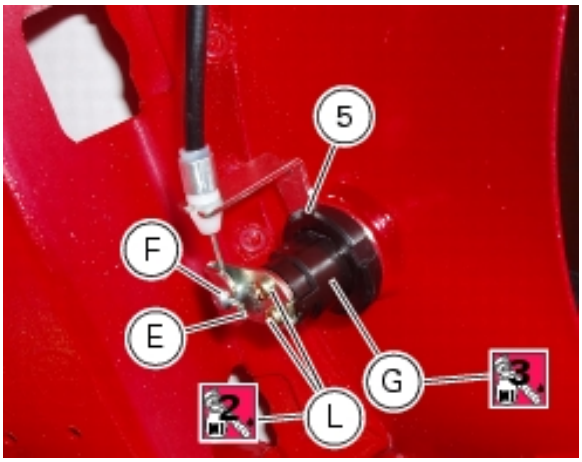
Unscrew the two retaining bolts (L) and remove the lever (E).
Disconnect the end fitting (F) of the release control cable from the lever (E).
Remove the fuel tank/seat assembly.
Unscrew the nut (G) and remove the lock (H) from the plate (5).



Disconnect the end fitting (M) of the release cable from the catch.

Refitting the seat release mechanism

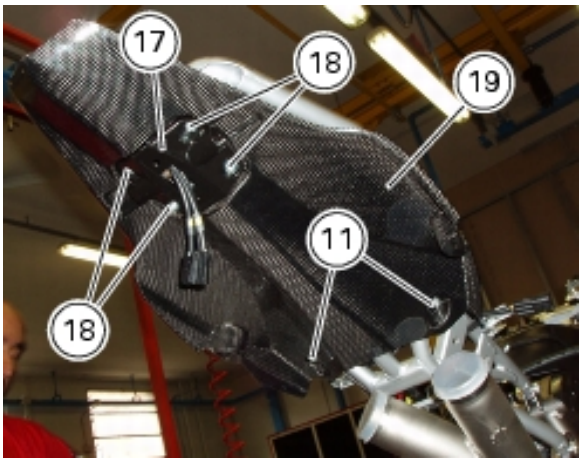
Refitting is the reverse of removal.
Apply threadlocker to the nut (G) and the bolts (L).



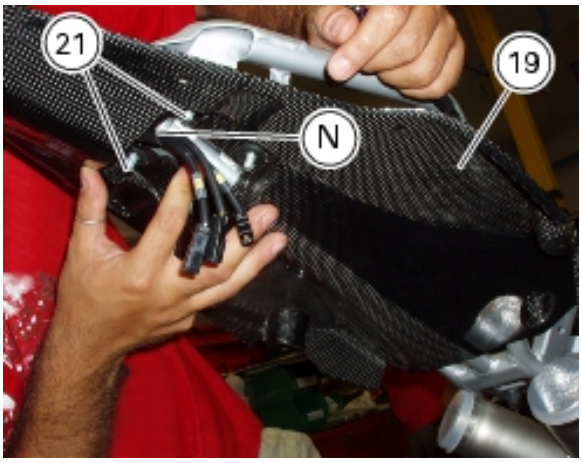
Removal of the seat cowling heat shield

Remove the exhaust silencers and their clamps as indicated in Sect. L 8, Removal of the exhaust system.

In order to remove the seat cowling heat shield, you first need to remove the seats, side panels and seat cowling as described previously.
Unscrew the lower front bolts (11) securing the heat shield (19). Undo the retaining nuts (18) and remove the support (17).

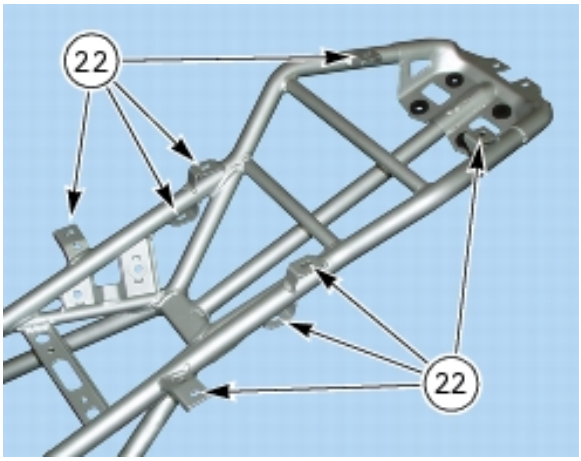


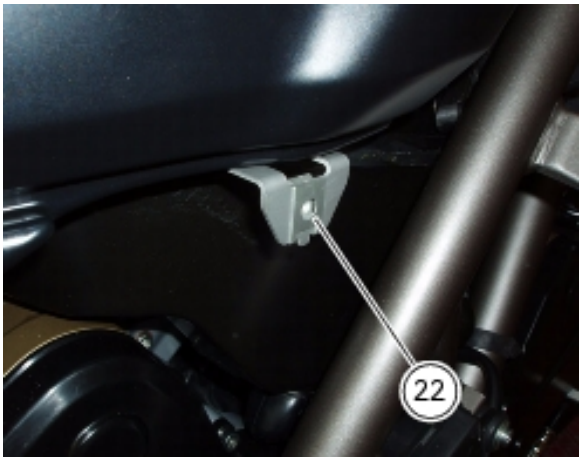
Remove the heat shield (19) from the flanges (21), freeing the wiring (N).

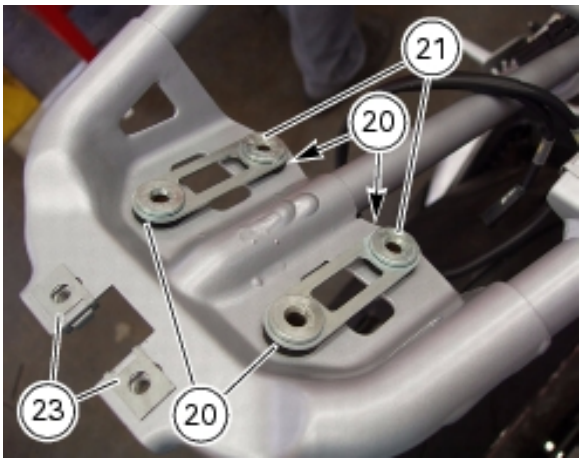


Refitting the side panels and seat cowling

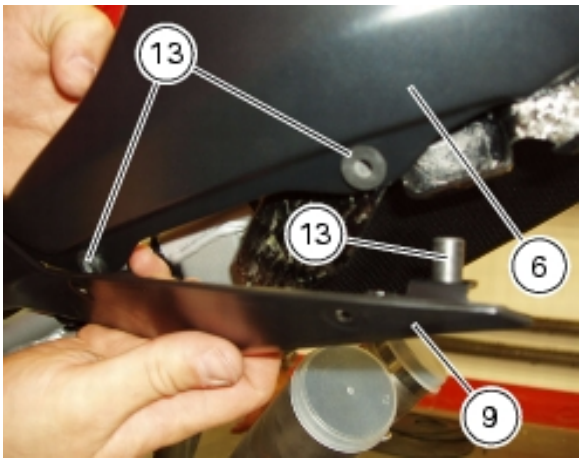
Make sure that the M5 clips (22), M6 clips (23), rubber mountings (20) and the flanges (21) are all fitted to the bike.





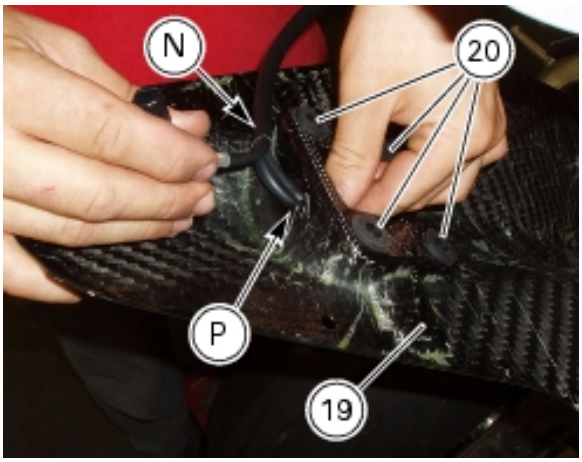


Check that threaded inserts (13) are present on the seat cowling (6) and on side panels (9) and (10).



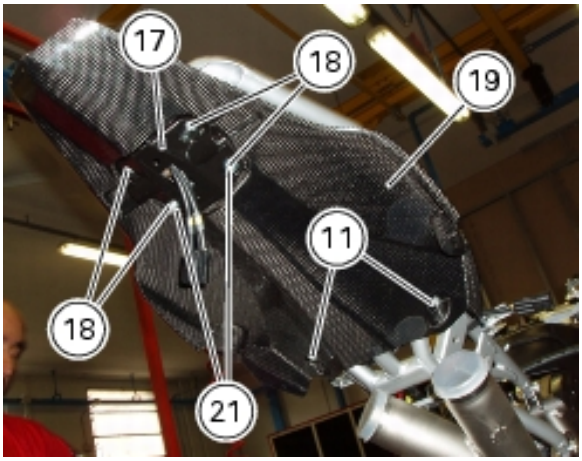
Check that the rubber mountings (20) are present on the heat shield (19). Offer the shield (19) up to the subframe

and feed the wiring (N) through the aperture (P).



Refitting the seat cowling heat shield

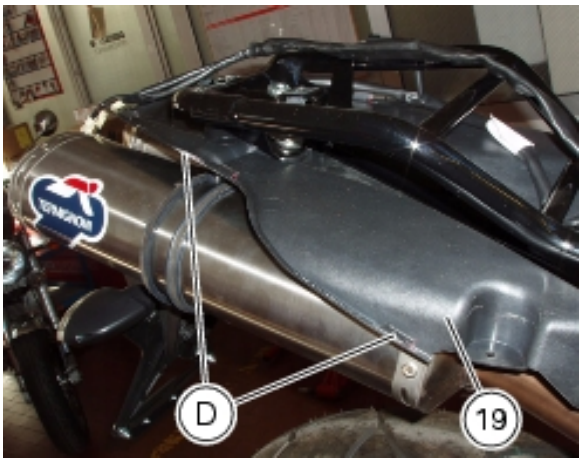
Refit the heat shield (19) to the flanges (21). Position the support (17) and tighten the nuts (18). Refit the lower front bolts (11) securing the heat shield (19). Tighten the bolts (11) and nuts (18) to the specified torque (Sect. C 3, Frame torque settings).



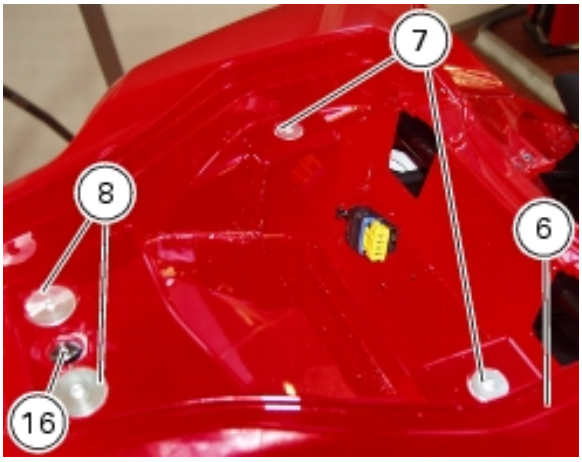
Refit the exhaust silencers and the relative clamps as indicated in Sect. L 8, Refitting the exhaust system.

Refitting the seat cowling

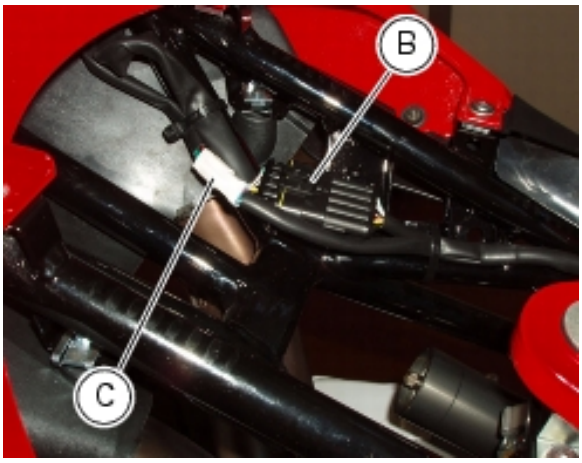
Refit the seat cowling (6) to the heat shield (19), pushing the cowling towards the rear of the bike so that it engages the catches (D) on the shield (19).



Refit the two upper bolts (7) securing the seat cowling (6). Refit the two bolts (8) securing the catch for the lock (16). Check that the catch of the seat release mechanism (16) is fixed correctly and the release cable is not pinched. Tighten the bolts (7) and (8) to the specified torque (Sect. C 3, Frame torque settings).

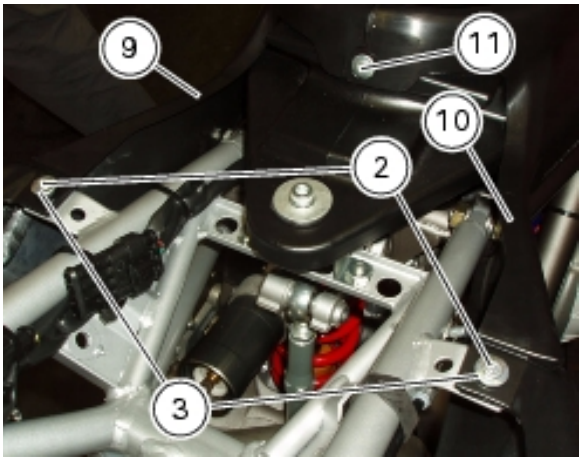


Reconnect the wiring connectors (B) of the rear wiring loom and the connector (C) of the data acquisition wiring.

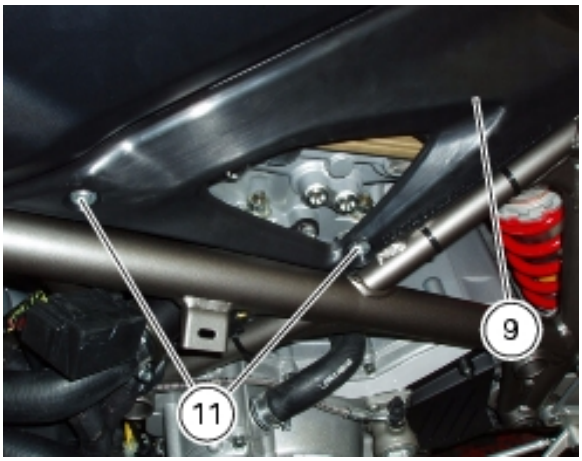


Refitting the side panels

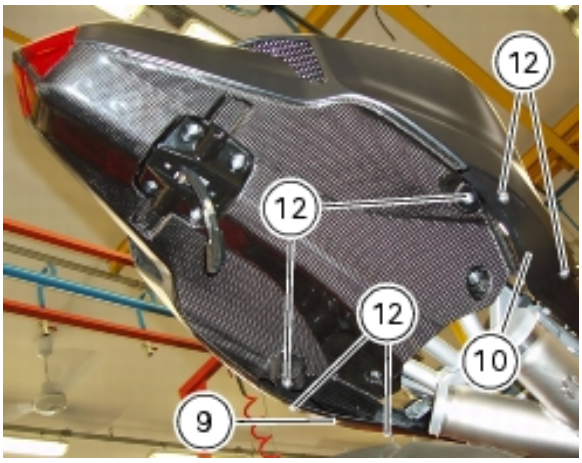
Position the left side panel (9) on the bike first and then the right (10) and fit the bolt (11) that connects the two side panels together and to the fuel tank. Fit the washers (3) on the bolts (2) and secure the central parts of the side panels to the rear subframe.



Refit the two front retaining bolts (11) of the right (10) and left (9) side panels.



Fit the four bolts (12) securing the rear of the right (10) and left (9) side panels to the rear subframe. Fit the two lateral rear retaining bolts (12). Tighten the bolts (11), (2) and (12) to the specified torque (Sect. C 3, Frame torque settings).

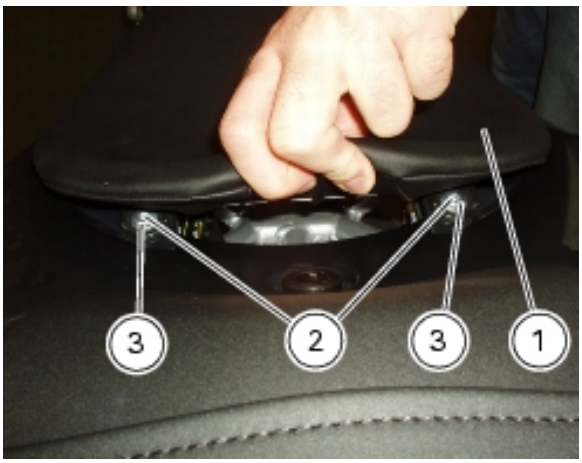


Refitting the seats

Refitting the rider seat

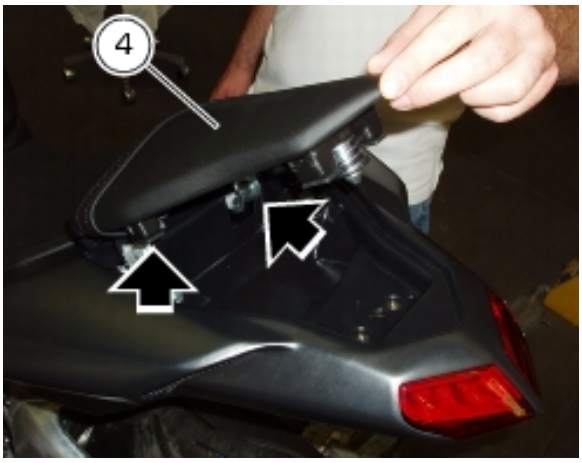
Position the seat (1) on the bike pushing it against the fuel tank so that the front catches engage the corresponding locations on the fuel tank.

Fit the washers (3) on the bolts (2) and fit them in the rear slots of the seat (1) to secure it to the rear subframe.
Tighten the bolts (2) to the specified torque (Sect. C 3, Frame torque settings).

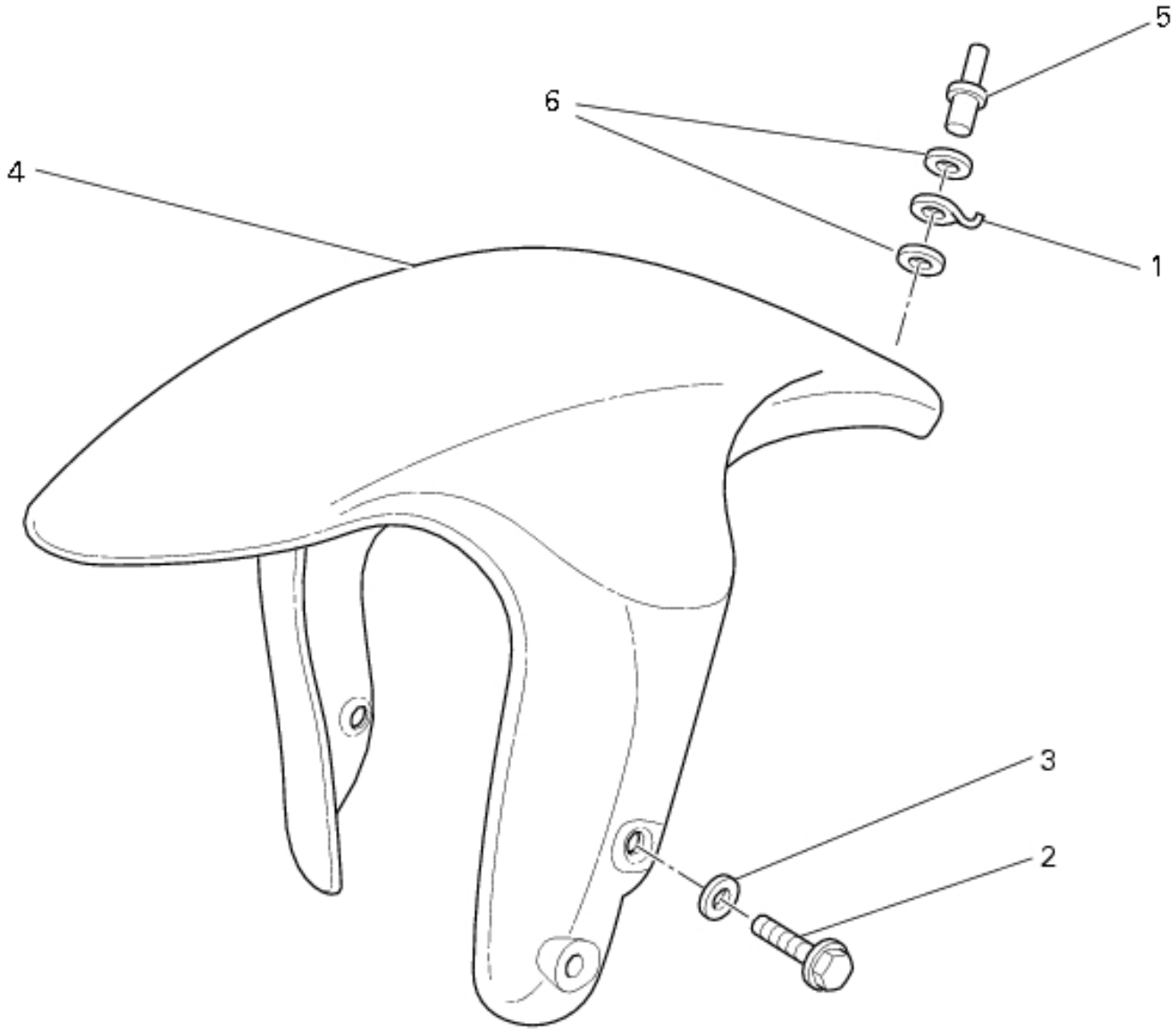


Refitting the pillion seat

Refit the pillion seat (4) and fit the catches on the seat base under the frame cross tube.
Press down on the pillion seat until you hear the catch engage with an audible click.
Make sure that the pillion seat (4) is fully engaged by lightly pulling it upwards.


4

4 - Front mudguard



1 Clip
2 Bolt
3 Nylon washer
4 Front mudguard
5 Rivet
6 Washer

Parts catalogue

FAIRING

Important

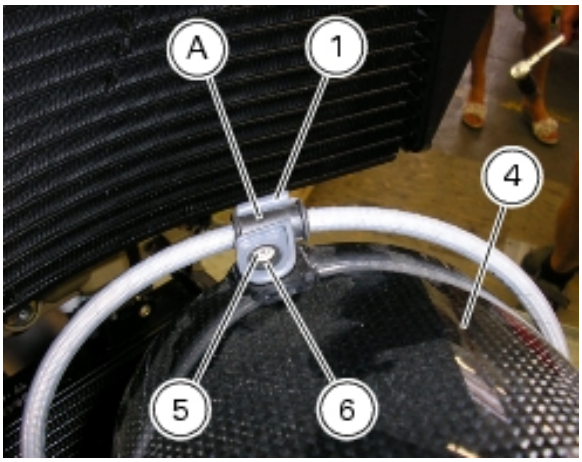
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the front mudguard

Disconnect the brake hose (A) from the clip (1).
Remove the retaining bolts (2) and recover the nylon washers (3).
Remove the front mudguard (4).

Notes

The clip (1) is secured to the front mudguard by means of a shear rivet (5) with two washers (6).

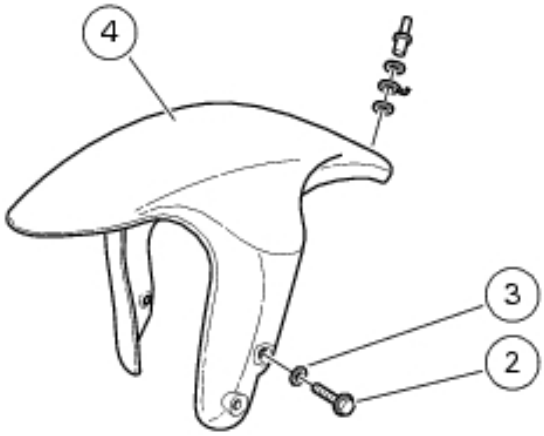


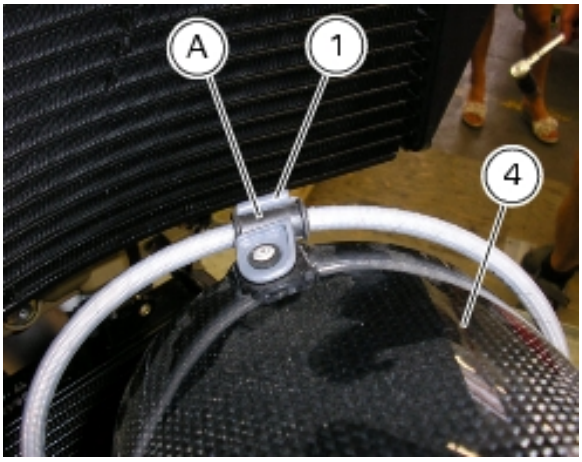
Refitting the front mudguard

Warning

Do not ride the motorcycle without the front mudguard. The front mudguard also acts as a brake hose support and prevents the brake hose from fouling the wheel when braking.

Position the front mudguard (4) and refit the retaining bolts (2) with the washers (3).
Locate the front brake hose grommet (A) in the mudguard clip (1).
Tighten the bolts (2) to the specified torque (Sect. C 3, Frame torque settings).


4
3
2


A
1
4

4
2

1 - Throttle twistgrip 3
Adjusting the throttle cable 4
Removal of the throttle twistgrip 4
Refitting the throttle twistgrip 5

2 - Hydraulic clutch control 7
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Refitting the clutch master cylinder assembly 9
Removal of the clutch slave cylinder 10
Refitting the clutch slave cylinder 12

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4 - Rear brake control 18
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Disassembly of the gearchange mechanism 24
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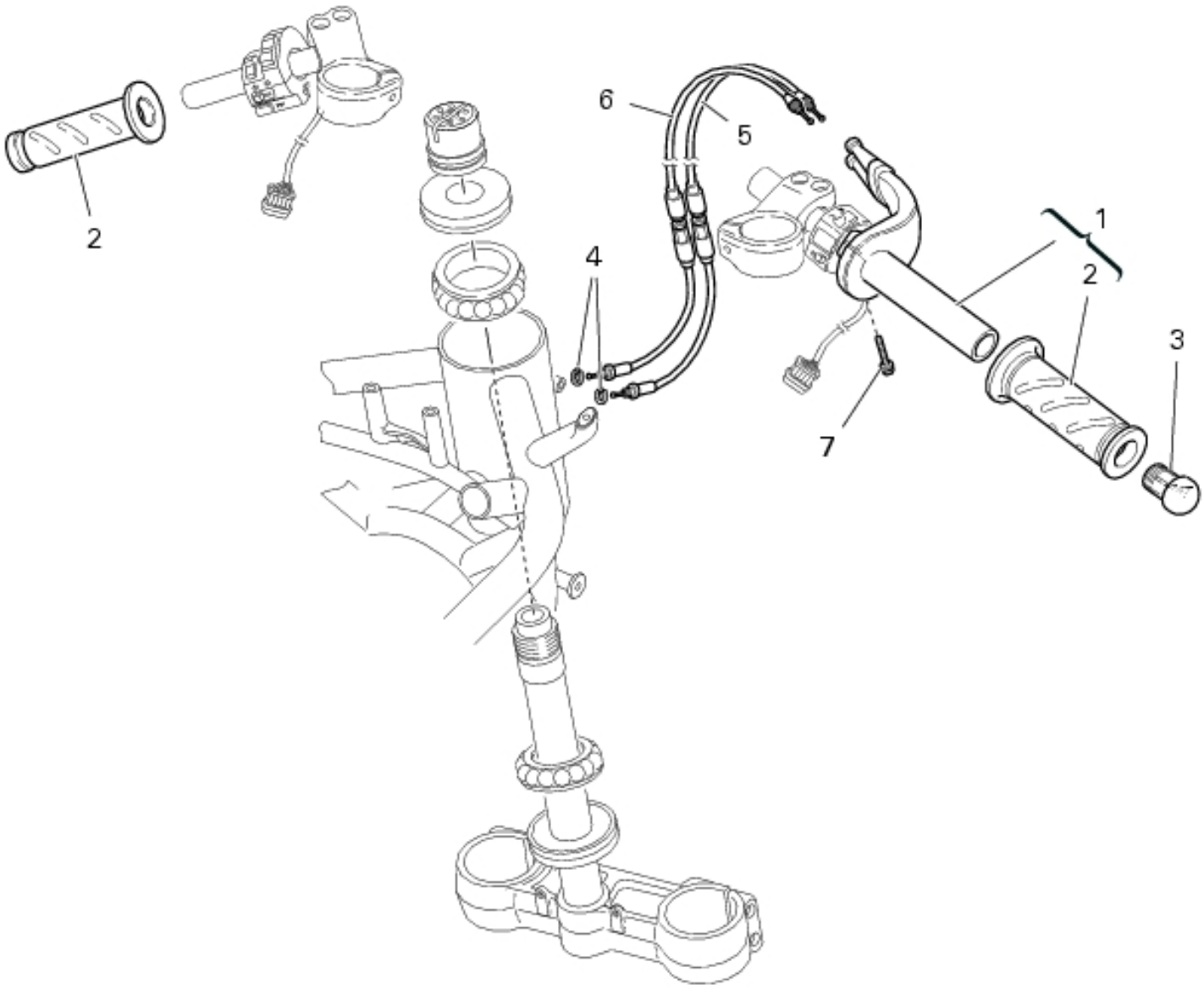
0F - Controls - Devices

1 - Throttle twistgrip



1 Throttle twistgrip
2 Grips
3 Plug
4 Circlip
5 Throttle opening cable
6 Throttle closing cable
7 Bolt

Parts catalogue

HANDLEBARS and controls

Important

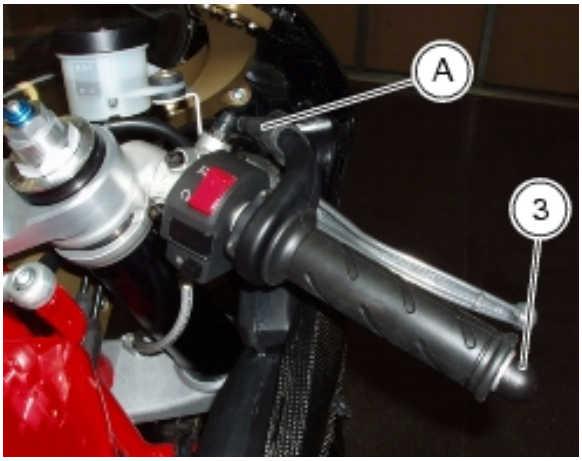
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Adjusting the throttle cable

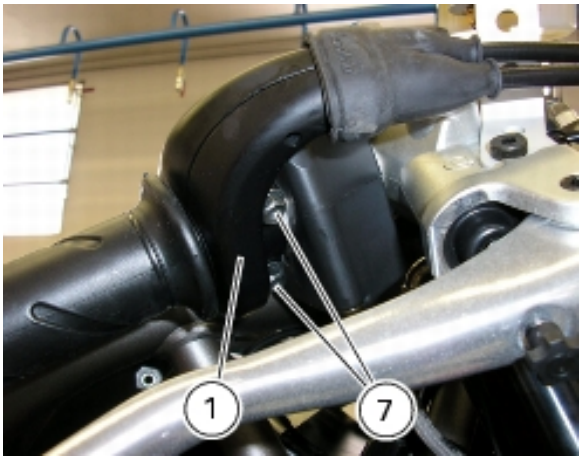
For instructions on how to adjust the throttle cable, see Sect. D 4, Adjusting the throttle cable.

Removal of the throttle twistgrip

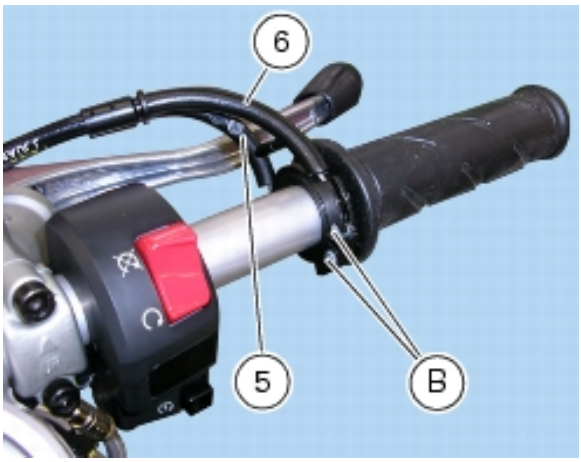
Remove the end plug (3) from the handlebar.
Peel back the rubber sleeve (A) protecting the throttle control cables.



Undo the screws (7) of the twistgrip (1) and open the housing.



Disconnect the throttle opening (5) and closing (6) cables by unhooking the cable ends (B) from their seats.
Remove the throttle twistgrip (1) from the right-hand handlebar.



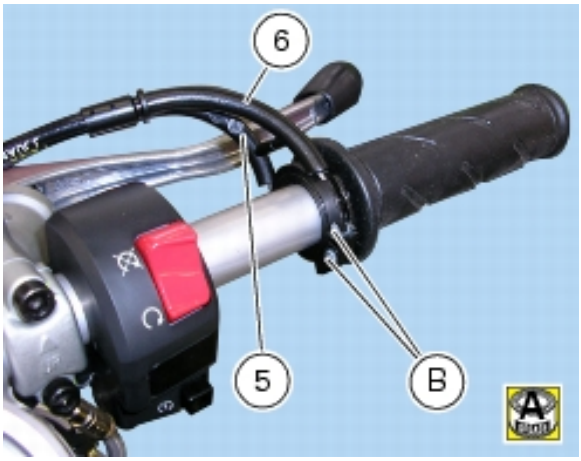
Notes

To renew the throttle cables, disconnect them from the throttle body as described in Sect. L 6, Refitting the airbox and throttle body.

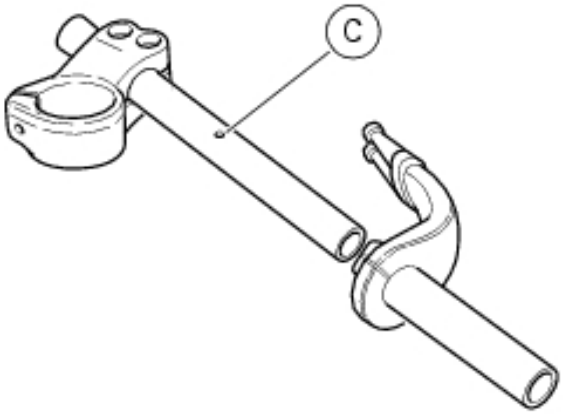
Replacement throttle cables are supplied complete with adjusters.

Refitting the throttle twistgrip

Lubricate the ends of the throttle cables (5) and (6) and the twistgrip race with the recommended grease.



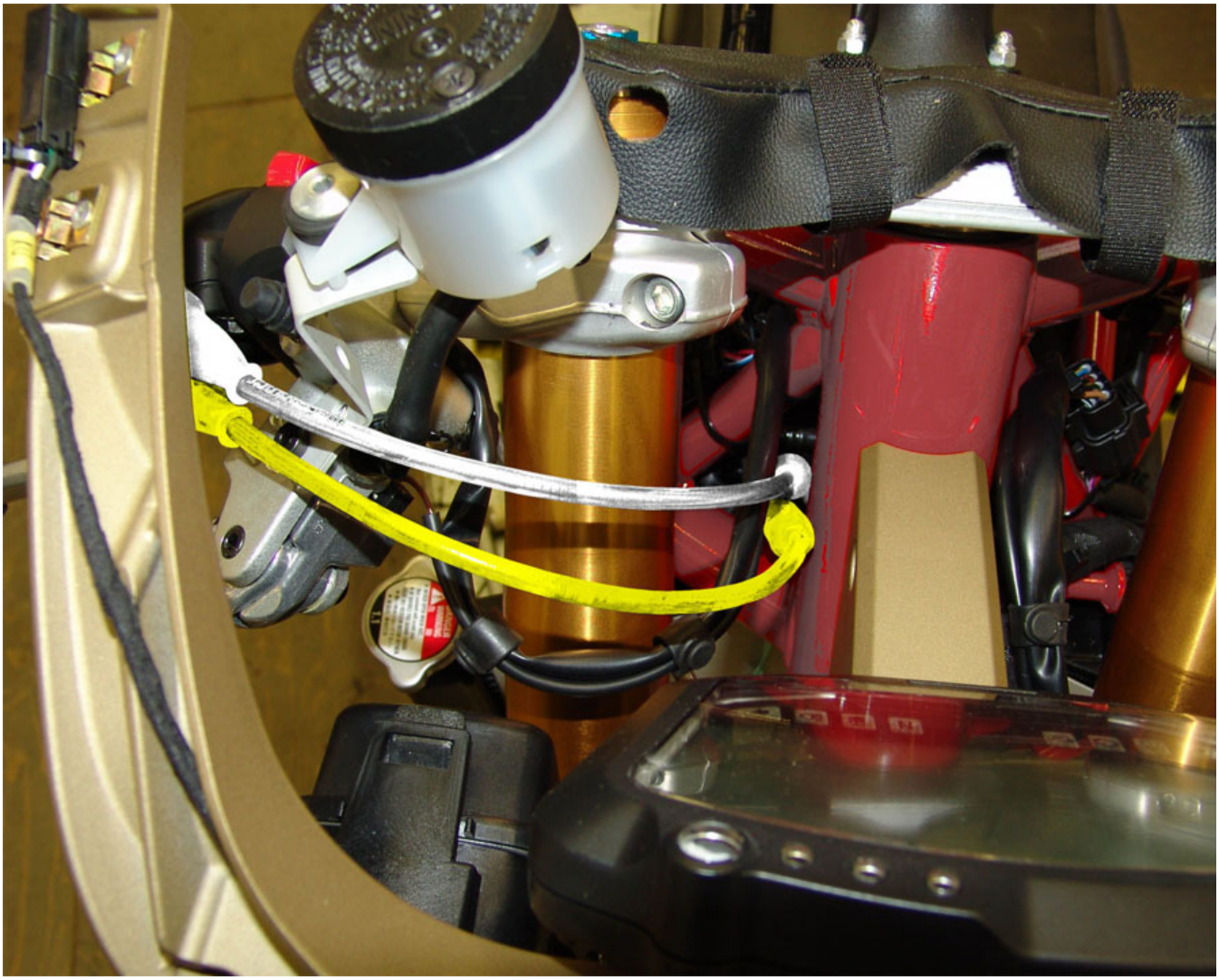
To refit the throttle control components, proceed in inverse order to the disassembly procedure, making sure that the throttle covers locate in the reference hole (C) in the handlebar.



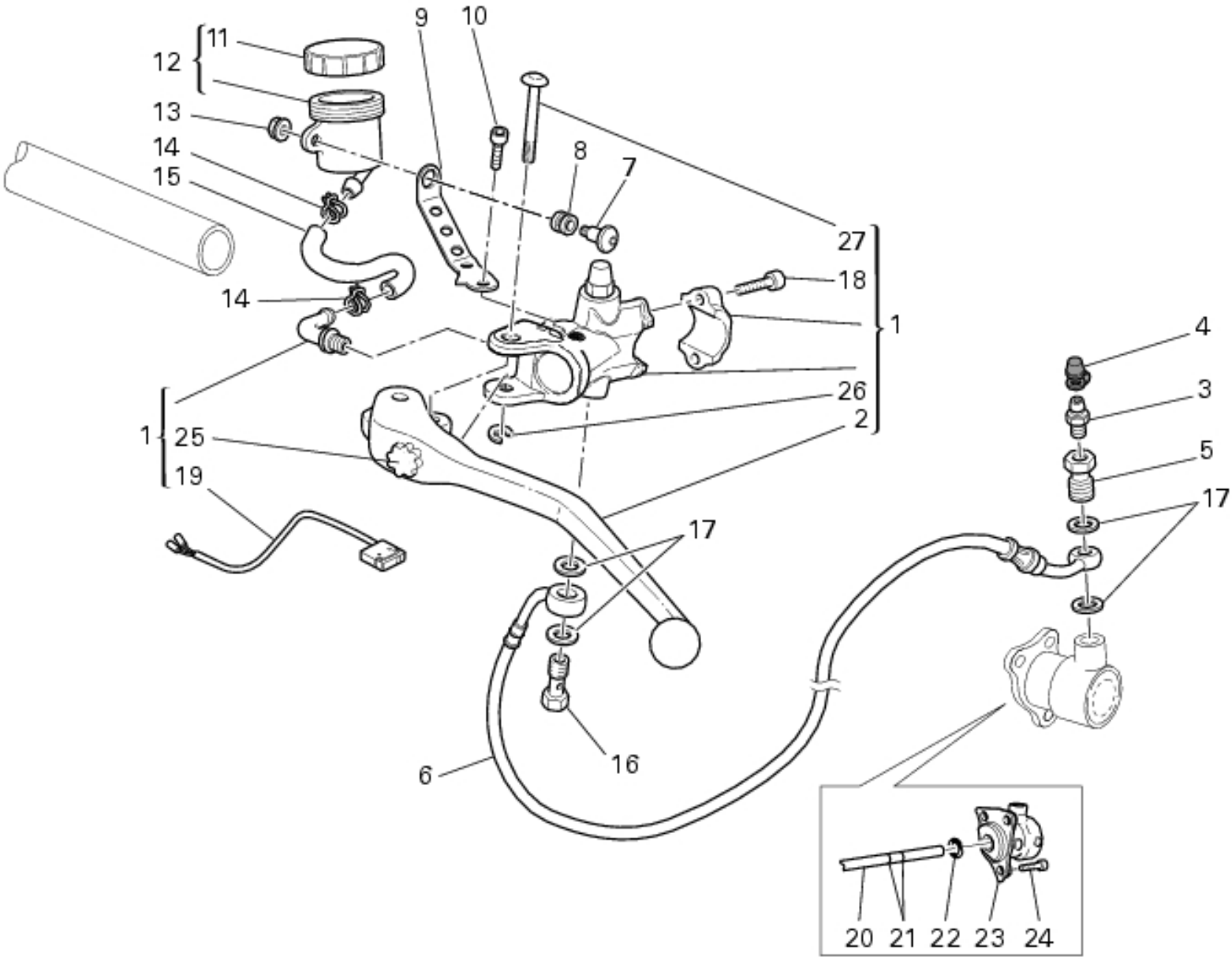
Notes

Refer to the figures at the end of the chapter for correct routing of the throttle control cables.

Throttle cable routing



2 - Hydraulic clutch control



1 Clutch master cylinder
2 Lever
3 Bleed valve
4 Dust cap
5 Banjo bolt
6 Clutch control hose
7 Bolt
8 Rubber mounting
9 Bracket
10 Bolt
11 Cover
12 Fluid reservoir assembly
13 Nut
14 Hose clip
15 Hose
16 Banjo bolt
17 Sealing washer
18 Bolt

19 Microswitch
20 Clutch pushrod
21 O-ring
22 O-ring
23 Clutch slave cylinder
24 Bolt
25 Adjuster screw
26 Circlip
27 Banjo bolt

Parts catalogue

Clutch control

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

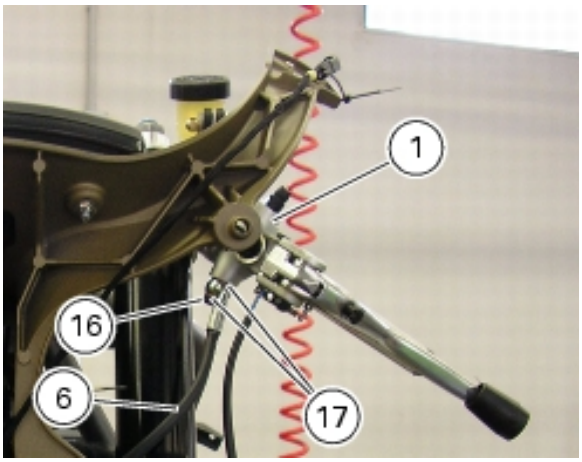
Removal of the clutch master cylinder assembly

Warning
The clutch master cylinder manufacturer advises against servicing of the clutch master cylinder (1) due to the safety-critical nature of this component. Incorrect overhaul of these critical safety components can endanger rider and passenger safety.

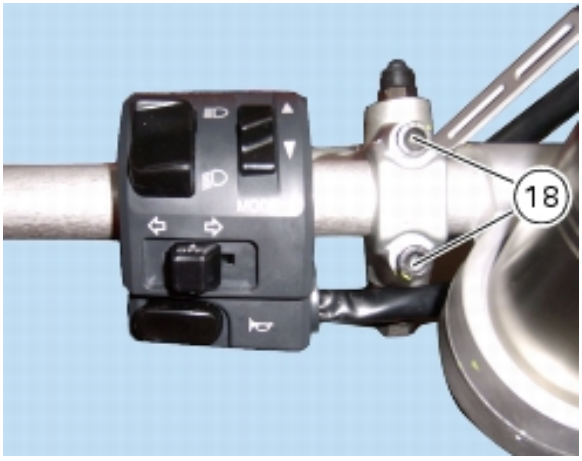
Maintenance operations of the master cylinder are limited to replacing the following parts: control lever, reservoir unit, and master cylinder fasteners.

Operation	Section reference
Drain the clutch system	D 4, Draining the clutch hydraulic circuit

Unscrew the banjo bolt (16) recovering the sealing washers (17), to release the clutch master cylinder assembly (1) from the clutch control hose (6).



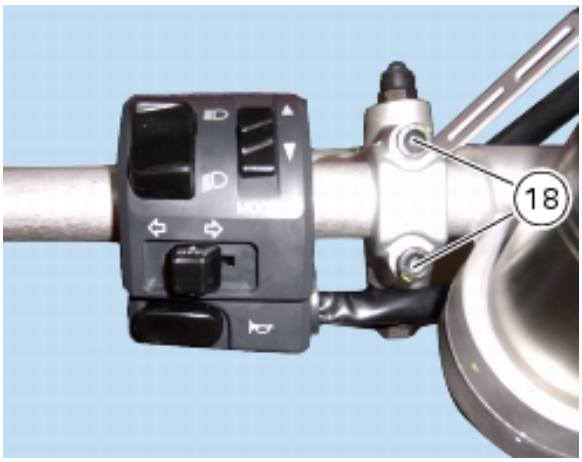
Unscrew the two clamp bolts (18) securing the clutch master cylinder assembly to the handlebar.



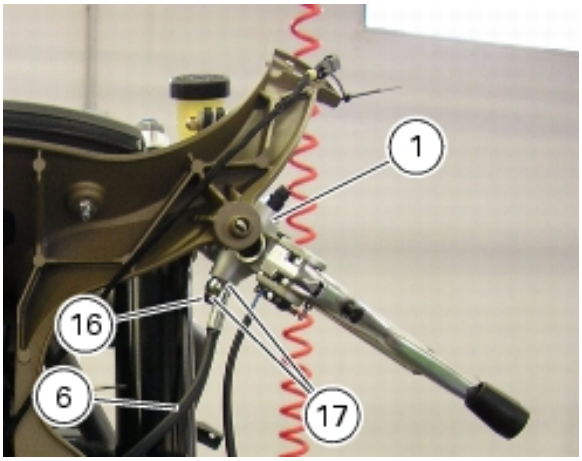
Refer to the exploded view at the beginning of this section for indications on disassembly and replacement of the master cylinder components.

Refitting the clutch master cylinder assembly

Locate the complete master cylinder assembly (1) on the handlebar, aligning it with the locating grub screw. Tighten the retaining bolts (18) to the specified torque (Sect. C 3, Frame torque settings), in the sequence 1-2-1.



Locate the hose (6) and sealing washers (17) on the master cylinder (1) and secure with the banjo bolt (16), but do not tighten at this stage.

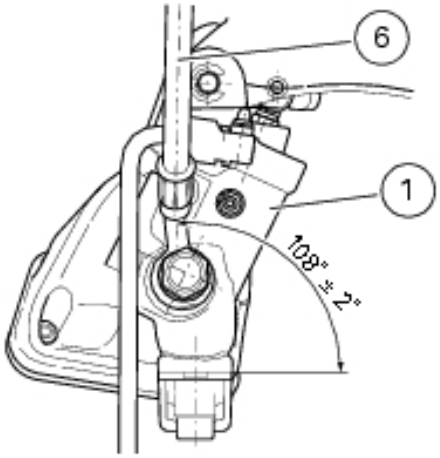


Warning

An incorrectly positioned hose can cause clutch faults and interfere with moving parts.

For the positioning of the clutch hose (6) and retaining clips, see the illustration at the end of this section. Locate the hose (6) as shown in the figure, then tighten the banjo bolt (16) to the specified torque (Sect. C 3, Frame

torque settings).



Operation	Section reference
Fill the clutch system with fluid	D 4, Filling the clutch circuit

Removal of the clutch slave cylinder

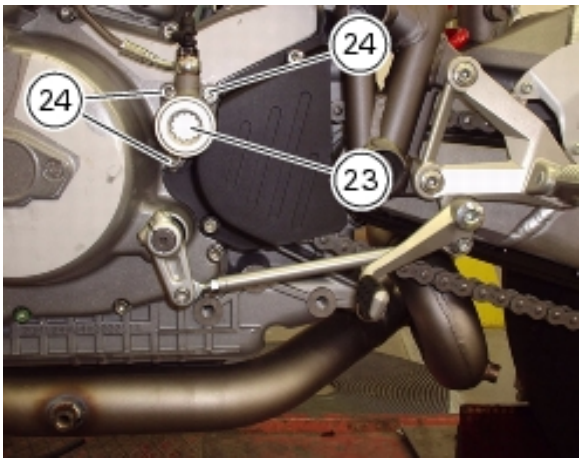
Warning

The clutch slave cylinder manufacturer advises against servicing the internal components of the slave cylinder (23) due to the safety-critical nature of the unit.
Incorrect overhaul of these critical safety components can endanger rider and passenger safety.

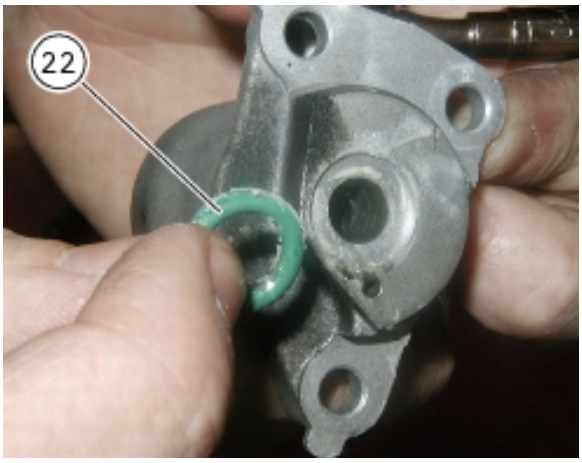
The only components that should be renewed are the complete clutch slave unit, the bleed valve, the O-ring seal and the clutch pushrod assembly.

Operation	Section reference
Drain the clutch system	D 4, Draining the clutch hydraulic circuit
Remove the left-hand fairing	E 2, Removal of the side fairings

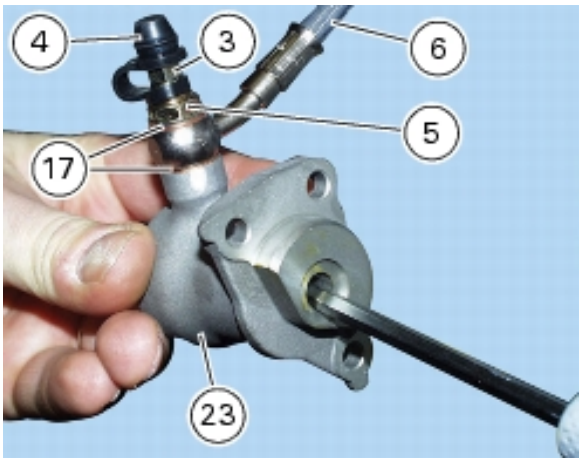
Undo the three bolts (24) securing the clutch slave cylinder (23) to the engine.



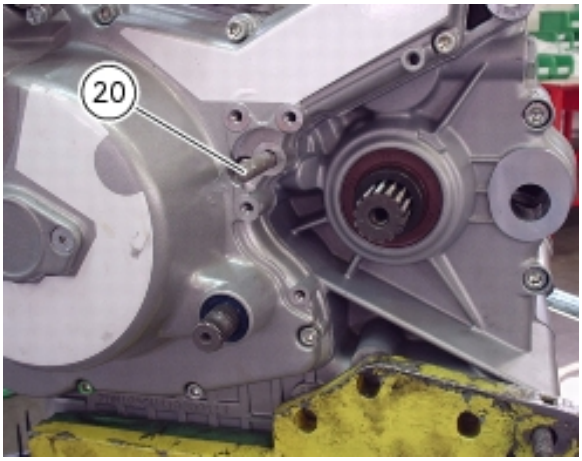
Remove the clutch slave cylinder from the crankcase, taking care to recover the internal O-ring (22).



Remove the dust cap (4) and the bleed valve (3) and unscrew the banjo bolt (5), taking care to recover the sealing washers (17): the unit (23) is now disconnected from hose (6).
Push in the piston to force out all the fluid from inside the cap.

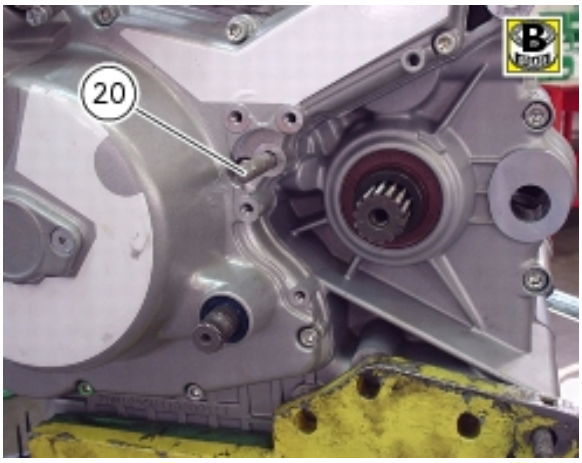


The clutch pushrod (20) can now be removed. Inspect both O-rings (**21**) for wear and renew them if necessary.

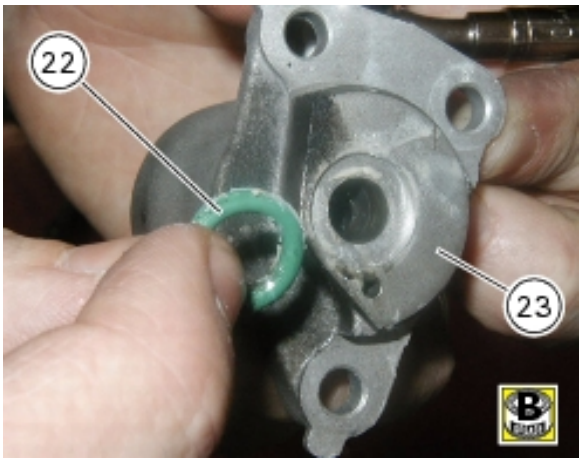


Refitting the clutch slave cylinder

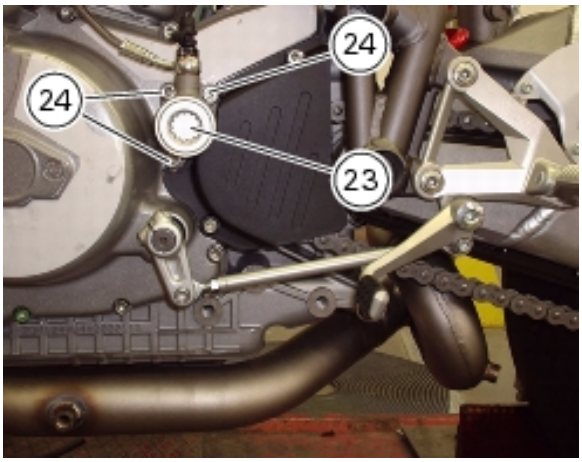
Grease and refit the clutch pushrod (20) with the two O-rings (**21**).



Lubricate the seal (22) and locate it along with the slave cylinder (23) in the crankcase.



Tighten the bolts (24) to the specified torque (Sect. C 3, Frame torque settings).



Locate the hose (6) on the slave cylinder (23), ensuring that the hose end fitting is correctly positioned relative to the slave cylinder.

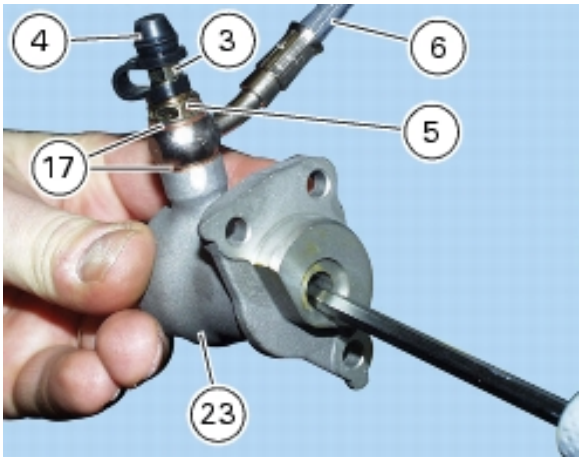
Warning

An incorrectly positioned hose can cause clutch faults and interfere with moving parts.

Locate the two sealing washers (17) and tighten the banjo bolt (5) to the specified torque (Sect. C 3, Frame torque settings).

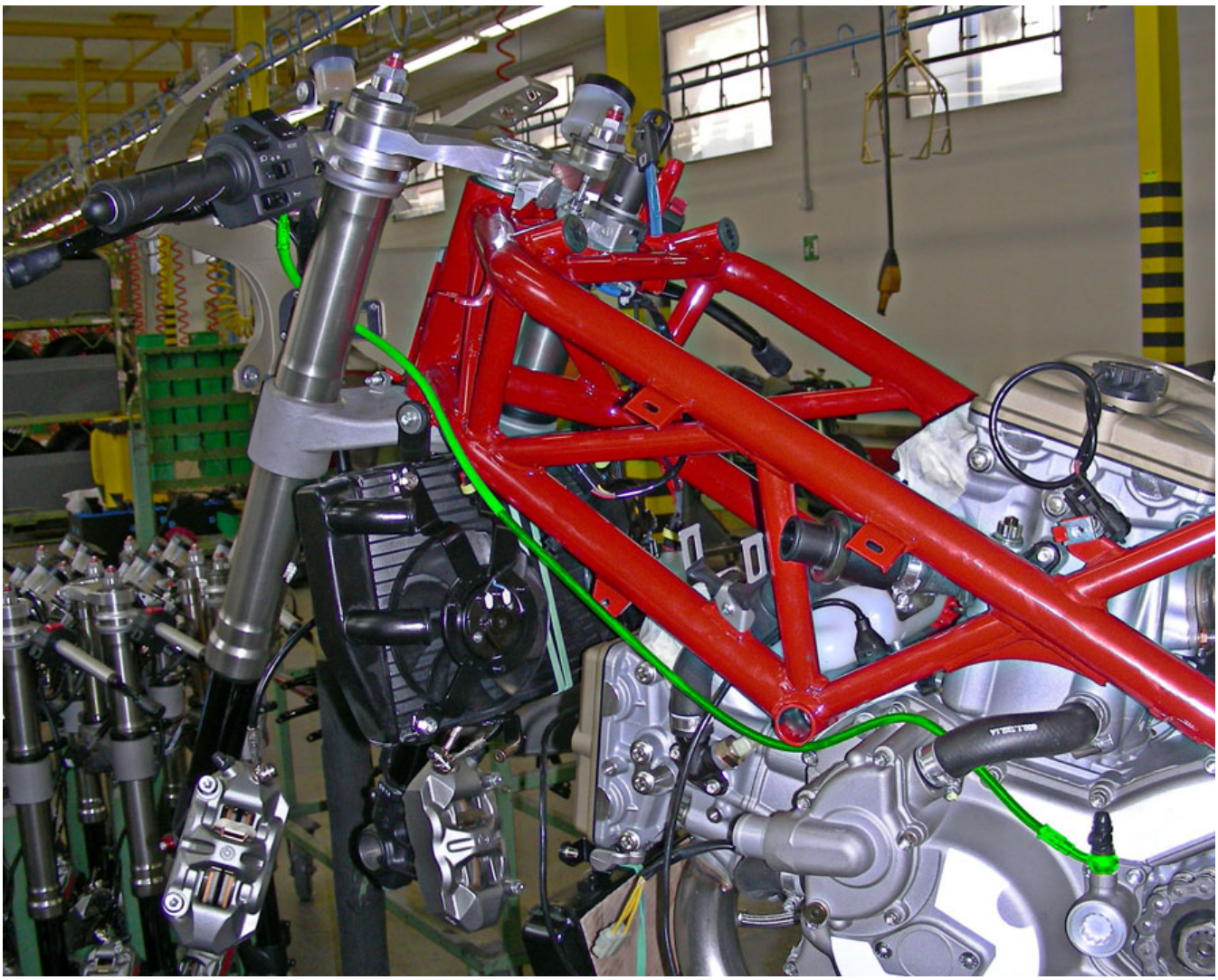
Refit the bleed valve (3) and the dust cap (4).

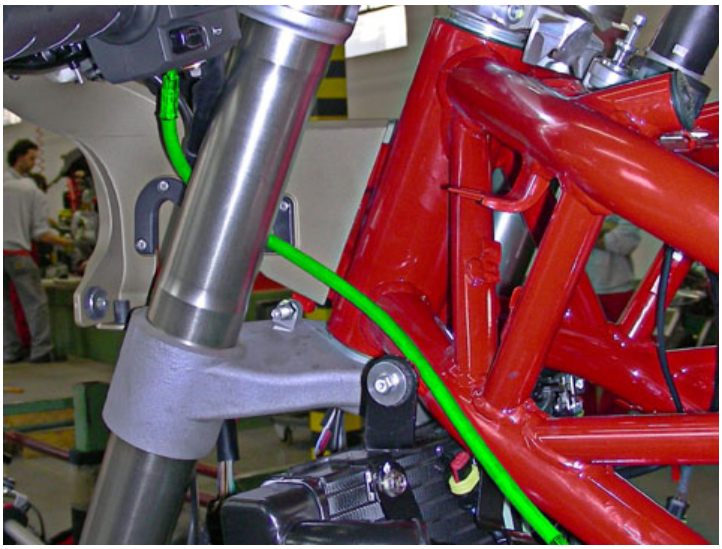
Refer to the diagram on the following page for correct positioning of the hose retaining clips.



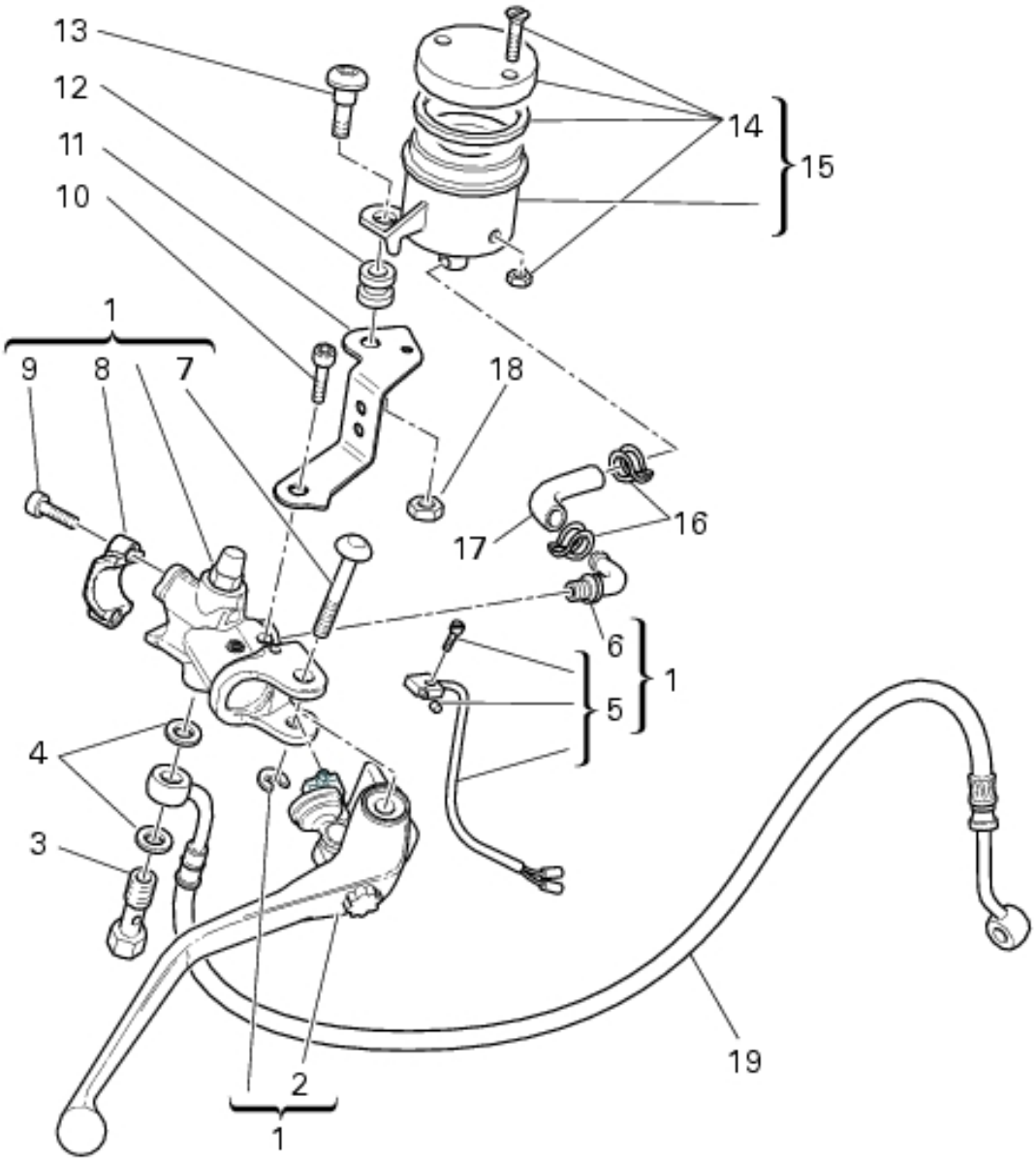
Operation	Section reference
Fill the clutch system with fluid	D 4, Filling the clutch circuit
Refit the left-hand fairing	E 2, Refitting the side fairings

Positioning of the clutch hose





3 - Front brake control



1 Front brake master cylinder
2 Brake lever pedal
3 Banjo bolt
4 Sealing washer, thickness 1
5 Microswitch
6 Hose fitting
7 Pin
8 Upper clamp
9 Bolt
10 Bolt
11 Reservoir bracket
12 Rubber mounting
13 Bolt
14 Fluid reservoir cover
15 Fluid reservoir assembly
16 Hose clip
17 Reservoir-master cylinder hose
18 Nut

19 Calipers−master cylinder hose

Parts catalogue

Front brake

Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

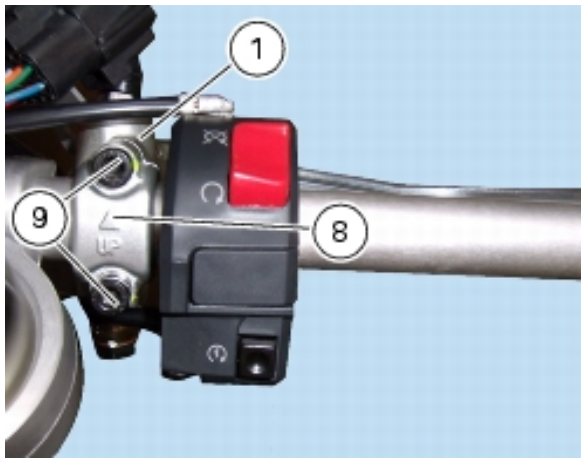
Removal of the front brake master cylinder

Warning

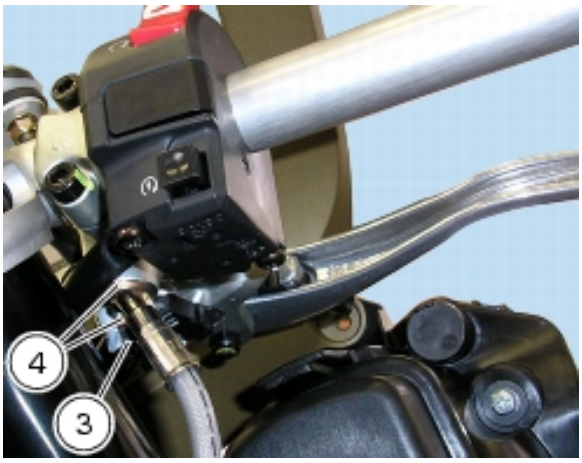
The brake master cylinder manufacturer advises against servicing the brake master cylinder due to the safety critical nature of this component. Incorrect overhaul of this component could endanger rider safety.
Maintenance operations on these units are limited to renewal of the following parts: control lever, fluid reservoir assembly and relative fasteners and master cylinder fasteners.

Operation	Section reference
Drain the braking system	D 4, Draining the brake circuit
Disconnect the brake hose from the master cylinder unit	G 3, Removal of the front brake system

Unscrew the bolts (9) securing the mounting clamp (8) and then remove the front brake master cylinder assembly (1) from the handlebar.

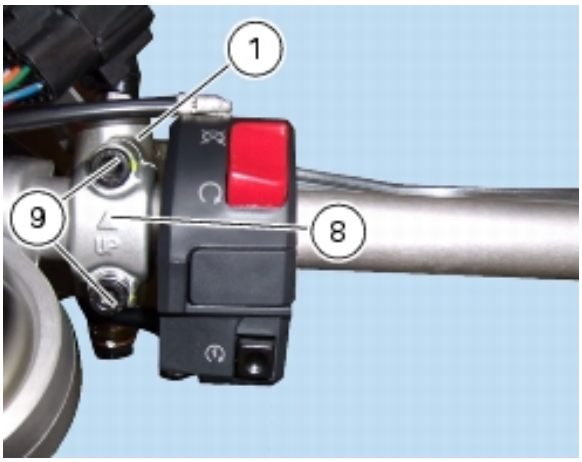


For disassembly of components of the master cylinder unit (1), refer to the exploded view at the beginning of this chapter.
When reconnecting the hoses, install the hose end fitting (3) with the sealing washers (4) and tighten the banjo bolt to the specified torque (Sect. C 3, Frame torque settings).



Refitting the front brake master cylinder

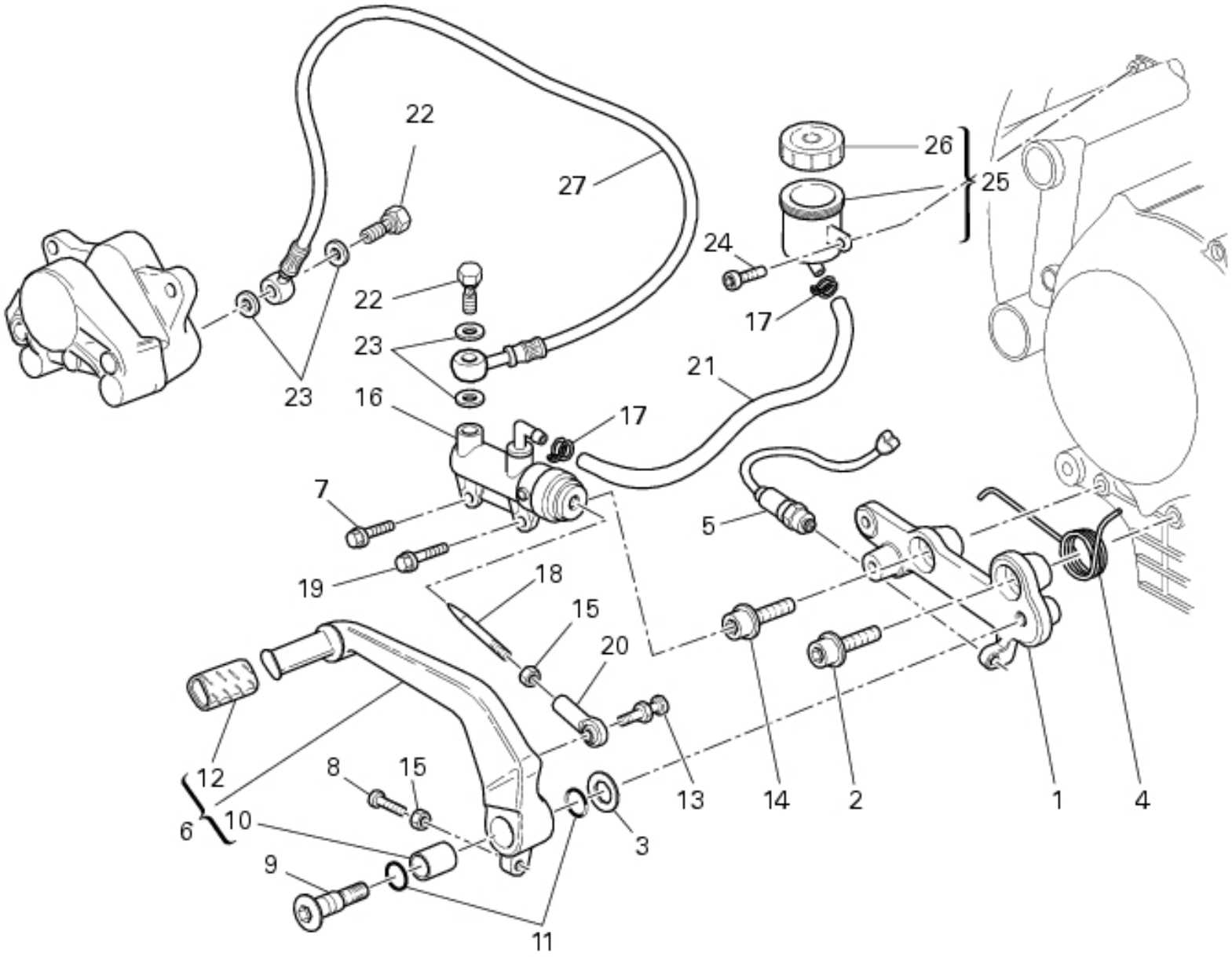
Locate the mounting clamp (8) of the complete master cylinder assembly (1) aligning it with the locating grub screw on the handlebar.
Tighten the bolts (9) of the mounting clamp (8) to the specified torque (Sect. C 3, Frame torque settings), in the sequence 1-2-1.



If any work has been carried out on the hose (19), follow the instructions given in Sect. G 3, Refitting the front brake system.

Operation	Section reference
Reconnect the brake hose to the master cylinder	G 3, Refitting the front brake system
Fill the brake circuit	D 4, Filling the clutch circuit

4 - Rear brake control



1 Support
2 Bolt
3 Washer
4 Spring
5 Switch
6 Brake lever pedal
7 Bolt
8 Adjuster screw
9 Pedal pivot bolt
10 Bush
11 O-ring
12 Rubber
13 Pin
14 Banjo bolt
15 Nut
16 Rear brake master cylinder
17 Clamp
18 Pushrod

19 Bolt
20 Ball joint
21 Hose
22 Banjo bolt
23 Sealing washer, thickness 1
24 Bolt
25 Fluid reservoir assembly
26 Plug
27 Rear brake hose

Parts catalogue

Rear brake

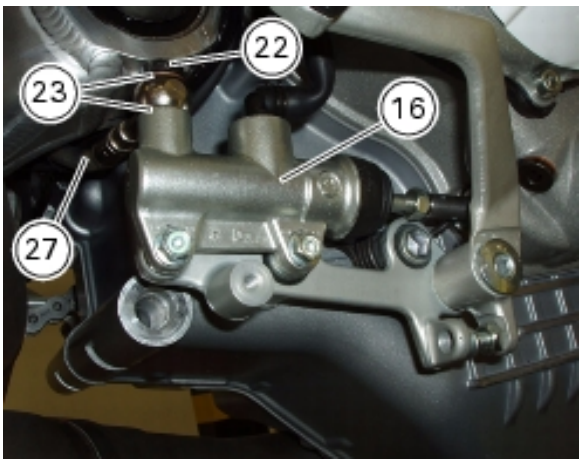
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the rear brake control

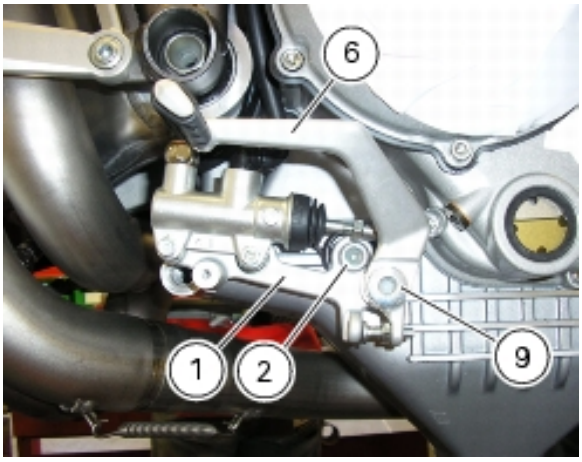
Operation	Section reference
Drain the braking system	D 4, Draining the brake circuit
Remove the right-hand fairing	E 2, Removal of the side fairings

Warning
The brake master cylinder manufacturer advises against servicing the brake master cylinder due to the safety critical nature of this component.
Incorrect overhaul of this critical safety component can endanger the rider and passenger.

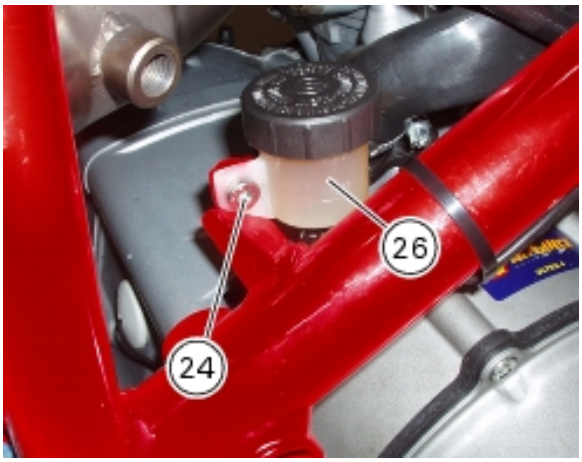
Maintenance operations on these units are limited to renewal of the following parts: control lever, fluid reservoir assembly and relative fasteners and master cylinder fasteners.
Disconnect the rear brake light switch (**5**) from the main wiring (Sect. P 1, Plate 24).
Unscrew the banjo bolt (22) from the master cylinder (16) and withdraw the hose (27). Recover the sealing washers (23).



Unscrew the bolt (2) securing the master cylinder bracket (1) to the engine.
Unscrew the bolt (9) securing the pedal (6) and bracket to the engine.



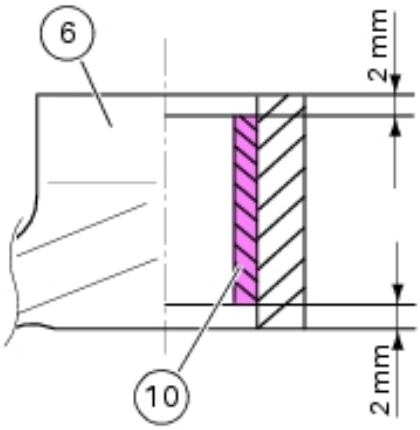
Remove the brake fluid reservoir (26) complete with the hose (**21**) from the frame by unscrewing the bolt (24).



Remove the complete rear brake control.

Disassembly of the rear brake control

The brake master cylinder is supplied only as a complete unit; internal components cannot be replaced.
To disassemble the master cylinder's outer parts, follow the indications given in the exploded view at the beginning of this section.
If the bush (10) inside the brake pedal (6) needs replacing, drive the replacement bush into place using a press. The bush must be seated 2 mm below the pedal's outer face.



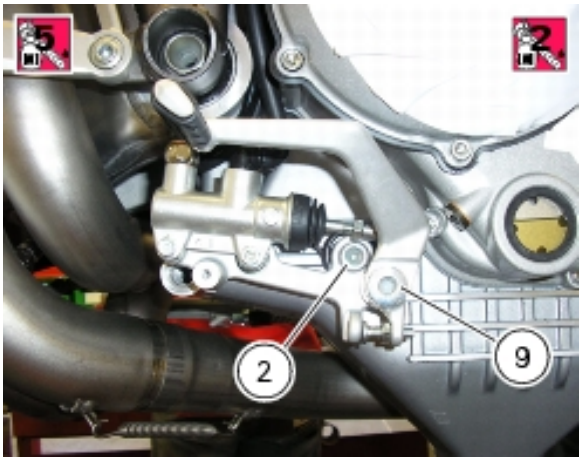
To disassemble the various parts of the system, refer to the exploded view at the beginning of this chapter.

Warning

After working on the rear brake control, check the operation of the brake pedal followingthe instructions given in Sect. D 4, Adjusting the position of the gearchange and rear brake pedals.

Refitting the rear brake control

To refit the assembly, carry out the removal operations in reverse order, applying the recommended threadlocker to the bolts (2) and (9).



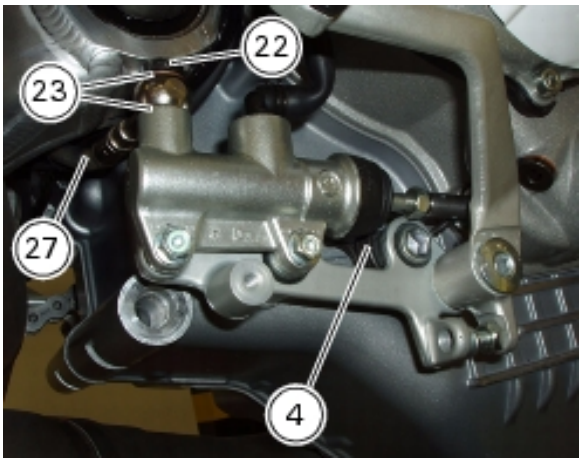
Important

When refitting the brake master cylinder to the engine, take care to position the brake lever return spring (4) correctly.

Notes

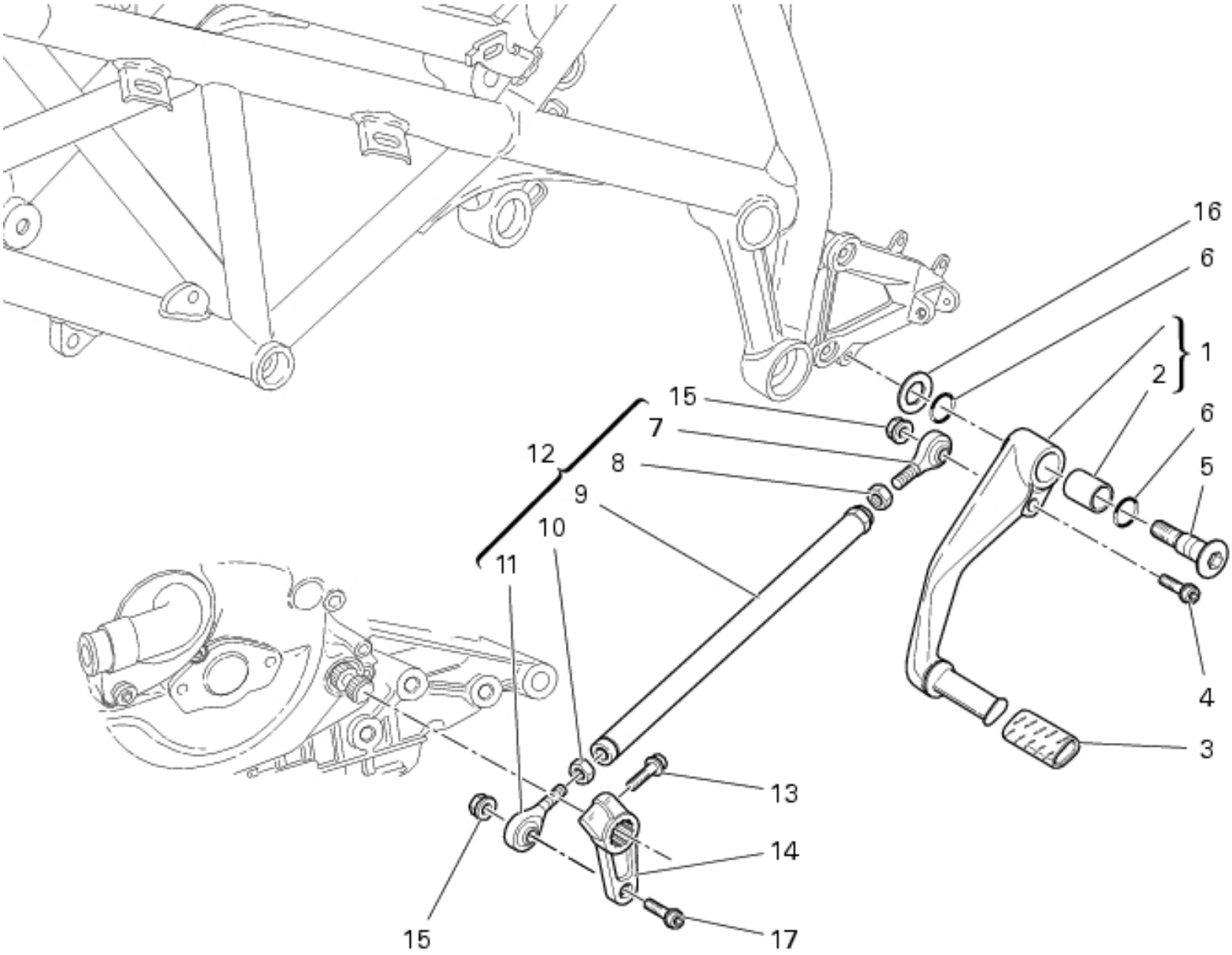
If the case of renewal of the the master cylinder - caliper pipe (27) and the master cylinder - reservoir pipe (21), take care to ernsure that the pipe unions are correctly oriented on the master cylinder.

Install the sealing washers (23) on either side of the end fitting of the hose (27) and connect to the master cylinder. Position the hose end fitting as shown in the figure and tighten the banjo bolt (22) to the specified torque (Sect. C 3, Frame torque settings).



Operation	Section reference
Fill the brake circuit	D 4, Filling the clutch circuit
Refit the right-hand fairing	E 2, Refitting the side fairings

5 - Gearchange mechanism



1 Gearchange pedal
2 Bush
3 Rubber
4 Bolt
5 Pin
6 O-ring
7 Ball joint
8 Nut
9 Gearchange lever tie-rod
10 Nut
11 Ball joint
12 Gearchange lever tie-rod assembly
13 Bolt
14 Gearchange pedal
15 Nut
16 Washer
17 Bolt

duc.nu>>

Parts catalogue

FRAME

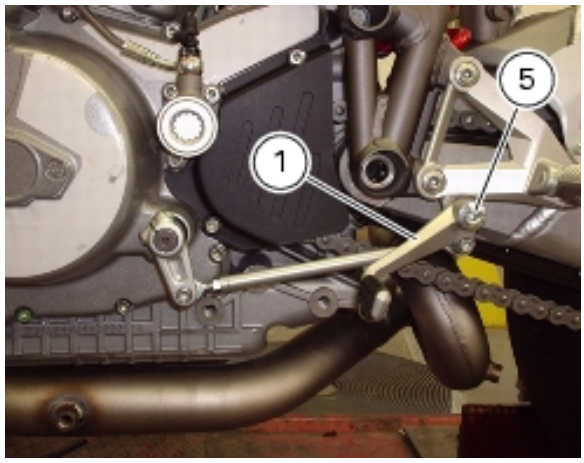
Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the gearchange mechanism

Operation	Section reference
Remove the left-hand fairing	E 2, Removal of the side fairings

Unscrew and remove the pivot bolt (5) securing the gear pedal (1) and recover the O-ring seals (**6**).

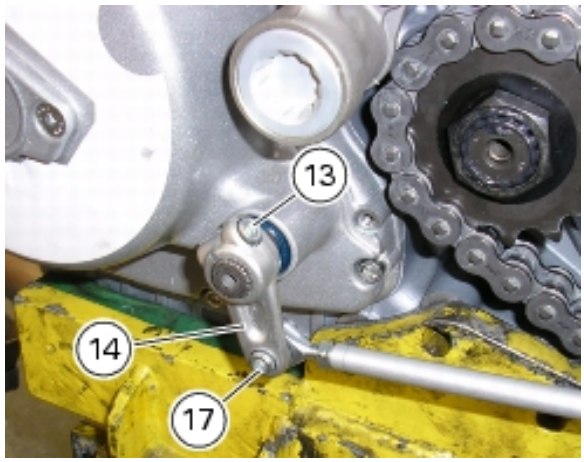


Unscrew and remove the bolt (13) securing the lever to the gearbox shaft.
Withdraw the lever (14) complete with the gearchange control assembly.

Notes

Mark the position of lever (14) relative to the gear selector shaft.

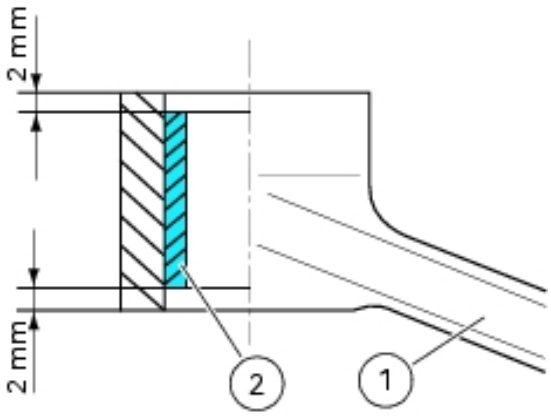
To remove the lever (14) from the gearchange assembly, unscrew the bolt (17), recover the nut (**15**), and then slide off the lever (14).



Disassembly of the gearchange mechanism

Refer to the exploded view at the beginning of this section for indications on disassembly and renewal of gearchange

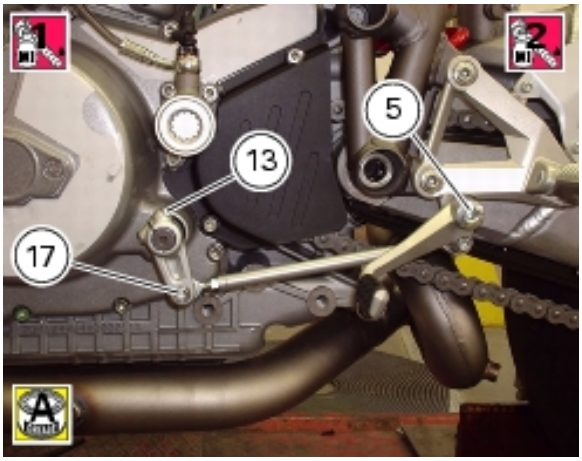
components.
If the bush (2) inside the pedal (1) needs replacing, drive the new bush into place using a press. The bush must be seated **2** mm below the outer face of the pedal.



Warning
After working on the gearchange mechanism, check the position of the gear pedal.
To adjust the position of the gear pedal, follow the instructions provided in Sect. D 4, Adjusting the position of the gearchange and rear brake pedals.

Refitting the gearchange mechanism

To refit the gearchange mechanism, reverse the operations of the removal procedure.
In particular, grease the O-rings (**6**), apply threadlocker to the bolt (13), pivot bolt (5) and bolt (17) and then tighten them to the specified torque (Sect. C 3, Frame torque settings).



Operation	Section reference
Refit the left-hand fairing	E 2, Refitting the side fairings

0G - Wheels - Suspension - Brakes

1 - Front wheel 3

Removal of the front wheel 4
Overhauling the front wheel 6
Refitting the front wheel 9

2 - Front fork 11

Removal of the front forks 12
Overhauling the front forks 13
Refitting the front forks 20

3 - Hydraulic front brake 22

Maintenance operations 23
Removal of the front brake system 24
Refitting the brake discs 26
Overhauling the front brake components 27
Refitting the front brake system 28

4 - Rear wheel 31

Removal of the rear wheel 32
Overhauling the rear wheel 33
Refitting the rear wheel 34

5 - Rear swingarm 35

Removal of the rear wheel eccentric hub and rear wheel axle 36
Refitting the rear wheel eccentric hub and rear wheel axle 38
Removal of the swingarm 41
Inspecting the swingarm pivot shaft 43
Overhauling the rear swingarm 44
Refitting the swingarm 49

6 - Hydraulic rear brake 51

Removal of the rear brake caliper 52
Removal of the rear brake disc 53
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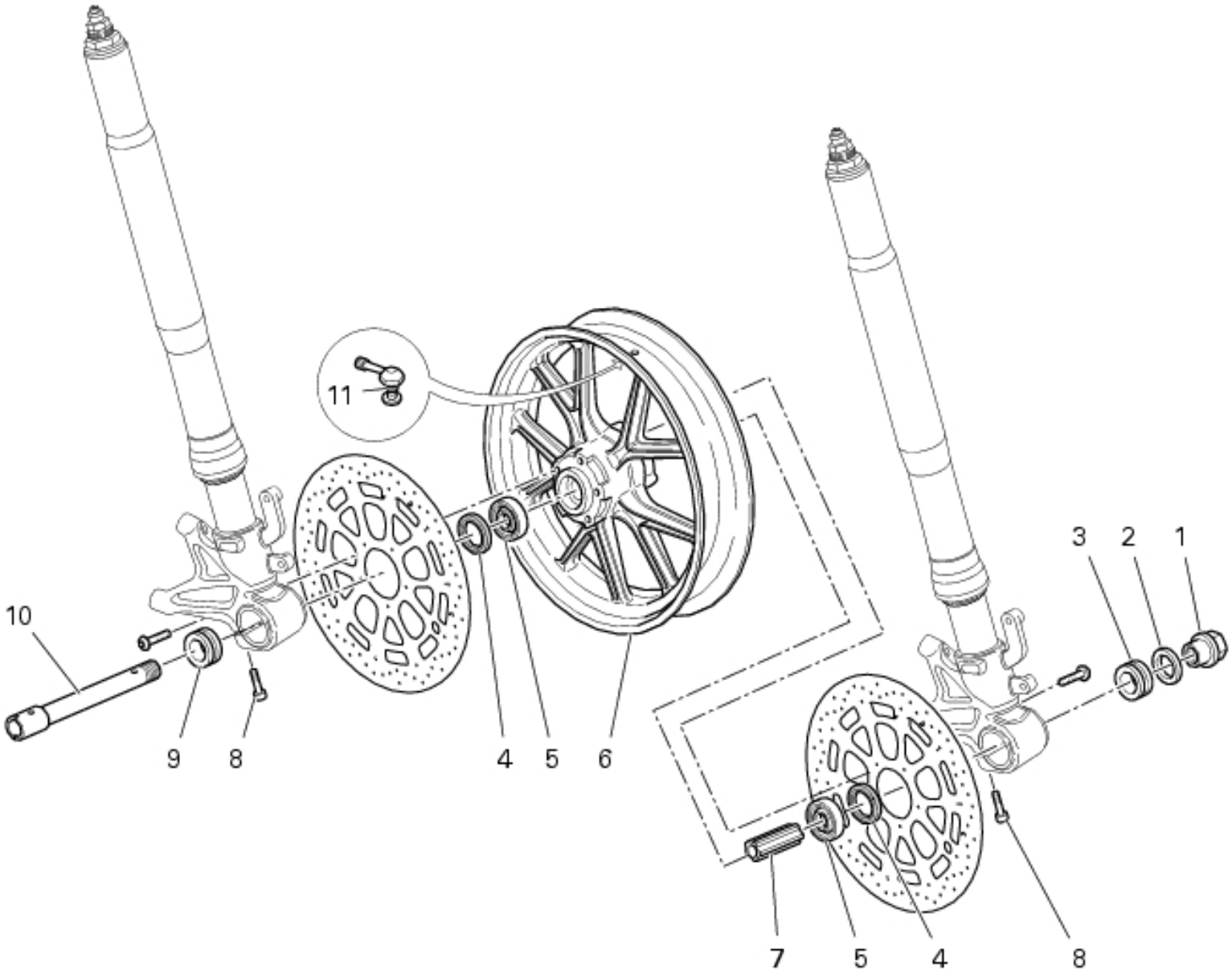
7 - Rear suspension 55

Rear suspension system 56
Removal of the rear shock absorber 56
Overhauling the rear shock absorber 57
Removal of the rear suspension rocker arm 58
Overhauling the rear suspension rocker arm 59
Disassembly of the shock absorber tie-rod 60
Refitting the rear suspension 60

8 - Final drive 63
Inspecting the final drive 64
Removal of the front sprocket 65
Refitting the front sprocket 67
Renewal of the rear sprocket 69
Refitting the rear sprocket 70
Washing the chain 71
Lubricating the chain 71

1 - Front wheel



1 Nut
2 Washer
3 Left spacer
4 Seal
5 Bearing
6 Front wheel rim
7 Inner spacer
8 Bolt
9 Right spacer
10 Front wheel axle
11 Valve

Parts catalogue

Front forkS
FRONT AND REAR WHEELS

Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

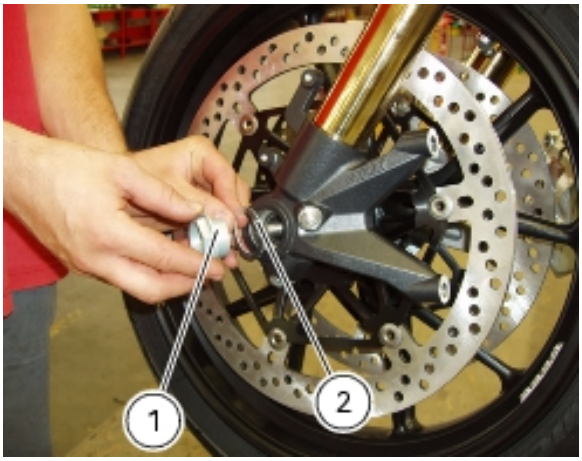
Removal of the front wheel

Remove the front brake calipers complete with hoses by undoing the bolts (A).

Warning

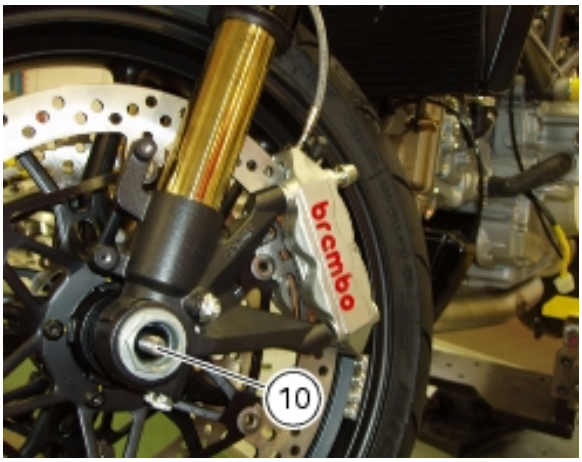
Do not operate the brake lever when the calipers are removed. This can cause the brake pistons to be expelled.

Support the bike so that the front wheel is raised from the ground.
Loosen and remove the nut (1) on left side of the axle.
Recover the washer (2).

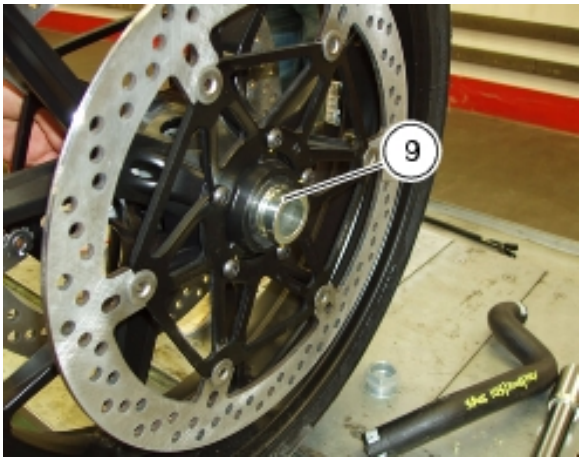


Loosen the axle clamp bolts (8) on the ends of the fork legs.

Working from the left-hand side, use a plastic mallet to drive the axle (10) out from the opposite side and remove it.



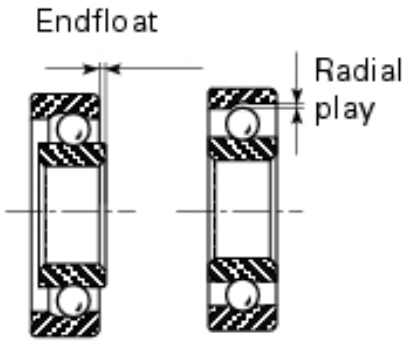
Remove the wheel and recover the spacers (3) and (9).



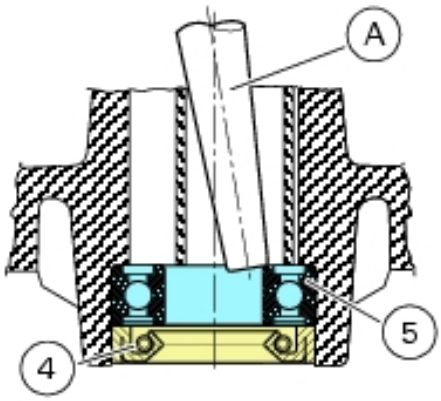
Overhauling the front wheel

Wheel bearings

Before checking the dimensions, check the wear on wheel bearings. Check for wear by hand after cleaning and degreasing the bearings in their seats.
Turn the inner race.
Check the amount of radial and axial play. Excessive play will cause vibration and make the bike unstable; in this case the bearings must be renewed.

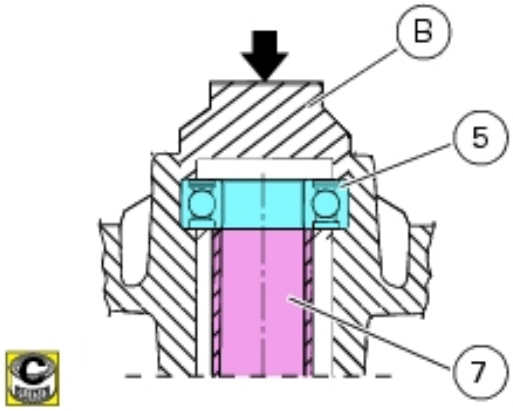


To remove the bearings (5) and seals (4) from the wheel hub, follow the instructions below.
Position a drift (A) against the inner race of the bearing (5).
Tap the drift with a hammer to drive out the bearing (5) and the oil seal (4).
Apply the drift at different points to keep the bearing square during removal.

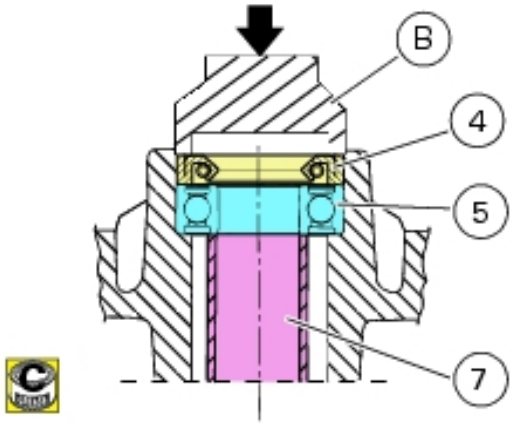


Important

Once removed, the used bearings and seals must not be refitted.
Before fitting new bearings, check that the housing is clean and free from scoring and damage.
Grease the bearing seat and then push the new bearing into its seat.
Using a tubular drift (B) that only bears on the outer race of the bearing, drive the bearing (5) fully into its seat.



Use the same method to install the seals (4).
Ensure that spacer (7) is fitted between the two wheel bearings.

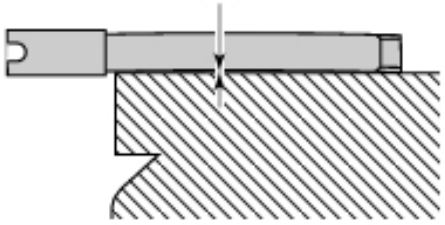


Notes

Wheels must be rebalanced after repair, maintenance and overhaul operations.

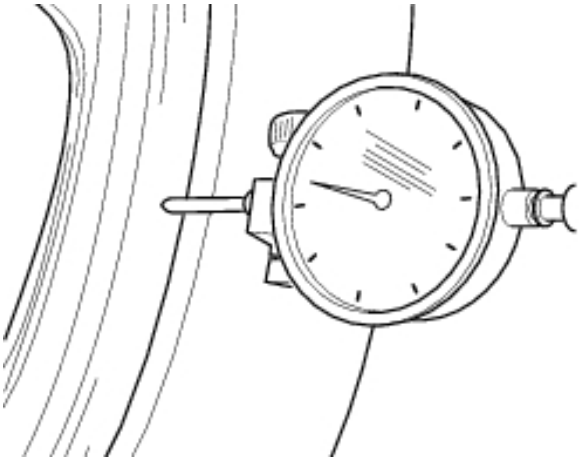
Inspecting the wheel axle

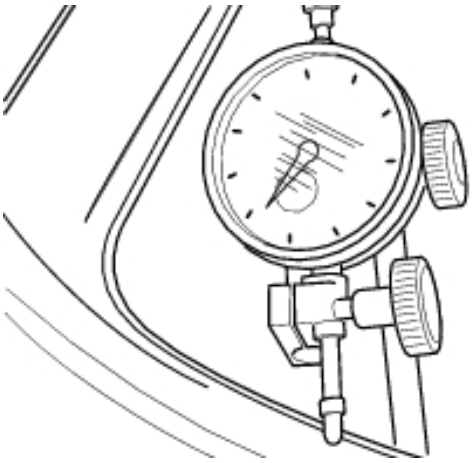
Check the wheel axle for straightness.
Roll the axle on a reference surface and measure maximum distortion using a feeler gauge (see Sect. C 1.1, Front wheel).



Overhauling the wheel

After you have checked the bearings, check the rim as follows.
Visually inspect the rim for cracks, scoring and deformation; change the wheel if damaged.
Insert the axle in the wheel and mount it on two fixed reference blocks.
Using a dial gauge, measure rim runout and out-of-round relative to the wheel axle (see Sect. C 1.1, Front wheel).

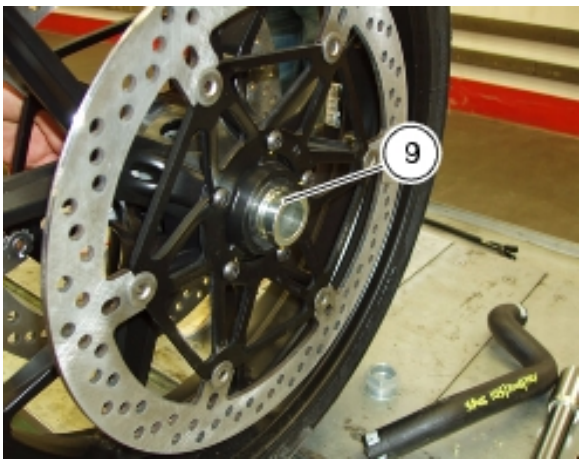




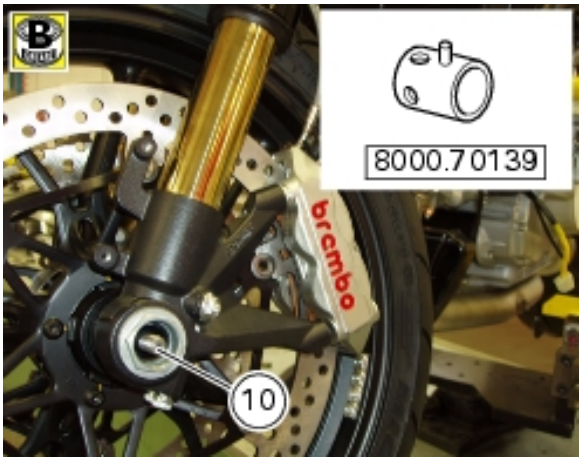
If the values measured are not within the tolerance limits, renew the wheel.

Refitting the front wheel

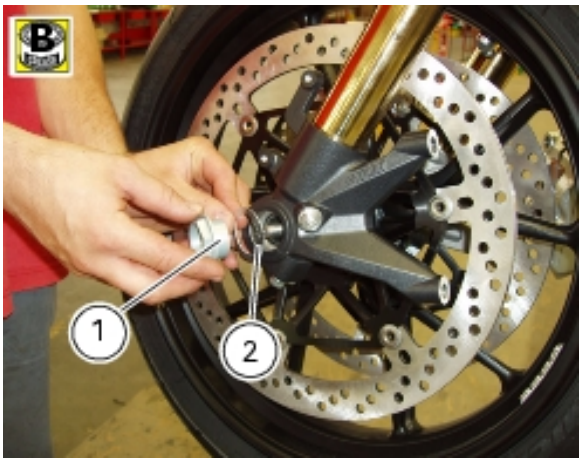
When all the necessary inspections have been completed, refit the wheel as follows.
Lubricate and fit the spacers (**3**) and (9) to the oil seals on the sides of the wheel hub.



Install the complete wheel between the fork legs.
Lubricate the shank and thread of the wheel axle (10).
Fit service tool no. **8000.70139** on the wheel axle (10).
Drive the axle (10) fully home into the wheel hub, inserting the locating peg of the service tool in the special notches at the bottom end of the fork.

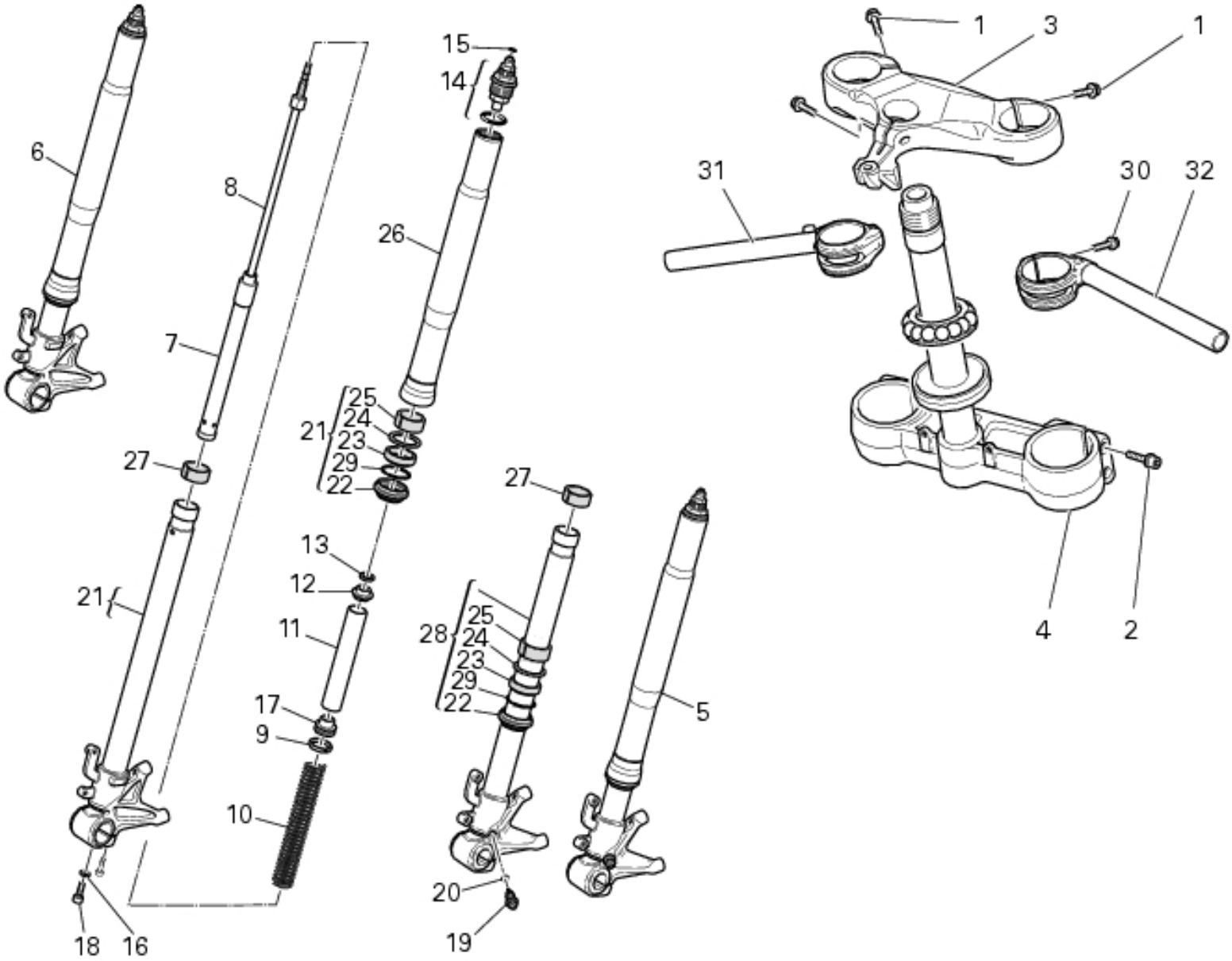


Fit the washer (2) on the end of the axle.
Grease the thread and the underside of the head of the axle lock nut (1), then screw it on.
Tighten the nut (1) to the specified torque (Sect. C 3, Frame torque settings).



Refit the front brake calipers as described in Sect. G 3, Removal of the front brake system.
Check that the brake discs turn freely inside the calipers.
Before tightening the axle clamp bolts (8), lower the bike to the ground and press up and down on the handlebars to load the suspension so the fork legs will become properly seated onto the wheel axle.
Lubricate the bolts (8).
Tighten the bolts (8) to the specified torque (Sect. C 3, Frame torque settings), in the sequence 1-2-1.

2 - Front fork



1 Bolt
2 Bolt
3 Top yoke
4 Bottom yoke
5 Left fork leg assembly
6 Right fork leg assembly
7 Locating ring
8 Damper assembly
9 Oil seal
10 Spring
11 Upper spacer
12 Spacer
13 Washer
14 Top cap assembly
15 Circlip
16 Washer
17 Dust cap
18 Bolt

19 Adjuster screw
20 Special washer
21 Right inner tube assembly
22 Dust cap
23 Oil seal
24 Circlip
25 Bush
26 Outer tube
27 Bush
28 Left inner tube assembly
29 Ring
30 Bolt
31 Left handlebar
32 Right handlebar

Parts catalogue

HANDLEBARS and controls
Front forkS

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

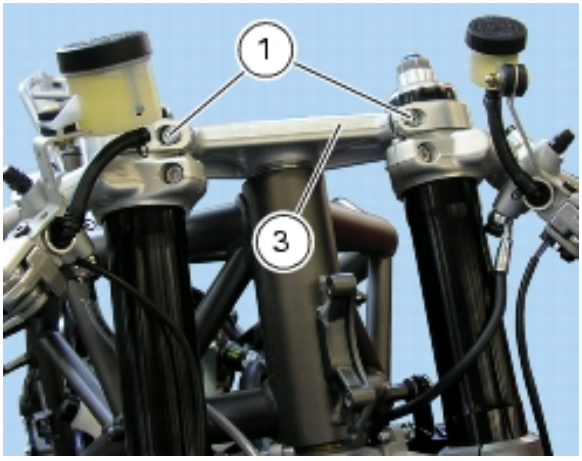
Removal of the front forks

Before removing the front forks, it is necessary to remove the following parts:

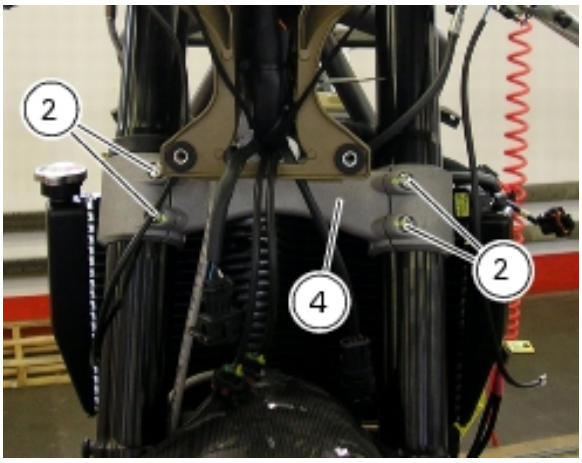
Operation	Section reference
Removal of the front brake calipers	G 3, Removal of the front brake system
Remove the front mudguard	E 4, Removal of the front mudguard
Remove the front wheel	G 1, Removal of the front wheel
Remove the headlight shell	E 1, Removal of the headlight shell

Important
Not all the components described in this chapter are available as individual replacement parts: however they are indicated for clearer explanation of the procedure.

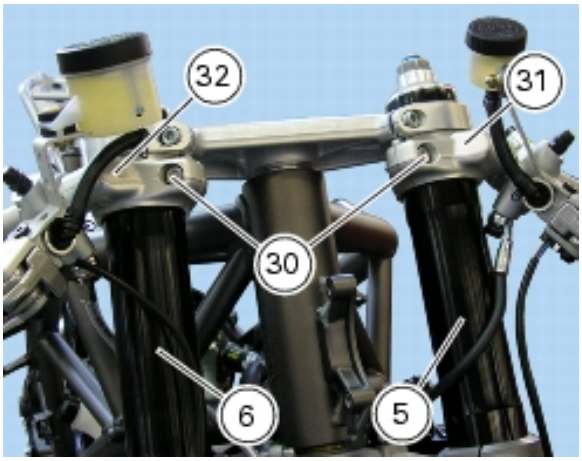
Loosen the clamp bolts (1) holding the fork legs to the top yoke (3).



Loosen the clamp bolts (2) securing the fork legs to the bottom yoke (4).



Slacken off the bolts (30) securing the handlebar clamps (31) and (32) to the fork legs.
Withdraw the fork legs (5) and (6) downwards in order to carry out to all the necessary overhaul operations.



Overhauling the front forks

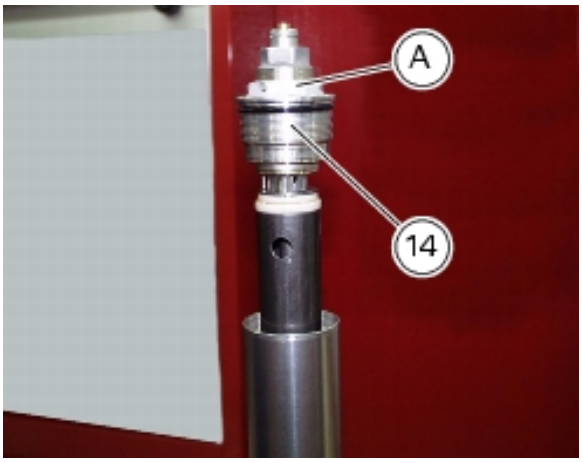
Notes

It is advisable to loosen the top cap (14) when the fork is still fitted to the motorcycle.

Notes

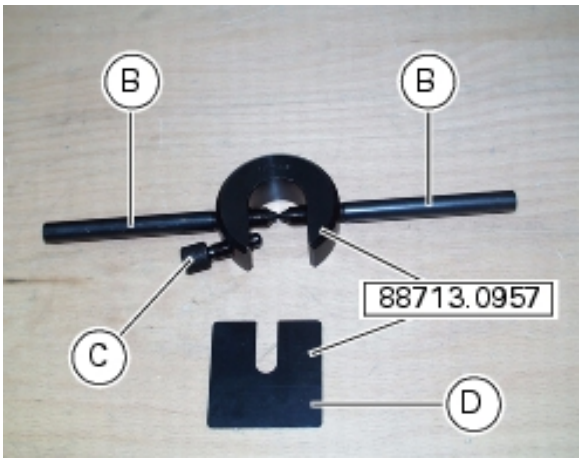
The service tools required for front fork overhaul are listed in Sect. C 4, Specific tools for the frame.

Loosen the preload adjuster (A) before unscrewing the top cap (14).
Unscrew the top cap (14) complete with the rebound damping adjuster.

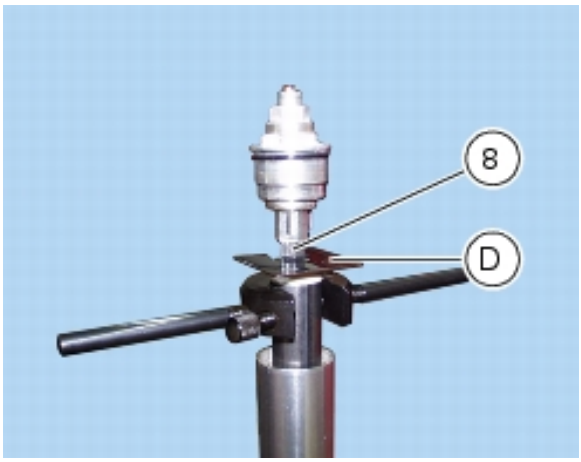


Disassembly of the front fork

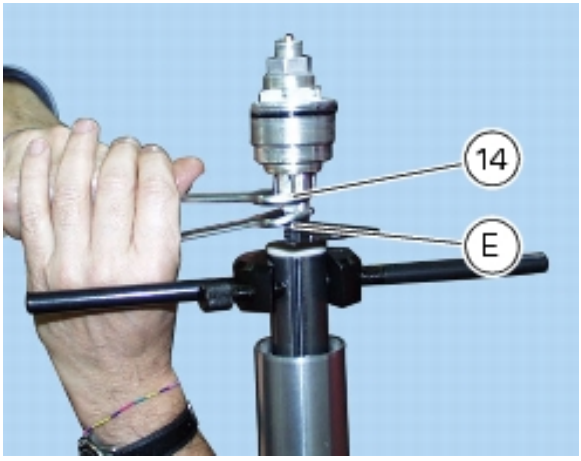
Fit the service tool no. **88713.0957**, engaging its pins (B) in the upper spacer, and secure in place with the screw (C).



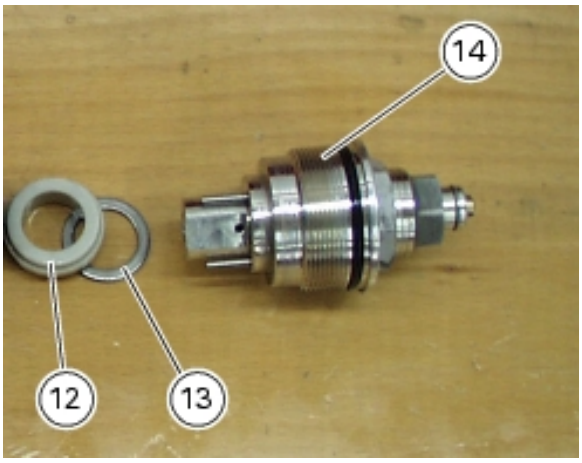
Push the tool down to compress the spring and then fit the tool spacer (D) under the cartridge lock nut (8).



Apply a wrench to the flats (E) and hold the lock nut steady to loosen the top cap (14).

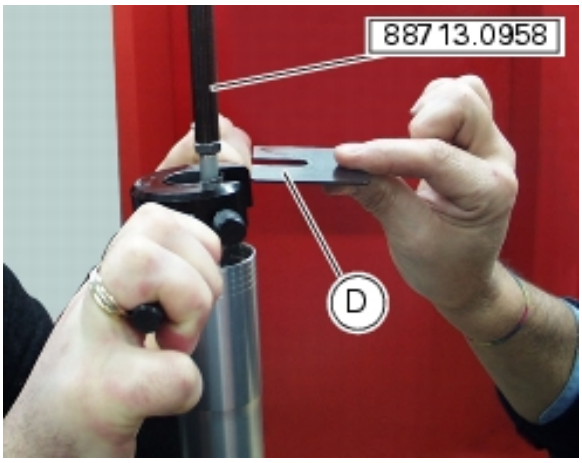


Remove the upper cap (14) complete with the collar (12) and washer (13).

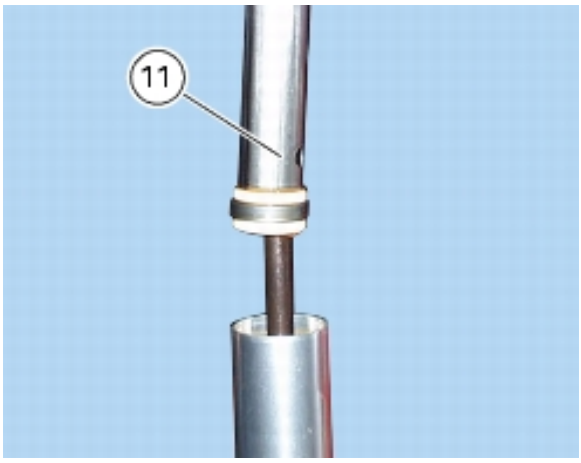


Fit service tool no. **88713.0958** and screw it onto the damper rod.

Push downwards to overcome the force of the spring and remove the spacer (D).



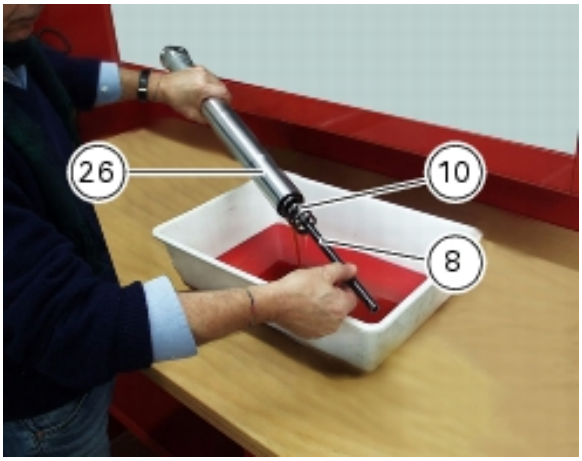
Remove the service tool no. **88713.0957** and slide out the upper spacer (11).



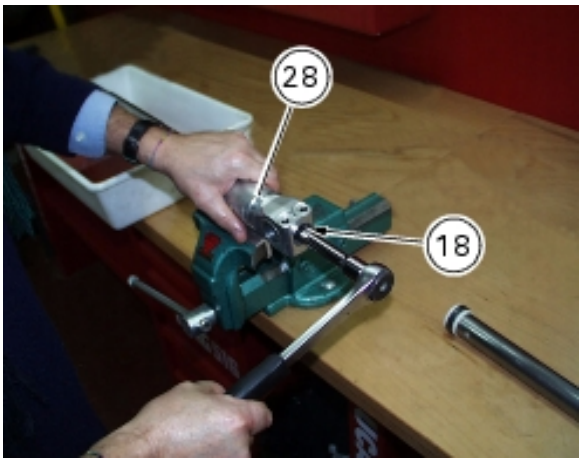
Remove the spring (10) and pump the outer tube (26) and the damper (8) to expel the oil from the fork.

Warning

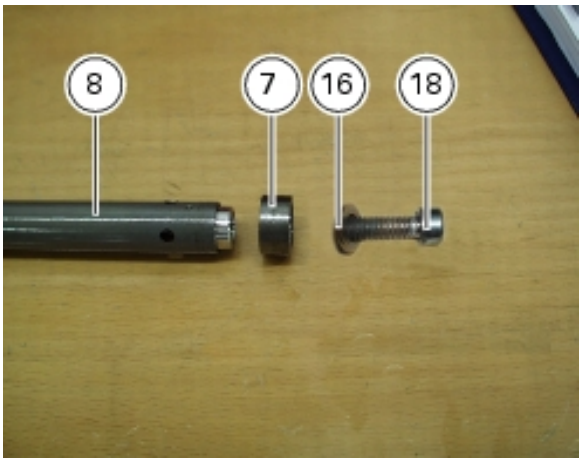
This movement generates pressure so that the oil will be rapidly expelled from the fork.
Aim the jet of oil into a previously prepared container and avoid contact with fork oil.



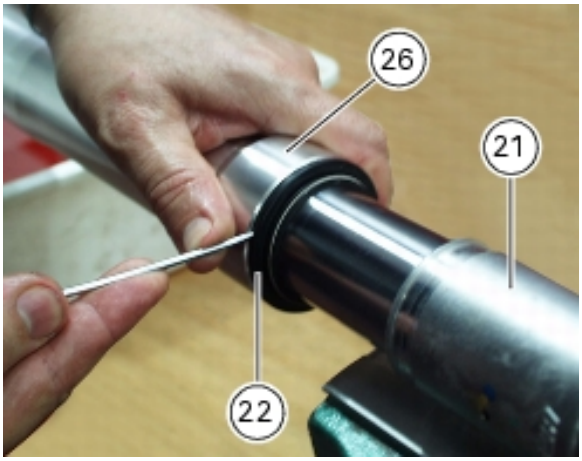
Clamp the inner tube (28) in a vice with soft-faced jaws.
Unscrew the bolt (18).



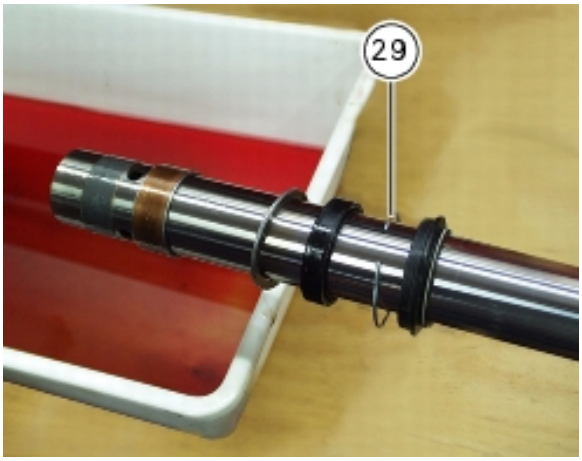
Remove the adjuster screw (18) and recover the seal (16).
Remove the complete damper assembly (8) and locating ring (7).



Slide the dust seal (22) off the outer tube (26), prising it off with a screwdriver.

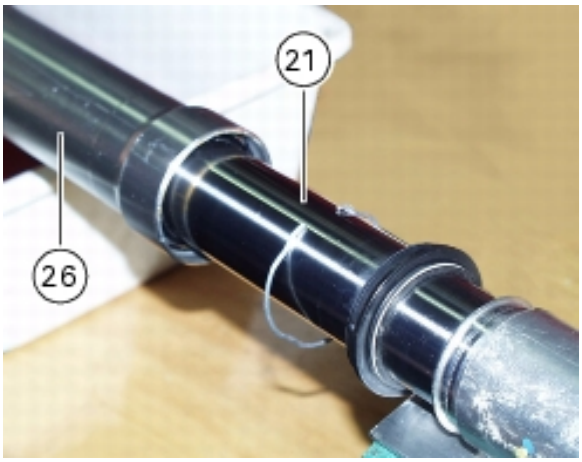


Remove the circlip (29).



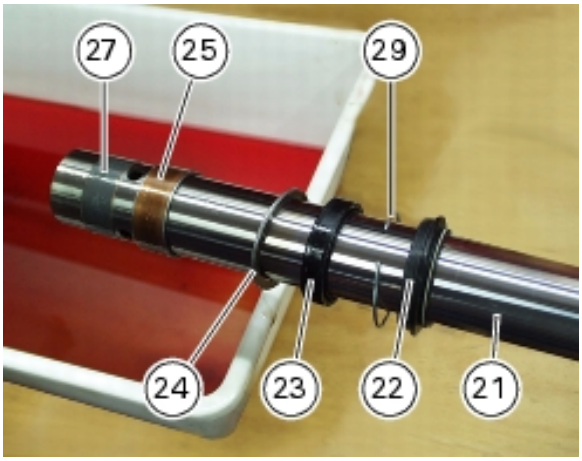
Important

Take care not to damage the outer tube (26) or inner tube (21).



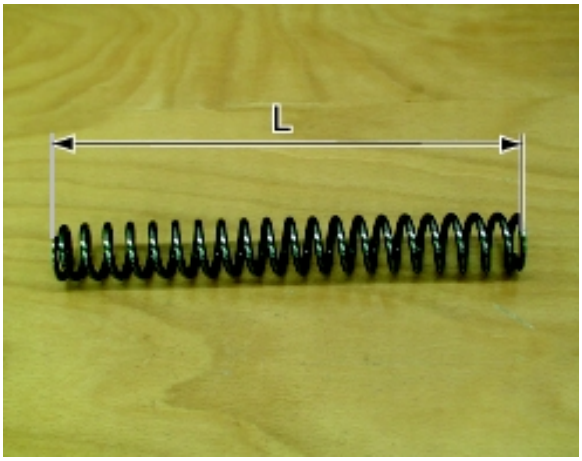
To separate the outer tube (26) from the inner tube (21), pull the inner tube sharply outwards repeatedly to gradually displace the bottom bush (25).
Insert the tip of a screwdriver in the slit in the bush (27) and open it up sufficiently to slide the bush off the inner tube.

Remove the following parts from the inner tube (21):
- bush (25)
- ring (24)
- oil seal (23)
- circlip (29)
- dust seal (22).

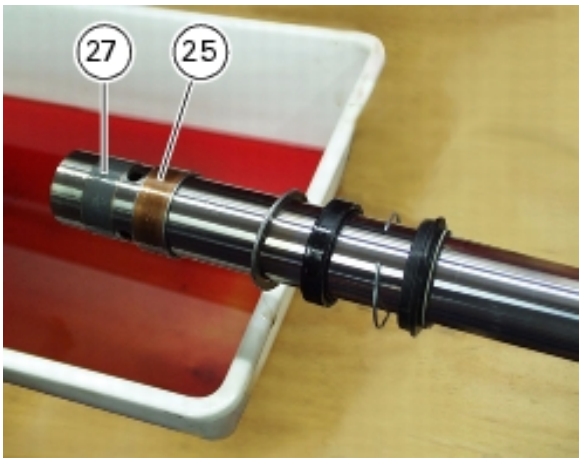


Inspection of the adjustable front fork

Place the spring on a flat surface and measure the free length (L).



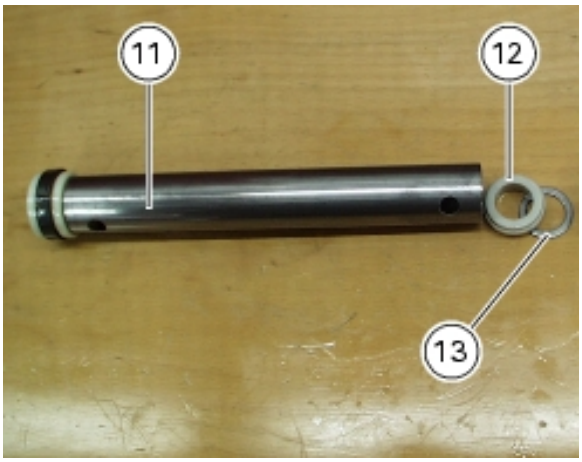
Service limit:
270 mm.
Renew the spring if the length is not within the specified limit.
Inspect the outer surfaces of both fork inner tubes and the internal surfaces of both outer tubes. They must be free from scoring, steps, or dents.
Check that outer tubes are straight:
maximum permissible error **0.10** mm.
Whenever the inner tube is removed from the outer tube it is good practice to renew the bushes (25) and (27).



Clean off any oil from spring (10) and spring joint (11) before assembly.

Notes
Install the spring (10), ensuring that the end with tighter coils is towards the bottom of the fork.

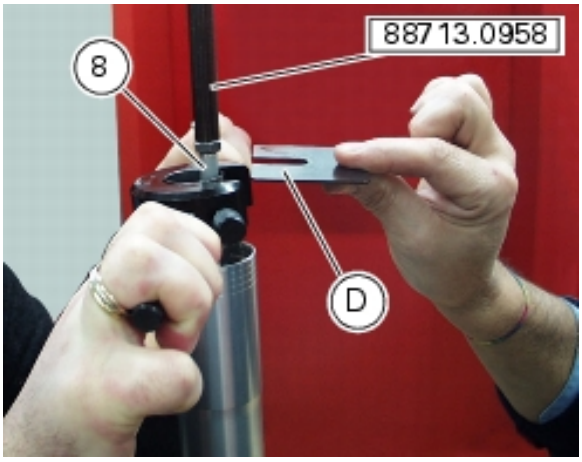
Fit the following components:
- spring (10);
- upper spacer (11);
- spacer (12);
- washer (13).

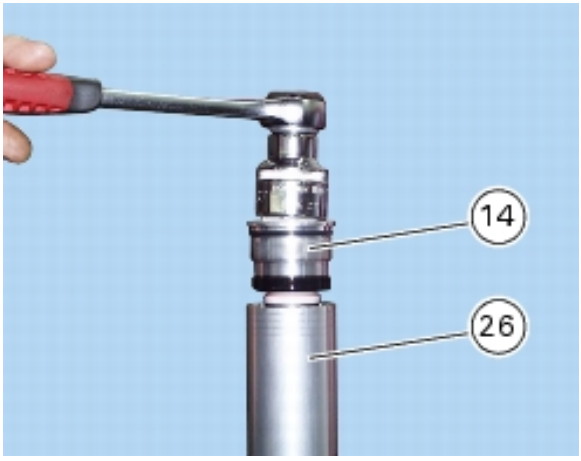


Fit service tool **88713.0957** (previously used for removal) into the lateral hole of upper spacer (11).
Push the tool down and position the spacer (D) under the lock nut of damper (8).
Remove service tool no. **88713.0958**.
Screw the top cap (14) onto the damper (8).
Using a hex wrench, hold the rebound damping adjuster (E) and tighten the top cap to **30** to **40** Nm.
Remove spacer (D) by pushing tool (C, no. **88713.0957**) downwards.

Warning
The adjuster (A) on the top cap (14) should be screwed fully onto the thread of the damper (8).

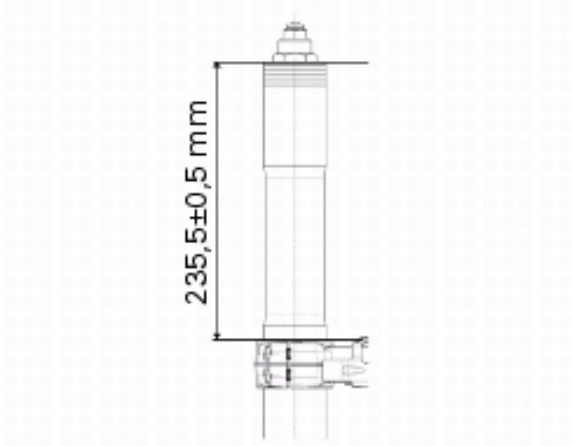
Lift the outer tube (26) and tighten the top cap (14) to a torque of **30** to **40** Nm.
Set the adjusters according to riding requirements.



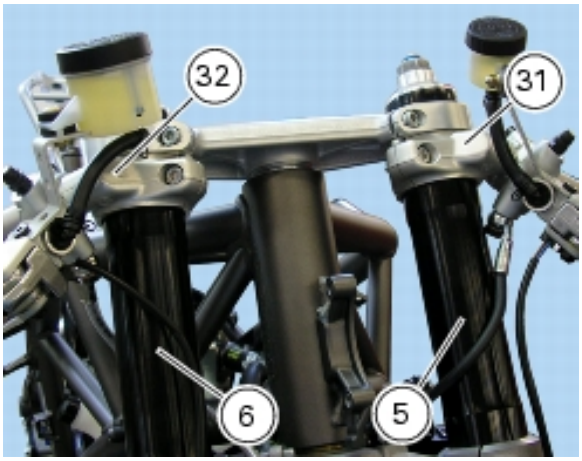


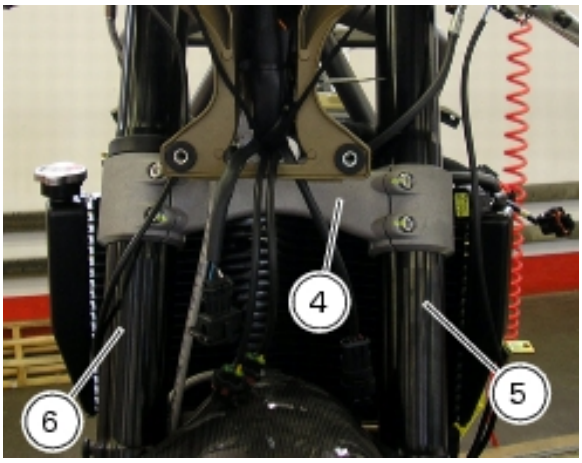
Refitting the front forks

Refit the fork legs, positioning them at the height shown in the figure relative to the upper surface of the bottom yoke.

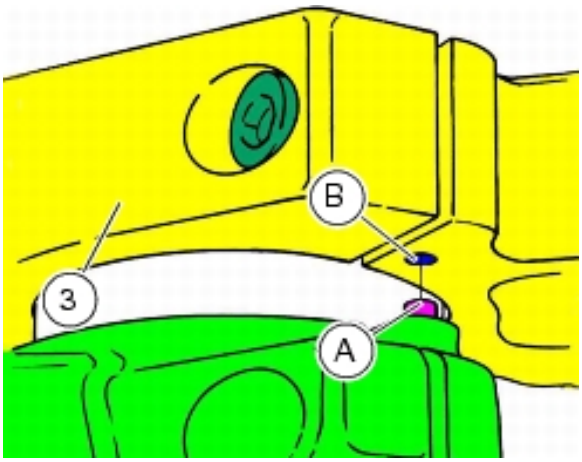


Locate the fork legs (5) and (6) in the bottom yoke (4) and then fit the handlebars (31) and (32).





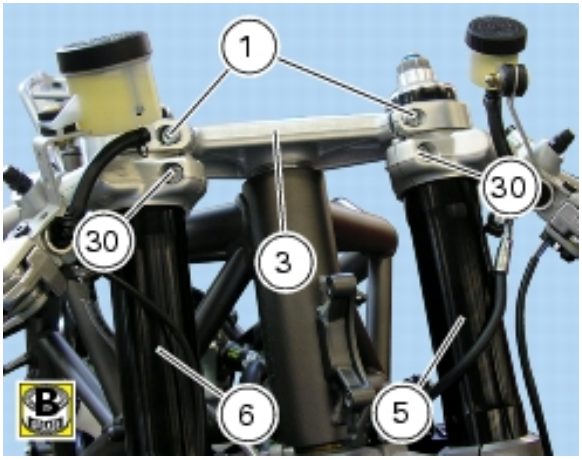
Locate the fork legs (5) and (6) in the top yoke (3).
To ensure the handlebars are correctly positioned, check that the end of the pin (A) engages the corresponding slot (B) in the top yoke (3).

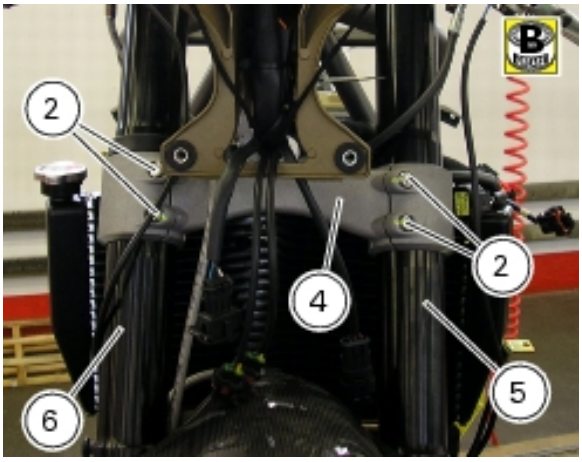


Tighten to the specified torque (Sect. C 3, Frame torque settings) the clamp bolts (1) and (2) securing the legs to the bottom yoke (4) and to the top yoke (3).
Apply the recommended grease to the bolts (30).
Tighten the handlebar bolts (30) to the specified torque (Sect. C 3, Frame torque settings).

Important
If the clamp bolts (1) and (2) were removed on disassembly, smear the threads with the specified grease before tightening.

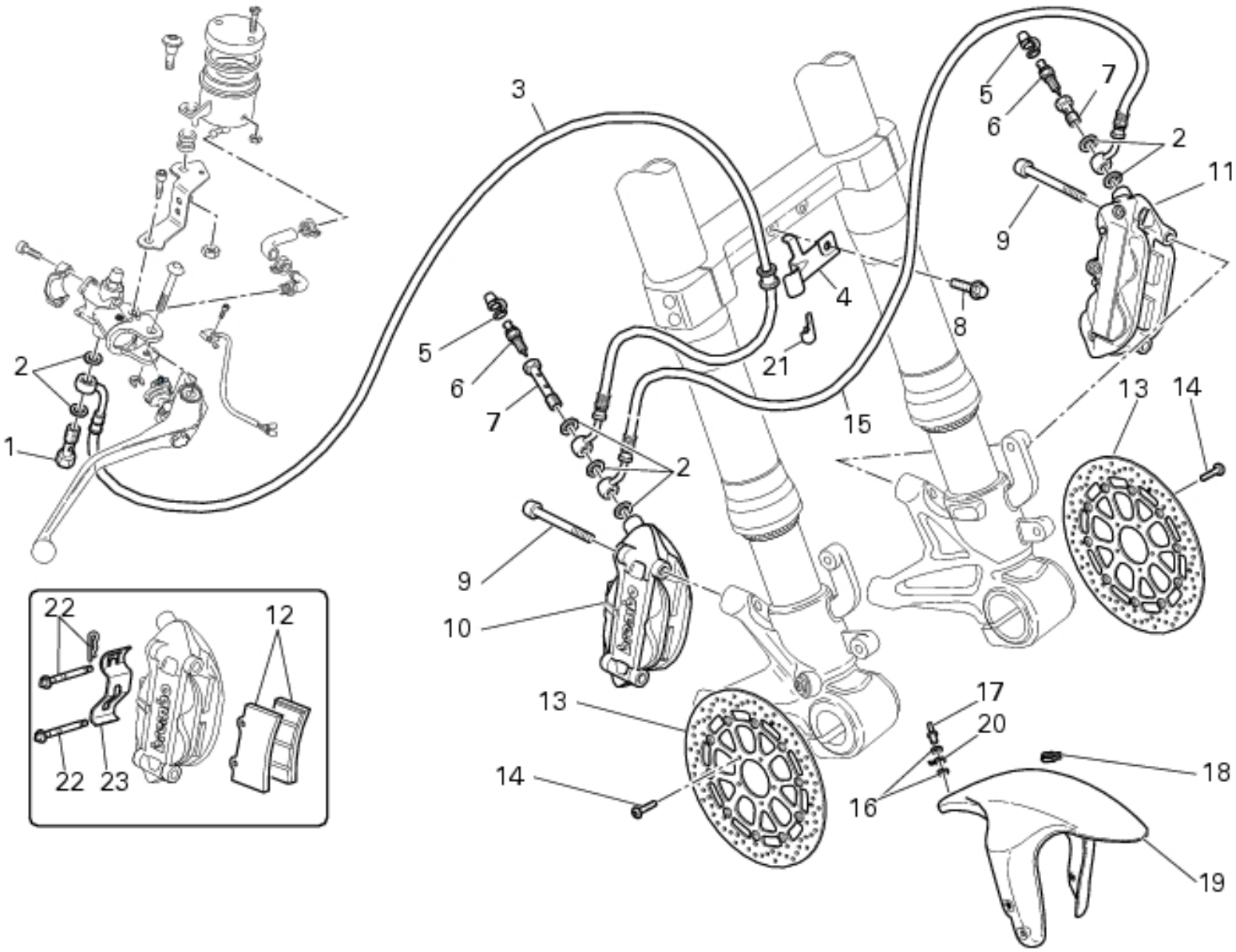
Warning
Do not use the motorcycle without the front mudguard fitted to avoid the risk of the brake pipes fouling the wheel on braking.





Operation	Section reference
Refit the headlight shell	E 1, Refitting the headlight shell
Refit the front wheel	G 1, Refitting the front wheel
Refit the front mudguard	E 4, Refitting the front mudguard
Refit the front brake calipers	G 3, Refitting the front brake system

3 - Hydraulic front brake



1 Banjo bolt
2 Sealing washer
3 Calipers−master cylinder hose
4 Bracket
5 Dust cap
6 Bleed valve
7 Banjo bolt
8 Bolt
9 Bolt
10 Right brake caliper
11 Left brake caliper
12 Pair of brake pads
13 Brake disc
14 Bolt
15 Front brake hose
16 Washer
17 Rivet
18 Rubber

19 Mudguard
20 Clip
21 Guide
22 Pad retaining pin and clip
23 Clip

Parts catalogue

Front brake
FRONT AND REAR WHEELS
FAIRING

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Maintenance operations

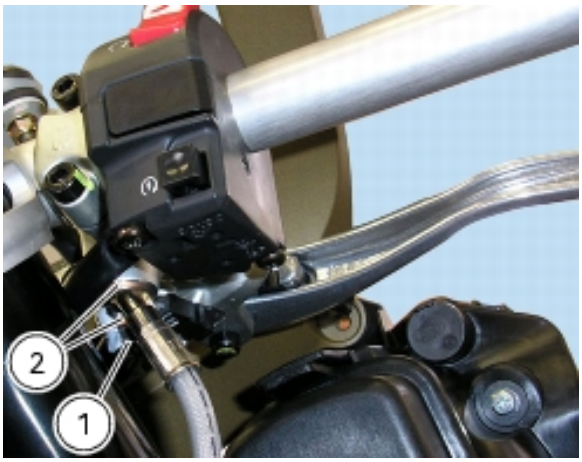
Warning
Brake fluid is corrosive and will damage paintwork. Avoid contact with eyes and skin. In case of accidental contact, wash the affected area with abundant running water and consult a doctor if necessary.

For maintenance instructions (brake pad wear check and renewal, brake fluid change, etc.) refer to Sect. D 4, Maintenance operations.

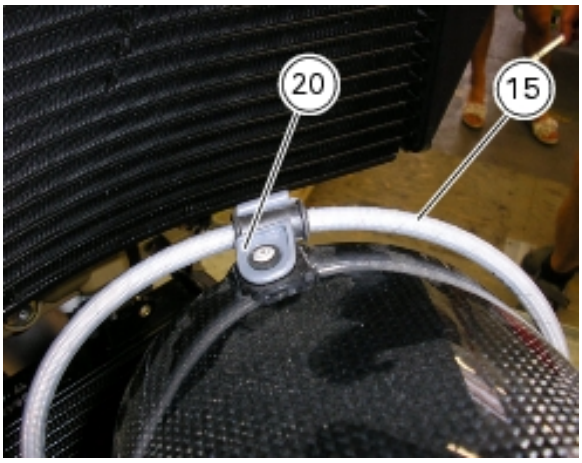
Removal of the front brake system

Operation	Section reference
Drain the braking system	D 4, Draining the brake circuit

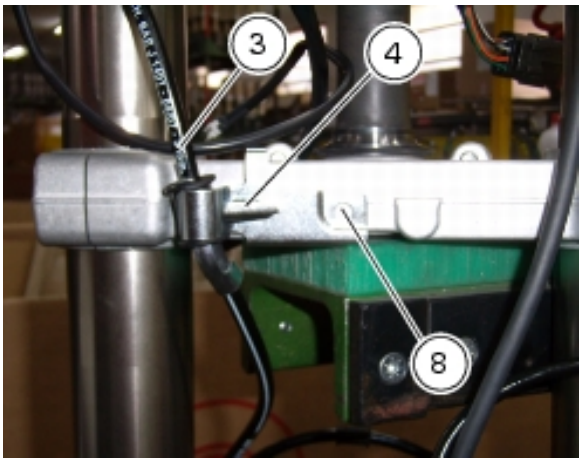
Unscrew the banjo bolt (1) securing the brake hose to the master cylinder and recover the sealing washers (2).



Remove the hose (15) from the grommet (**18**) on the mudguard and from the clip (20).



Loosen the bolt (8) and withdraw the hose (3) from the bracket (4).



Remove the hose (3) from the brake master cylinder.

Warning

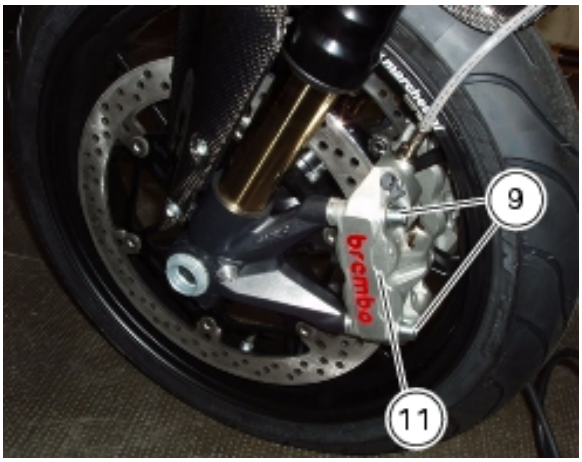
If the clip (20) is damaged while removing the front brake hose, it must be replaced (Sect. E 4, Removal of the front mudguard).

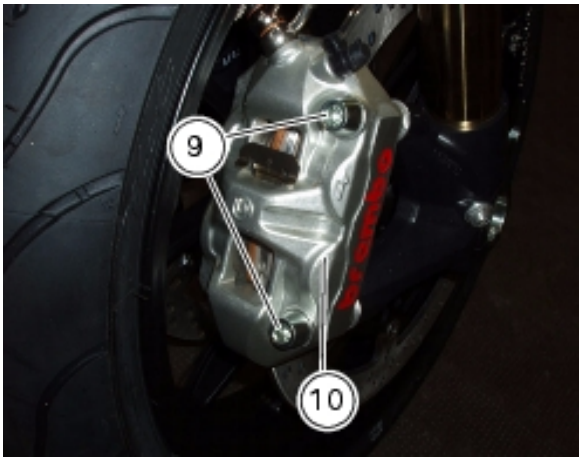
In the absence of the restraint provided by the clip, the brake hose could come into contact with the tyre during braking and thus lead to accidents.

Remove the brake master cylinder (Sect. F 3, Removal of the front brake master cylinder).

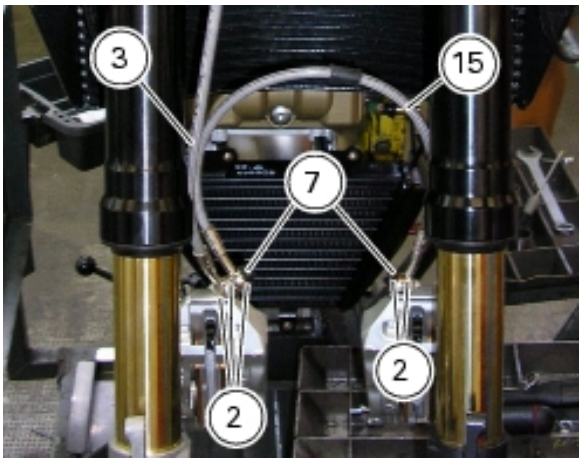
Unscrew the two retaining bolts (9) securing the left front brake caliper (11) to the fork leg.

Repeat the operation for the right brake caliper (10).





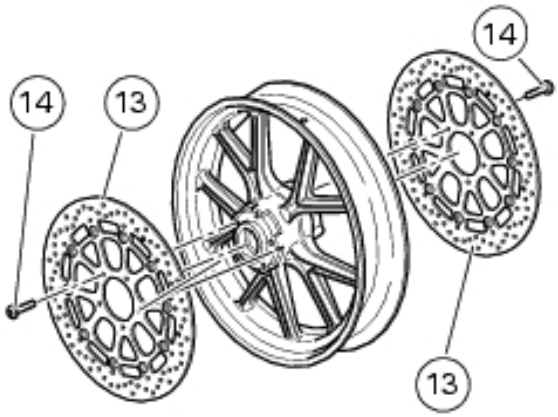
Unscrew the banjo bolts (7) from both calipers and recover the sealing washers (2).
Detach the front brake calipers from the hose (3) and (15).



Refitting the brake discs

The front brake discs consist of an inner carrier, which is mounted to the wheel, and an outer rotor. Both parts must be changed together as a pair.

Remove the front wheel (Sect. G 1, Removal of the front wheel).
Undo the bolts (14) securing the brake discs to the wheel and remove the discs (13) from both sides of the wheel.



Overhauling the front brake components

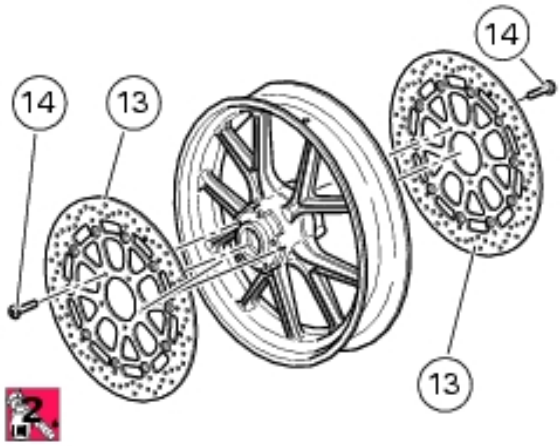
Important
Critical safety components. The brake caliper manufacturer advises against any servicing of the internal components

of calipers. Incorrect overhaul of this component could endanger rider safety.

Operations should be limited to renewal of the pads, fasteners and the bleed valve assembly.
Refer to the exploded view at the beginning of this section for indications on renewal of the above components.
The brake disc must be clean without any signs of rust, oil, grease or dirt and no deep scoring.
For brake disc wear inspection, adhere to the service limits given in Sect. C 1.1, Hydraulic brakes.

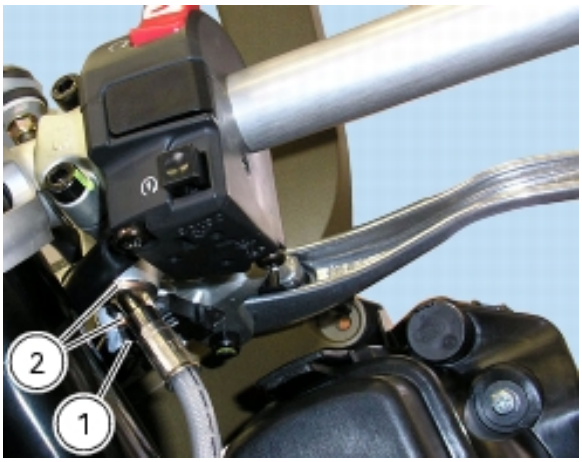
Refitting the front brake system

Before refitting the brake disc to the wheel, clean all contact surfaces thoroughly and smear a medium strength threadlocker on the threads of retaining bolts (14).
Screw in the bolts (14) securing the front brake disc (13) to the front wheel in this sequence: 1-3-5-2-4.



Tighten the bolts to the specified torque (Sect. C 3, Frame torque settings).
Refit the wheel to the motorcycle (Sect. G 1, Refitting the front wheel).

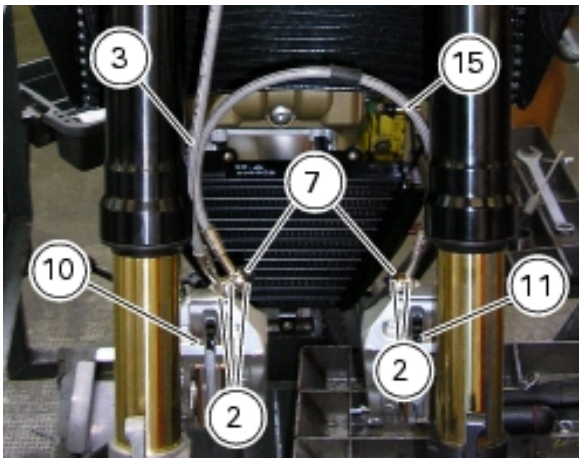
When reconnecting the brake hose to the caliper or master cylinder, make sure to install the sealing washers (2) either side of the hose end fitting.
After positioning the fitting correctly, tighten down the banjo bolt (1) to the specified torque (Sect. C 3, Frame torque settings).



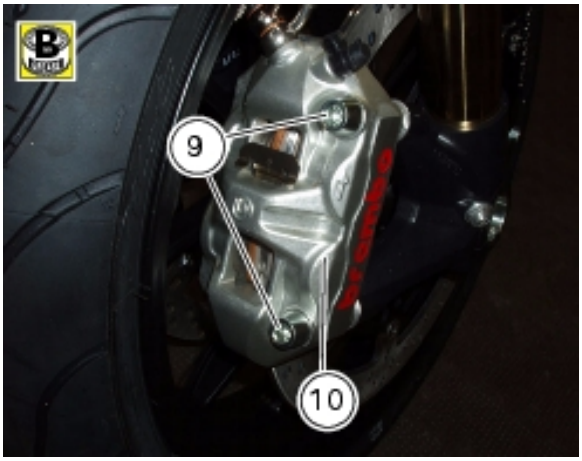
Reconnect the hoses (3) and (15) to the front brake calipers (10) and (11) and tighten the bolts (7) to their specified torque (Sect. C 3, Frame torque settings).

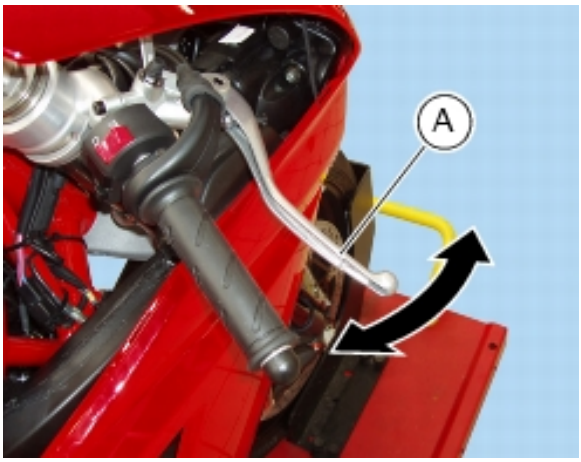
Notes

Make sure that internal hose fitting (3) and external hose fitting (15) are installed to the right brake caliper (10).

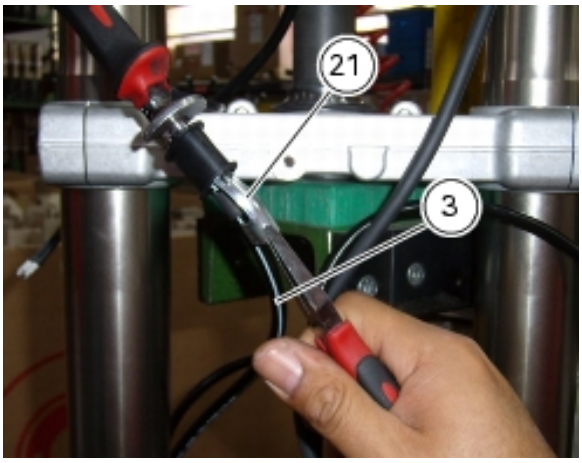


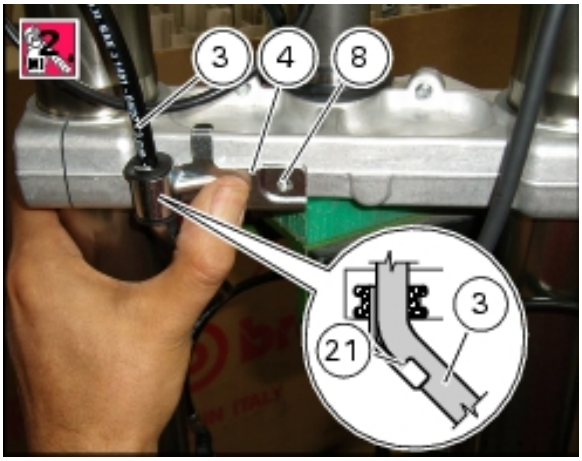
Fit the right caliper (10) over the disc.
Locate the hose (3) in the grommet (**18**).
Apply recommended grease to the bolts (9).
Hand tighten the bolts (9) to secure the calipers to the fork legs.
Locate the brake master cylinder-lever assembly (Sect. F 3, Refitting the front brake master cylinder).
Operate the brake lever (A) two or three times to pressurise the circuit so that the brake pads are brought into contact with the brake disk.
Hold the lever pressed towards the grip and tighten the caliper bolts (9) to the specified torque (Sect. C 3, Frame torque settings).



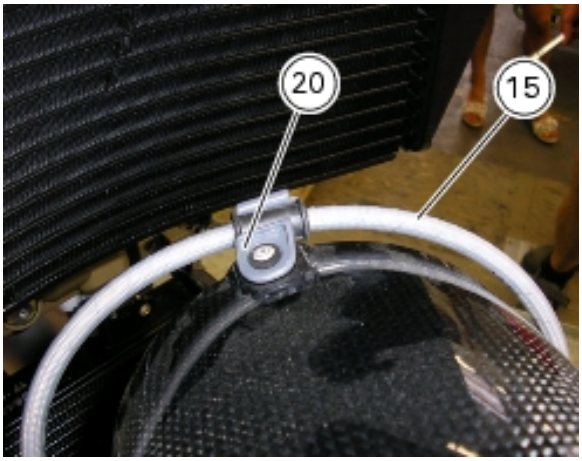


Repeat the procedure to refit the other brake caliper.
Insert the hose (3) in plate (4), making sure that grommet (21) is positioned correctly.
The special shape of the guide restrains the movement of hose (3) during braking.
Position the hose as shown in the figure.
Apply the recommended threadlocker to the bolt (8) and tighten to the specified torque (Sect. C 3, Frame torque settings).



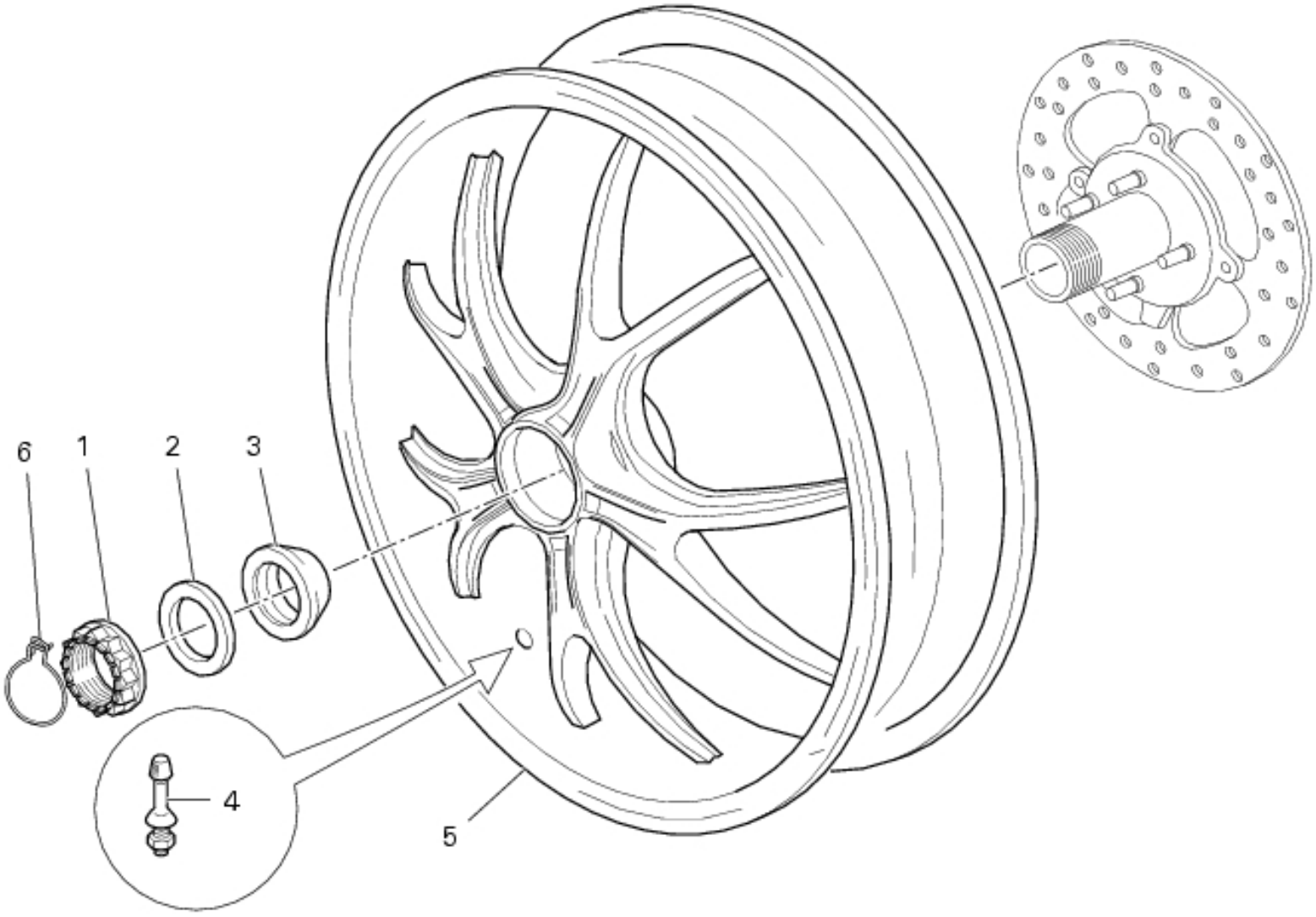


Insert the front brake hose (15) in the clip (20) on the front mudguard.



Operation	Section reference
Fill the brake circuit	D 4, Filling the brake system with fluid

4 - Rear wheel



1 Right-hand wheel nut
2 Washer
3 Bush
4 Valve
5 Wheel
6 Circlip

Parts catalogue

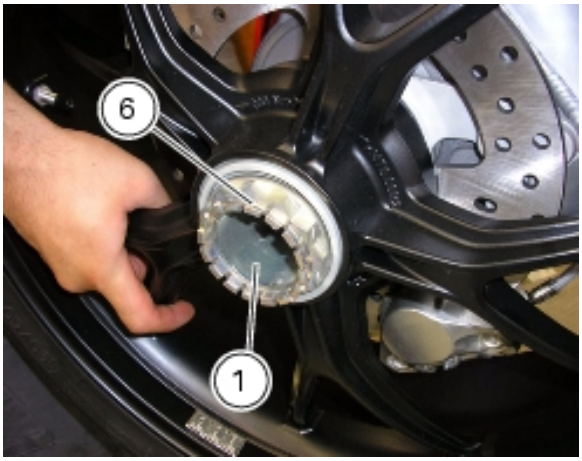
FRONT AND REAR WHEELS

Important

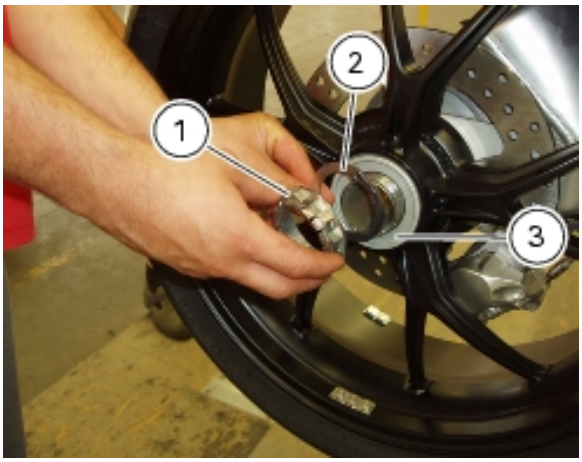
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the rear wheel

Place the motorcycle on the rear service stand and engage 1st gear.
Remove the circlip (6).
Using a suitable socket, loosen the wheel nut (1).



Fully unscrew the wheel nut (1), then slide of the washer (2) and the bush (3).
Remove the rear wheel from the motorcycle.

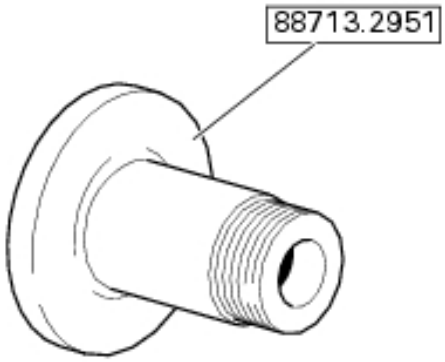


Overhauling the rear wheel

Inspect the condition of the rear wheel.
As the rear wheel has no bearings, it should be supported on the service tool part no. **88713.2951**.

Notes

This service tool can also be used to install the wheel on a balancing machine.



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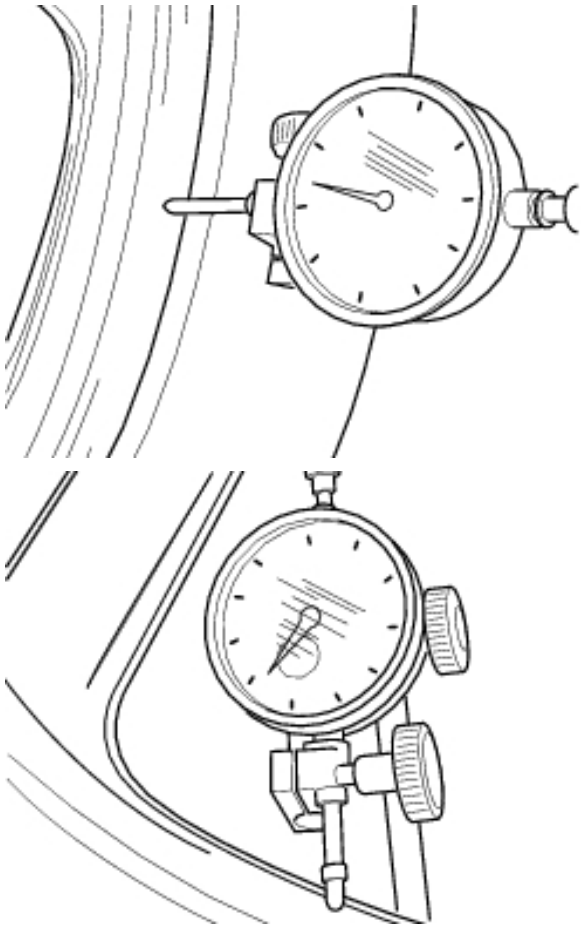
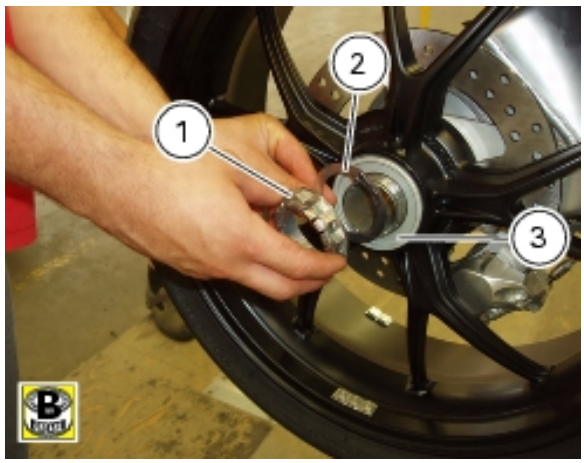
Overhauling the wheel

Inspect the wheel as follows:
Visually inspect the wheel for cracks, scoring and deformation; change the wheel if damaged.
Fit the wheel on service tool no. **88713.2951** using the original fasteners.
Using a dial gauge, measure rim run-out and out-of-round relative to the wheel axle (see Sect. C 1.1, Rear wheel).
If the values measured are not within the tolerance limits, renew the wheel.



Refitting the rear wheel

Clean the mating surfaces and grease the threaded end of the stub axle with the recommended grease.
Fit the wheel, aligning it with the stub axle and the driving pins.
Fit the tapered bush (3) and the washer (2), and hand tighten the wheel nut (1).



Tighten the wheel nut (1) to the specified torque (Sect. C 3, Frame torque settings) and check that the hole in the nut is aligned with one of the holes in the stub axle.
If not, tighten the nut slightly to bring the holes into alignment.
Fit the circlip (6).

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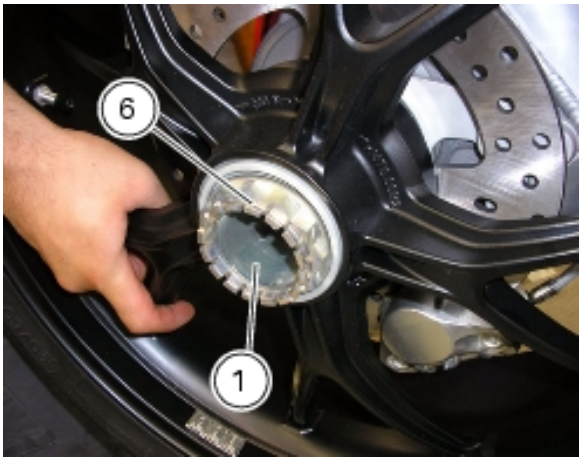
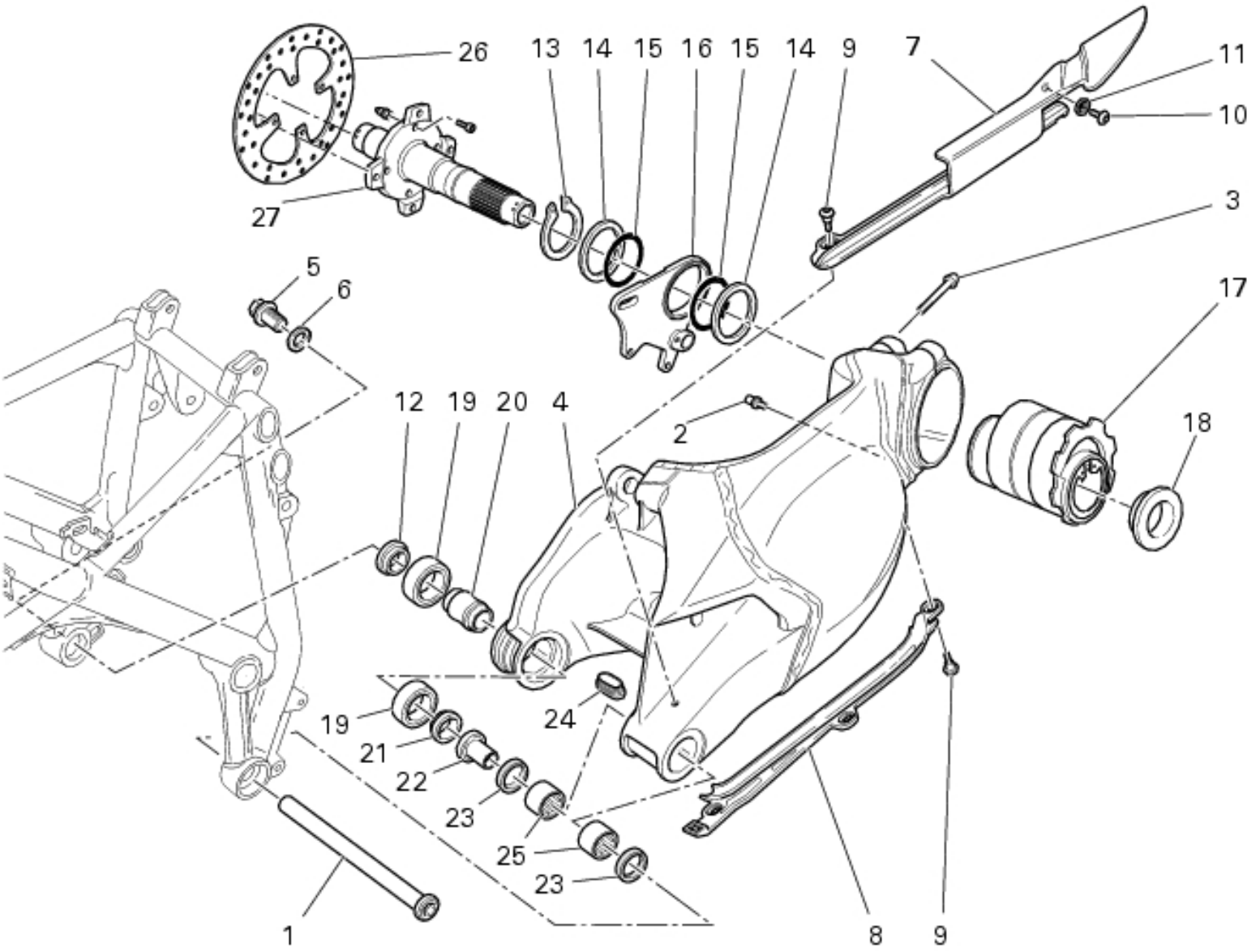


5 - Rear swingarm



1 Swingarm pivot shaft
2 Pin
3 Bolt
4 Rear swingarm
5 Nut
6 Washer
7 Upper drive chain slider
8 Lower drive chain slider
9 Bolt
10 Bolt
11 Washer
12 Left spacer
13 Circlip
14 Washer
15 O-ring
16 Caliper mounting bracket
17 Eccentric hub
18 Spacer

19 Bearing
20 Spacer
21 Right spacer
22 Bush
23 Seal
24 Plug
25 Roller bearing
26 Rear brake disc
27 Rear wheel axle

Parts catalogue

rear wheel axle
swingarm

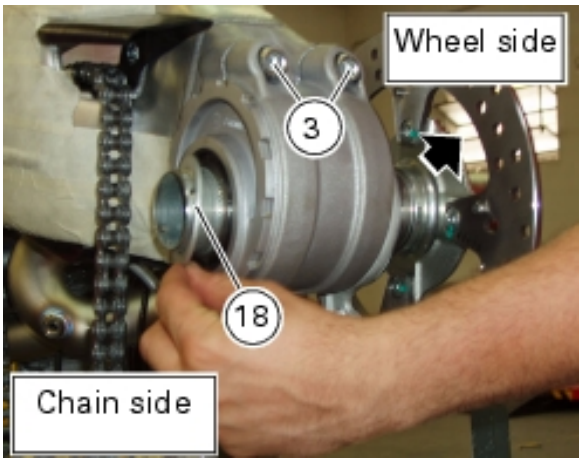
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

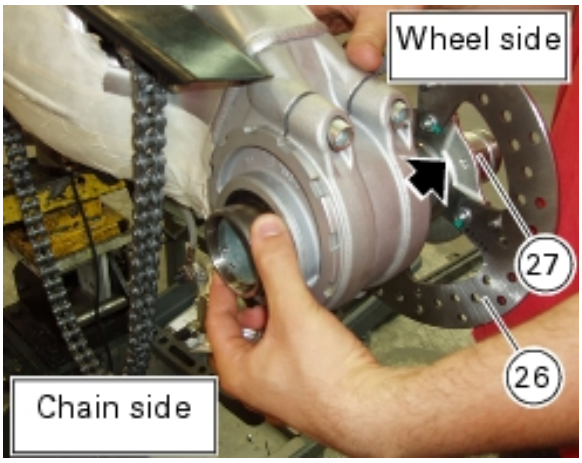
Removal of the rear wheel eccentric hub and rear wheel axle

Before removing the eccentric hub, you must first remove the following parts:

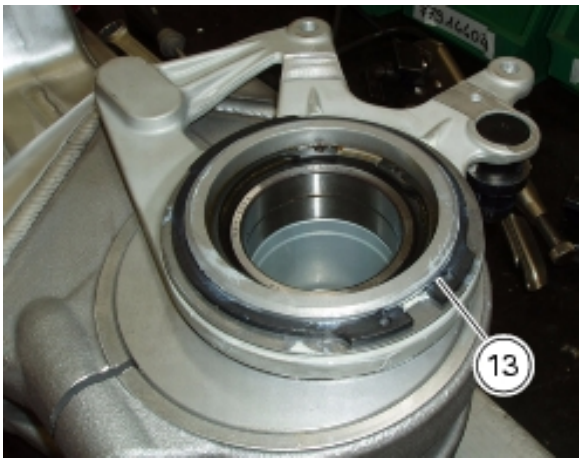
Operation	Section reference
Remove the rear wheel	G 4, Removal of the rear wheel
Remove the rear sprocket	G 8, Renewal of the rear sprocket
Remove the rear brake caliper	G 6, Removal of the rear brake caliper

Slacken off the bolts (3).
Withdraw the spacer (18) on the chain side and withdraw the stub axle (26) complete with brake disc (27) from the opposite side.

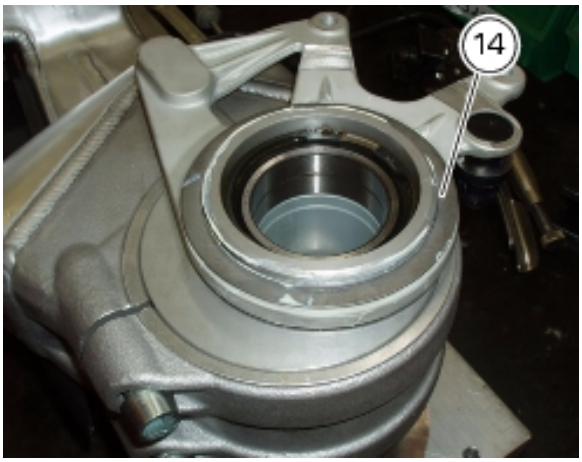


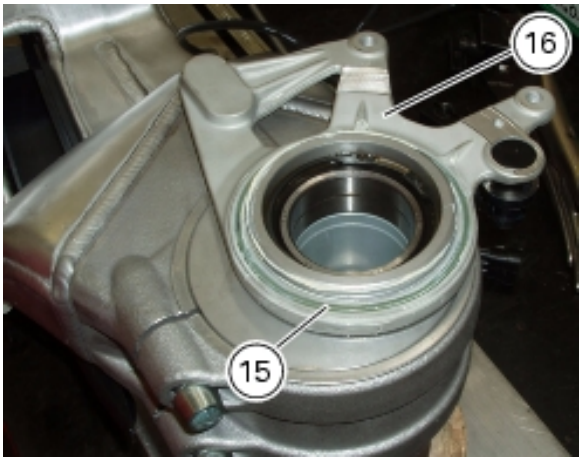


Remove the circlip (13) on the wheel side of the eccentric hub.

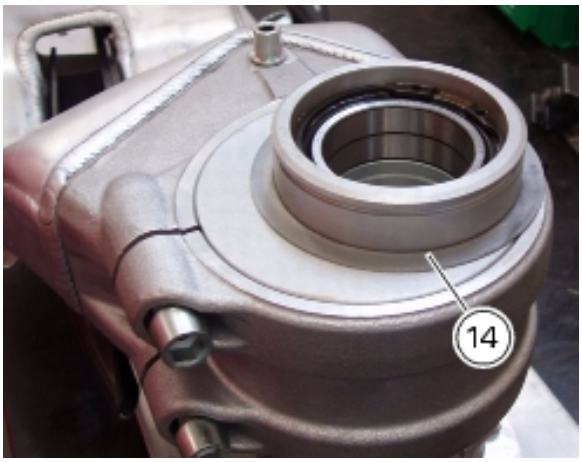


Remove the washer (14), the caliper mounting bracket (16) with the O-rings (15).

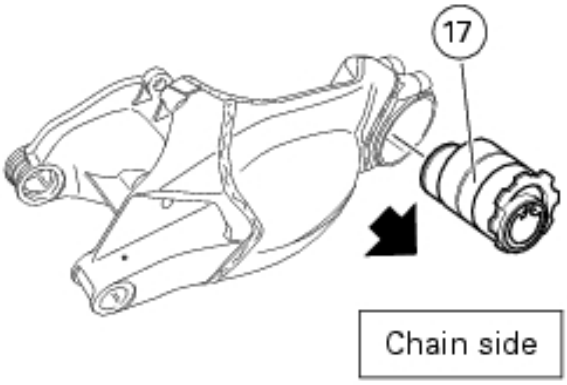




Remove the other washer (14).



Withdraw the eccentric hub (17) from the chain side of the swingarm.

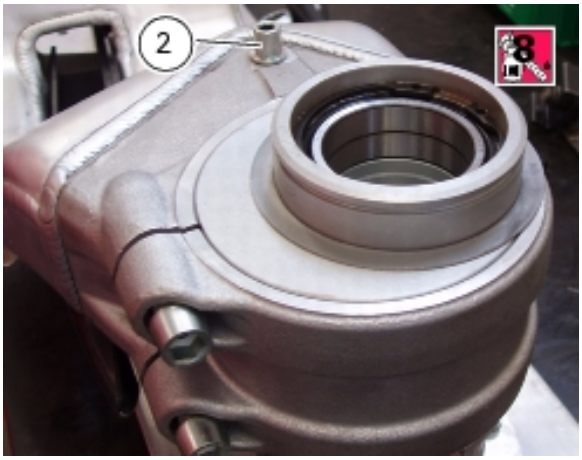


Notes

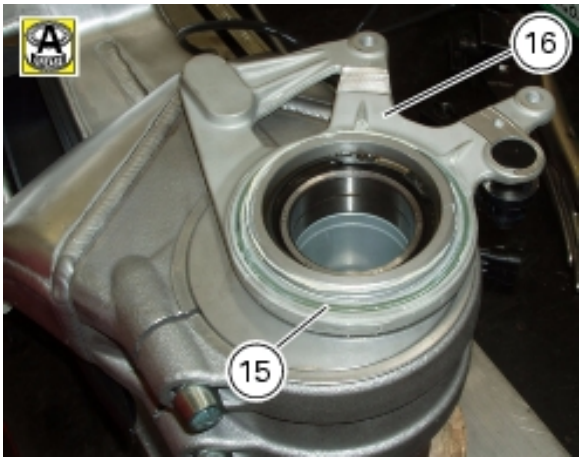
The rear hub is a component particularly critical to the dynamic safety of the motorcycle. For this reason, any overhaul of the internal components of the hub is strictly forbidden. The hub is available as complete assembly, part no. **819.2.042.1A**.

Refitting the rear wheel eccentric hub and rear wheel axle

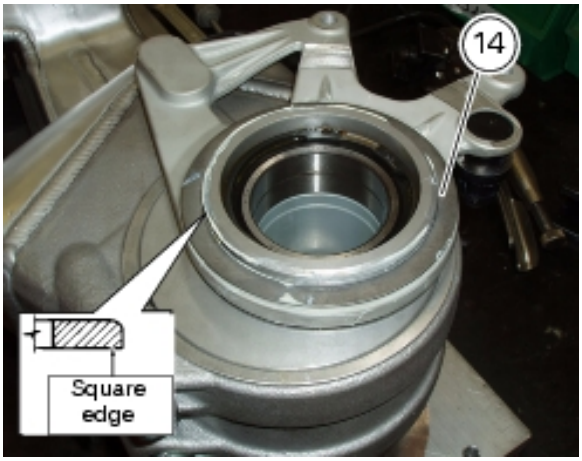
Refitting is the reverse of removal, with attention to the following points.
If the caliper bracket locating pin (2) was removed, apply the recommended threadlocker on reassembly.

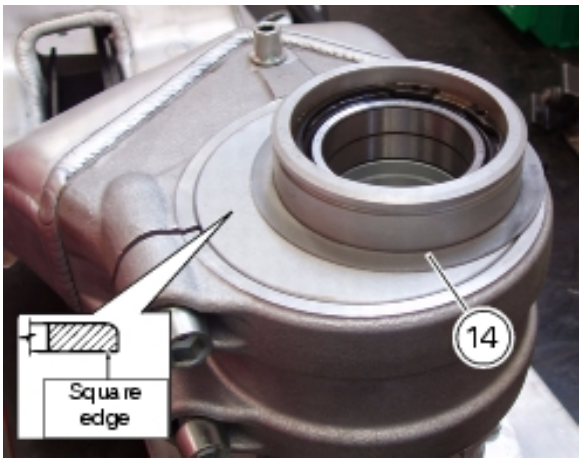


Before refitting, apply the recommended grease to the seat on the eccentric hub (17) of the caliper mounting bracket (16) on which the rings (15), also greased, will be located. Position the mounting bracket (16) so that the point indicated is aligned with the anti-rotation pin (2).

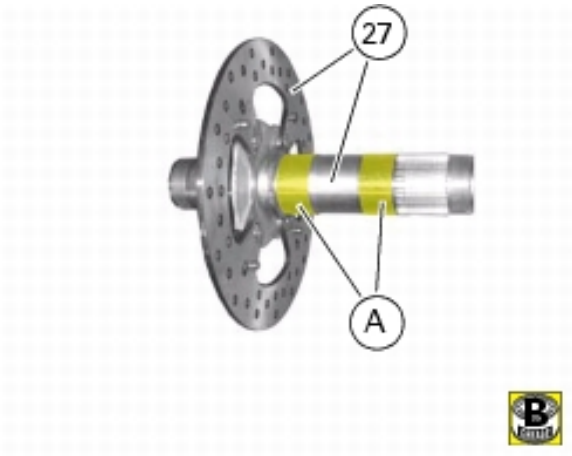


Refit the washers (14) with their square edges facing the eccentric hub.



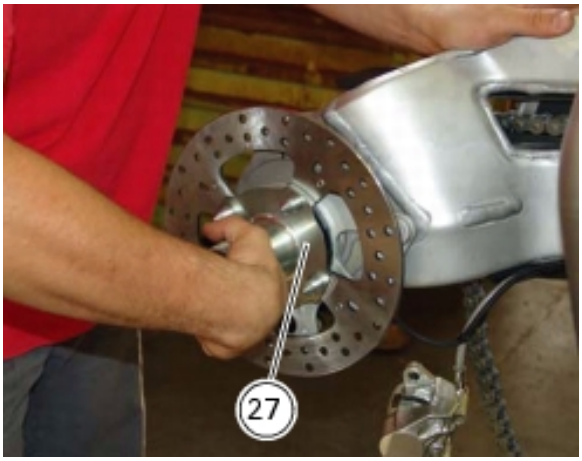


Apply an even coating of the recommended grease in the areas (A) of the axle (27).

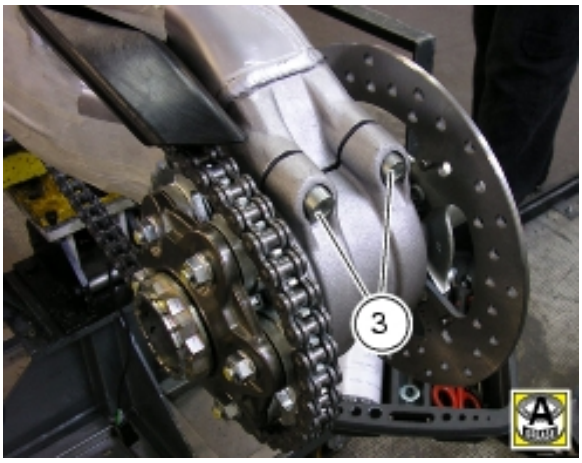


Insert the rear wheel stub axle (27) in the hub.

Ensure the stub axle (27) is seated in the hub.



Apply the recommended grease to the bolts (3) and tighten to the specified torque (Sect. C 3, Frame torque settings) in the sequence 1-2-1.



Operation	Section reference
Refit the rear brake caliper	G 6, Refitting the rear brake caliper
Refit the rear sprocket	G 8, Refitting the rear sprocket
Refit the rear wheel	G 4, Refitting the rear wheel

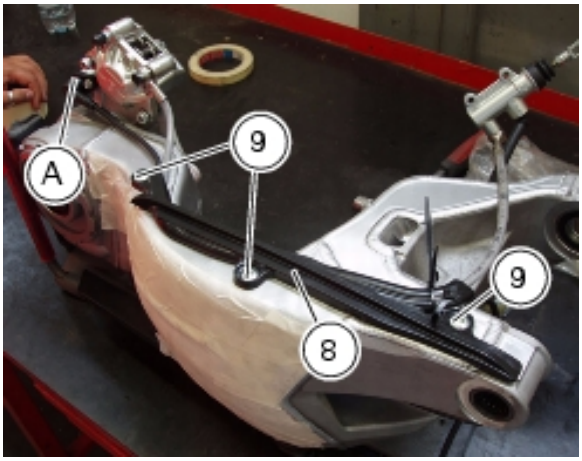
Tension the drive chain as indicated in the paragraph "Adjusting the chain tension", in Sect. D 4.

Removal of the swingarm

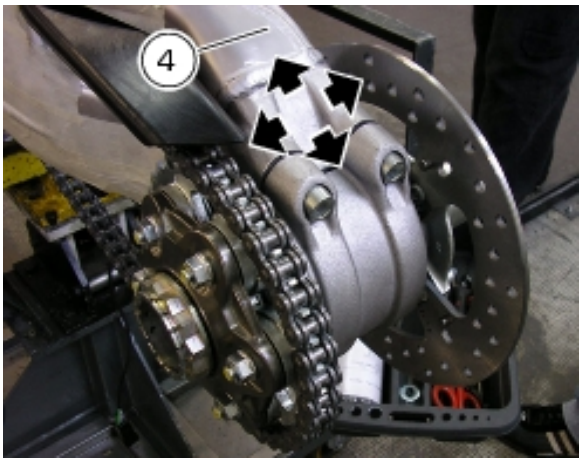
Before removing the parts in question, you must first carry out the following operations:

Operation	Section reference
Remove the rear wheel	G 4, Removal of the rear wheel
Remove the rear sprocket	G 8, Renewal of the rear sprocket
Remove the rear brake caliper	G 6, Removal of the rear brake caliper
Remove the shock absorber and tie-rod from the swingarm	G 7, Removal of the rear suspension rocker arm

Remove the rear hub as described in "Removal of the rear wheel eccentric hub and rear wheel axle" in this section.
Free the rear brake hose from the lower chain slider (8) and the speed sensor wiring by unscrewing the bolts (9).
Disconnect the speed sensor wiring connector (A) from the main wiring loom.

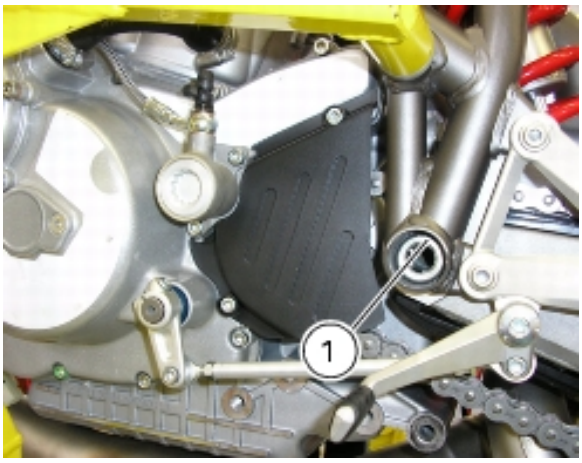


You can check the play in the swingarm bearings while the swingarm (4) still installed on the motorcycle frame
Grasp the rear of the swingarm (4) and try to move it in the four directions shown by the arrows.

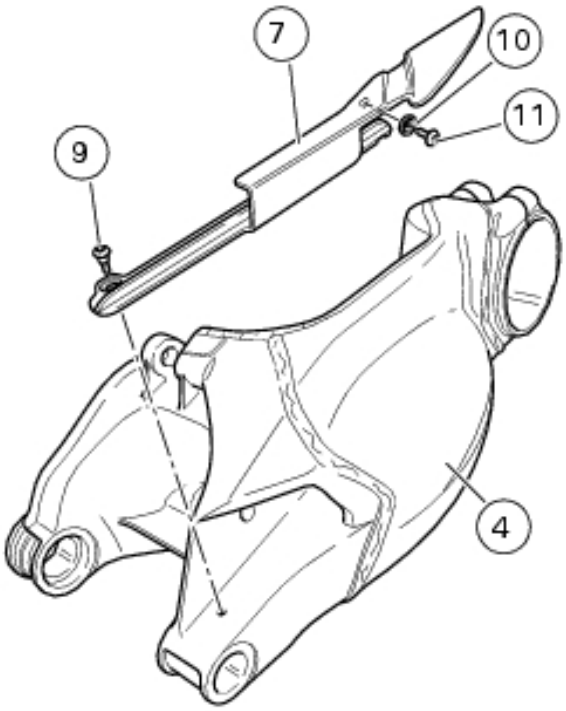


Any abnormal movement is a sign of worn bearings that could cause instability when riding.
Refer to the indications for checking swingarm bearing play in Sect. G 1, Wheel bearings.

Once the play in the swingarm bearings has been checked, the swingarm (4) may be removed from the motorcycle.
Restrain the swingarm pivot shaft (1) on the left side of the motorcycle while undoing the bolt (5) on the opposite side: recover the washer (**6**).

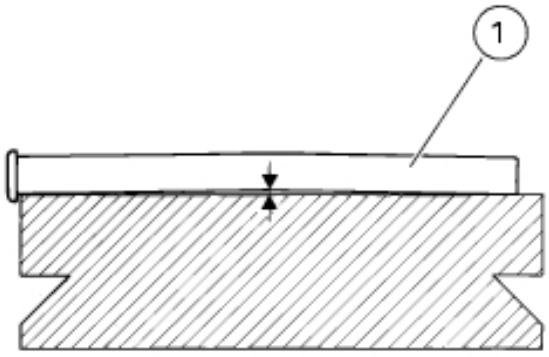


Using drift **88713.1074**, fully extract the swingarm pivot shaft.
Remove the swingarm (4) assembly from the frame.
Detach the upper chain slider (7) from the swingarm (4) by unscrewing the bolts (9) and (10), recovering the washer (11).



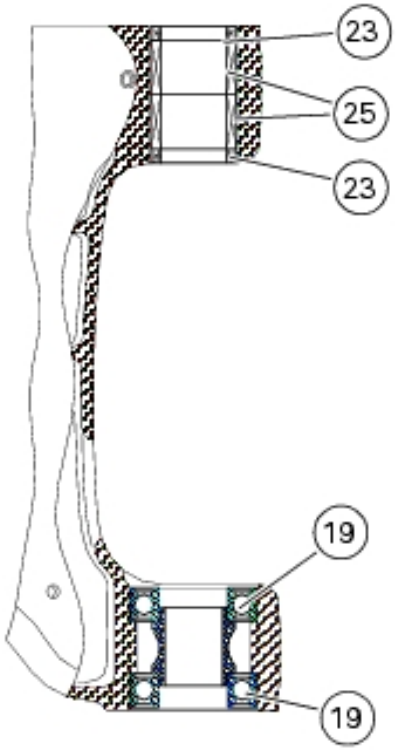
Inspecting the swingarm pivot shaft

Before refitting the swingarm pivot shaft (1), check it carefully for distortion.
Roll the shaft on a reference surface and measure maximum distortion using a feeler gauge (see Sect. C 1.1, Rear wheel).



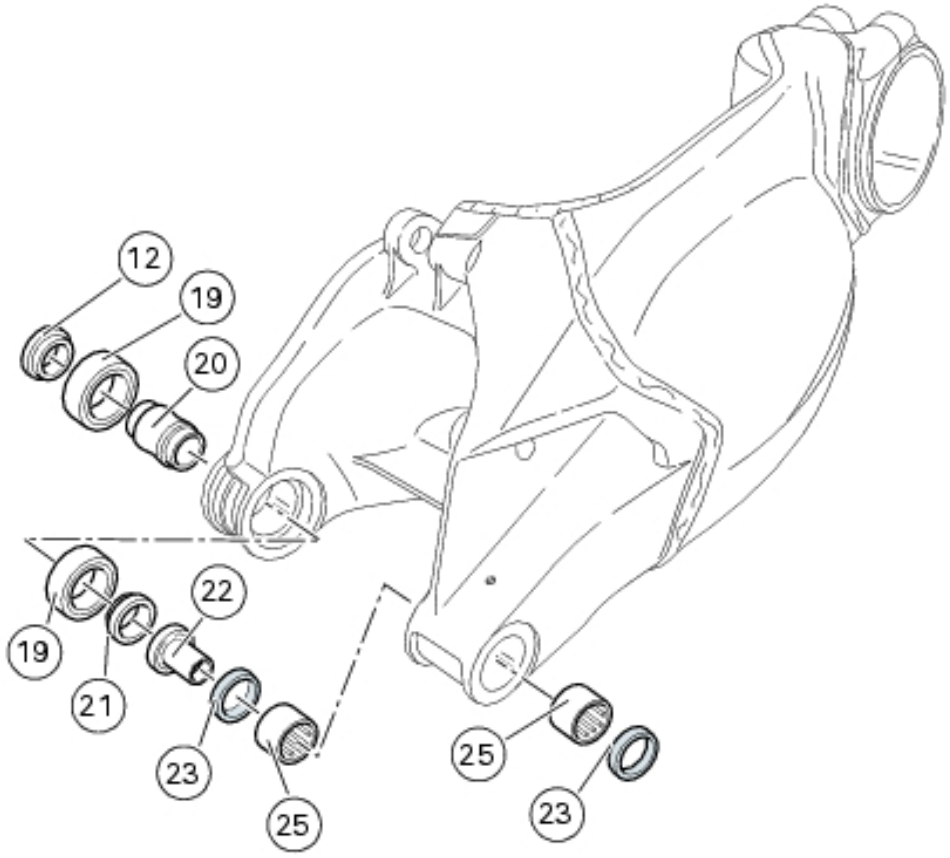
Overhauling the rear swingarm

Inside the swingarm (4), at the point at which it pivots on the frame, there are a pair of ball bearing races (19) on the right-hand side and a pair of roller bearings (25), with seal rings (23), on the left-hand side.

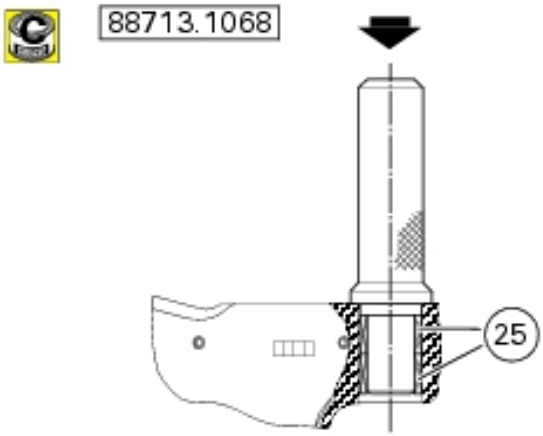


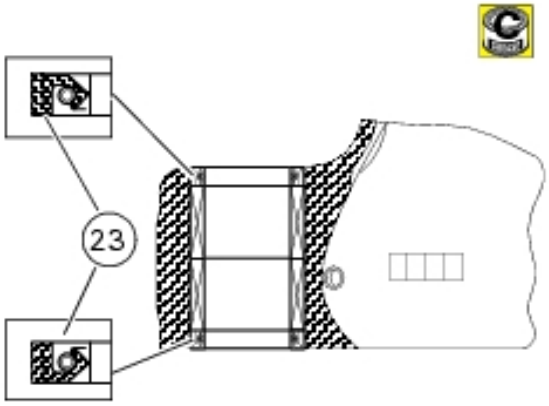
To change the bearings, proceed as follows.
Remove the spacers (21) from the right-hand side of the swingarm and remove the bush (22) from the left-hand side. Remove the ball bearings (19), seal rings (23) and roller bearings (25) with a suitable punch and press. Support the swingarm and take care not to damage the bearing bores.

Important
Once removed, the bearings (19), seal rings (23) and roller bearings (25) must not be reinstalled.



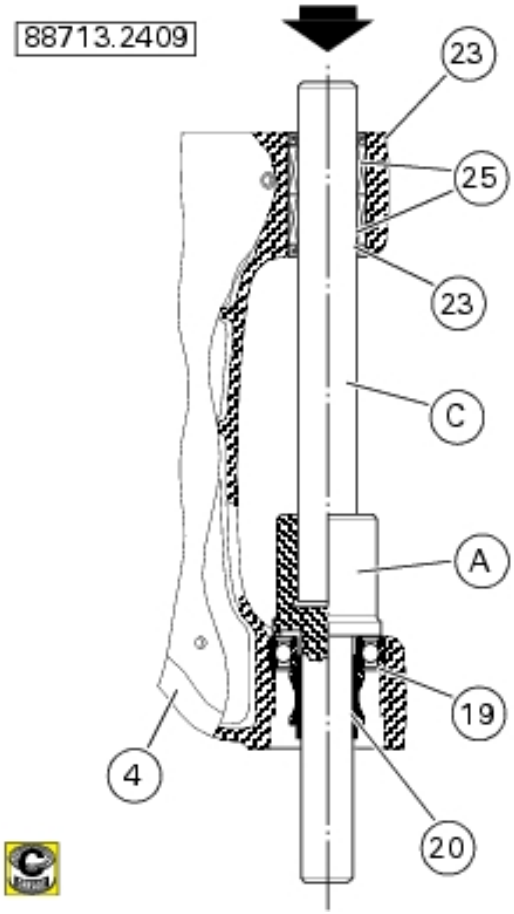
Heat the entire swingarm up to **150** °C and support it.
Insert the new roller bearings (25) in the service tool no. **88713.1068** and install them from the outside into the bore on the left-hand side of the swingarm.
Drive them in until the tool is fully seated against the swingarm.
Use the same tool to fit the new seals (23), positioned as shown in the sectional view, so that they seat against the newly installed roller bearings.



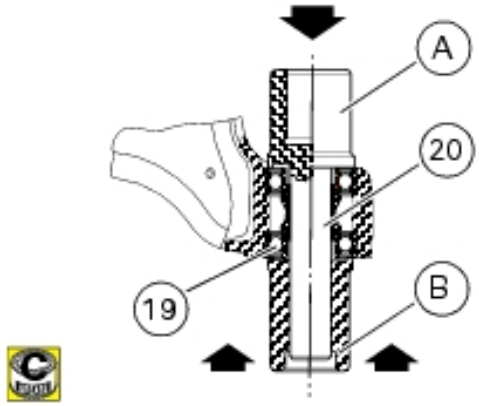


To install the ball bearing races (19) you will need service tool no. **88713.2409** comprised of:
(A) − drift for internal bearings;
(A) − drift for external bearings;
(C) − guide pin.

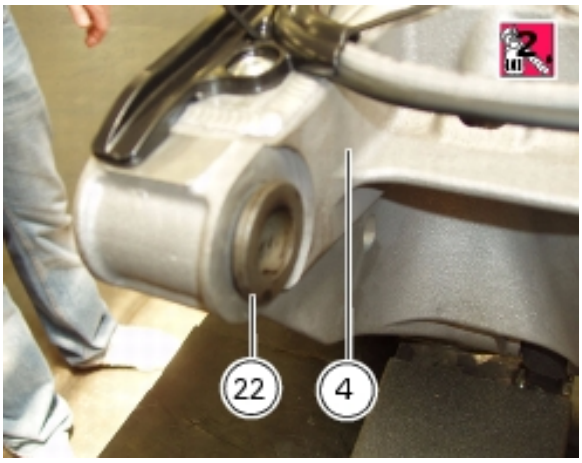
Fit a new bearing (19) with the internal spacer (20) onto the drift (A) and position it on the interior of the right-hand side support of the swingarm.
Insert the guide pin (C) into the previously mounted roller bearings and insert the other end in the bore in the tool (A).
Drive the bearing (19) fully into the swingarm.
Fit the other new bearing (19) at the outer end of tool (A).

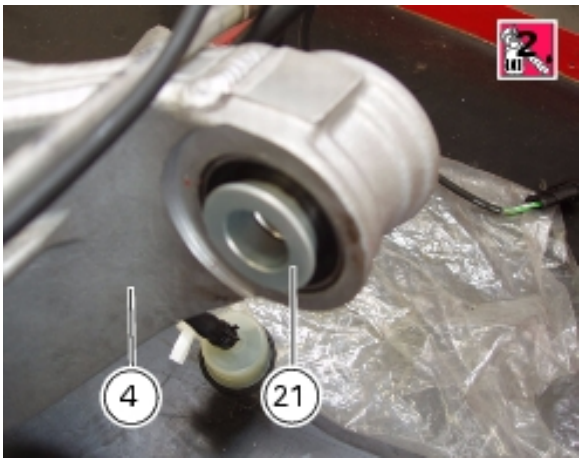


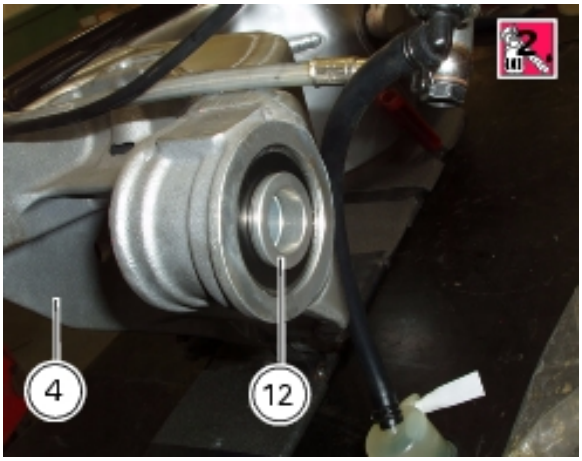
Using tool (A) as a stop, use tool (B) to drive the external bearing up against spacer (20): remove the tools.
Before refitting the swingarm (4), grease the ball bearings (19), roller bearings (25) and seal rings (23) with the recommended grease.



Remove the spacers (21) and (12) from the right-hand side of the swingarm (4) and remove the bush (22) from the left-hand side.

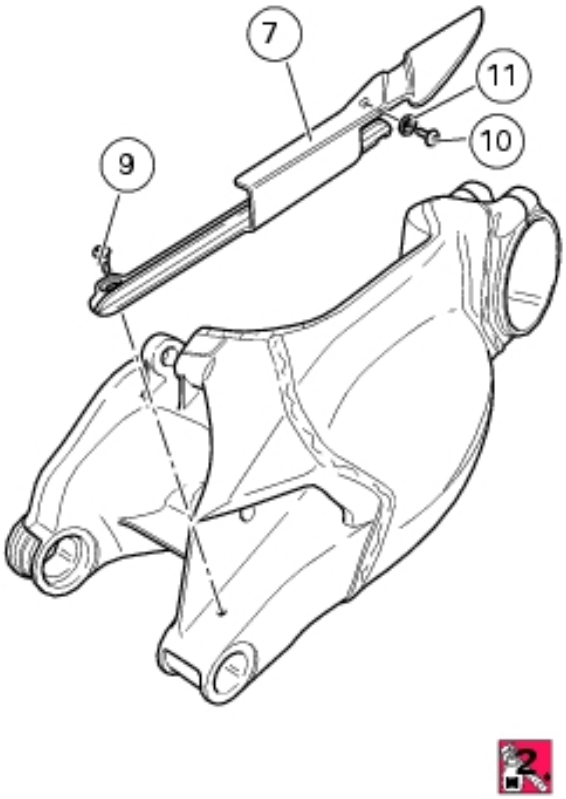




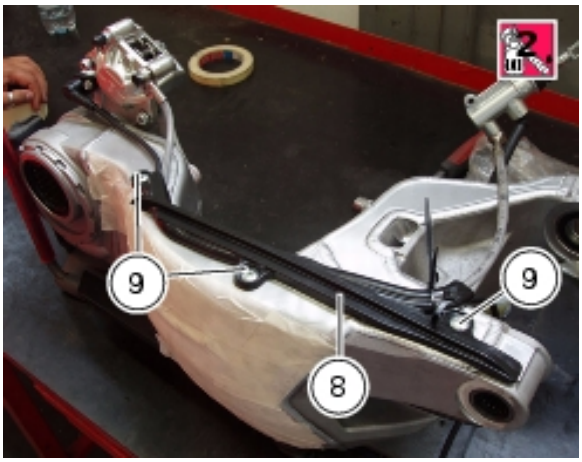


Refitting the swingarm

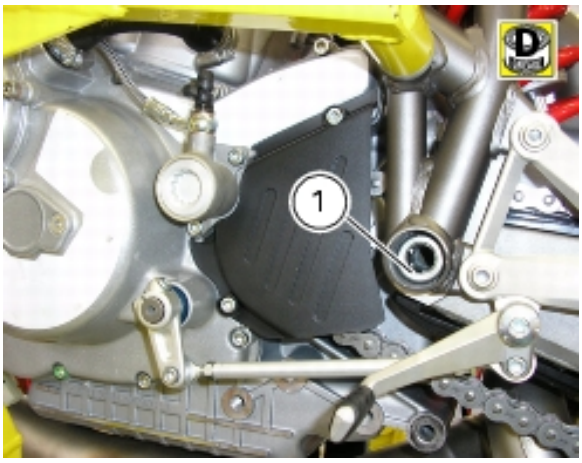
Refit the upper chain slider (7) securing it with the bolts (9) and (10) and the washers (11).



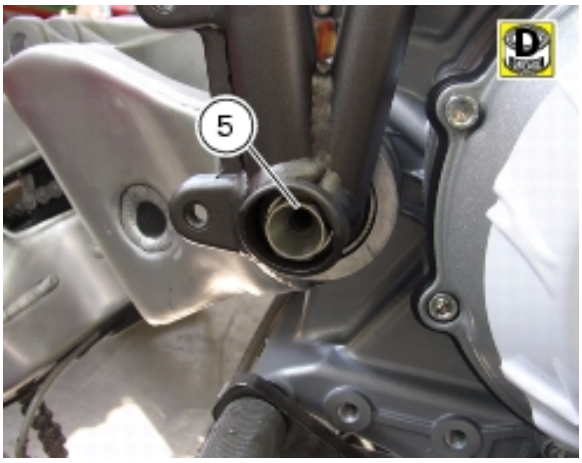
Refit the rear brake hose and speed sensor to the swingarm (4), securing them with the lower chain slider (8) and tightening the bolts (9).
Apply the recommended threadlocker to the bolts (9) and (10) and tighten to the specified torque (Sect. C 3, Frame torque settings).



Locate the swingarm (4) on the frame.
Lubricate the swingarm pivot shaft (1) with the recommended grease and drive it home in the frame.



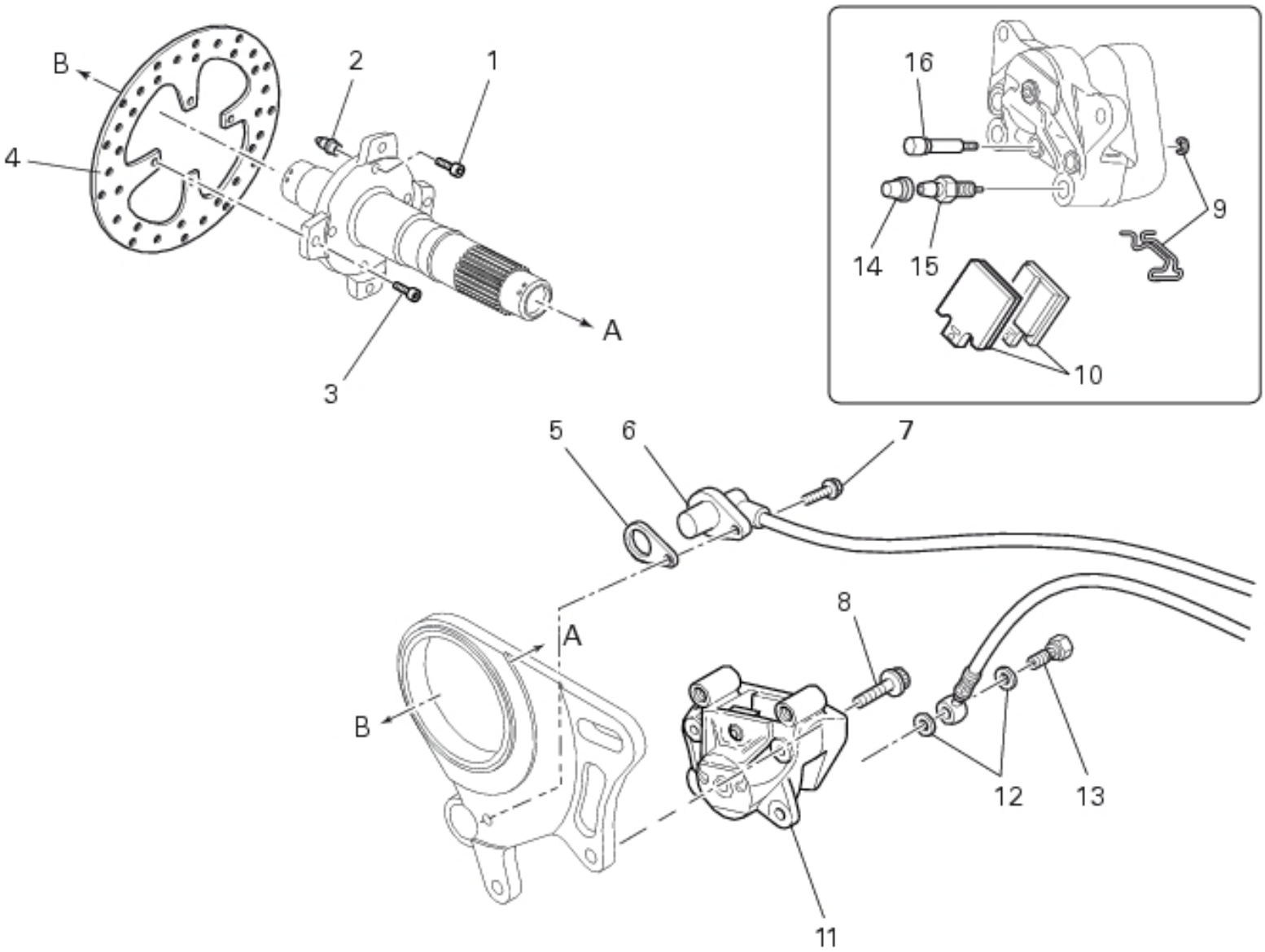
On the opposite side of the bike, secure the swingarm pivot shaft (1) with the nut (5) after applying the recommended grease, interposing the washers (**6**).
Tighten the nut (5) to the specified torque (Sect. C 3, Frame torque settings).



Connect the speed sensor to the main wiring loom.

Operation	Section reference
Reconnect the shock absorber and tie-rod to the swingarm	G 7, Refitting the rear suspension
Refit the rear brake caliper	G 6, Refitting the rear brake caliper
Refit the rear sprocket	G 8, Refitting the rear sprocket
Refit the rear wheel	G 4, Refitting the rear wheel

6 - Hydraulic rear brake



1 Bolt
2 Pin
3 Bolt
4 Rear brake disc
5 Spacer
6 Speed sensor
7 Bolt
8 Bolt
9 Pad retaining pin and clip
10 Pair of brake pads
11 Rear brake caliper
12 Sealing washer
13 Banjo bolt
14 Dust cap
15 Bleed valve

Parts catalogue

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Rear brake
REAR WHEEL AXLE

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

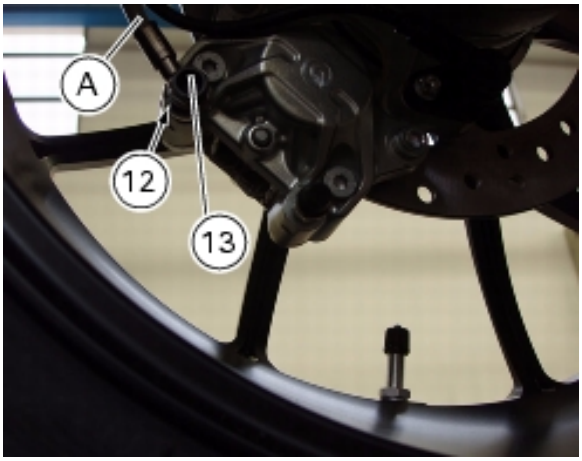
Removal of the rear brake caliper

Important
Critical safety components. The brake manufacturer advises against any servicing of the internal components of brake calipers or the master cylinder. Incorrect overhaul of these critical safety components can endanger rider and passenger safety.

Before removing the parts in question, you must first carry out the following operations:

Operation	Section reference
Remove the right-hand side fairing	E 2, Removal of the side fairings
Drain the rear brake circuit	D 4, Draining the brake circuit
Remove the banjo bolt securing the brake hose to the rear brake master cylinder	F 4, Removal of the rear brake control
Remove the rear wheel	G 4, Removal of the rear wheel
Remove the lower chain slider	G 5, Removal of the swingarm

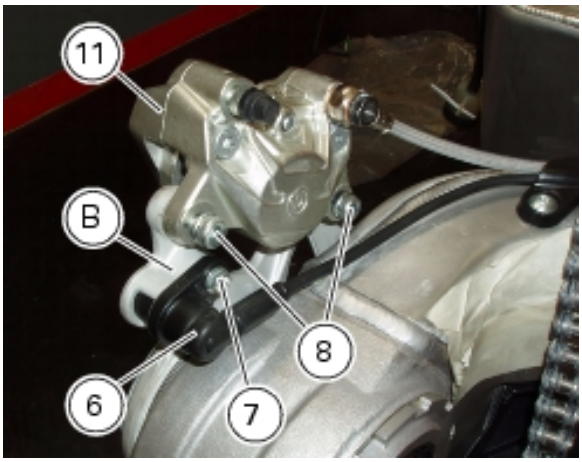
Unscrew and remove the banjo bolt (13) securing the hose (A) to the rear brake caliper and recover the sealing washers (12).
Remove the hose (A).



Unscrew the two bolts (8) securing the rear brake caliper (11) to the caliper mounting bracket and remove the caliper (11).
If it is necessary to remove the caliper mounting bracket (B), refer to Sect. G 5, Removal of the rear wheel eccentric hub and rear wheel axle.

Notes
See "Checking brake pad wear and changing brake pads" (Sect. D 4) for instructions on how to change the brake pads.
To remove the speed sensor (6), unscrew the bolt (7) securing it to the caliper mounting bracket, taking care to

recover the spacers (**5**).



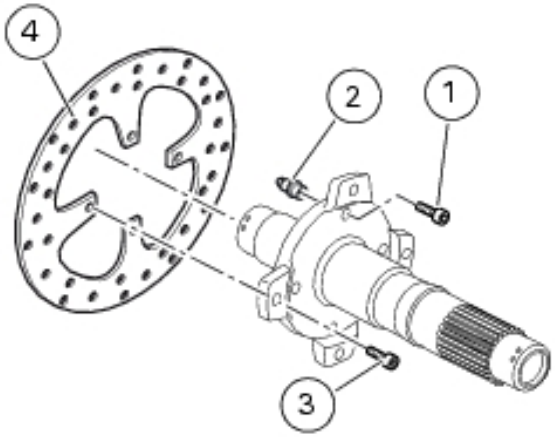
Only the following parts should be renewed:
Caliper: pads, fasteners and bleed valve assembly.
Master cylinder: control pedal, bleed valve assembly, reservoir and its parts (Sect. F 4).

Refer to the exploded view at the beginning of this section for indications on renewal of the above components.

Removal of the rear brake disc

Remove the rear eccentric hub (Sect. G 5, Removal of the rear wheel eccentric hub and rear wheel axle).
Unscrew and remove the four bolts (3) securing the brake disc to the stub axle and remove the rear brake disc (4).
If they are to be renewed, unscrew the bolts (1) from the hub and remove the locating pins (2).
The disc must be perfectly clean with no signs of rust, oil or grease deposits or other contaminants and must be free of any deep scoring.
Refer to Sect. C 1.1, Hydraulic brakes for the brake disc wear tolerance limits.
Proceed with the refitting of the rear brake disc (4), tightening the bolts (3) to the specified torque (Sect. C 3, Frame torque settings) in the sequence 1-2-3-4.

Refit the rear eccentric hub as described in Sect. G 5, Refitting the rear wheel eccentric hub and rear wheel axle.



Refitting the rear brake caliper

If the brake hoses are renewed or if one of the components of the rear brake system have been removed, make sure that the hose connection fittings on the master cylinder and the caliper are correctly positioned.

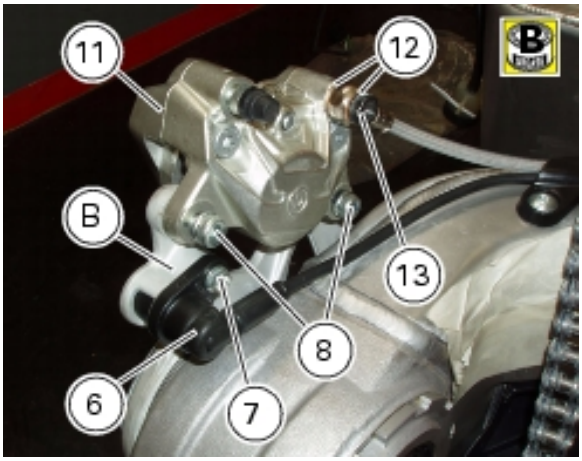
Warning

If incorrectly positioned, the hose can affect brake operation and foul moving parts. Position the hose as shown in the figure.
Remember to fit the copper faced sealing washers (12) to the either of the hose end fitting the brake hose to the

caliper (11).
After positioning the union correctly, tighten the banjo bolt (13) to the specified torque (Sect. C 3, Frame torque settings).
If removed, locate the speed sensor (6) on the caliper mounting bracket (B) with the spacer (**5**) and tighten the bolt (7) to the specified torque (Sect. C 3, Frame torque settings).

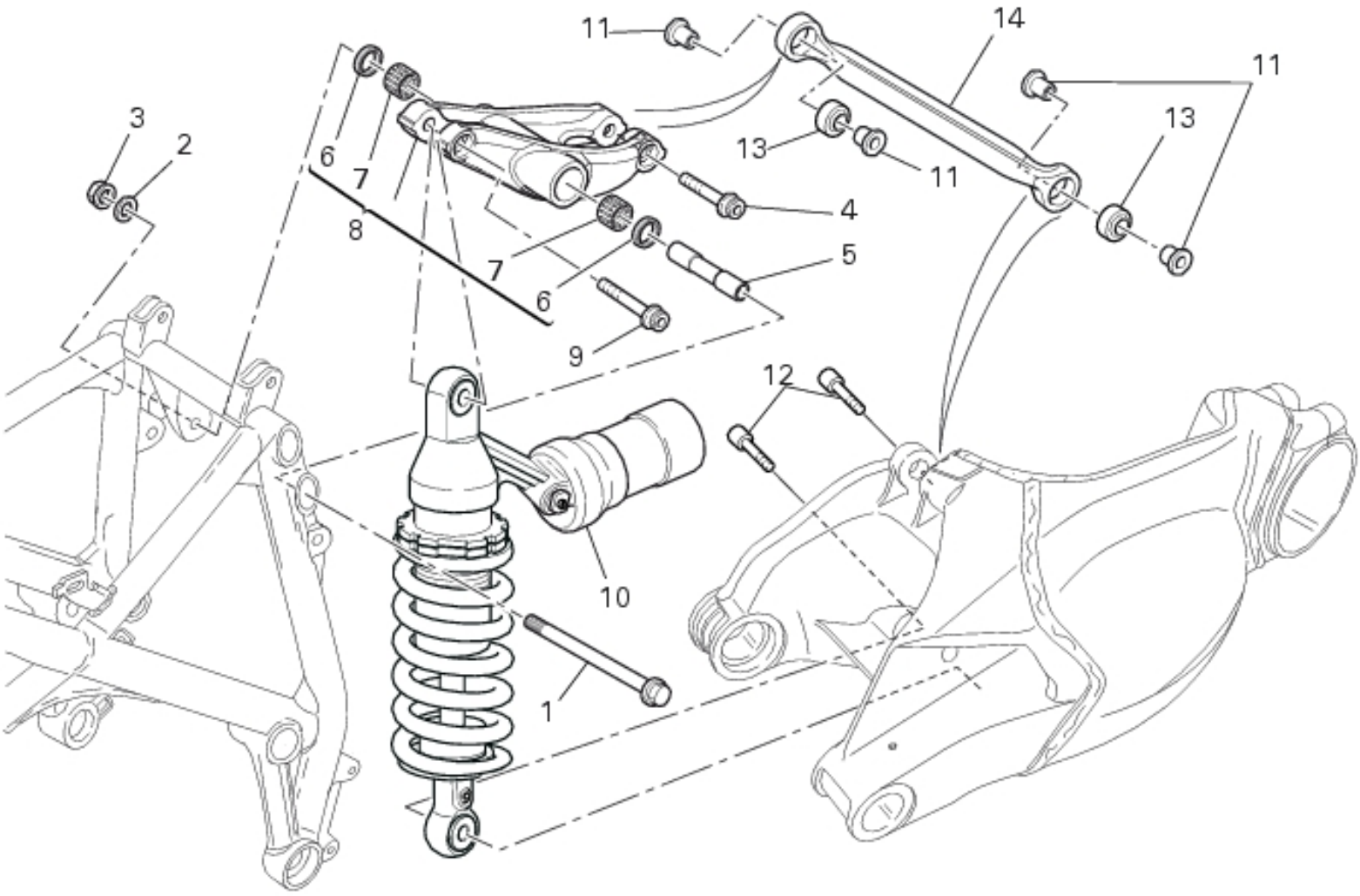
Notes

The gap between the sensor (6) and the brake disc bolt must be between **0.6** and **2.2** mm.
If the caliper mounting bracket (B) was removed, see Sect. G 5, Refitting the rear wheel eccentric hub and rear wheel axle for refitting instructions.
Fit the rear brake caliper (11) over the brake disc, aligning it with the holes in caliper mounting bracket (B).
Apply grease to the bolts (8) and tighten to the specified torque (Sect. C 3, Frame torque settings).



Operation	Section reference
Remove the lower chain slider	G 5, Refitting the swingarm
Refit the rear wheel	G 4, Refitting the rear wheel
Remove the banjo bolt securing the brake hose to the rear brake master cylinder	F 4, Refitting the rear brake control
Fill the rear braking system with brake fluid	D 4, Filling the brake system with fluid
Refit the right-hand side fairing	E 2, Refitting the side fairings

7 - Rear suspension



1 Bolt
2 Washer
3 Nut
4 Bolt
5 Spacer
6 Seal
7 Roller bearing
8 Rocker arm assembly
9 Bolt
10 Shock absorber
11 Bush
12 Bolt
13 Ball joint
14 Tie-rod

Parts catalogue

duc.nu>>

Rear suspension

Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Rear suspension system

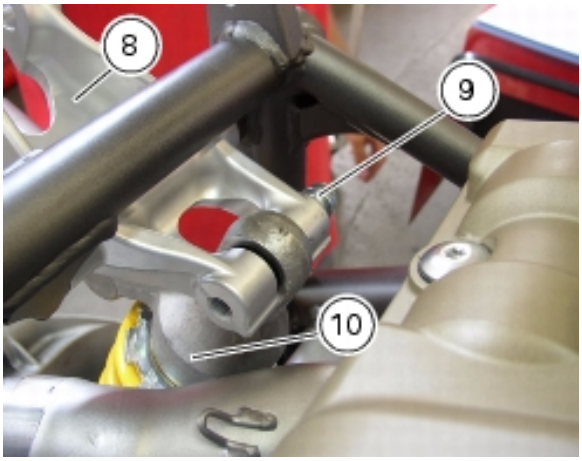
The rear suspension uses a fully adjustable progressive hydraulic monoshock (10). The system consists of an upper rocker arm (8) and a non-adjustable tie-rod (14), which is fixed to the single-sided swingarm.
The swingarm pivots on the frame and the engine to achieve maximum rigidity; the rear end of the swingarm supports the eccentric wheel hub which allows chain tension adjustment.

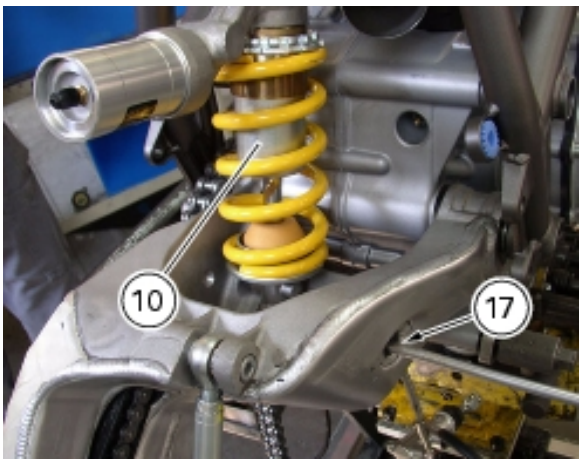
For adjustment of the rear shock absorber, refer to Sect. D 4, Adjusting the rear shock absorber.

Removal of the rear shock absorber

Operation	Section reference
Remove the seat cowling	E 3, Removal of the side panels and seat cowling
Remove the rear wheel	G 4, Removal of the rear wheel

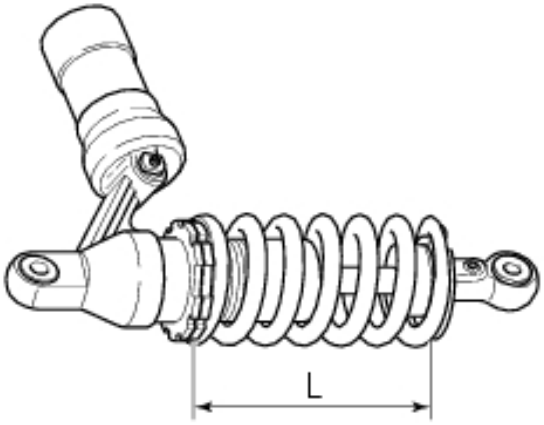
To remove the rear shock absorber (10) from the swingarm and from the rocker arm (8), remove the upper (9) and lower (17) mounting bolts.





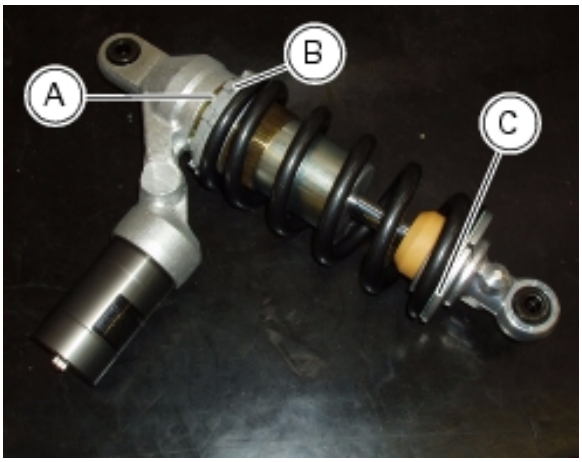
Overhauling the rear shock absorber

Before dismantling the shock absorber, measure the spring preload length (L). The same length must be restored on re-assembly.



Disassembly of the rear shock absorber

Slacken off locknut (A) and spring adjuster nut (B) with a pin wrench or special tool.
Remove the retaining ring (C) and the spring.



Visually inspect the shock absorber for oil leaks and other problems.
Renew the shock absorber if necessary.

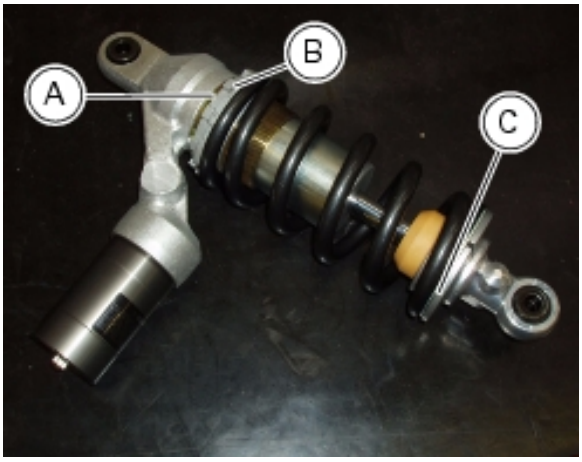
Reassembly of the rear shock absorber

Fit the spring into its seat in the shock absorber with the tapered end towards the lower mounting.
Fit the spring retaining ring (C).
Screw in the spring adjuster nut (B) to obtain the previously measured length (L).

Notes

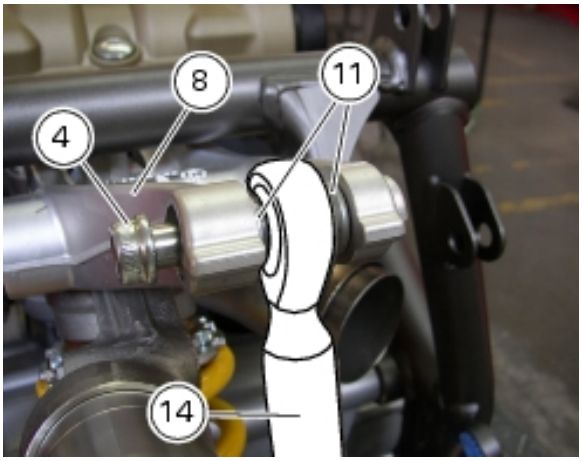
One full turn of the adjuster nut changes the length of the spring by **1.5** mm.

Tighten down the lock nut (A) against the adjuster (B).

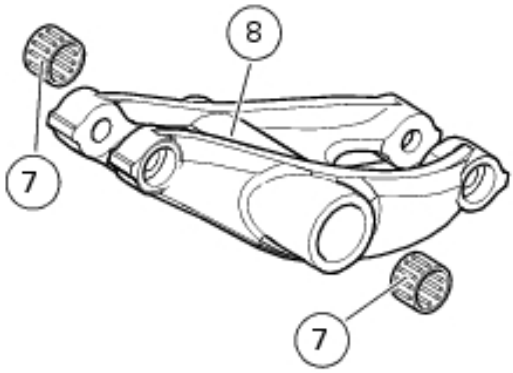


Removal of the rear suspension rocker arm

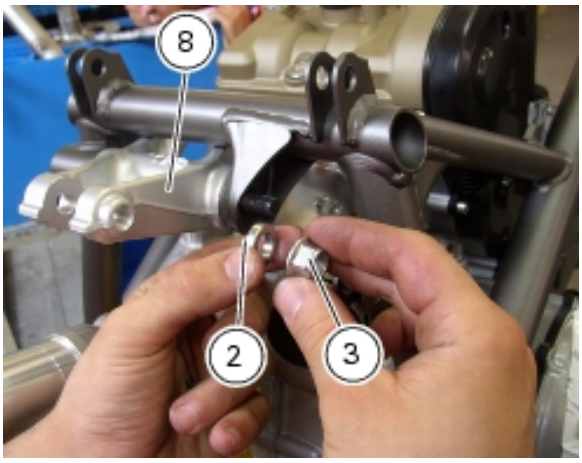
Disconnect the top of the rear shock absorber from the rocker arm as described in "Removal of the rear shock absorber" in this section.
Separate the tie-rod (14) and the rocker arm (8) by unscrewing the bolt (4) and recover the bushes (11).



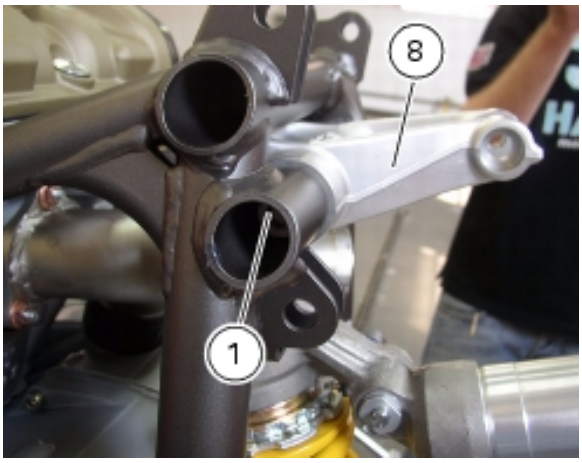
Before removing the rocker arm (8) from the frame, check the play of its internal needle roller bearings (7).



Grasp the rear end of the rocker arm and push and pull it in all directions.
If excessive play is encountered, the bearings need to be renewed.
To remove the rocker arm (8) from the frame, unscrew the nut (3) and withdraw the washer (2).



Slide out the bolt (1) and remove the rocker arm assembly (8) from the frame.



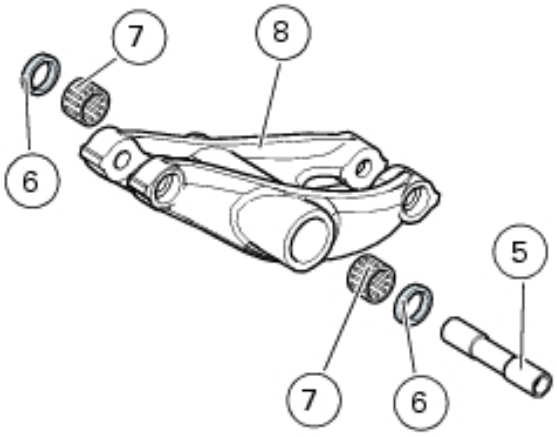
Overhauling the rear suspension rocker arm

Disassembly of the rear suspension rocker arm

The rocker arm movement is obtained by needle roller bearings (7) rotating on an internal spacer (5). Two oil seals (6) on the outer sides of the bearings keep the lubricant inside the cages.
First remove the inner spacer (5), then remove the oil seals (6) and the needle roller bearings (7) using a suitable drift.

Important

Take care not to damage the bearing housings on the rocker arm while driving out the bearings. Once disturbed, the seals (6) and needle roller bearings (7) may not be refitted.

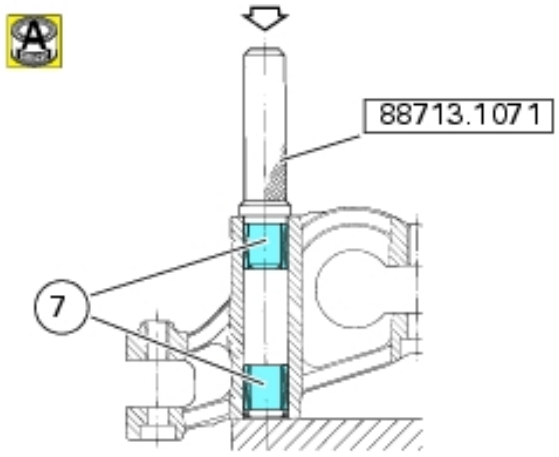


Reassembly of the rear suspension rocker arm

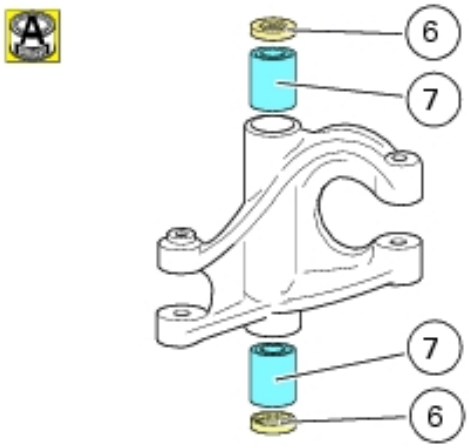
Place two new needle roller bearings (7) on drift part no. **88713.1071** and lubricate with the recommended grease. Support the rocker arm and drive in the needle roller bearings until the tool is seated against rocker arm.

Important

Make sure that the bearings are installed perfectly square in the hole. Avoid jamming. Use a press, if necessary.

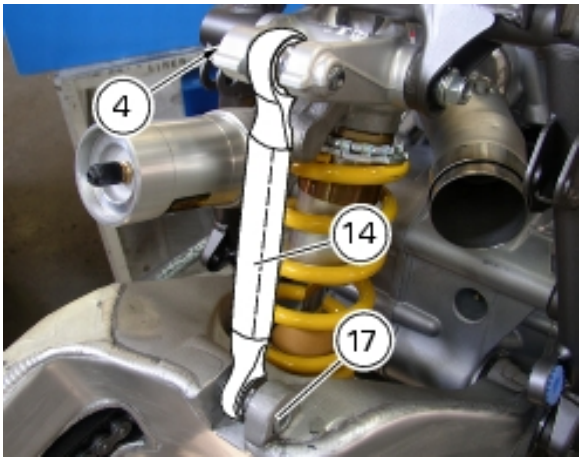


Fit a new seal (7) on the installation tool, with the metal side facing outwards, and drive it in so that it seats against the previously installed bearing.
Repeat the above procedure for the other roller bearing (7) and the other oil seal (6).
Lubricate the bearings and seals with the recommended grease and insert the inner spacer (6).



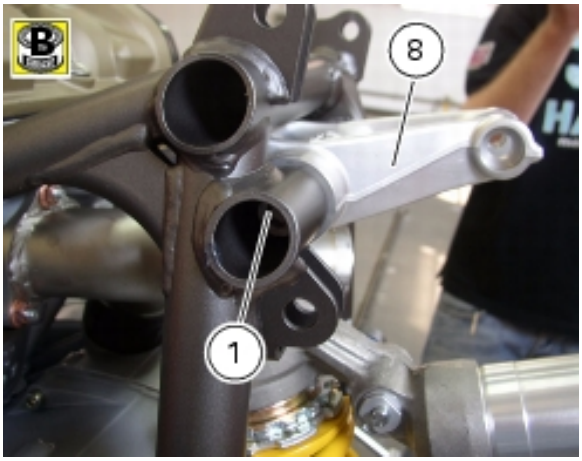
Disassembly of the shock absorber tie-rod

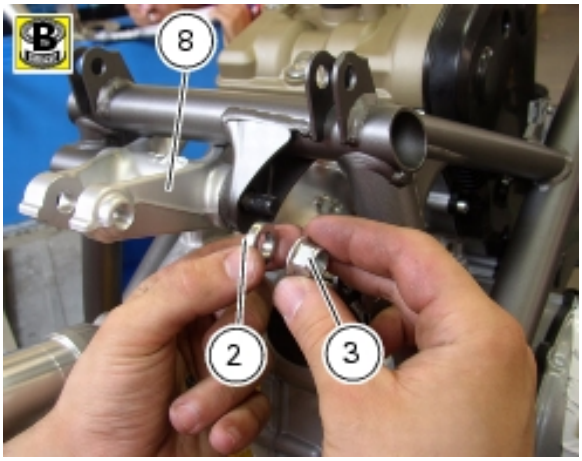
Unscrew and remove the upper bolt (4) and lower bolt (17).
Remove the tie-rod assembly (14).



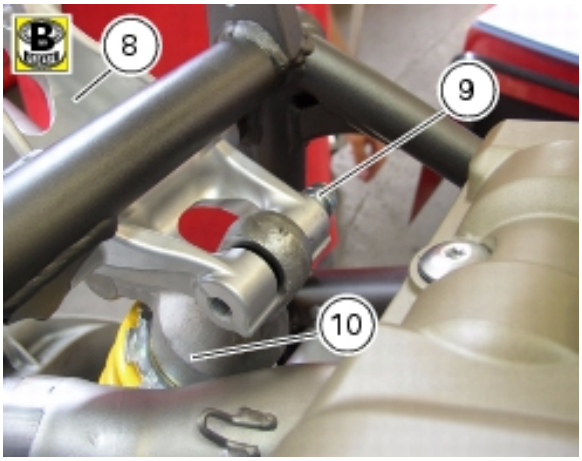
Refitting the rear suspension

Lubricate the shank and thread of the bolt (1) and the underside of the head of the nut (3) with the recommended grease.
Insert the rocker arm assembly (8) between the frame supports, as shown in the figure.
Drive the bolt (1) fully home in the frame.
Fit the nut (3) and washer (2) on the opposite side.
Counterhold the nut (3) and tighten the bolt (1) to the specified torque (Sect. C 3, Frame torque settings).

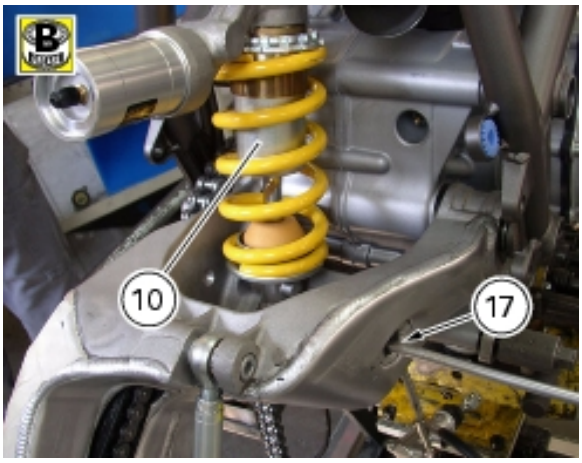




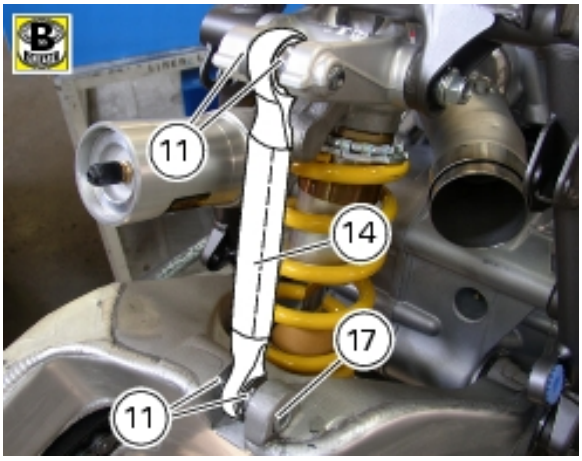
Grease the thread and the underside of the head of the upper shock absorber bolt (9) and insert it in the rocker arm.
Position the shock absorber (10) with the reservoir at the top.
Align the upper mounting of the shock absorber with the front hole in the rocker arm and lower mounting with the slot in the swingarm.



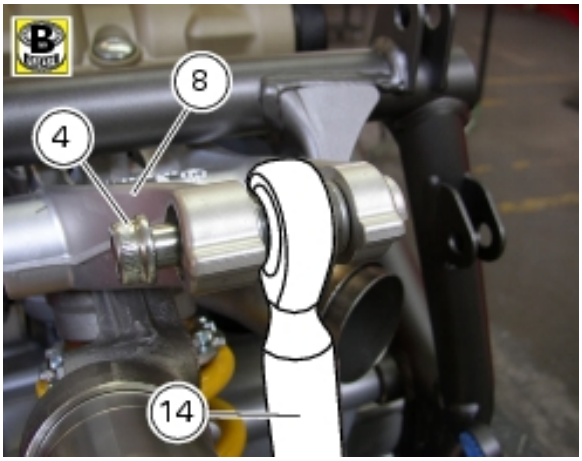
Grease the thread and underside of the head of the shock absorber lower mounting bolt (17), and tighten it to the specified torque (Sect. C 3, Frame torque settings).



Install the bushes (11) on both the ball joint end fittings.
Install the lower end of the tie-rod (14) on the swingarm.
Grease the thread, underside and sliding surface of the lower retaining bolt (17) and insert it in the swingarm from the right-hand side.
Tighten the bolt (17) to the specified torque (Sect. C 3, Frame torque settings).



Grease the thread and the underside of the head of the upper tie-rod bolt (4) and insert it in the rocker arm.
Insert the upper end of the tie-rod in the rocker arm and tighten the bolt (4) to its specified torque (Sect. C 3, Frame torque settings).



Operation	Section reference
Refit the rear wheel	G 4, Refitting the rear wheel
Refit the seat cowling	E 3, Refitting the side panels and seat cowling

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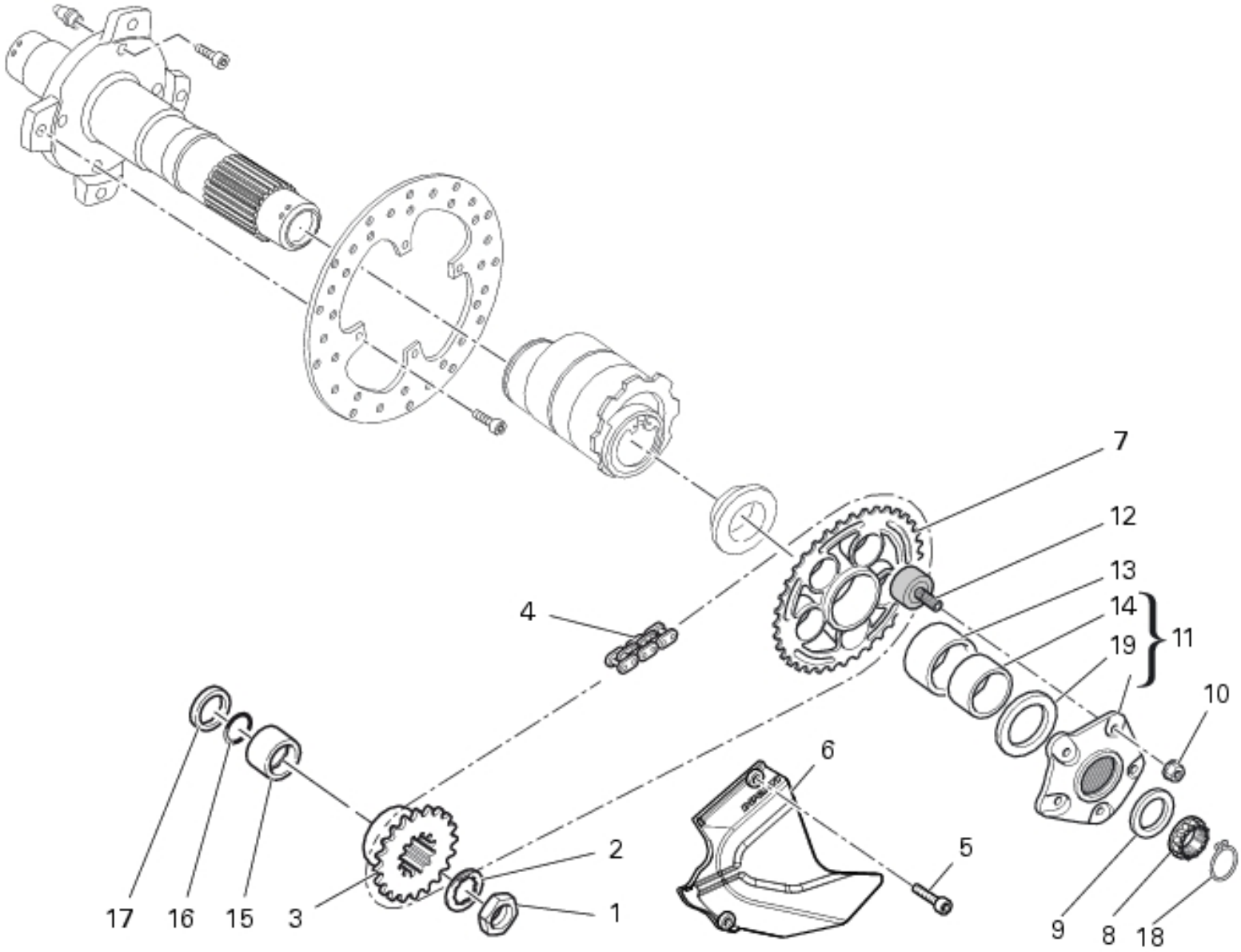
8 - Final drive



1 Nut
2 Lock washer
3 Front sprocket, Z=15
4 Chain
5 Bolt
6 Front sprocket cover
7 Rear sprocket, Z=38
8 Nut
9 Washer
10 Nut
11 Rear sprocket flange
12 Cush drive bush
13 Bush
14 Bush
15 Spacer
16 O-ring
17 Shim
18 Circlip

19 Washer

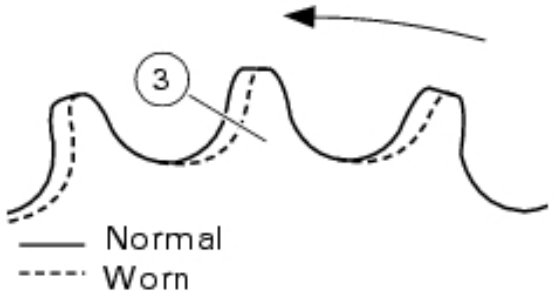
Parts catalogue

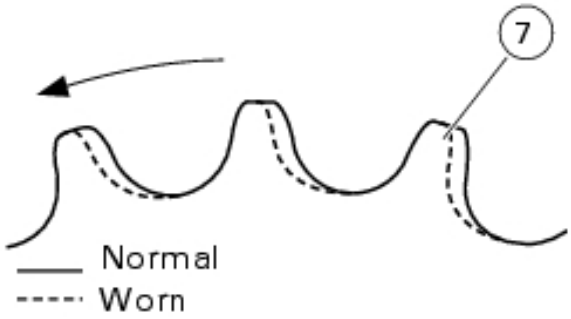
Gearbox
REAR WHEEL AXLE

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Inspecting the final drive

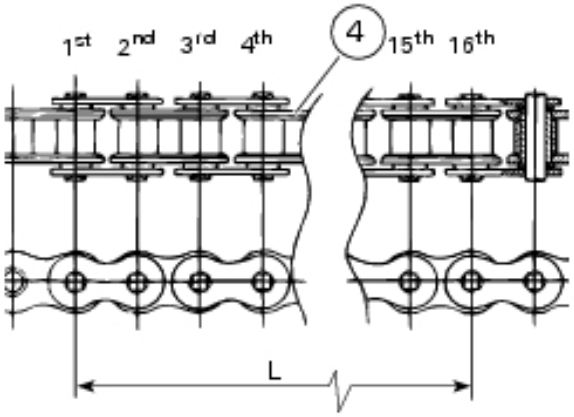
To check wear of the final drive, carry out a visual inspection of the front sprocket (3) and the rear sprocket (7). If the teeth are found to worn as shown in the figure (dotted line), the sprocket must be renewed.





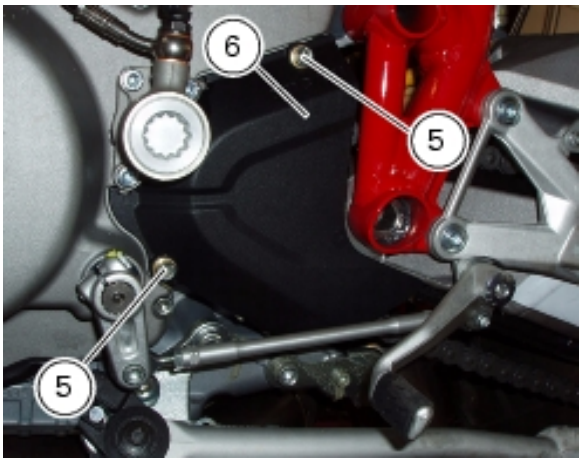
To check the amount of wear on the chain (4), keep the chain taut and measure **16** links.
If the length (L) is greater than **256.5** mm, the chain should be renewed.

Important
The rear sprocket (7), front sprocket (3) and chain (4) must all be renewed together.

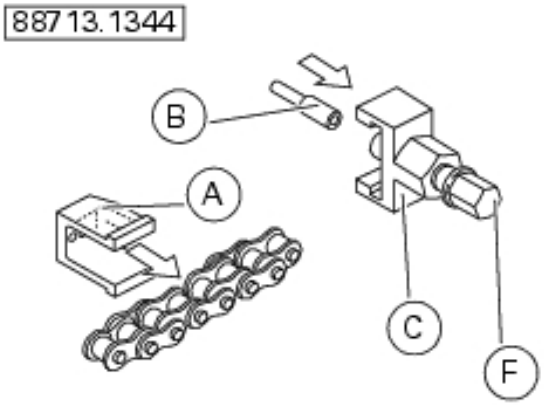


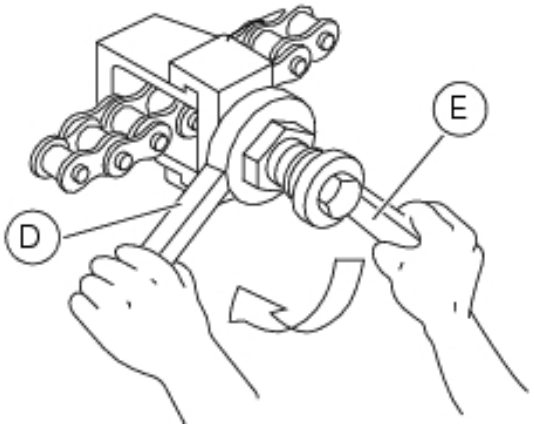
Removal of the front sprocket

Undo the bolts (5) and remove the sprocket cover (6).
Slacken the chain (Sect. D 4, Adjusting the chain tension).

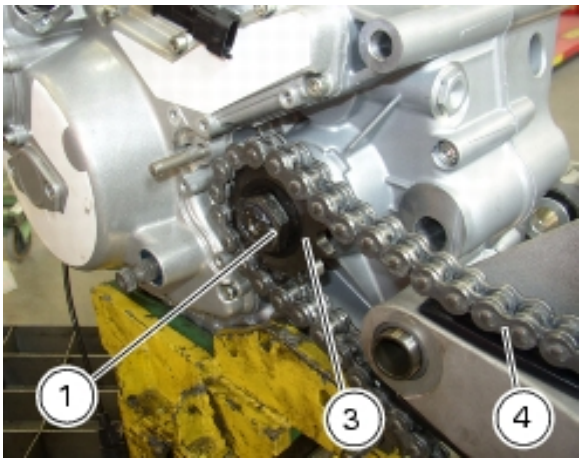


Remove the chain with the service tool no **88713.1344**.
The tool is composed of a holder (A), punch (B), body (C) and two wrenches (D) and (E).
Fit the link to be opened into the holder (A).
Fit a punch (B) into the body (C) and manually unscrew the bolt until the punch no longer protrudes.
Fit the holder (A) and link into the body (C).
Manually turn the bolt (F) on body (C) so that the punch (B) locates against the pin, taking care that they are aligned with each other.
Fit hex wrench (D) into the hexagonal part of the body (C) and wrench (E) onto the bolt.
Turn the bolt (F) clockwise to push out the pin.



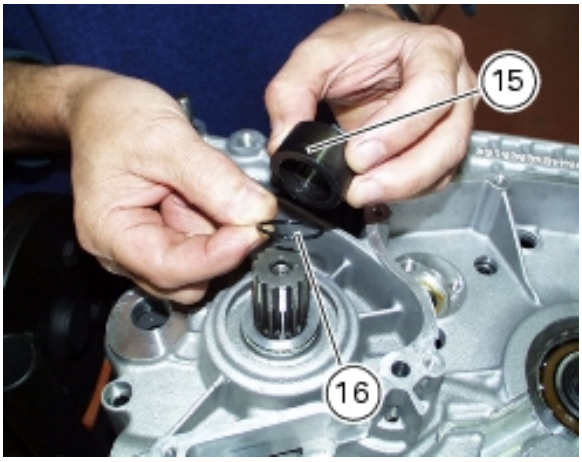


Remove the chain.
Engage a low gear and unscrew the nut (1).
Remove the nut (1) and the safety washer (**2**).
Remove the front sprocket (3) with the chain (4) from the gearbox output shaft.



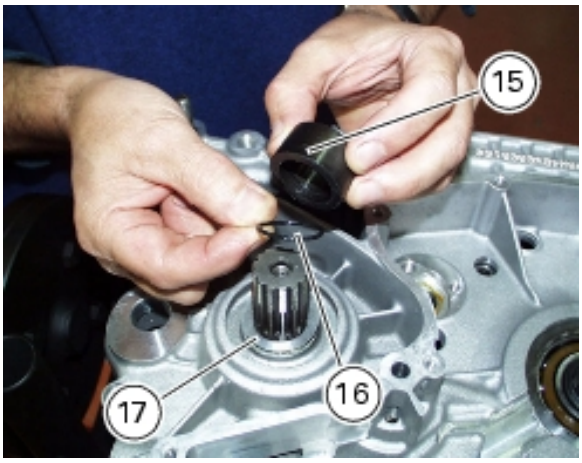
Remove the spacer (15) with the O-ring (16) from the gearbox output shaft.

Important
The O-ring (15) must be renewed on reassembly.

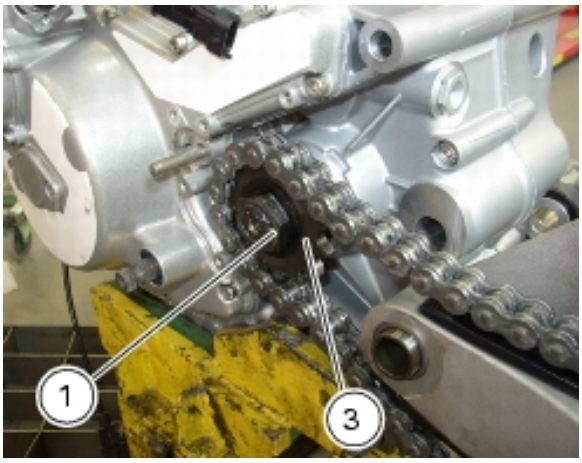


Refitting the front sprocket

Refit the ring (17) (Sect. N 9.2, Reassembly of the crankcase halves).
Grease the O-ring (16) and install it on the front sprocket spacer (15).
Fit the spacer, from the O-ring side, on the output shaft and drive it fully home against the inner ring of the bearing.
Before refitting the front sprocket, check that the spacer (15) is installed on the gearbox output shaft.



Check that the splines of the gearbox output shaft and the sprocket are in perfect condition.
Fit the front sprocket (3) and install the safety washer (2).
Tighten the nut (1) to the specified torque (Sect. C 3, Frame torque settings).

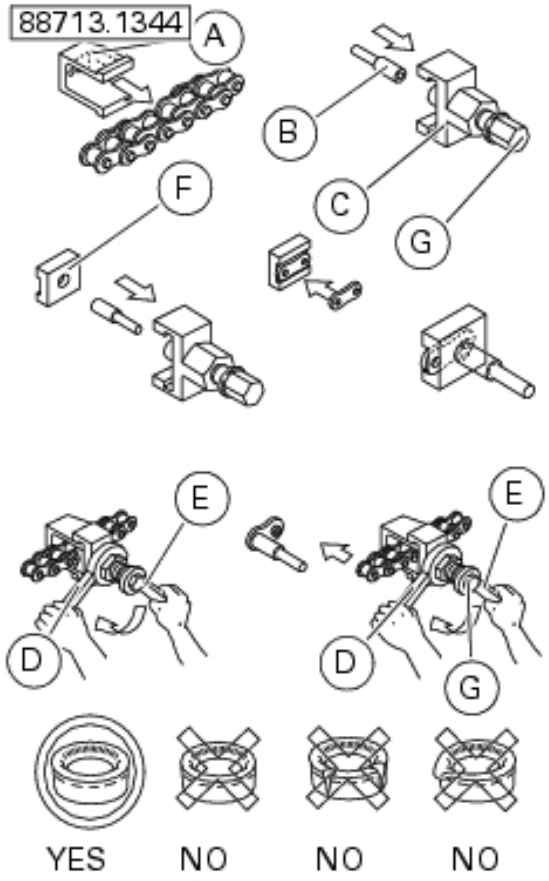


Fit the chain and join the links using the same service tool part no. **88713.1344** that was used to split the chain.
The tool is composed of a holder (A), punch (B), body (C) and two wrenches (D) and (E) and link plate holder (F).
Connect the two halves of the chain with the external link and manually fit the plate onto the pins.

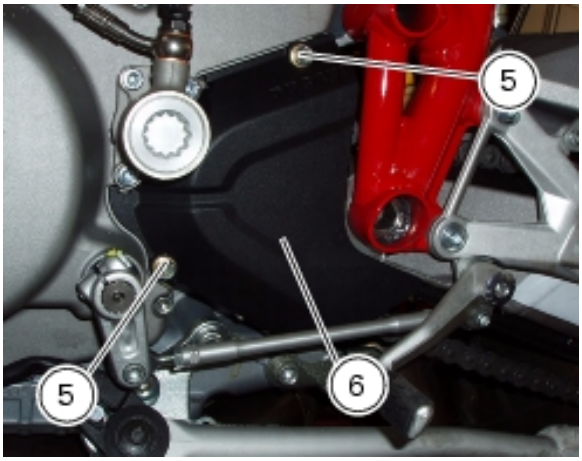
Warning
Lubricate the pins abundantly; try to avoid touching them with your hands.

Fit the holder (A) onto the external link.
Fit the punch (B) into the body (C) and the plate holder (F).
Fit the body (C) onto the holder (A) which holds the chain in position.
Manually turn the bolt (G) until the plate holder (F) is seated against the plate itself.
Use wrenches (D) and (E) to turn the bolt (G) clockwise until the chain pin is in contact with the holder (F).
Remove the holder (A) from the tool.
Manually turn the bolt (G) until the punch (B) locates against the pin, taking care that they are aligned with each other.
Use wrenches (D) and (E) to turn the bolt clockwise until the punch (B) is seated against the chain plate.
To complete reassembly, repeat the entire procedure with the second pin.

Warning
Carefully check the two pins: the figure shows the correct result of the procedure.



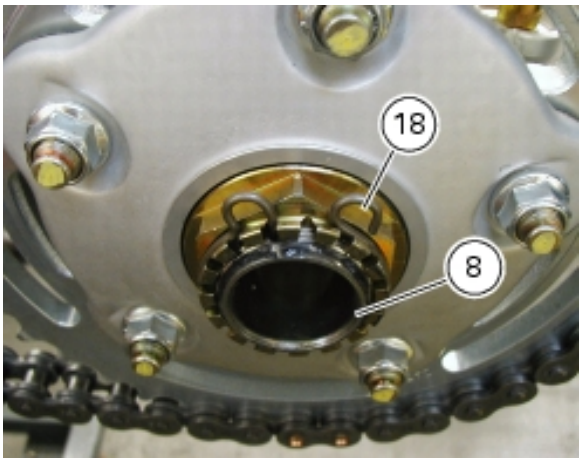
Adjust the chain tension (Sect. D 4, Adjusting the chain tension).
Fit the sprocket cover (6) and tighten the bolts (5) to the specified torque (Sect. C 3, Frame torque settings).



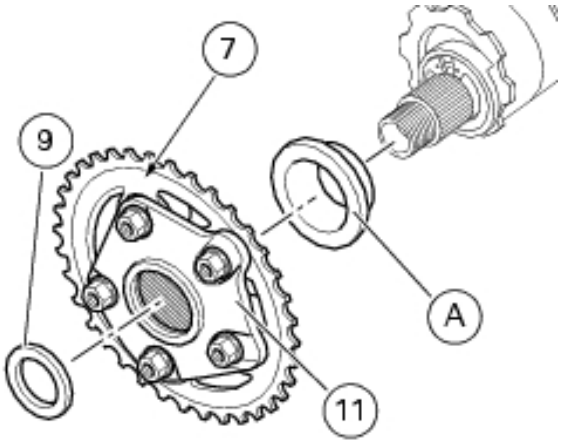
Renewal of the rear sprocket

Operation	Section reference
Slacken the chain	D 4, Adjusting the chain tension
Remove the rear wheel	G 4, Removal of the rear wheel

Remove the circlip (18) from the nut (8).
Restrain the stub axle against rotation and, using a socket wrench, loosen the nut (B).



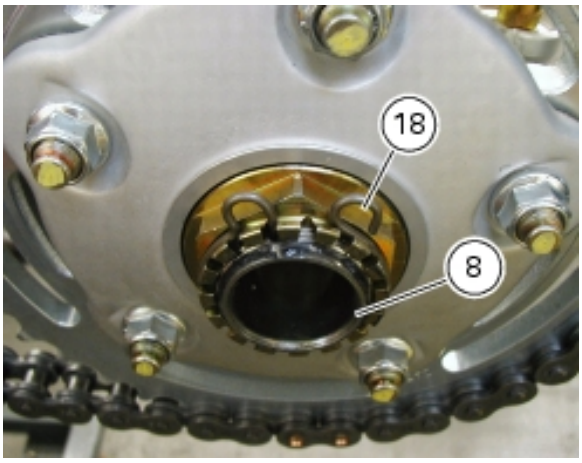
Fully unscrew the nut (8) and remove the washer (9) and the flange (11) complete with the rear sprocket (7).
Recover the collar (A).
Using a mallet, tap the sprocket flange (10) with the cush drive bushes (**12**) off the sprocket (7).



Refitting the rear sprocket

Check the cush drive bushes (12) for signs of wear and, if necessary, remove from the sprocket flange and renew them.
Refitting is the reverse of removal.
If it was necessary to remove the cush drive bushes (12), grease all the mating surfaces and the undersides of the retaining nuts (10) of the cush drive bushes (12) with the recommended grease.
Check for wear following the instructions given at the beginning of this section.

To refit the nut (8) and the circlip (18) securing the sprocket flange, follow the instructions given for tightening the wheel nut in Sect. G 4, Refitting the rear wheel.



Operation	Section reference
Refit the rear wheel	G 4, Refitting the rear wheel
Adjust the chain tension	D 4, Adjusting the chain tension

Washing the chain

Chains with O-rings must be washed in oil, diesel fuel or paraffin (kerosene).
Do not use petrol, trichloroethylene or other solvents, which could damage the rubber O-rings. For the same reason use only sprays specifically formulated for use with O-ring chains.

Lubricating the chain

Chains with O-rings are lubricated and sealed to protect the O-rings themselves against wear in the pin/bushing area. However, these chains need lubricating at regular intervals to protect metal parts of the chain and the O rings.
Lubrication also serves to keep the O-rings soft and pliable to ensure the maximum sealing efficiency.
Using a brush, apply a thin protective film of high-density gearbox oil along the entire length of the chain both inside and outside (Sect. C 2, Fuel, lubricants and other fluids).

0H - Frame

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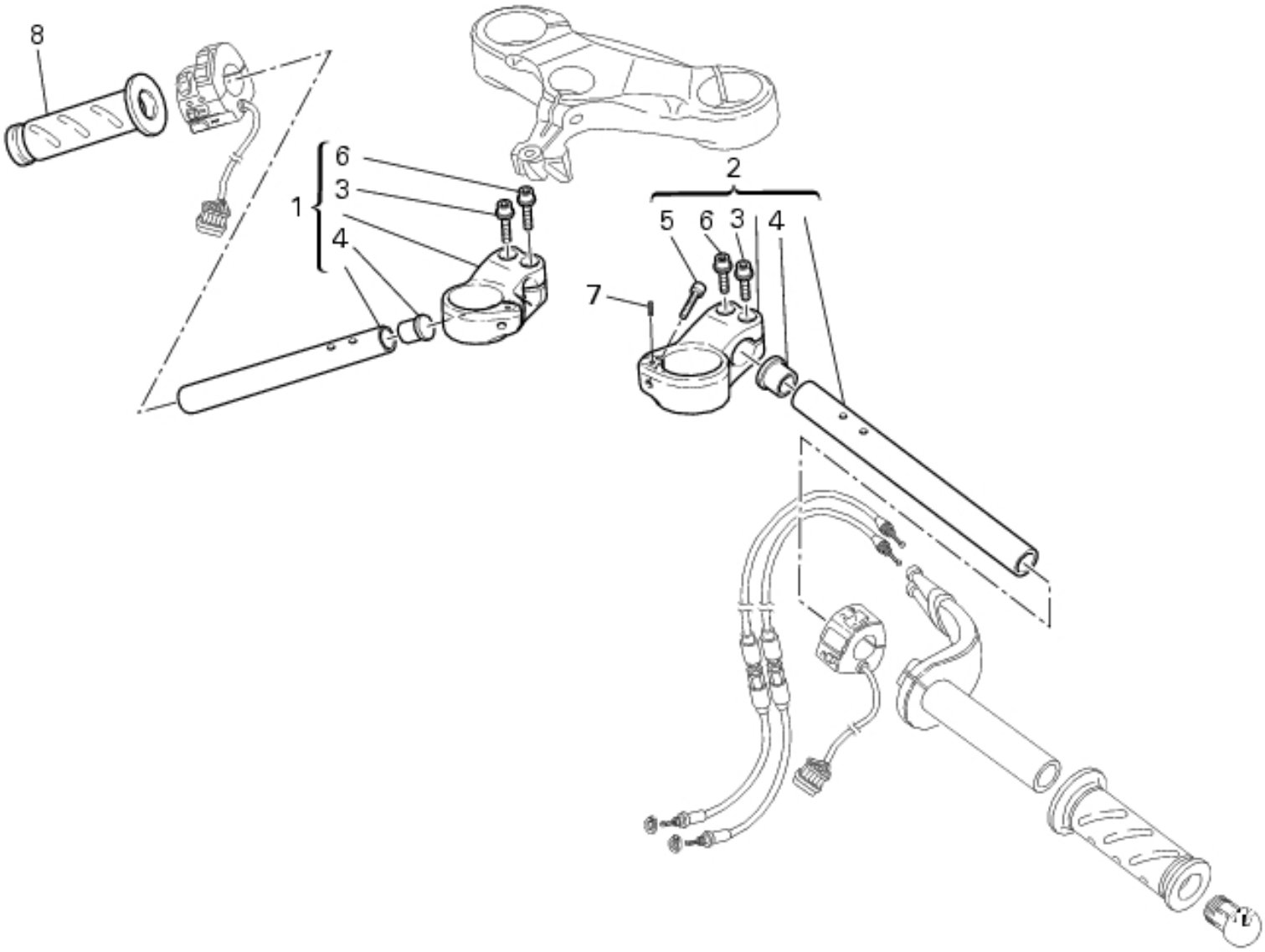
1 - Handlebars



1 Left handlebar
2 Right handlebar
3 Bolt
4 Plug
5 Bolt
6 Bolt
7 Spring pin
8 Grip

Parts catalogue

HANDLEBARS and controls

Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the handlebars

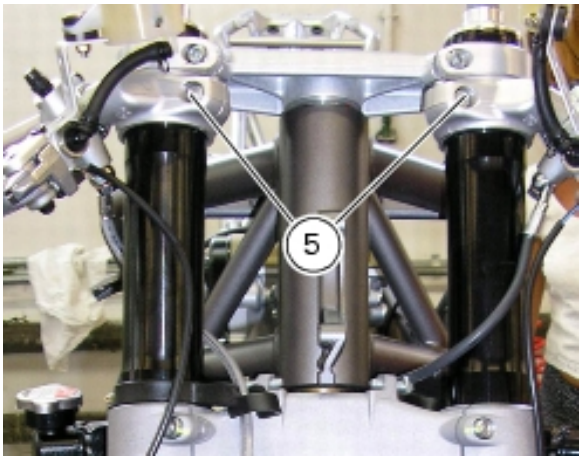
To remove the right handlebar, the following parts must be removed first:

Operation	Section reference
Remove the headlight shell	E 1, Removal of the headlight shell
Remove the throttle twistgrip	F 1, Removal of the throttle twistgrip
Remove the right-hand handlebar switch	P 5, Checking the right-hand handlebar switch
Remove the front brake lever	F 3, Removal of the front brake master cylinder
Remove the top yoke	H 2, Removal of the steering head components

To remove left handlebar, the following parts must be removed first:

Operation	Section reference
Remove the headlight shell	E 1, Removal of the headlight shell
Remove the left-hand handlebar switch	P 5, Checking the left-hand handlebar switch
Remove the clutch lever	F 2, Removal of the clutch master cylinder assembly
Remove the top yoke	H 2, Removal of the steering head components

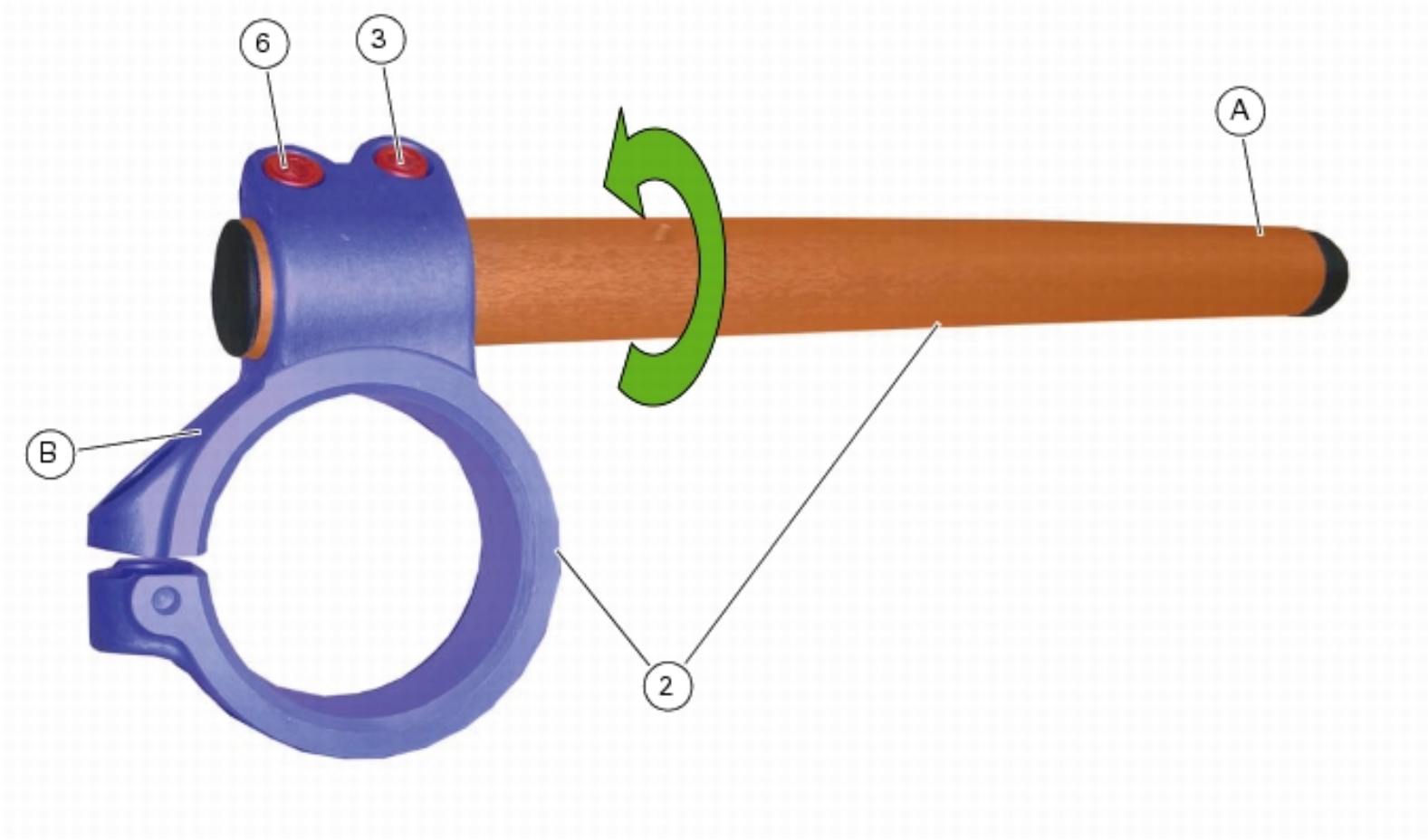
Loosen the bolts (5) securing the handlebar to the fork leg.

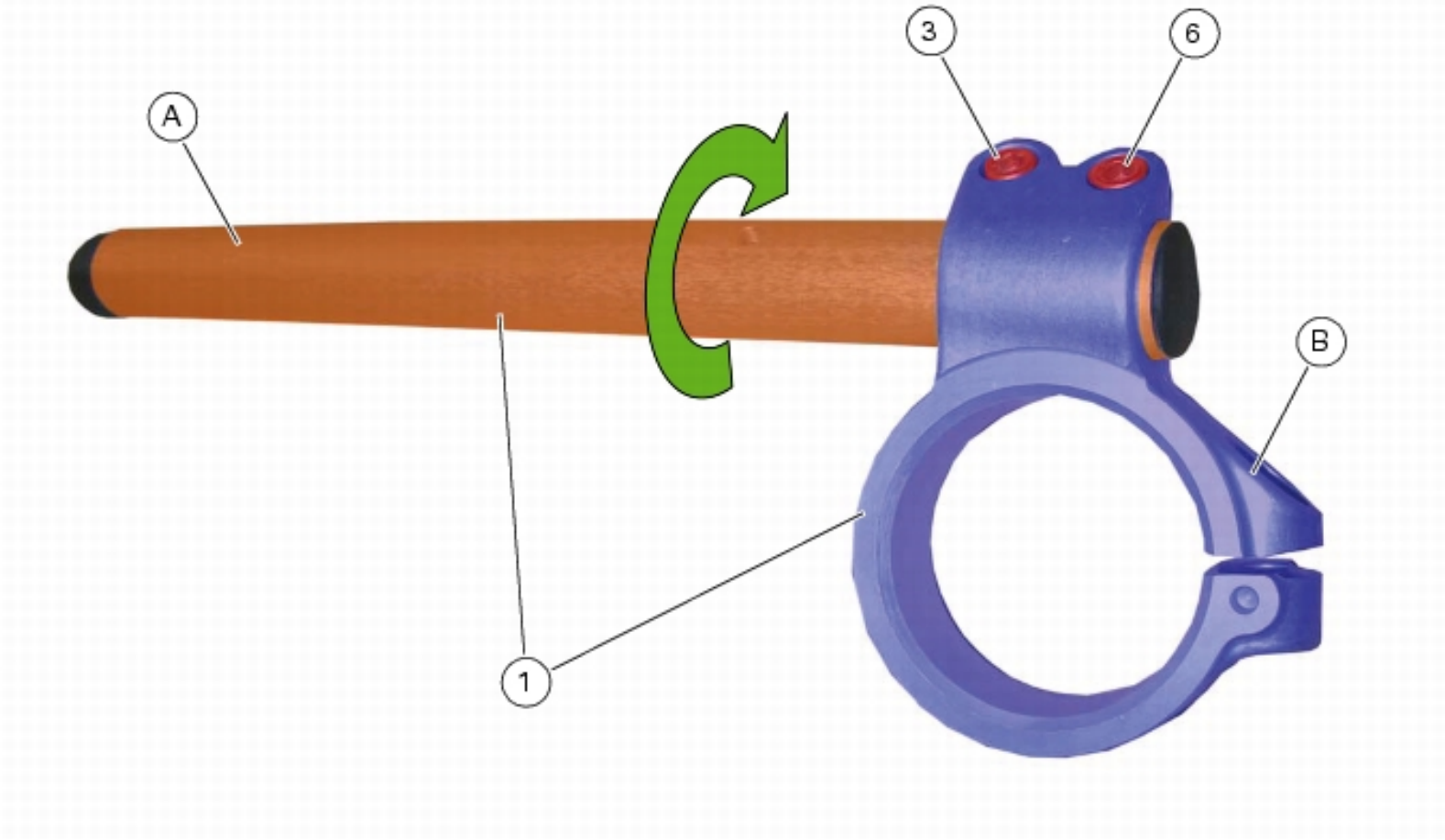


Open up the two parts of the mounting clamp and remove the handlebar from the fork tube.

Disassembly and reassembly of the handlebars

To disassemble the handlebars (1) and (2), unscrew the bolts (3) and (6) and remove the handlebars (A) from the mounting clamps (B).
On reassembly, eliminate any play between the handlebars (A) and the mounting clamps (B) by the turning the handlabars as far they will go in the direction indicated.
Tighten the bolts (3) and (6) to the specified torque (Sect. C 3, Frame torque settings).



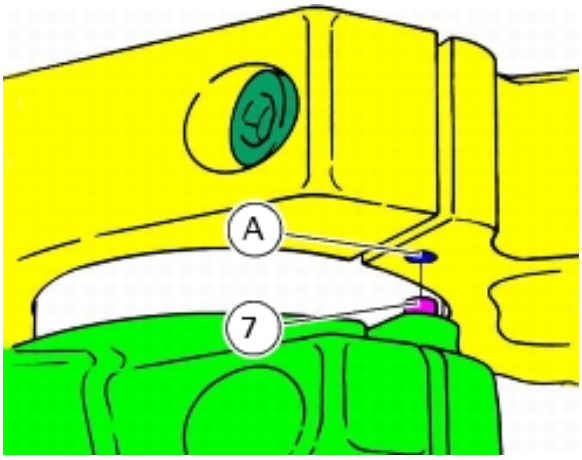


Refitting the handlebars

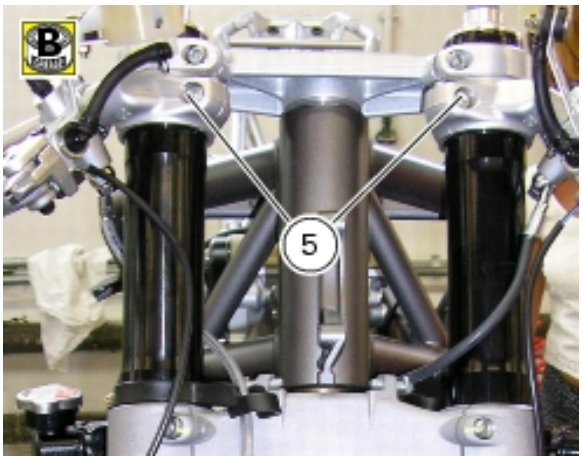
Fit the handlebar onto the fork leg and install the top yoke.

Important

When refitting the handlebars to the fork legs, position them relative to the top yoke by inserting the end of the handlebar pin (7) into the slot (A) in the top yoke.



If the bolts (5) securing the handlebar to the fork leg were removed when removing the handlebars, apply the recommended grease to their threads.
Tighten the bolts (5) to the specified torque (Sect. C 3, Frame torque settings).



To complete the RH handlebar refitting procedure, install the following parts:

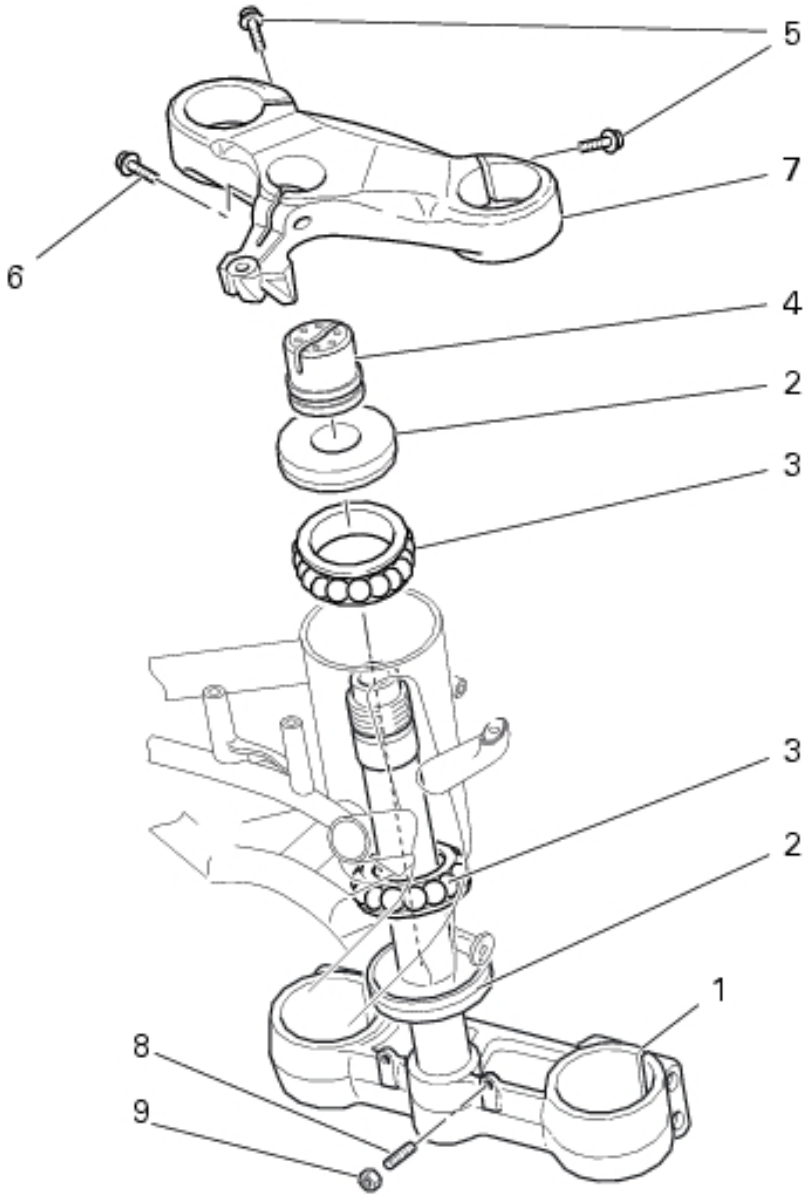
Operation	Section reference
Refit the headlight shell	E 1, Refitting the headlight shell
Refit the throttle twistgrip	F 1, Refitting the throttle twistgrip
Refit the right-hand handlebar switch	P 5, Checking the right-hand handlebar switch
Refit the front brake lever	F 3, Refitting the front brake master cylinder
Refit the top yoke	H 2, Refitting the steering head components

To complete the LH handlebar refitting procedure, install the following parts:

Operation	Section reference

Refit the headlight shell	E 1, Refitting the headlight shell
Refit the left-hand handlebar switch	P 5, Checking the left-hand handlebar switch
Refit the clutch lever	F 2, Refitting the clutch master cylinder assembly
Refit the top yoke	H 2, Refitting the steering head components

2 - Steering



1 Bottom yoke
2 Seal
3 Bearing
4 Nut
5 Bolt
6 Bolt
7 Top yoke
8 Adjuster screw
9 Nut

Parts catalogue

HANDLEBARS and controls

Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the

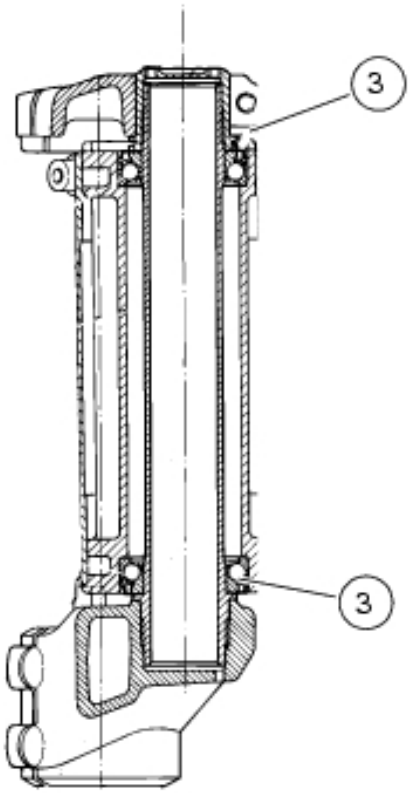
exploded view diagram.

Adjusting the steering head bearings

Notes

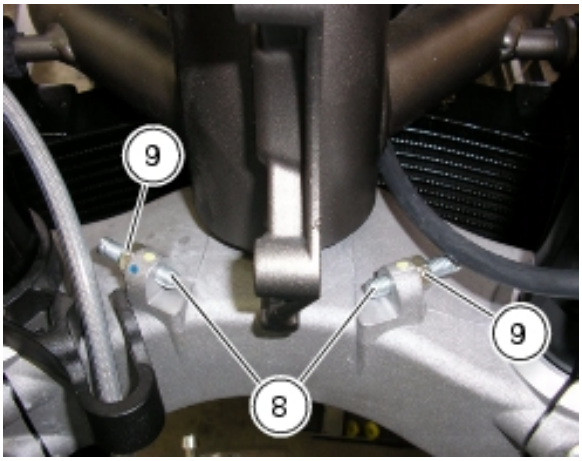
See Sect. D 4, Adjusting the steering head bearings for steering bearing play adjustment.

If this does not solve the problem, check the bearings (3) for wear and, if necessary, renew them as described in "Removal of the steering head components" in this chapter.



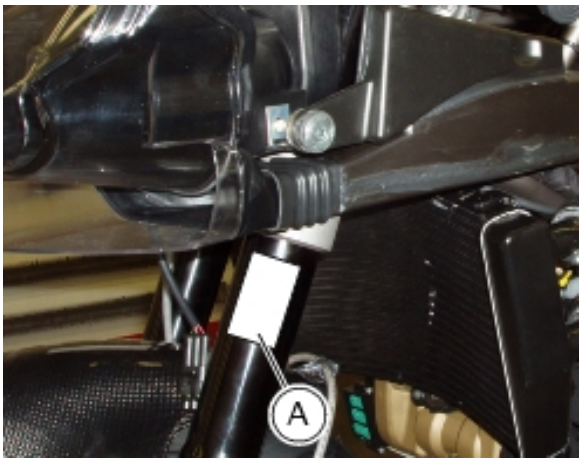
Steering angle adjustment

Loosen the nuts (9).
Loosen the adjuster screws (8) on both sides of the bottom yoke.

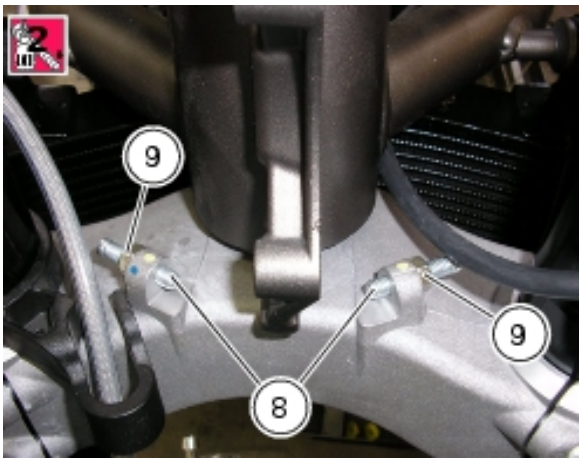


Use a 6 to 6.5 mm spacer (A) fitted to the fork outer tube, or use a gauge.

Turn the front forks to the right until the spacer (A) is seated against the frame top tube.



Turn the adjuster screw (8) on the opposite side to bring it into contact with the stop on the steering head.
Apply threadlocker to the thread of nut (9).
Hold the adjuster screw (8) firm and tighten the nut (9).
Turn the forks to the opposite side and repeat the process to adjust the other screw and tighten the relative lock nut.



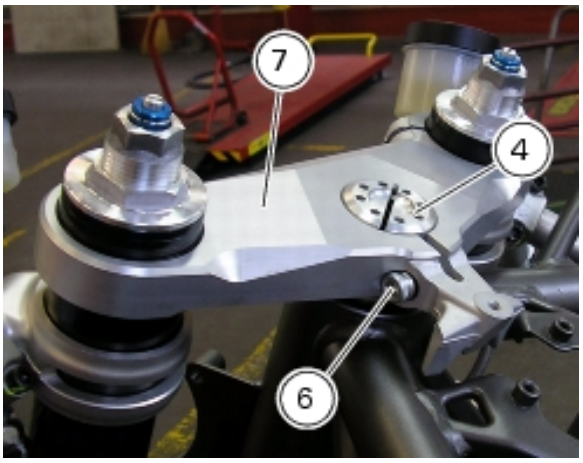
Removal of the steering head components

Operation	Section reference
Remove the side fairings	E 2, Removal of the side fairings
Remove the headlight shell	E 1, Removal of the headlight shell
Remove the fork legs	G 2, Removal of the front forks

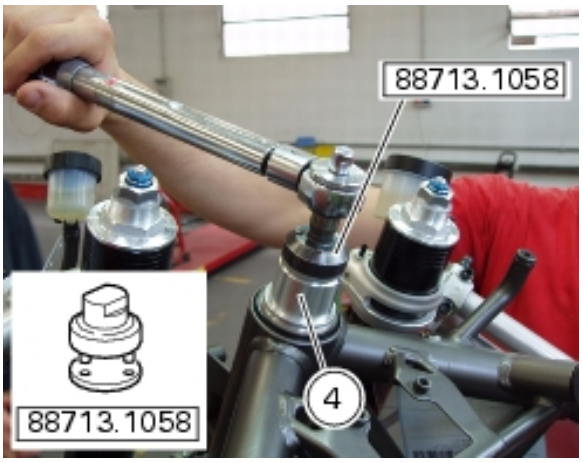
Notes

All parts fitted to the top and bottom yokes, including the wiring and control cables, can remain on the motorcycle provided they do not hinder the following operations.

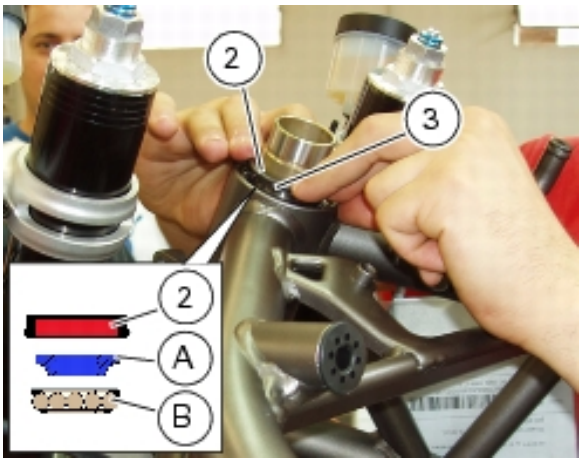
Loosen the bolt (6) securing the top yoke (7) to the steering stem nut (4).
Remove the top yoke (7).



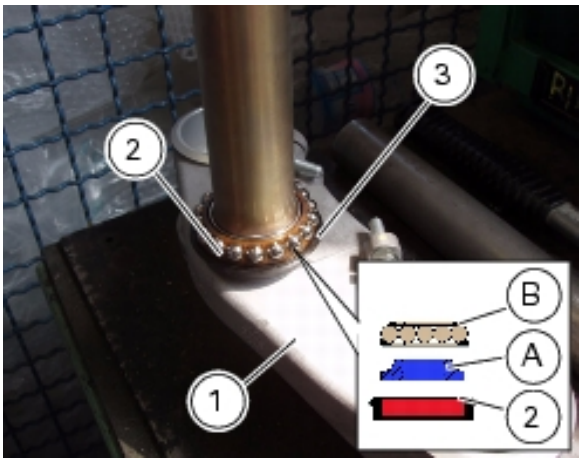
With the service tool no. **88713.1058** loosen the nut (4) and unscrew it from the steering stem.



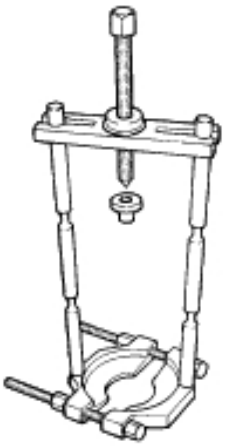
Slide the dust seal (2), the inner race (A) and the ball race (B) of the upper bearing (3) off the steering stem.



Remove the bottom yoke (1) complete with the steering stem from the frame tube.
Remove the ball race (B) of the lower bearing (3).
The inner race (A) of the lower bearing (3) and the relative seal (2) will remain on the steering stem.



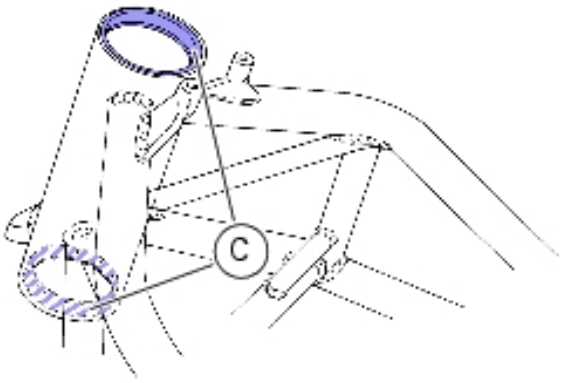
Using a universal puller (of the type shown in the figure) remove the ring (C) from the steering stem, taking care not to damage the seat.



Important

Once removed, the seals (2) and the bearings (3) must not be refitted.

Using a suitable drift, remove the outer bearing races (C) from the steering head. Proceed with extreme care to avoid damaging the seats.

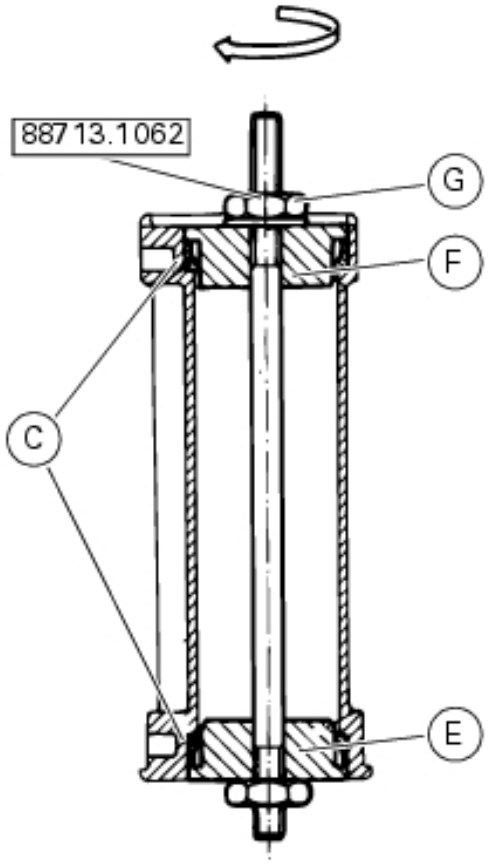


Refitting the steering head components

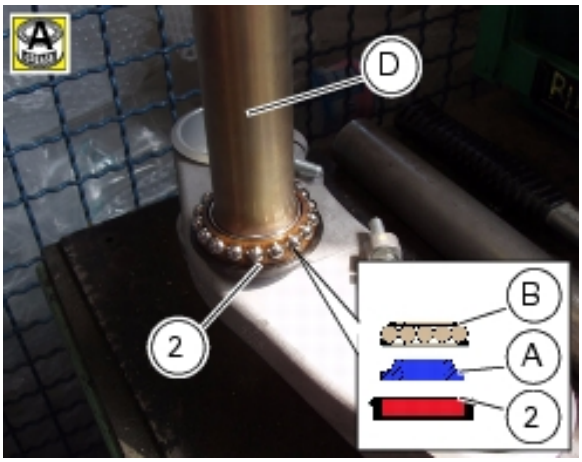
Important

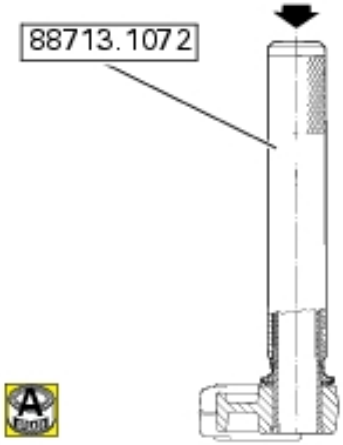
The steering tube bearings (3) are identical but in no case may their components be swapped around during reassembly.

Clean all contact surfaces and lubricate with the recommended grease.
To fit the outer races (C) of the bearings (3) to the steering head, use the service tool no. **88713.1062** and proceed as follows: heat the steering head to 150 °C;
fit the outer races (C) in their seats on the steering head;
fit the fixed bush (E, with threaded hole) of the tool into the lower race;
fit the other movable bush (F) into the upper end of the tool and drive it fully home against the upper bearing race;
tighten the nut (G) and use a wrench to seat the outer rings (C) fully in the steering head;
leave the tool assembled until the steering head has cooled down to ensure that bearings are properly seated.

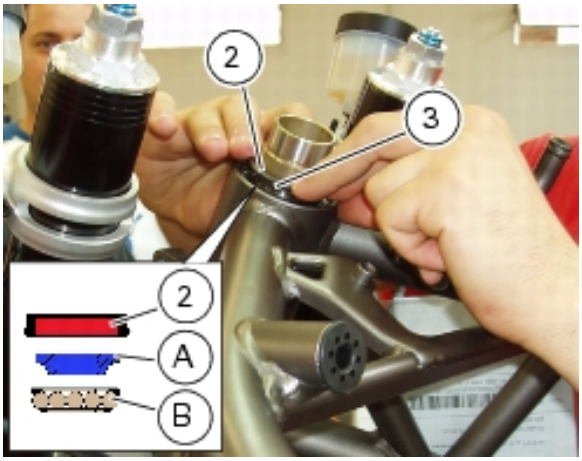


Fit the seal (2) (with the rim facing upwards) and inner race (A) of bottom bearing (3) onto the steering stem (D) after heating it for about 10 minutes to 120 °C.
Fit drift part no. **88713.1072** into the steering stem. Keep the inner race (A) pressed against the dust seal (2) by hand for at least 15 seconds.
Lubricate the inner bearing race (A) with the recommended grease.
Fit the ball race (B) to the steering stem (D) with the smaller diameter of the cage facing upwards and grease the ball race.
Insert the steering stem in steering head and push it in until it is axially seated.

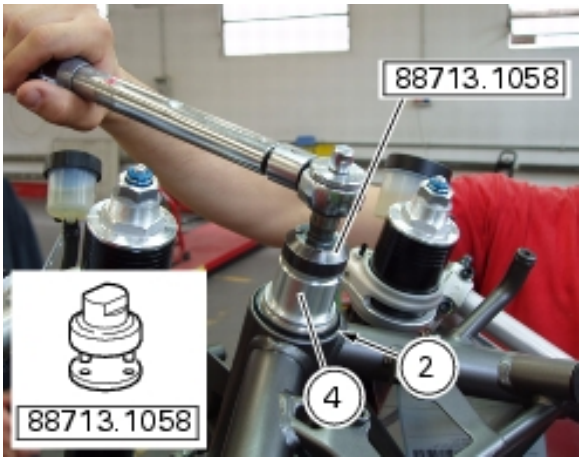




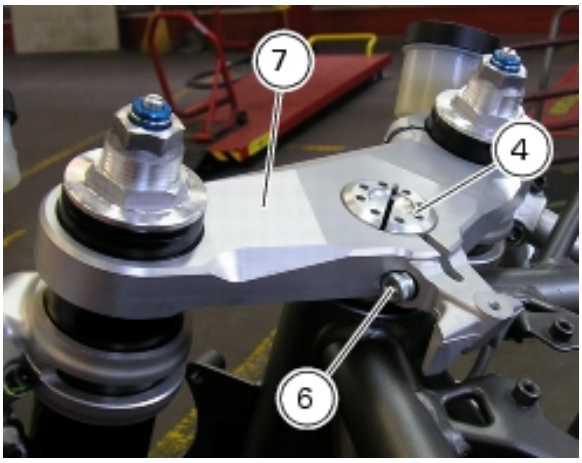
Fit the bottom yoke assembly to frame.
Grease the ball race (B) and fit it to outer race (C) of the top bearing.
Fit the inner race (A) of the upper bearing (3) to the steering head, with the larger diameter side of the race facing upwards.
Install the dust seal (2) with the flat side facing upwards.



Tighten the steering stem nut (4) by hand until it seats against the seal (2).
Fit service bush no. **88713.1058** to the steering stem nut (4) and fit the torque wrench to the bush.
Tighten the steering stem nut (4) to the specified torque (Sect. C 3, Frame torque settings).

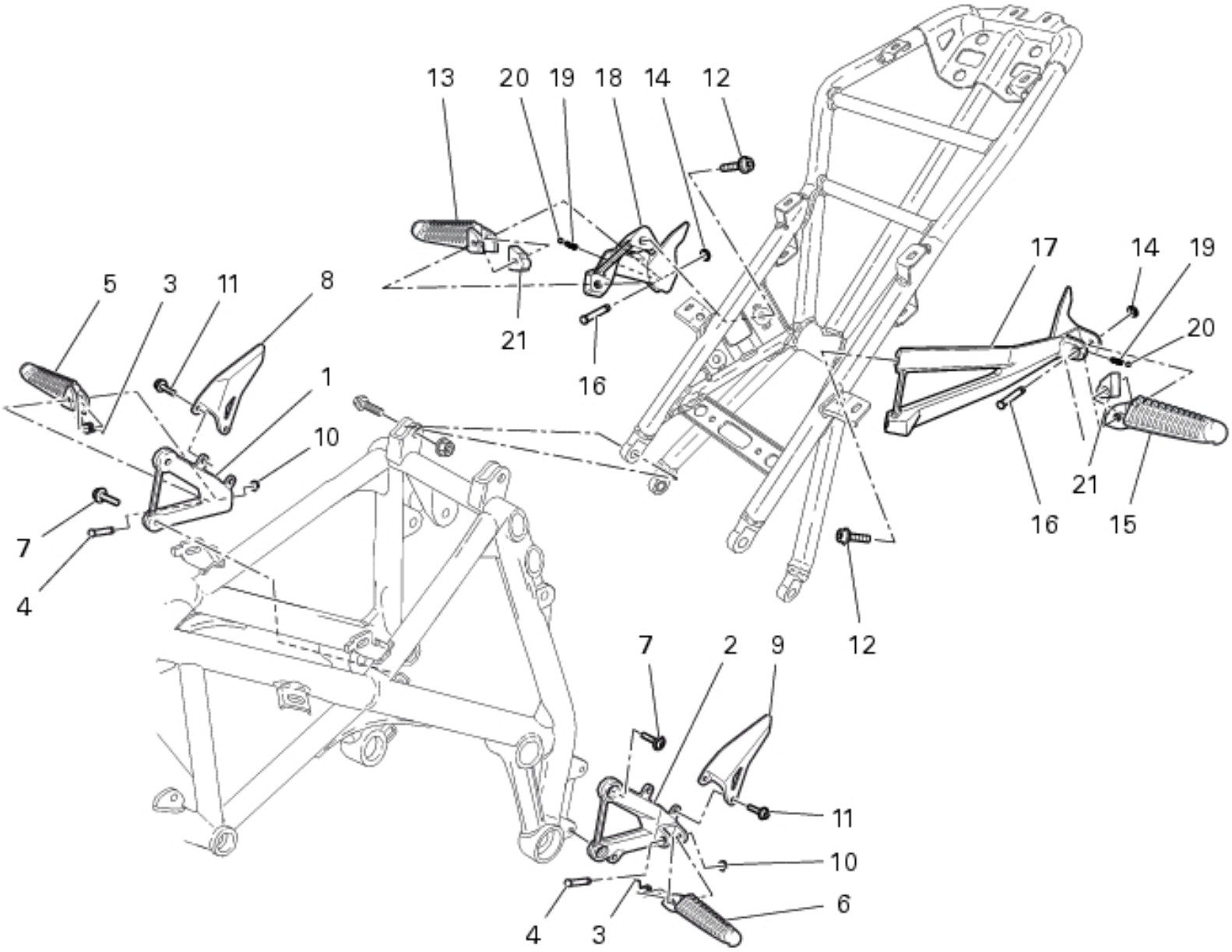


Fit the top yoke (7) on the steering stem nut (4), aligning the fork leg bores with the corresponding bores on the bottom yoke. Relocate the fork legs as described in Sect. G 2, Refitting the front forks.
Grease the bolt (6).
Tighten the bolt (6) on the top yoke to the specified torque (Sect. C 3, Frame torque settings).



Operation	Section reference
Refit the fork legs	G 2, Refitting the front forks
Refit the headlight shell	E 1, Refitting the headlight shell
Refit the side fairings	E 2, Refitting the side fairings

4 - Footrest brackets



1 Right front footrest bracket
2 Left front footrest bracket
3 Spring
4 Pin
5 Right front footrest
6 Left front footrest
7 Bolt
8 Right heel plate
9 Left heel plate
10 Circlip
11 Bolt
12 Bolt
13 Right rear footrest
14 Ring
15 Left rear footrest
16 Pin
17 Rear left footrest bracket
18 Rear right footrest bracket

19 Spring
20 Ball
21 Spacer

Parts catalogue

FRAME

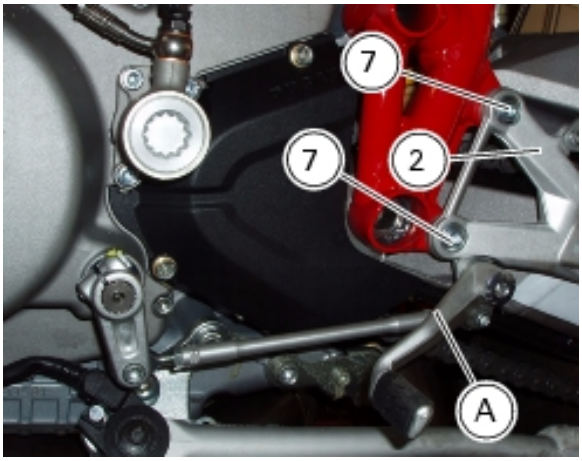
REAR SUBFRAME

Important

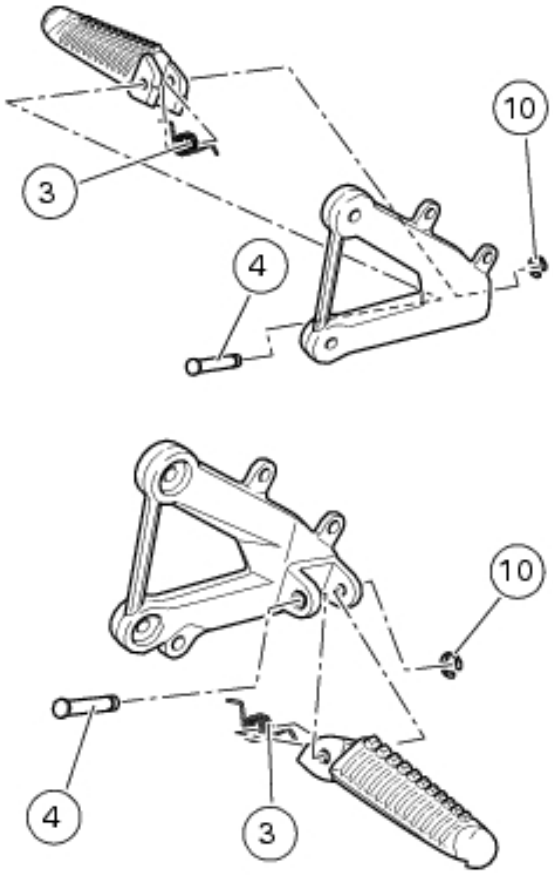
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the front footrests

The left footrest assembly can be removed after removing gearchange pedal (A) from the bracket (2) (Sect. F 5, Refitting the gearchange mechanism).
Undo the two bolts (7) securing the bracket to the frame and remove the complete footrest and bracket assembly.

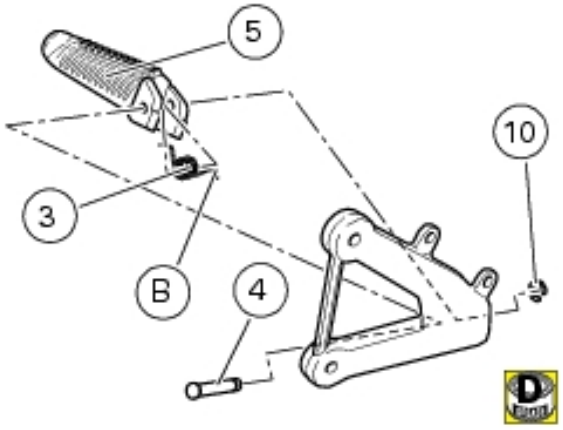


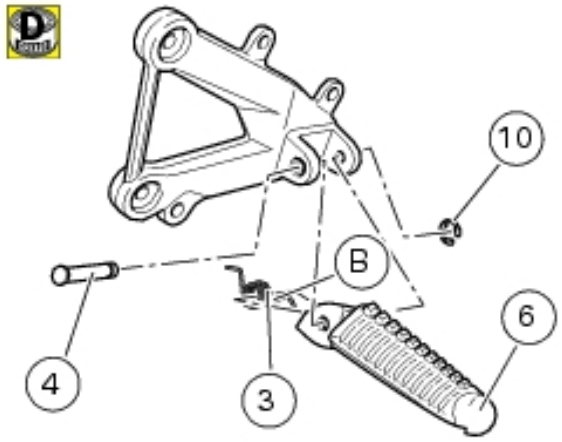
To separate the footrest from the bracket, remove the circlip (10) and withdraw the pin (4) to release the footrest and the spring (3).



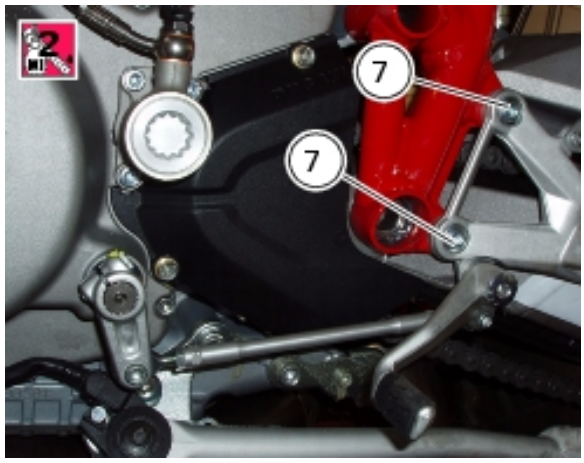
Refitting the front footrests

Position the spring (3) between the lugs of the footrest (5) or (6) and fit it to the bracket, inserting the straight end (B) of the spring in the hole in the bracket.
Grease the pivot bolt (4) and insert it from the front, securing it on the other side with the circlip (10).



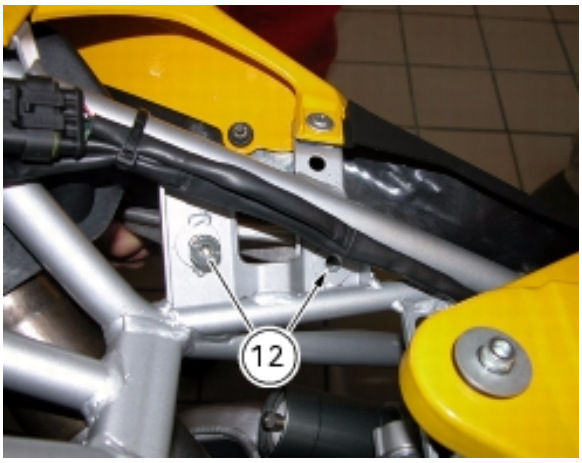


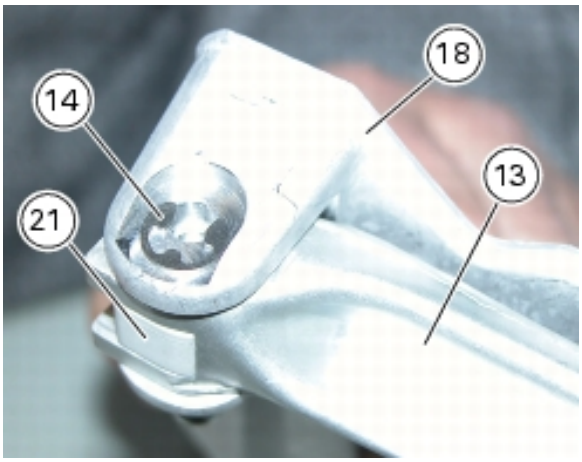
Fit the entire assembly to the frame, securing it with the bolts (7) coated with the recommended threadlocker.
Tighten the bolts (7) to the specified torque (Sect. C 3, Frame torque settings).
Refit the gearchange pedal (Sect. F 5, Refitting the gearchange mechanism) to the left footrest bracket.

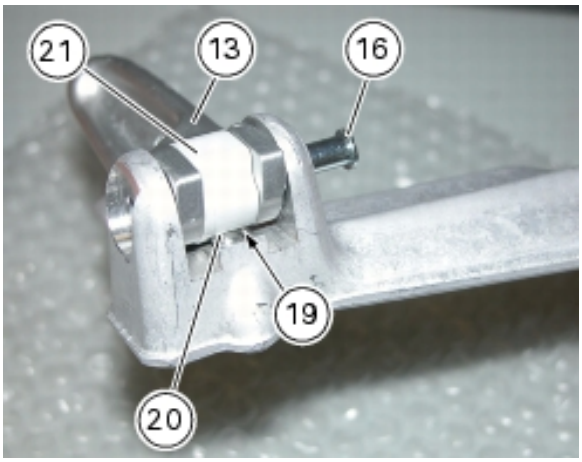


Removal of the rear footrests

Remove the rider seat (Sect. E 3, Removal of the seats).
Unscrew the bolts (12) and remove the brackets (17) and (18).
To separate the footrest (13) from the bracket (18), remove the circlip (14) and slide out the pin (16) to release the footrest, the spring (19), the ball (20) and the spacer (21).
The procedure is the same for the rear left footrest (15).

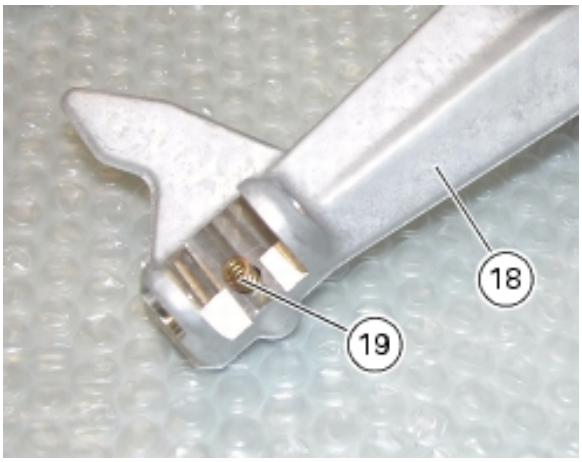


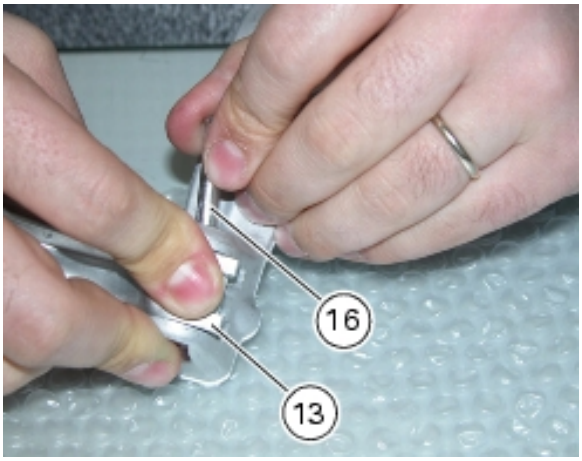


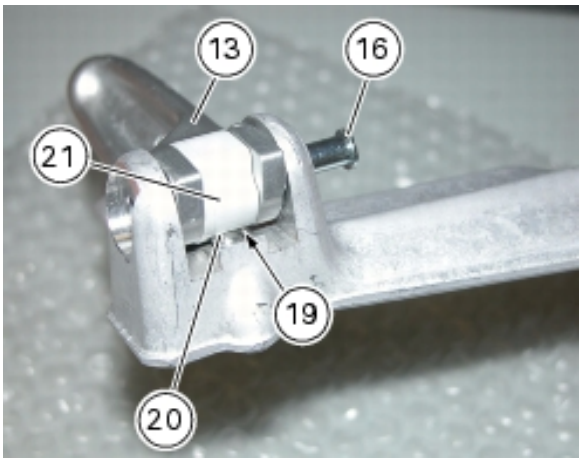


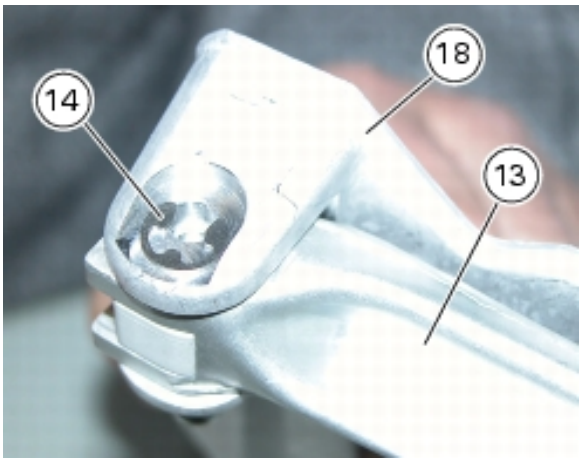
Refitting the rear footrests

Position the spring (19) and the ball (20) on the rear right footrest bracket (18).
Position the footrest (13) with the spacer (21) on the bracket (18) and insert the pivot bolt (16), while pressing the footrest (13).
Secure the pivot bolt on the opposite side with the circlip (14).
The procedure is the same for the rear left footrest (17).

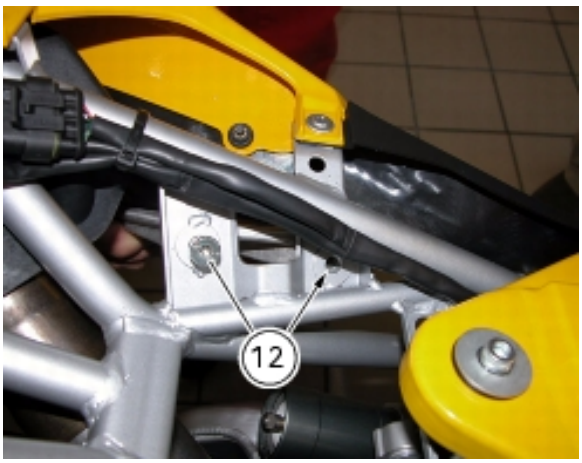




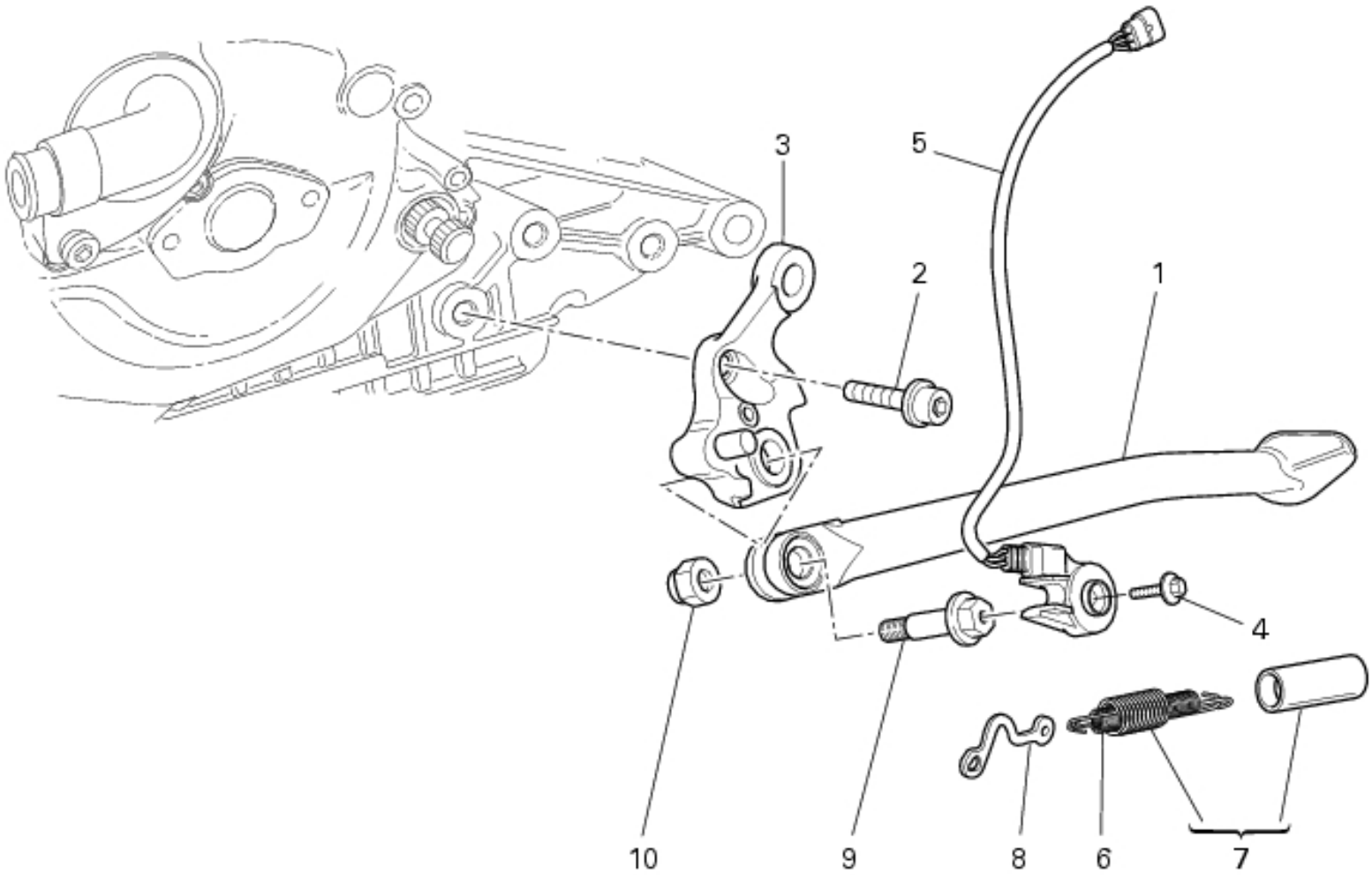




Locate the footrest brackets (17) and (18) and tighten the bolts (12) to the specified torque (Sect. C 3, Frame torque settings).
Refit the rider seat (Sect. E 3, Refitting the seats).



5 - Sidestands



1 Sidestand
2 Bolt
3 Bracket
4 Bolt
5 Switch
6 Inner spring
7 Spring assembly
8 Plate
9 Pin
10 Nut

Parts catalogue

stand

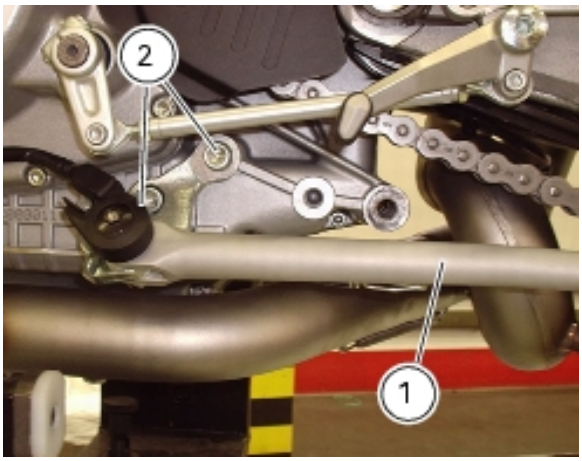
Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the sidestand

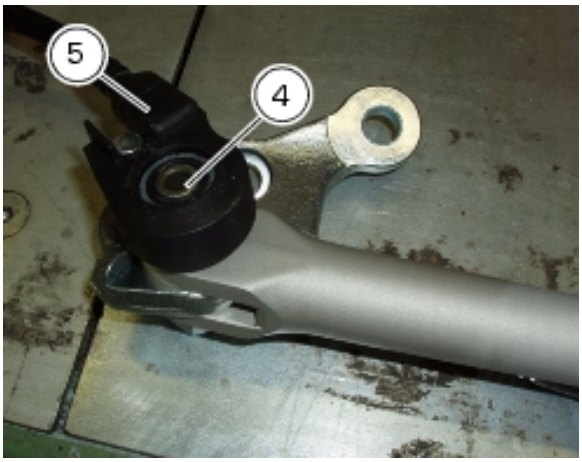
Operation	Section reference
Remove the left-hand side fairing	E 2, Removal of the side fairings

Disconnect the wiring connector of the sidestand switch (1) from the main wiring harness.
Unscrew the two bolts (2) securing the sidestand bracket (3) to the engine and remove the complete sidestand assembly.

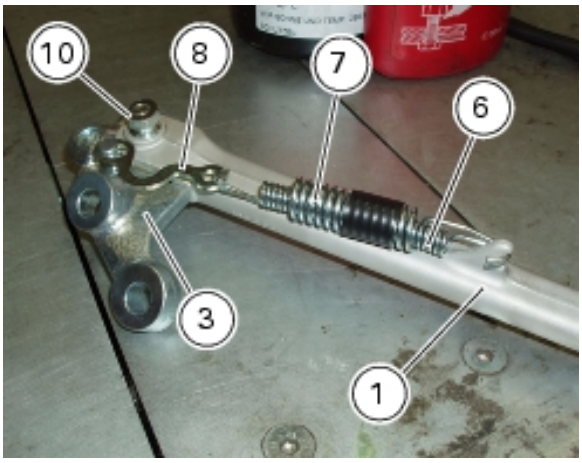


Disassembly of the sidestand

Unscrew the retaining bolt (4) and remove the sidestand switch (5).

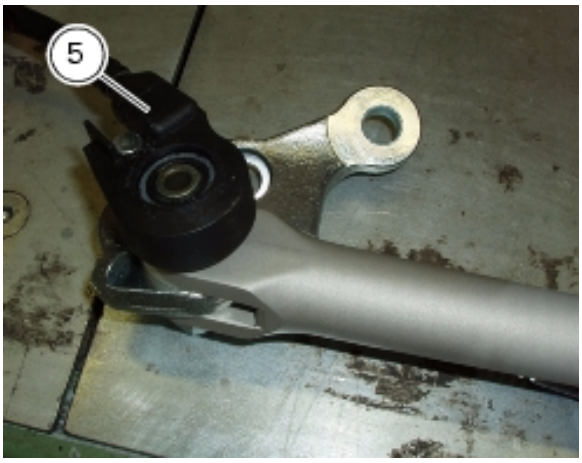


Release the sidestand springs (6) and (7) from the connecting plate (8) located on the sidestand bracket (3) and remove them.
Unscrew the pivot bolt (9) securing the sidestand to the bracket and remove the sidestand (1) and the nut (10).



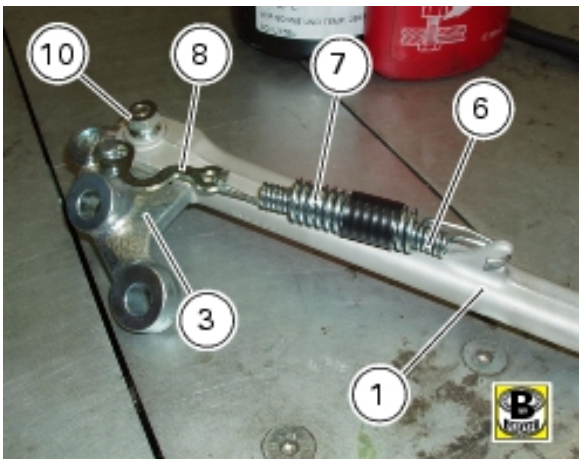
Inspecting the sidestand

Fit the sidestand leg to the bracket and check that there is no excessive play. Ensure that the ends of the sidestand are not bent with respect to the shank.
A stand which shows signs of cracking must be renewed immediately.
For details of how to test the switch (5), see Sect. P 6, Checking the sidestand switch.

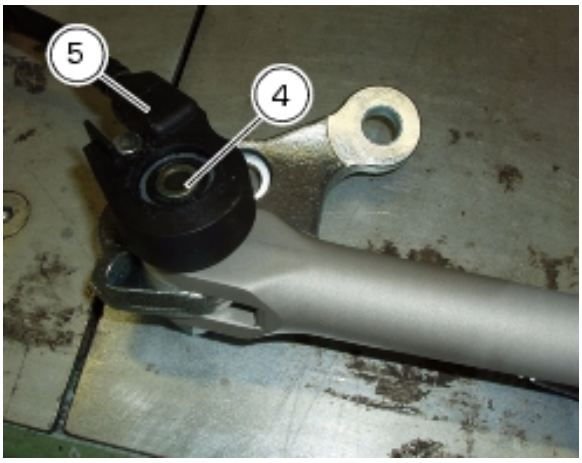


Reassembly of the sidestand

Grease the sidestand leg (1) and fit it to the bracket (3). Secure it with the pivot bolt (9) and the nut (10).
Tighten the pivot bolt (9) to the specified torque (Sect. C 3, Frame torque settings).
Locate the sidestand return springs (6) and (7) and attach them to the connection plate (8) and to the sidestand leg (1).

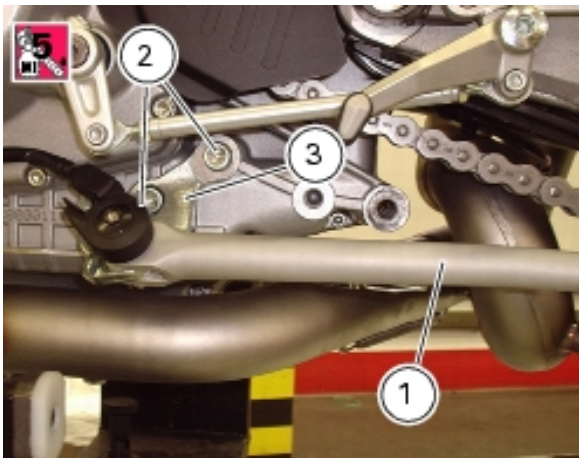


Locate the switch (5) on the bracket so that is seats against the pivot bolt (9).
Fit the retaining bolt (4) and tighten to the specified torque (Sect. C 3, Frame torque settings).



Refitting the sidestand

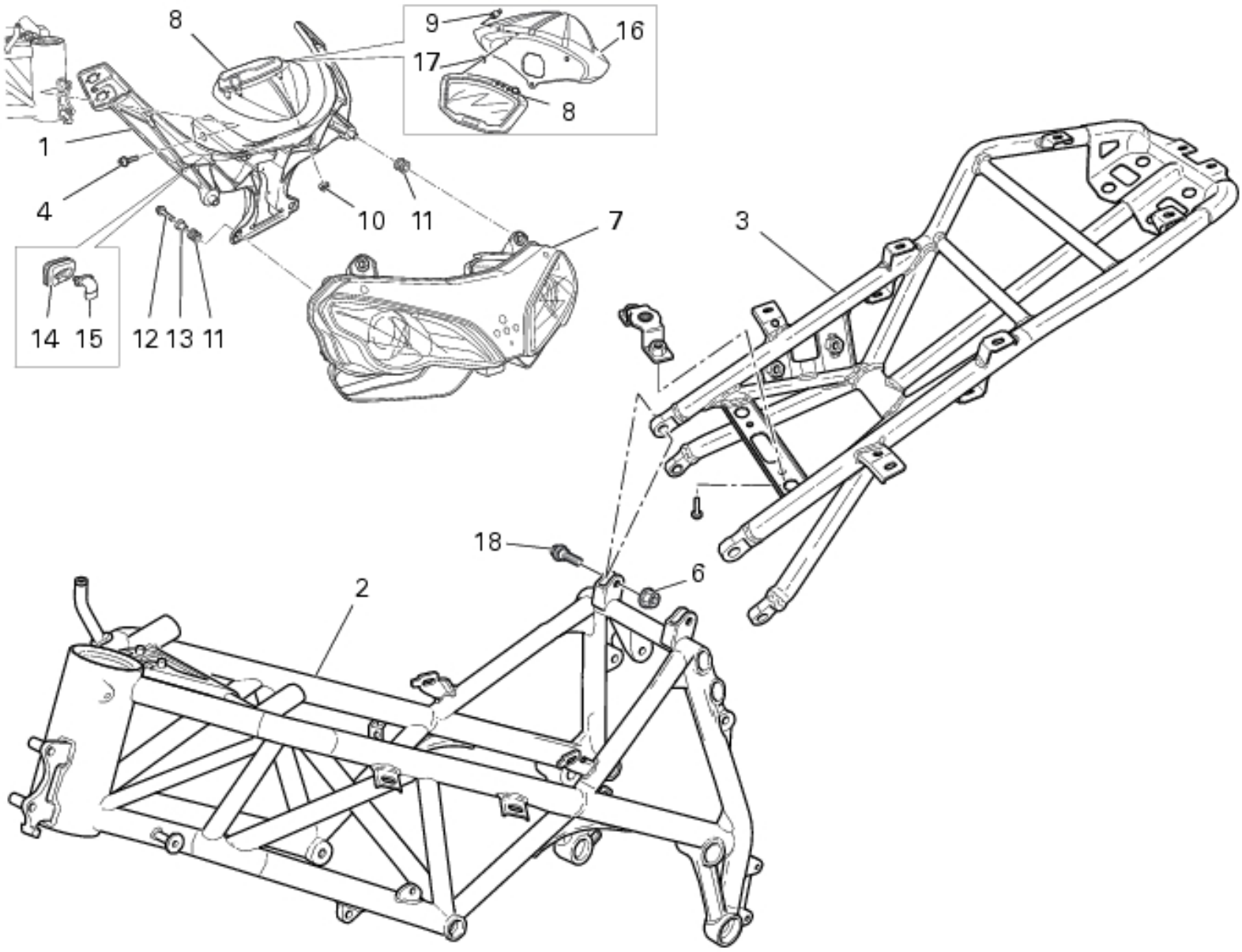
Position the bracket (3) on the frame, apply recommended threadlocker to the two bolts (2) and insert them. Tighten the bolts (2) to the specified torque (Sect. C 3, Frame torque settings).



Connect the sidestand switch connector to the main wiring harness.
For correct positioning of the sidestand switch wiring, refer to the plate in Sect. P 1, Plate 40.

Operation	Section reference
Refit the left-hand side fairing	E 2, Refitting the side fairings

6 - Frame inspection



1 Headlight assembly
2 Frame
3 Rear subframe
4 Bolt
5 Bolt
6 Nut
7 Headlight
8 Instrument panel
9 Spacer
10 Nut
11 Rubber
12 Bolt
13 Spacer
14 Rubber
15 Air temperature sensor
16 Instrument panel shroud
17 Spring washer
18 Bolt

Parts catalogue

HEADLIGHT & INSTR. PANEL

Frame

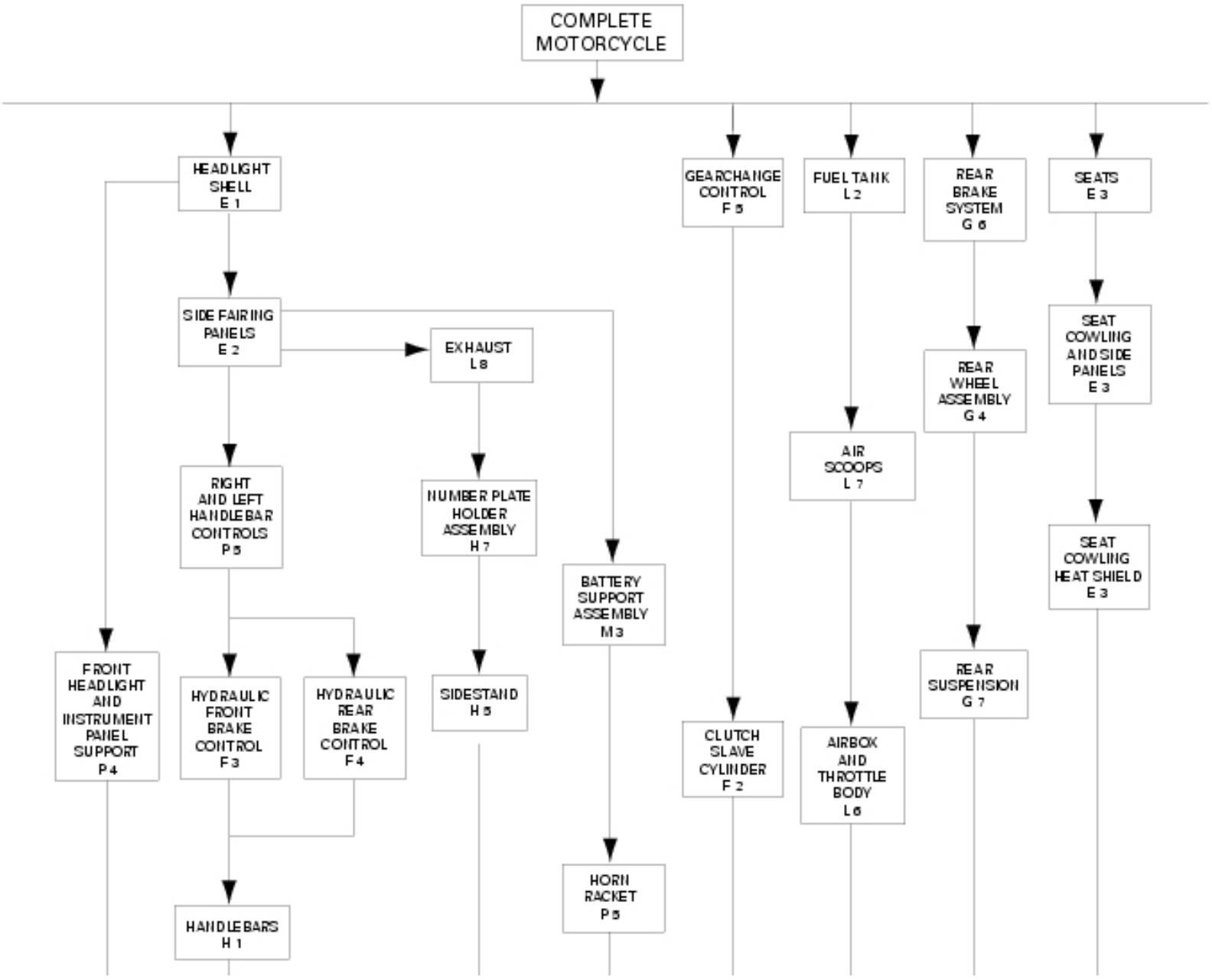
REAR SUBFRAME

Important

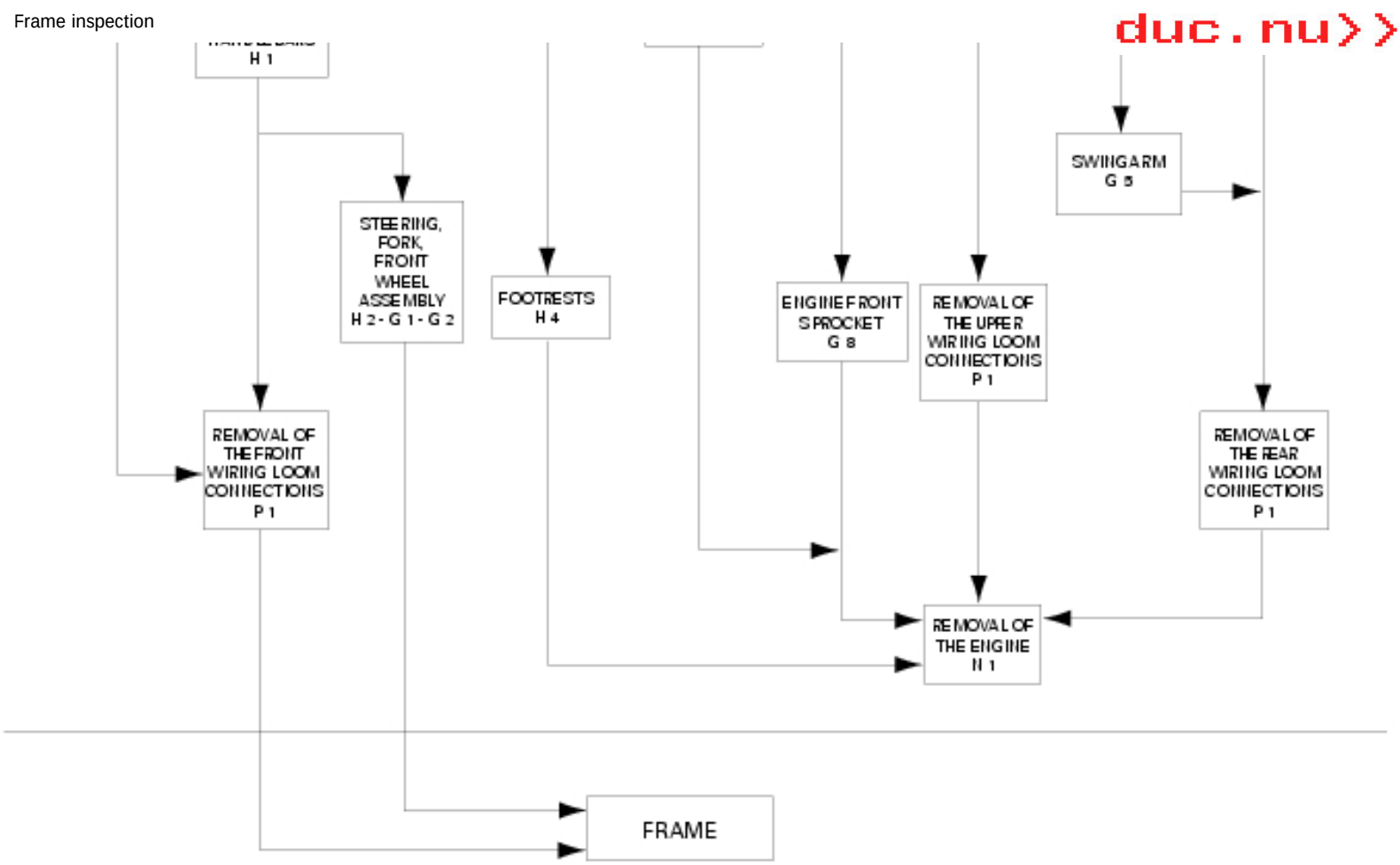
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Disassembly of structural components and the frame

Before carrying out dimensional checks on the frame, you must remove all the superstructures fitted, referring to the removal procedures outlined in the sections of this manual.
The structural components of the frame (2) are the headlight assembly (1) and the rear subframe (3).
Both serve to support motorcycle superstructures and must therefore be in perfect condition.
The flow chart below illustrates the logical sequence in which the parts are to be removed from the motorcycle and gives a reference to the section of the manual in which the removal procedure is described.

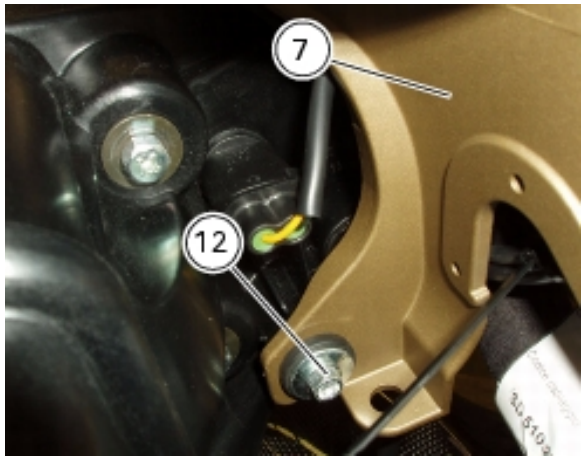


duc.nu>>



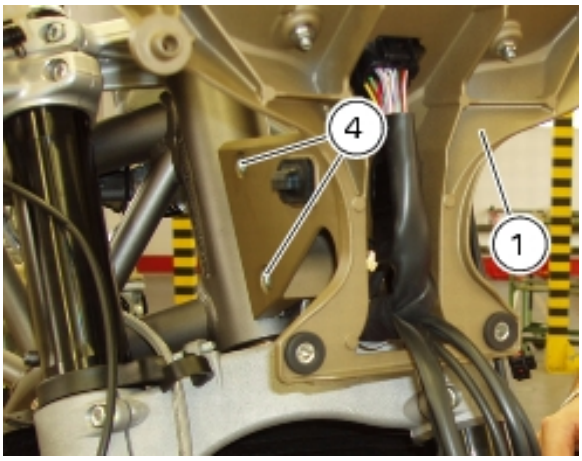
Removal of the headlight assembly

Unscrew the bolts (12) to disconnect the headlight (7).



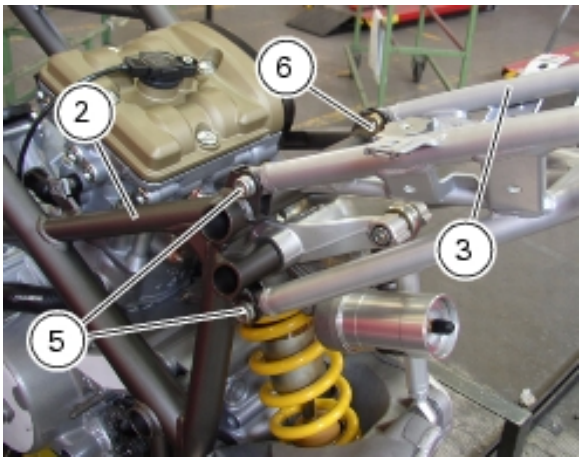
Disconnect the various wiring connectors, remove all cable ties from the headlight support (Sect. P 1, Plate 10) and

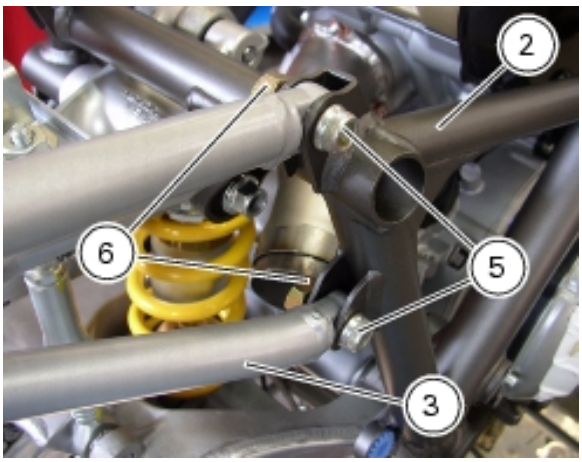
unscrew the bolts (4).
Remove the headlight assembly (1).



Removal of the rear subframe

Disconnect all the wiring connections of the electrical components mounted on the subframe (Sect. P 1, Plate 34, Plate 35) and remove the silencer (Sect. L 8, Removal of the exhaust system).
Unscrew the bolts (5) securing the rear subframe (3) to the frame (2).
Separate the rear subframe (3) from the main frame (4).
Recover the nuts (6).





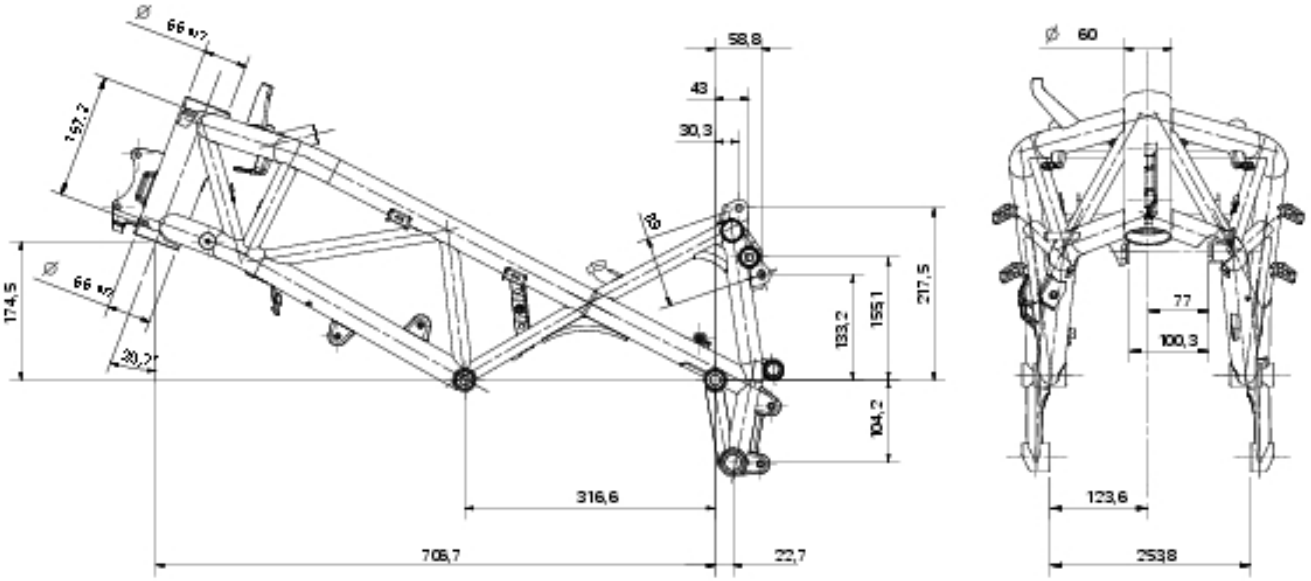
Checking the frame

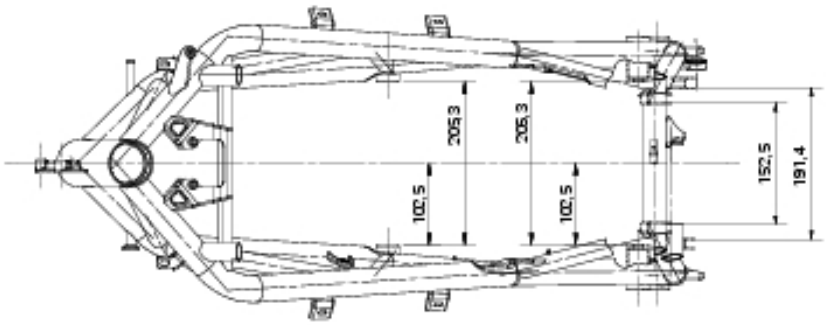
Check the dimensions of the frame against the dimensions shown here to determine whether it needs to be realigned or renewed.

Important

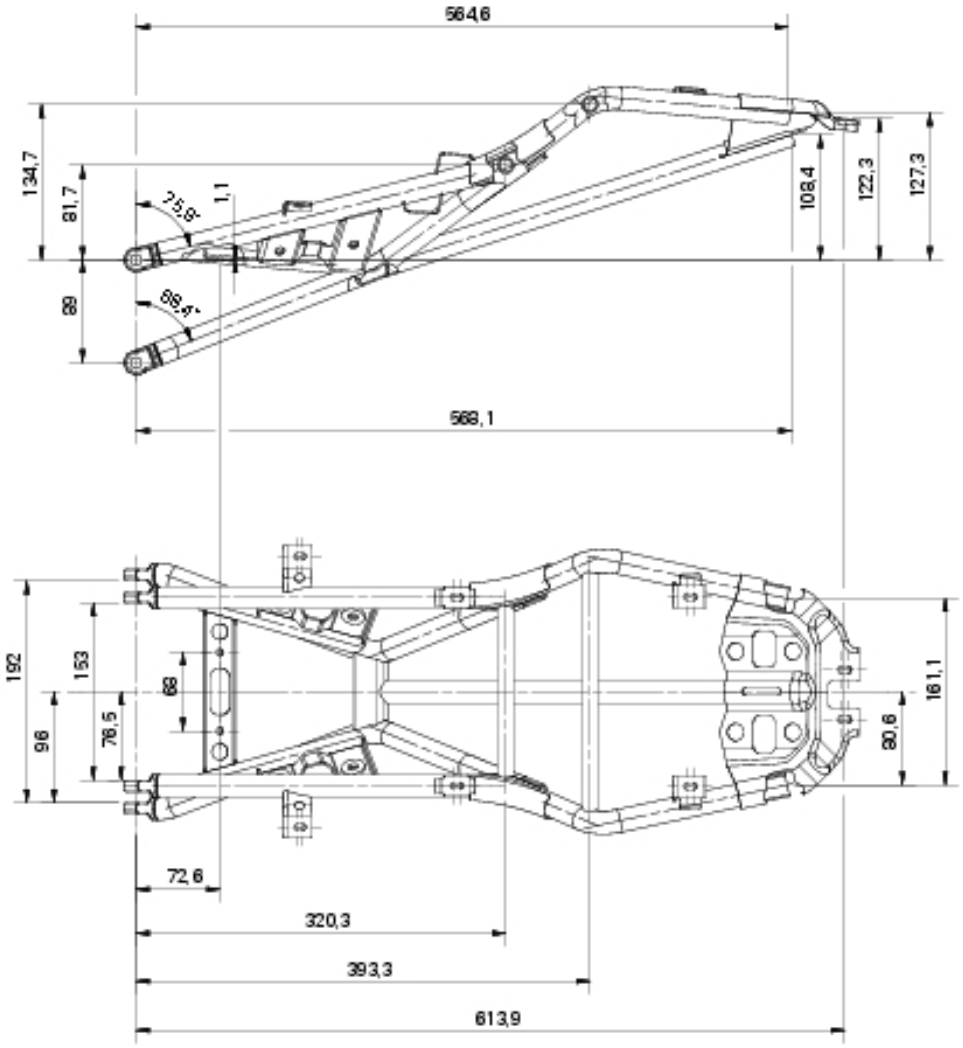
Badly damaged frames must be renewed and not repaired. Any work carried out on the frame can give rise to potential danger, infringing the requirements of EC directives concerning manufacturers' liability and general product safety.

Frame general dimensions (mm)





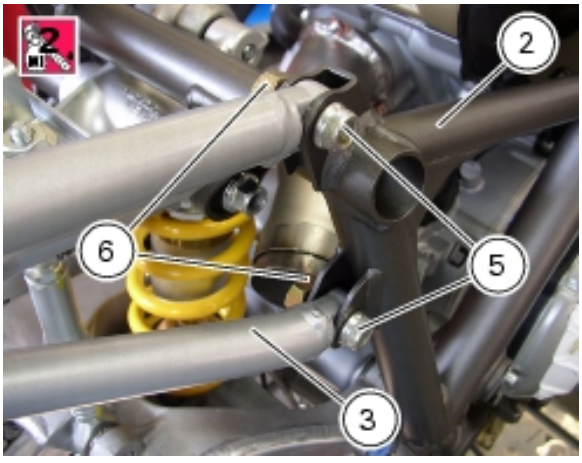
Rear subframe general dimensions (mm)

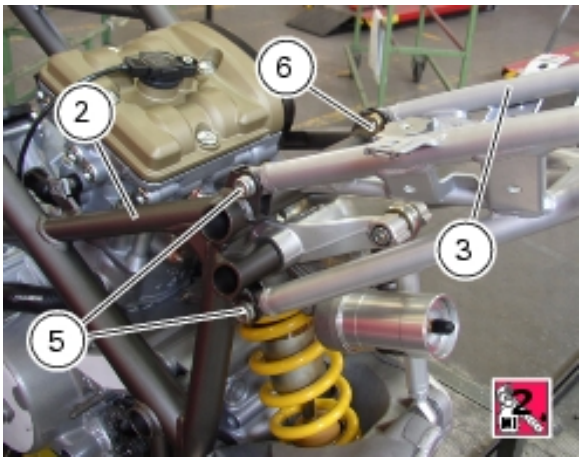


Reassembly of structural components and the frame

Refitting the rear subframe

Locate the rear subframe (3) on the mountings on the frame (2).
Insert the bolts (5) from the outside and secure on inside with the nuts (6), applying the specified threadlocker.
Tighten the bolts (5) to the specified torque (Sect. C 3, Frame torque settings).

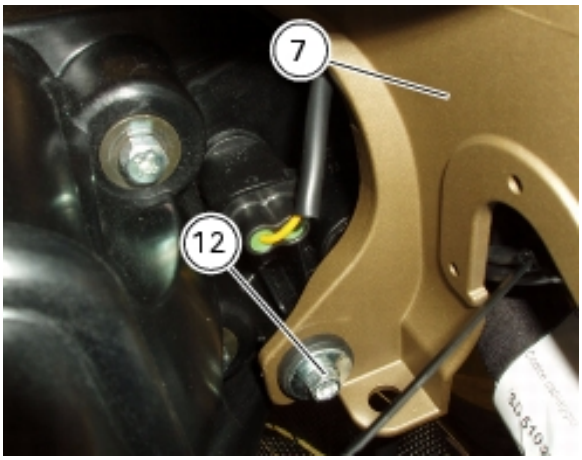




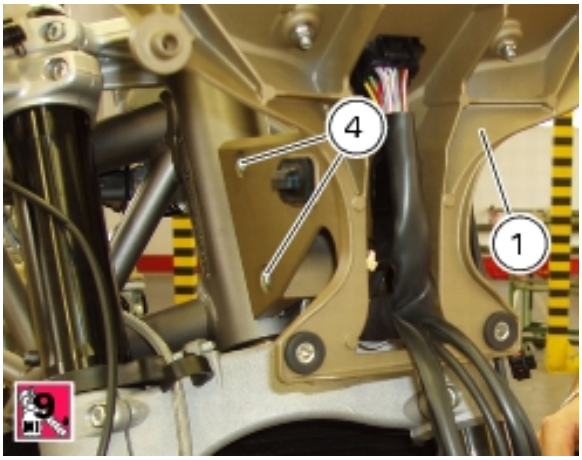
Reconnect the wiring connections (Sect. P 1, Plate 34, Plate 35) and refit the silencer (Sect. L 8, Refitting the exhaust system).

Refitting the headlight assembly

Fit the headlight (7), fit the retaining bolts (12) and tighten to the specified torque (Sect. C 3, Frame torque settings).

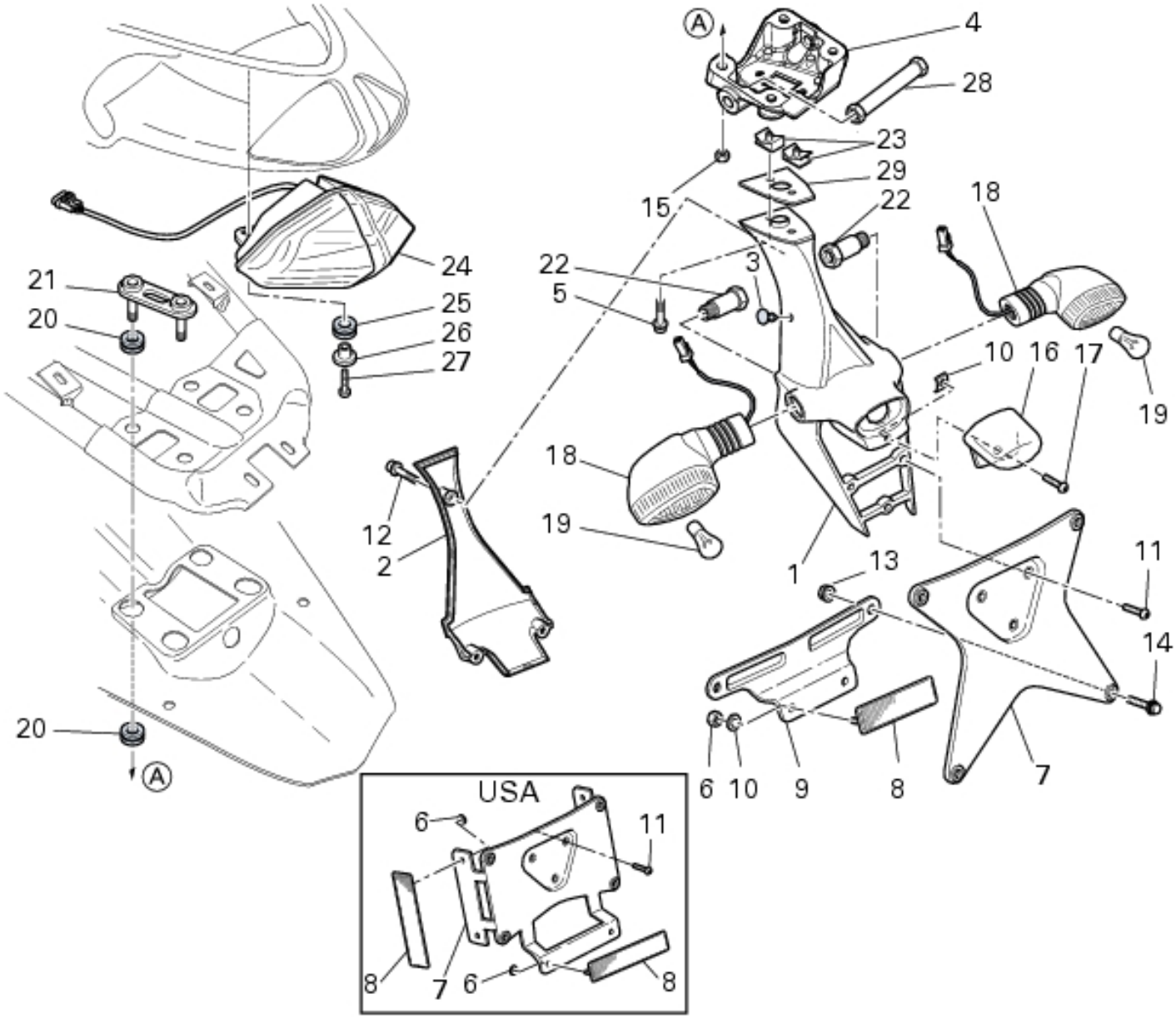


Install the headlight assembly (1) complete with accessories to the mounting on the front of the steering head, making sure the holes are aligned.
Insert the bolts (4) in the front mounting.
Apply the prescribed threadlocker and tighten the bolts (4) to the specified torque (Sect. C 3, Frame torque settings).



Reconnect and refit the wiring connectors (Sect. P 1, Plate 10).

7 - Number plate holder



1 Number plate holder
2 Cover
3 Rubber mounting
4 Support
5 Bolt
6 Nut
7 Support
8 Reflector
9 Bracket
10 Washer
11 Bolt
12 Bolt
13 Nut
14 Bolt
15 Nut
16 Number plate light
17 Bolt
18 Rear turn signals

19 Bulb
20 Rubber mounting
21 Flange
22 Nut
23 Quick-release fastener
24 Tail light
25 Rubber
26 Spacer
27 Bolt
28 Spacer
29 Plate

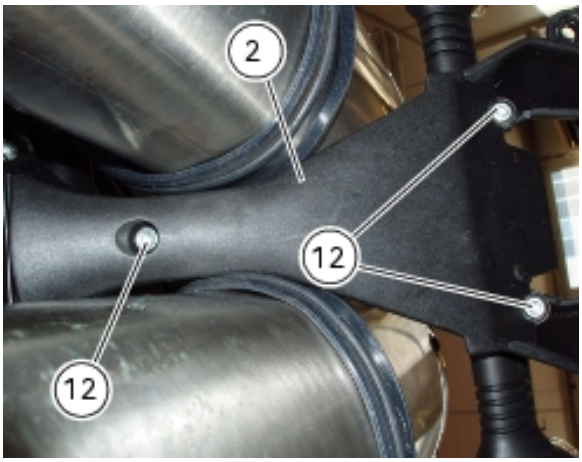
Parts catalogue

Number plate holder

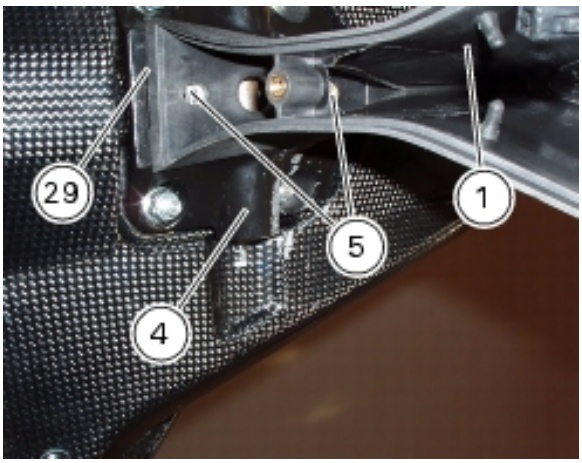
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the number plate holder

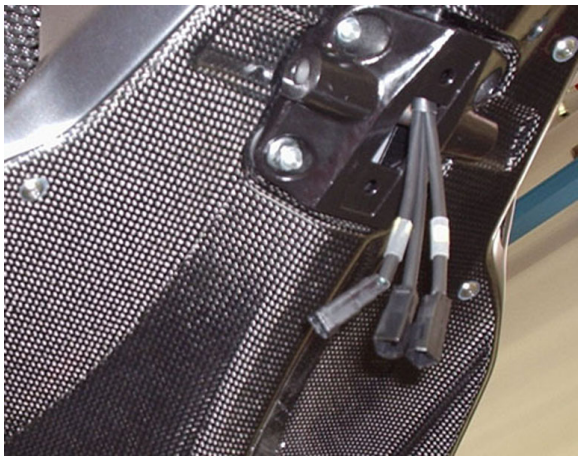
Undo the bolts (12) and remove the number plate holder cover (2).



Undo the bolts (5) securing the number plate holder (1) to the support (4) and recover the plate (29).



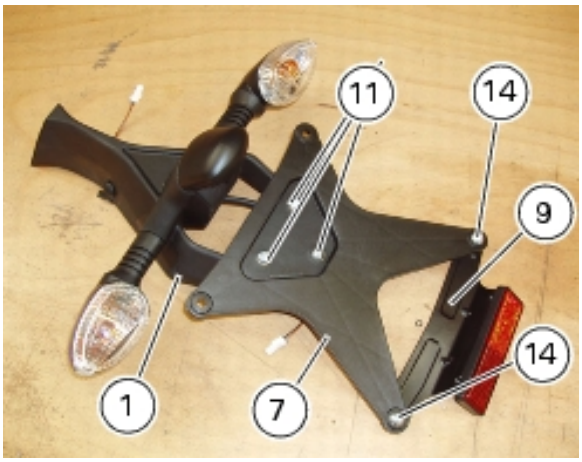
Disconnect the rear turn signal connectors from the main wiring loom (Sect. P 1, Plate 34, Plate 35) and remove the number plate holder assembly.



Unscrew the bolts (11) and (14) to remove the number plate holder support (7) from the number plate holder (1) and from the bracket (9).

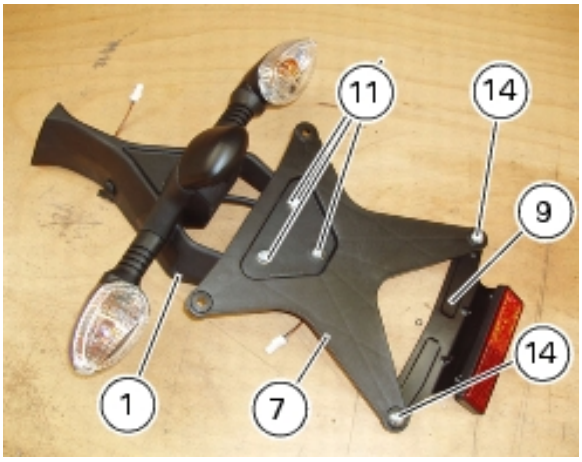
Notes

On the USA version the bracket (9) is integrated in the number plate holder support (7).

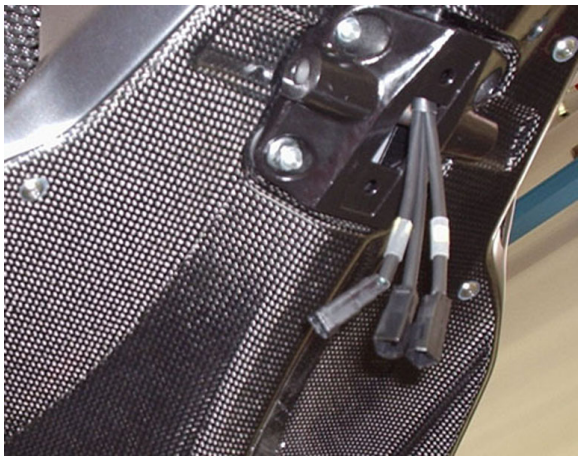


Refitting the number plate holder

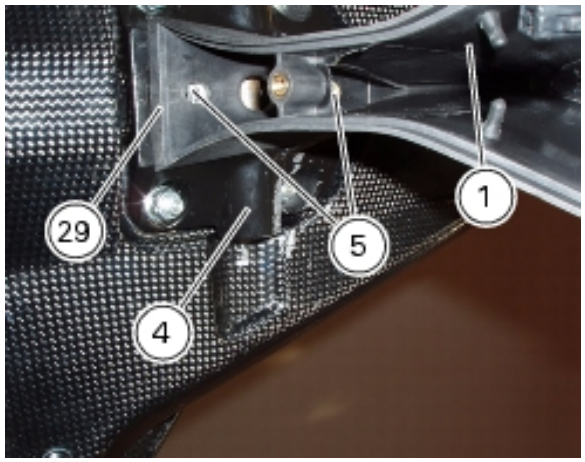
Refit the number plate holder support (7) to the bracket (9) and to the number plate holder by fitting the bolts (14) and (11).



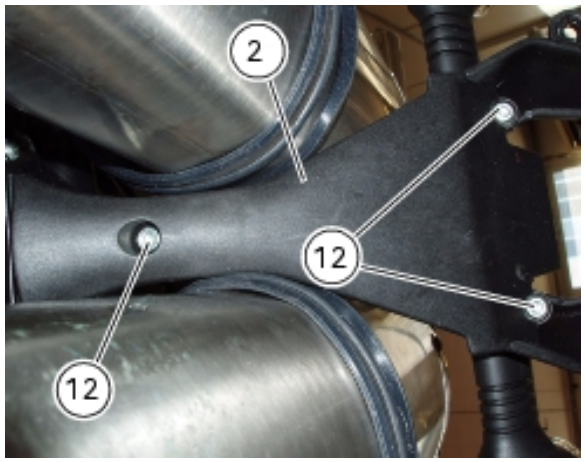
Reconnect the turn signal wiring connectors to the main wiring loom (Sect. P 1, Plate 34, Plate 35).



Refit the number plate holder (1) with the plate (29) to the support (4) with the bolts (5).



Refit the number plate holder cover (2) with the bolts (12).



0L - Fuel/Exhaust System

2 - Fuel tank 3

Removal of the fuel tank 4
Removal of the fuel filler cap assembly 6
Refitting the fuel filler cap assembly 7
Renewal of the fuel tank flange 8
Refitting the fuel tank flange 9
Refitting the fuel tank 10

6 - Airbox - Throttle Body 15

Refitting the airbox and throttle body 16
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7 - Air intake 31

Removal of the air filters 32
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8 - Exhaust system 34

Removal of the exhaust system 35
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Refitting the evaporative emissions canister 52
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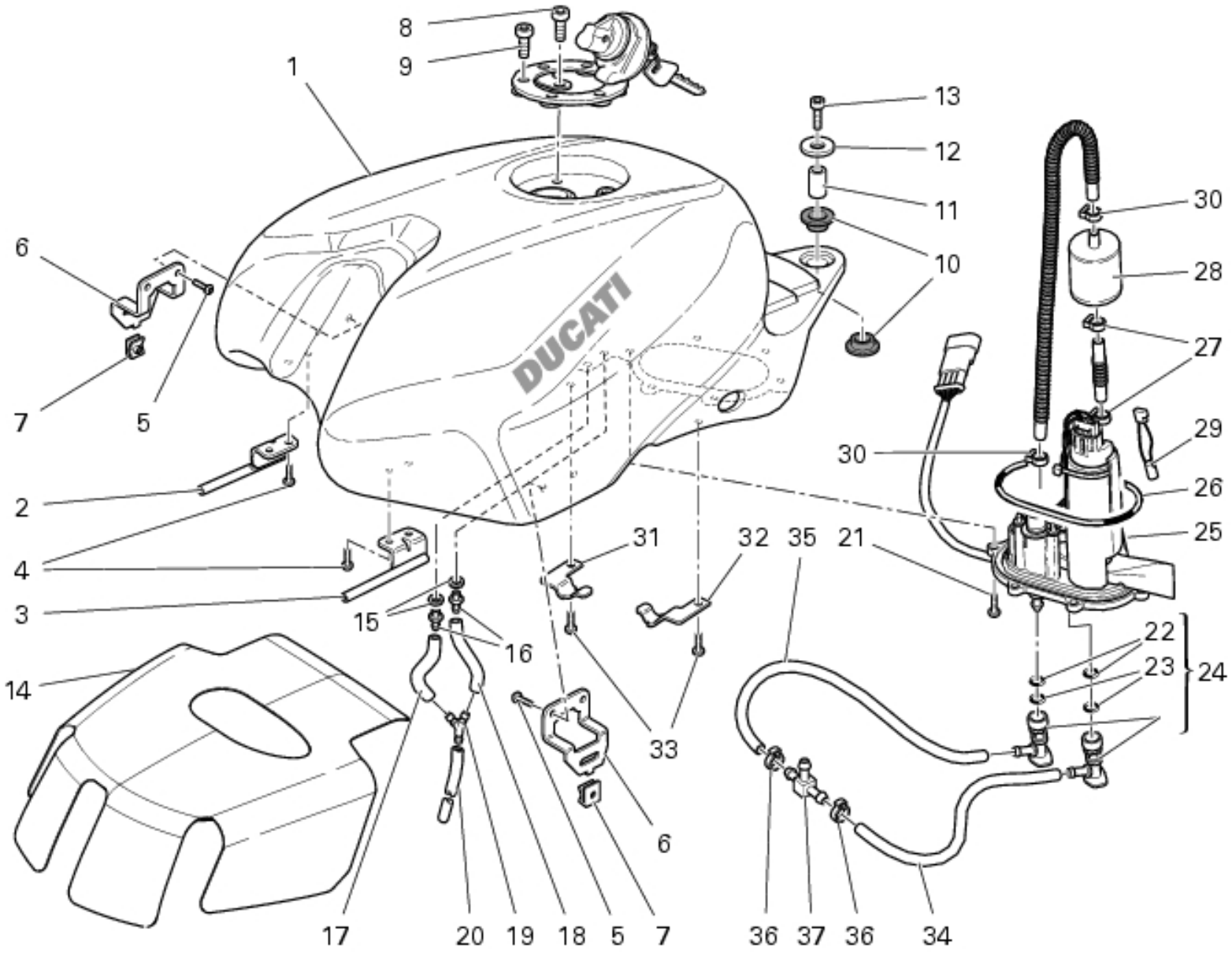
2 - Fuel tank



1 Fuel tank
2 Front fuel tank mounting (right)
3 Front fuel tank mounting (left)
4 Bolt
5 Bolt
6 Support
7 Quick-release fastener
8 Bolt
9 Bolt
10 Rubber
11 Spacer
12 Washer
13 Bolt
14 Panel
15 Seal
16 Union
17 Hose
18 Hose

19 Union
20 Hose
21 Bolt
22 O-ring
23 O-ring
24 Quick-release fitting
25 Flange
26 O-ring
27 Collar
28 Filter
29 Thermistor
30 Collar
31 Plate
32 Plate
33 Bolt
34 Hose
35 Hose
36 Clamp
37 T-fitting

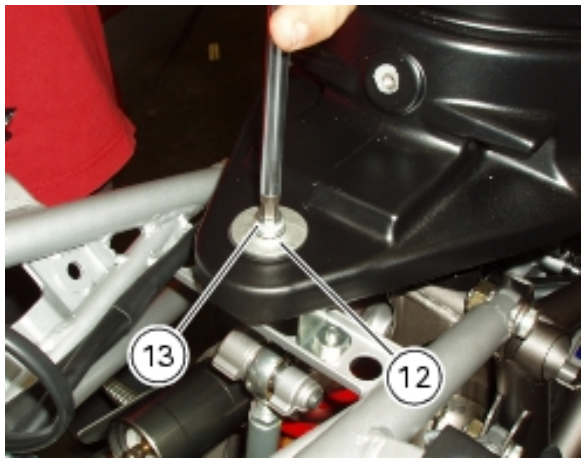
Parts catalogue

FUEL TANK
FUEL SYSTEM

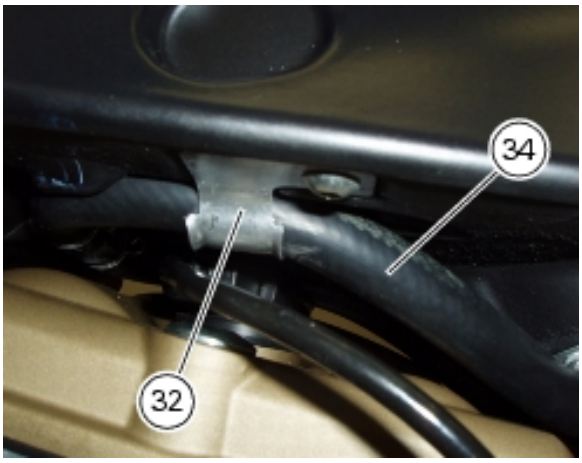
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the fuel tank

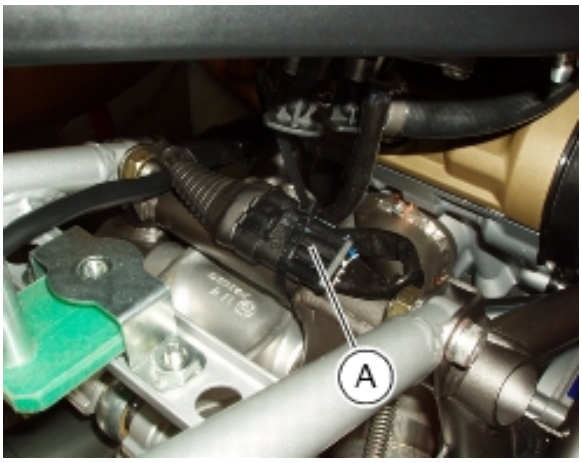
Remove the seat and side panels (Sect. E 3, Removal of the seats - Removal of the side panels and seat cowling). Remove the bolt (13) and recover the washer (12).



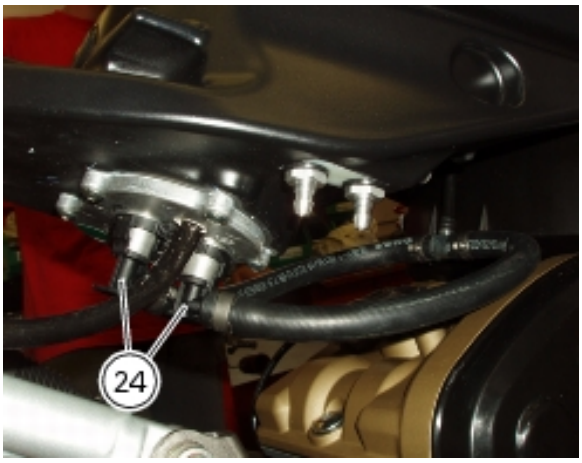
Detach the hoses (34) and (**35**) from plates (32) and (**31**) respectively.



Raise the fuel tank and disconnect the fuel level sensor (A) from the main wiring loom.



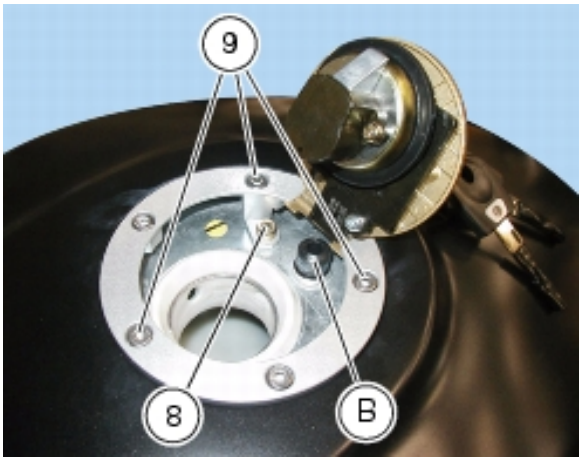
Disconnect the quick-release fittings (24) from the flange.

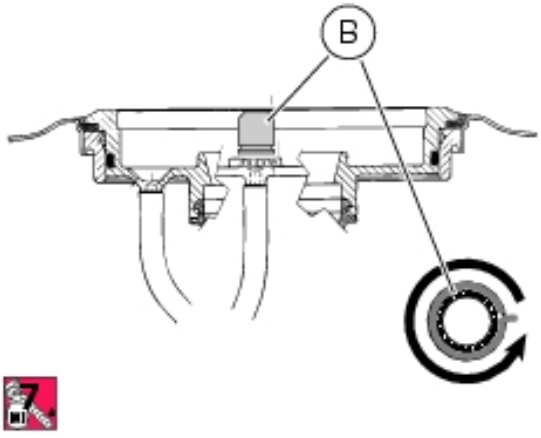


Withdraw the fuel tank (1) towards the rear of the motorcycle to disengage the front catches from the frame.

Removal of the fuel filler cap assembly

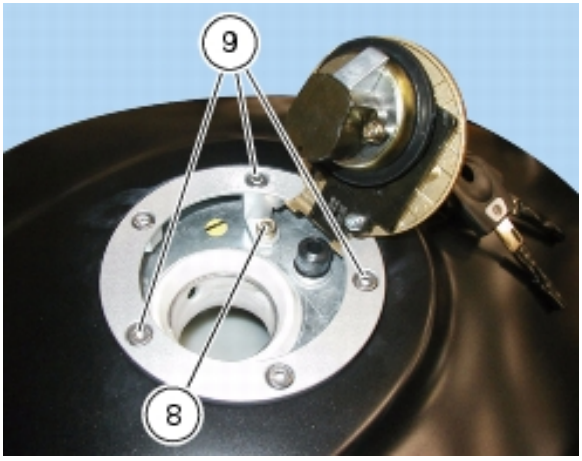
Open the filler cap.
Unscrew the outer bolts (9) securing the ring nut to the filler cap recess.
Unscrew the anti-theft screw (8) on the inside.
Remove the complete filler cap assembly.
The rubber breather nozzle (B) is located inside the filler cap. If the nozzle (B) is to be renewed, apply a uniform film of speed bonder around the groove.
Fit the rubber making sure that it is properly seated in the recess groove.





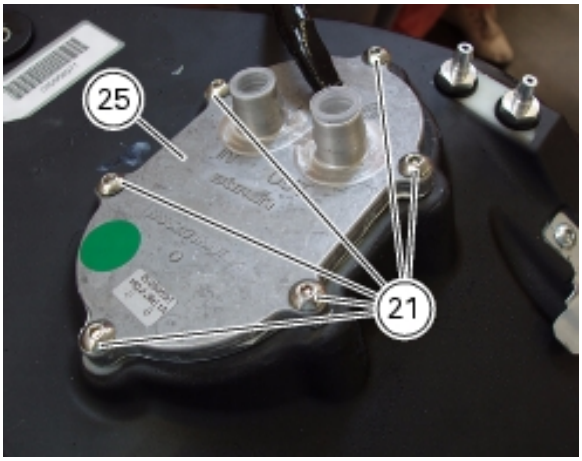
Refitting the fuel filler cap assembly

Grease the new O-ring and its groove in the fuel tank.
Refit the filler cap assembly in its seat in the tank and tighten the bolts (8) and (9) to the specified torque (Sect. C 3, Frame torque settings).



Renewal of the fuel tank flange

Unscrew the six bolts (21) securing the fuel tank flange. Remove three of the bolts, leaving three in position in order to help lift the flange.
Remove the flange (25) from the fuel tank.



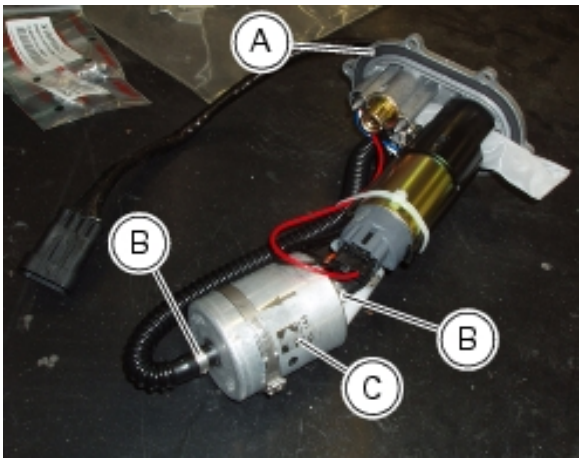
Recover the O-ring (A).
Using the appropriate tool, undo the clips (B) next to the fuel filter (C).
Remove the old filter from the connecting hoses and fit a new filter.
Before reassembly, carefully remove any deposits or scale from all parts.

Important

When installing the new filter, position it so that the arrow stamped on the outer casing points towards the flange.

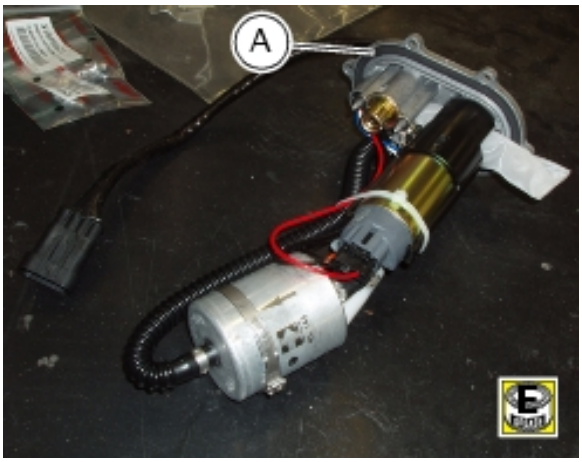
Notes

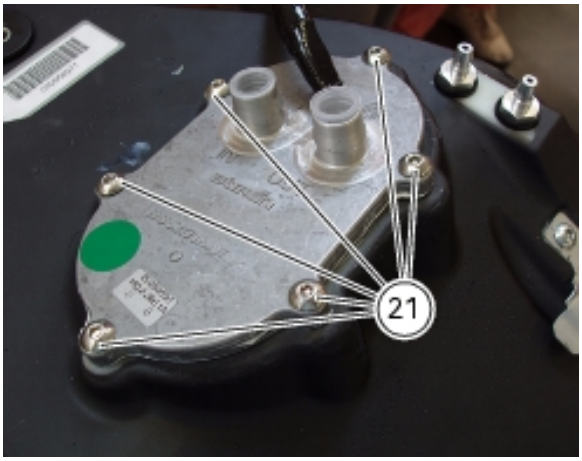
The flange is supplied as a spare part complete with the fuel pump and pressure regulator: the entire flange assembly must be replaced in the event of malfunction.



Refitting the fuel tank flange

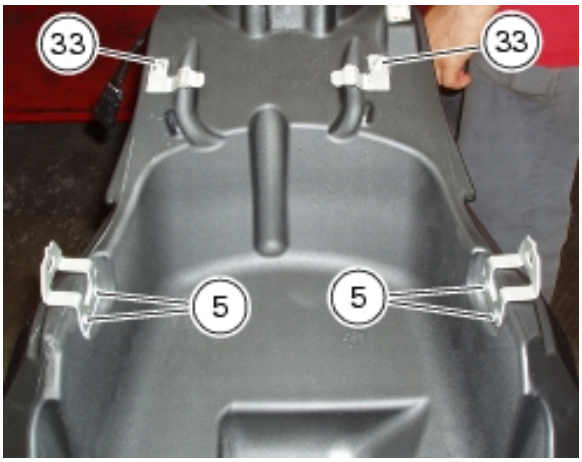
Grease the O-ring and locate the flange and refit by reversing the steps of the removal procedure. Tighten the bolts (21) to the specified torque (Sect. C 3, Frame torque settings).

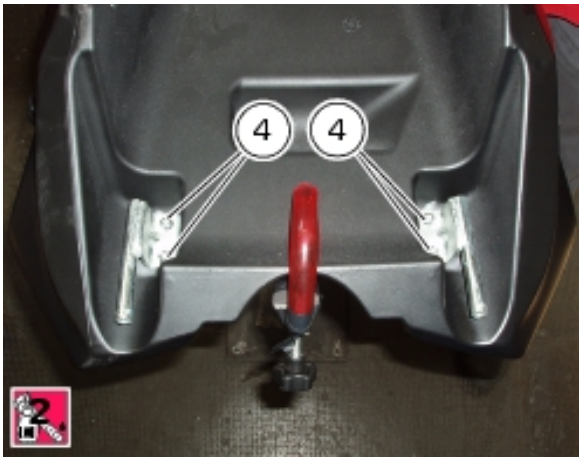


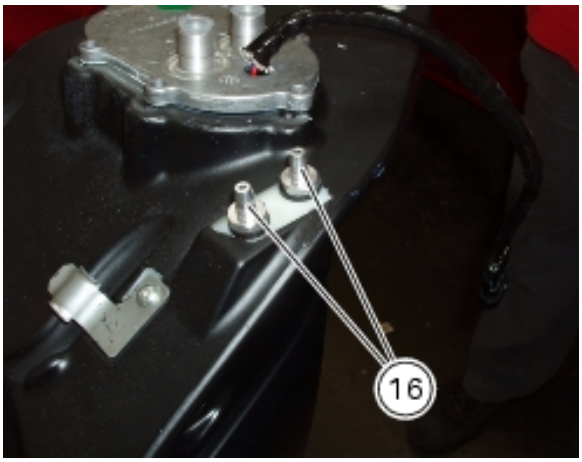


Refitting the fuel tank

If the fuel tank has been disassembled into its component parts, reposition all the parts as shown in the exploded view. In particular:
apply the recommended threadlocker to the bolts (4;
tighten the bolts (4), (5) and (33) and unions (16) to the specified torque (Sect. C 3, Frame torque settings).



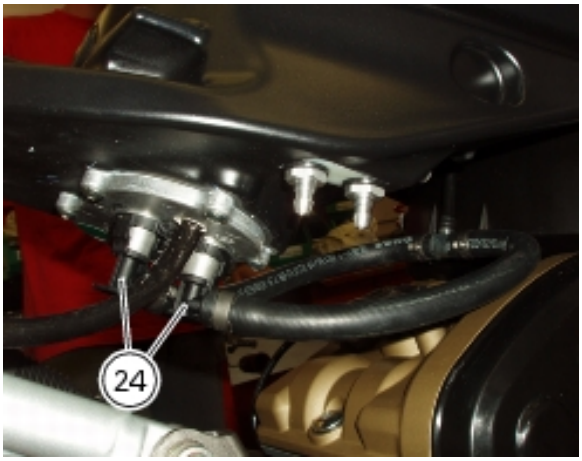




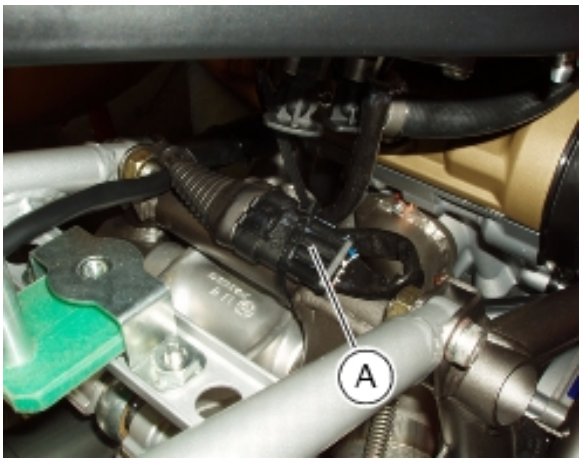
Check that the soundproofing panel (14) is positioned on the tank as shown.

Reposition the fuel tank (1), inserting the front catches in the corresponding locations on the frame.

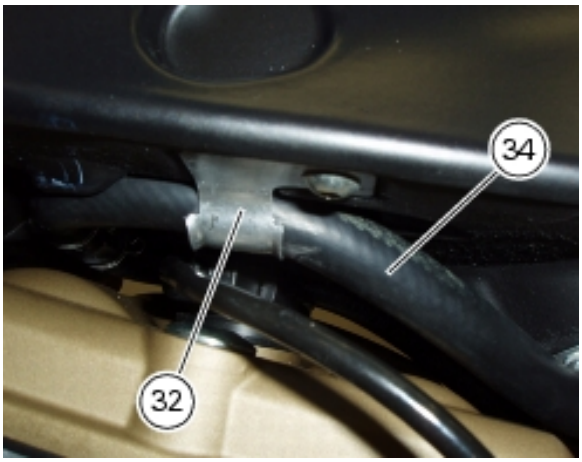
Connect the quick-release fittings (24) to the flange.



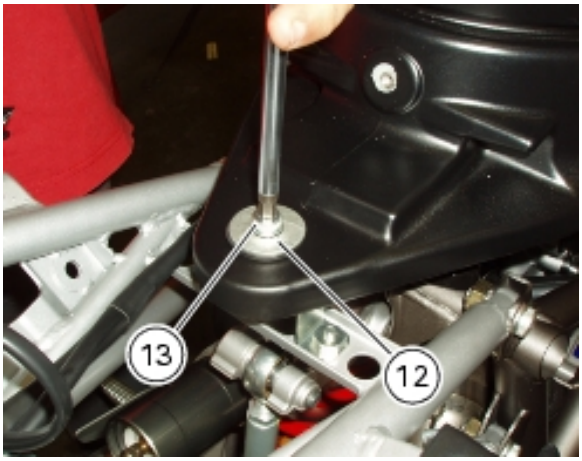
Connect the wiring connector (A) to the main wiring loom.



Insert the hoses (34) and (**35**) in plates (32) and (**31**) respectively.

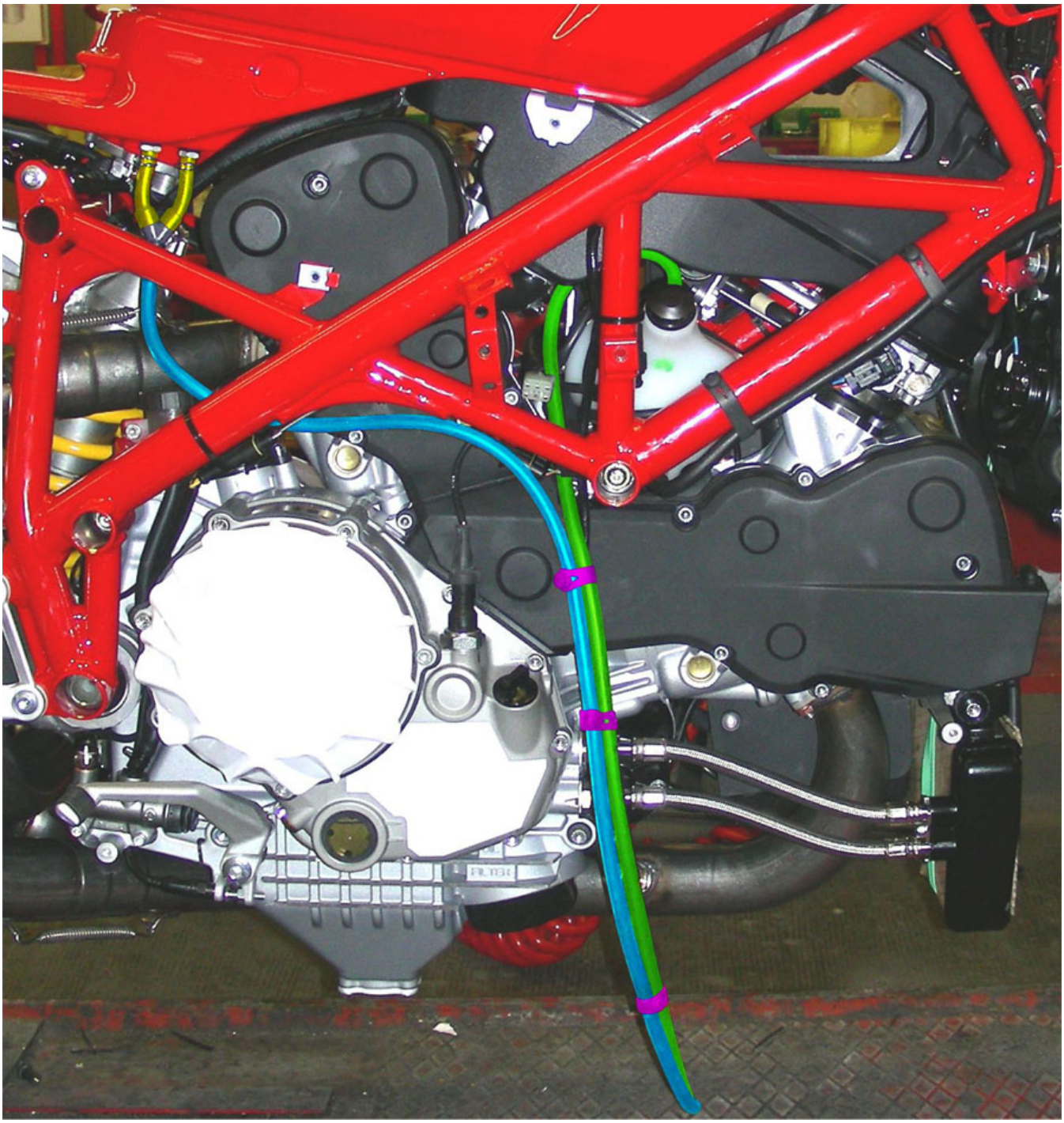


Secure the tank to the frame with the bolt (13) and the washer (12).
Tighten the bolt (13) to the specified torque (Sect. C 3, Frame torque settings).

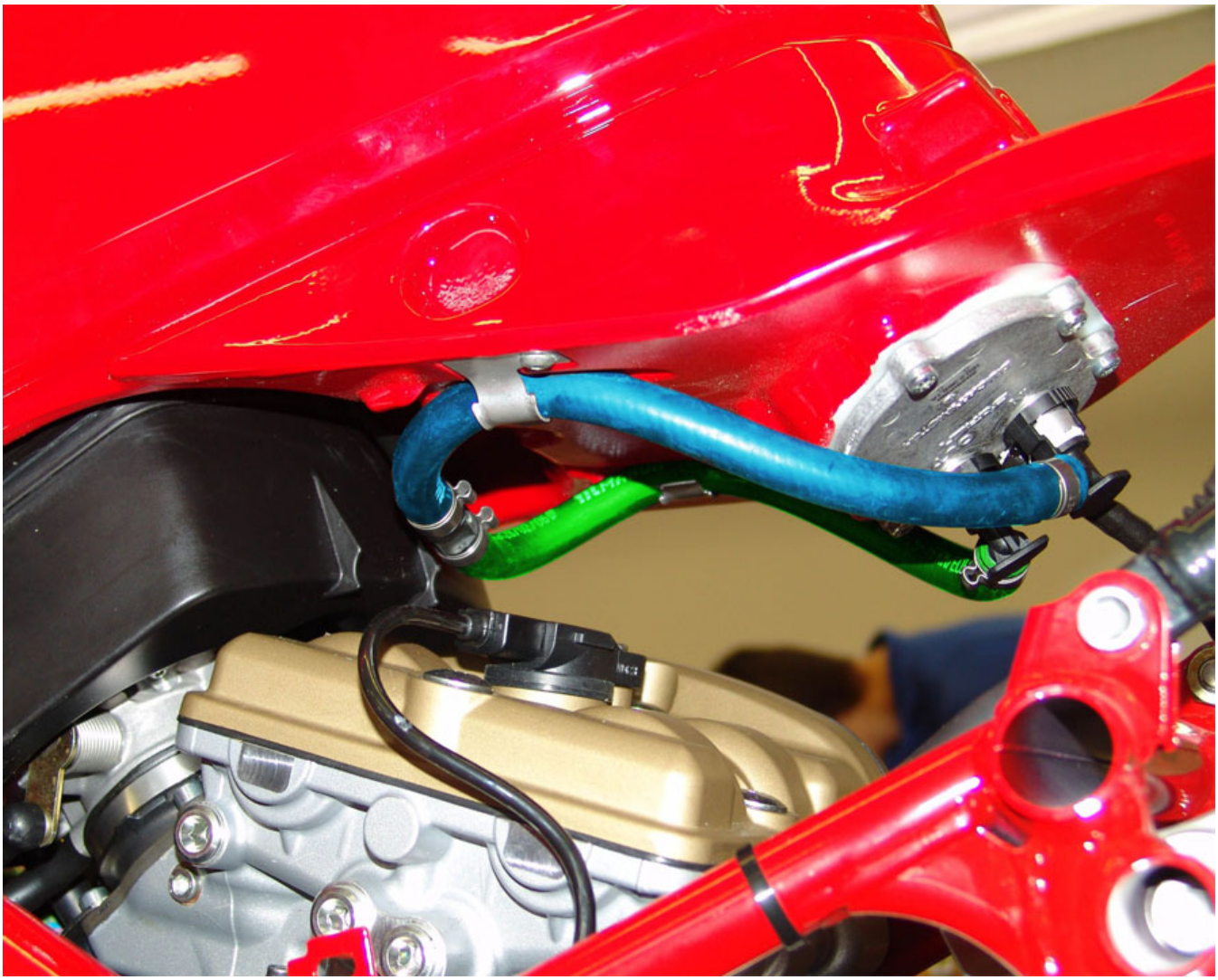


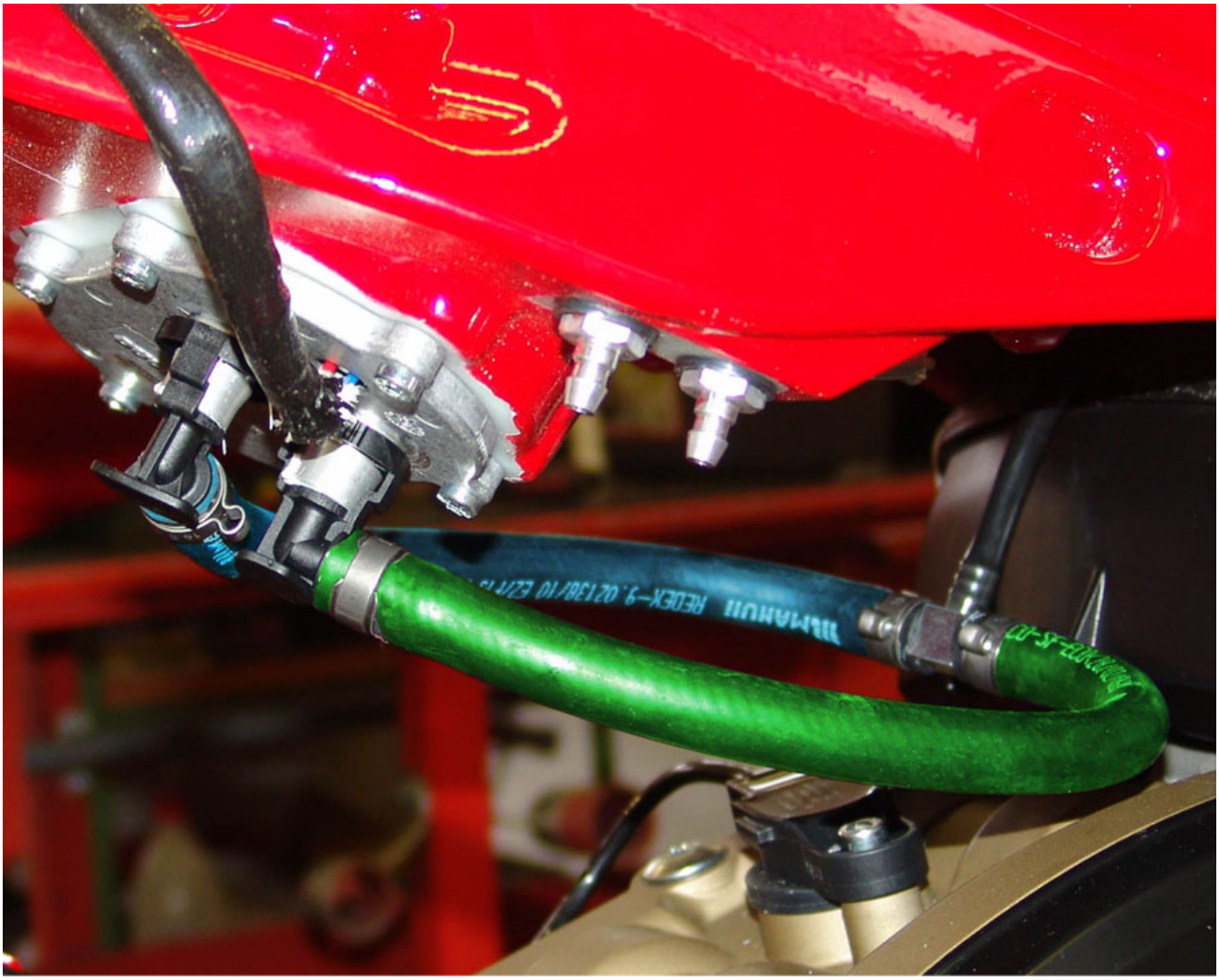
Refit the seat and side panels (Sect. E 3, Refitting the seats).

Positioning of the fuel tank breather and drain hoses and the water overflow hose and expansion tank

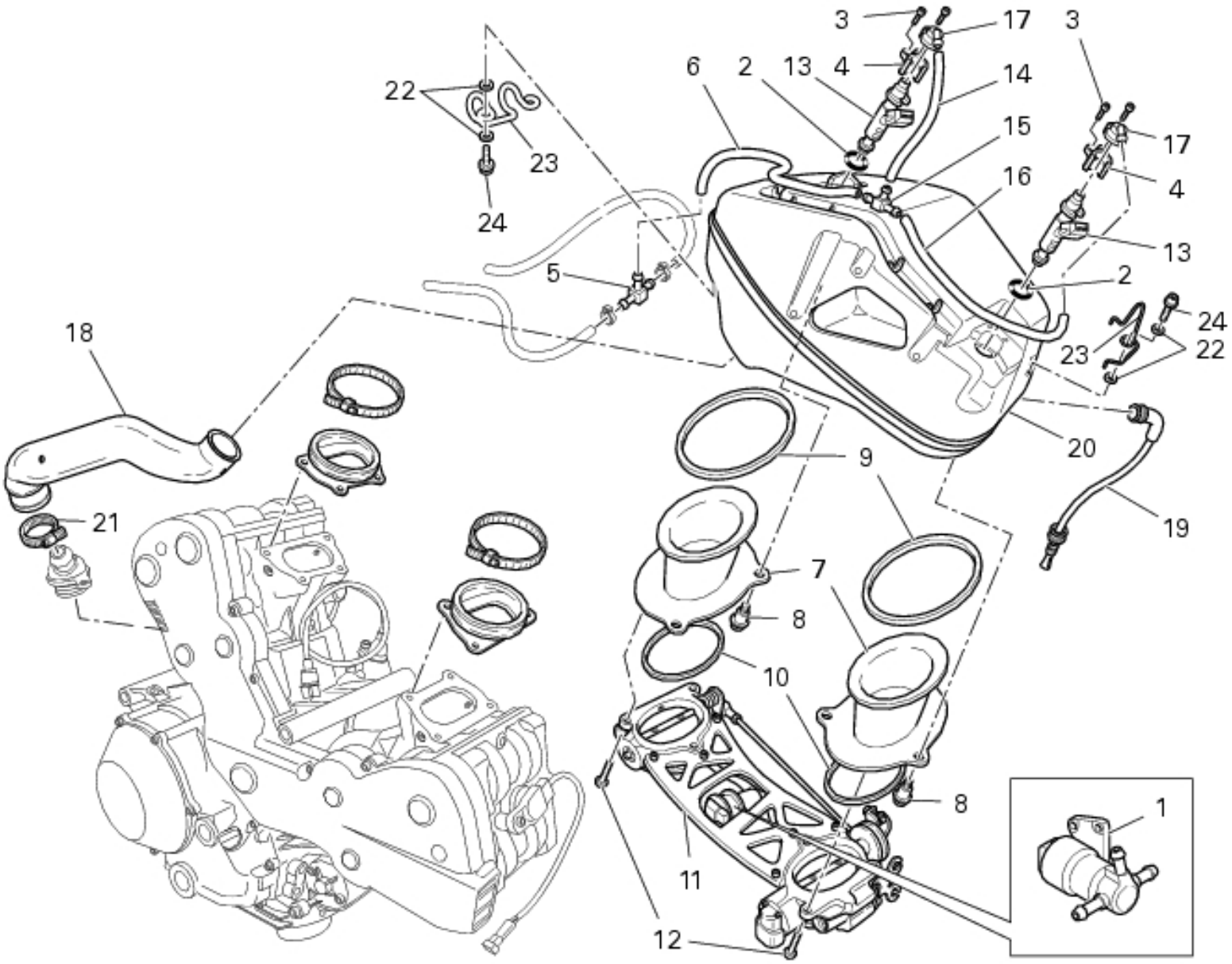


Positioning of the fuel hoses





6 - Airbox – Throttle Body



1 Stepper motor
2 O-ring
3 Bolt
4 Fuel injector support
5 Union
6 Hose
7 Intake manifold
8 Special bolt
9 Seal
10 Seal
11 Throttle body assembly
12 Bolt
13 Injector
14 Hose (vertical)
15 Union
16 Hose (horizontal)
17 Fuel injector cap
18 Drain hose

19 Hose
20 Airbox
21 Hose clip
22 Washer
23 Guide
24 Bolt

Parts catalogue

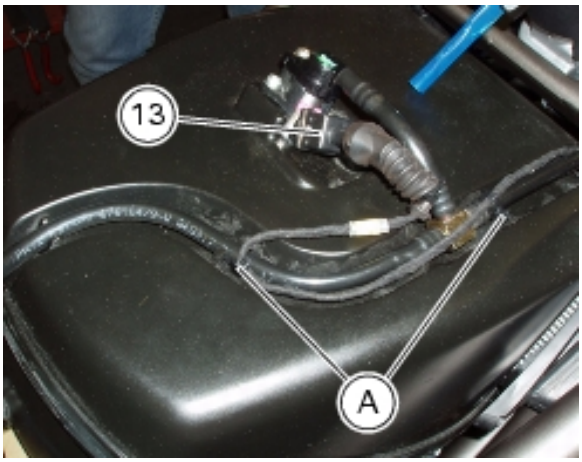
THROTTLE BODY
AIR INTAKE - OIL BREATHER

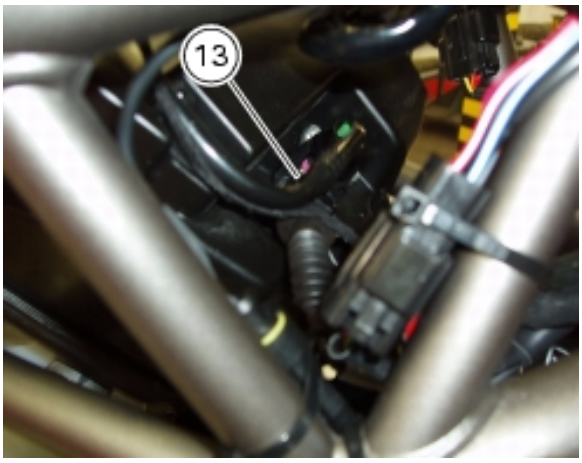
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Refitting the airbox and throttle body

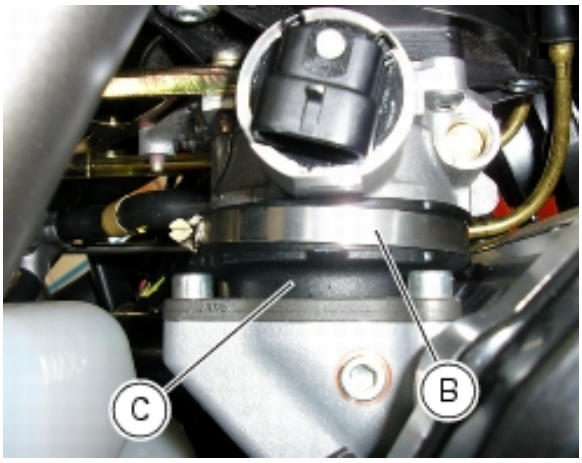
Operation	Section reference
Remove the side fairings	E 2, Removal of the side fairings
Remove the headlight shell	E 1, Removal of the headlight shell
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the air scoops	L 7, Removal of the air filters
Disconnect the throttle cable	F 1, Removal of the throttle twistgrip

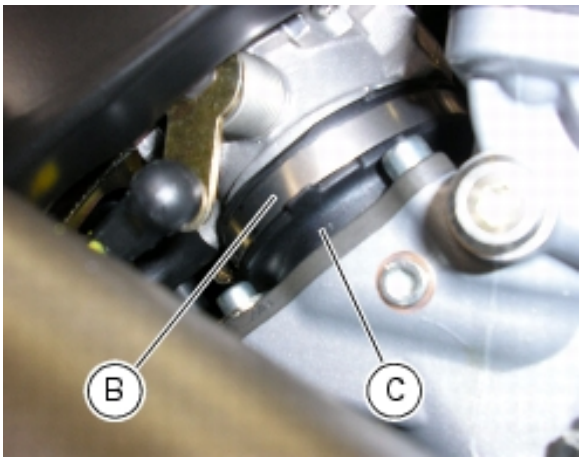
Disconnect the fuel injectors (13) from the main wiring loom.
Remove the retaining clips (A).



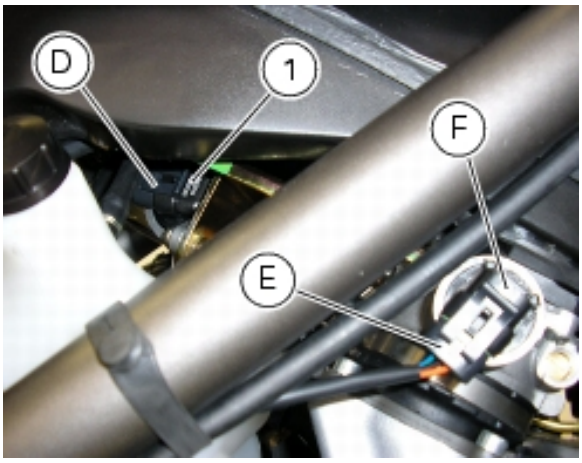


Loosen the clamps (B) securing the throttle body to the intake manifolds (C).

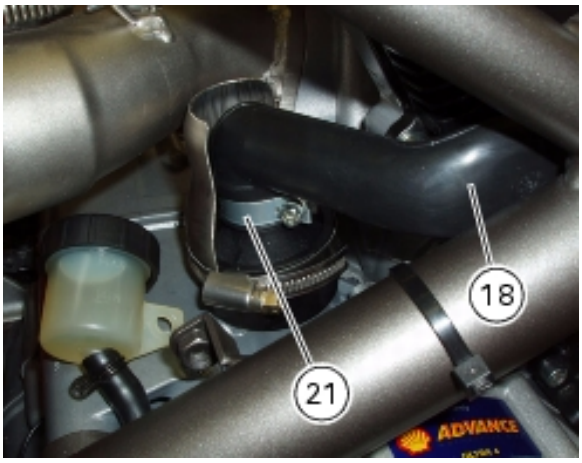




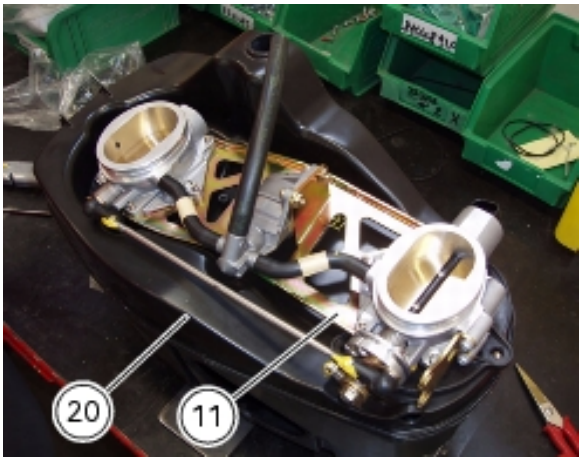
Disconnect the connector (D) connecting the main wiring loom to the stepper motor (1).
Disconnect the wiring connector (E) connecting the main wiring loom to the throttle position sensor (F).



Slacken off the clamp (21) securing the hose (18) to the blow-by valve.

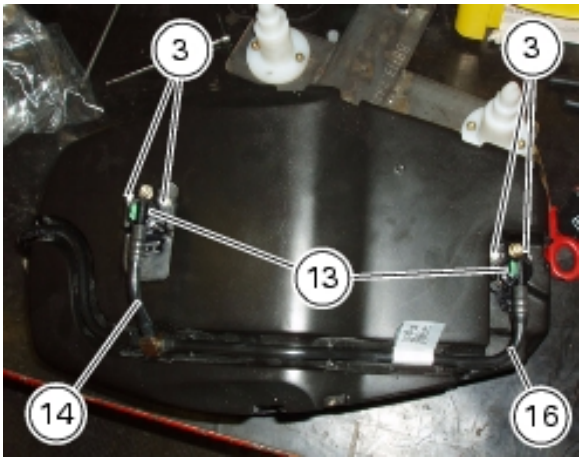


Withdraw the airbox (20) complete with the throttle body (11) and the fuel injectors (13).



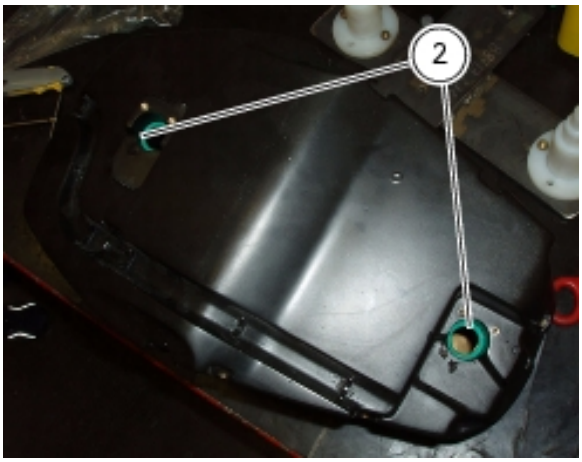
Removal of the fuel injectors

Unscrew the bolts (3) to remove the fuel injectors (13) complete with hoses (14) and (16) from the airbox.

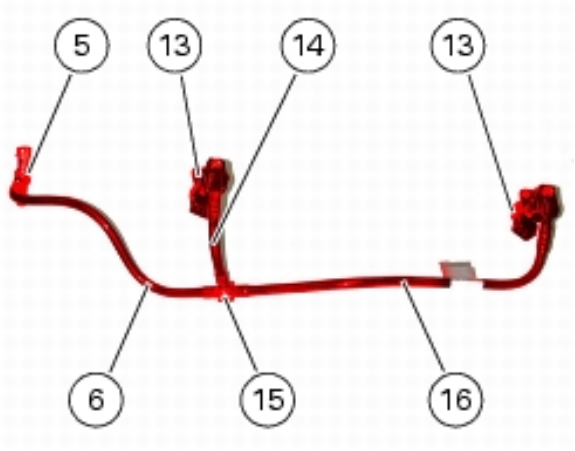


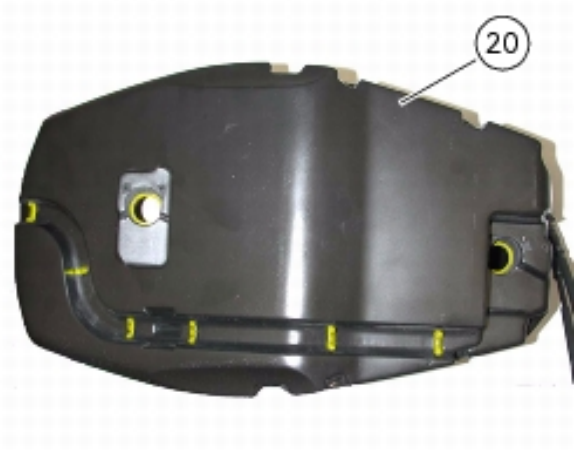
Refitting the injectors

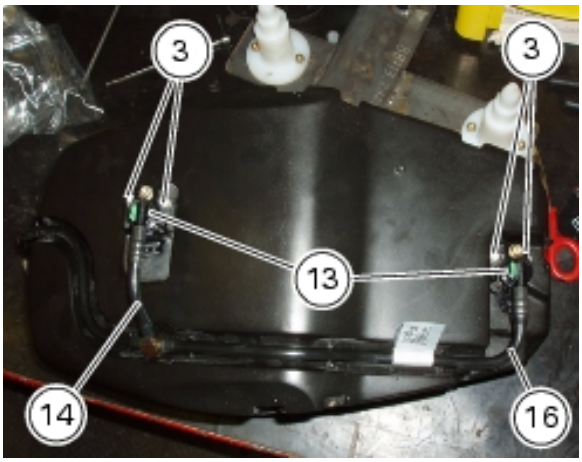
Check that the injector O-ring seals (2) are present.



Position the hoses and unions (5), (6), (14), (15) and (16) with the fuel injectors (13) on the airbox (20) in the corresponding yellow clips. Tighten the bolts (3) to the specified torque (Sect. C 3, Frame torque settings).

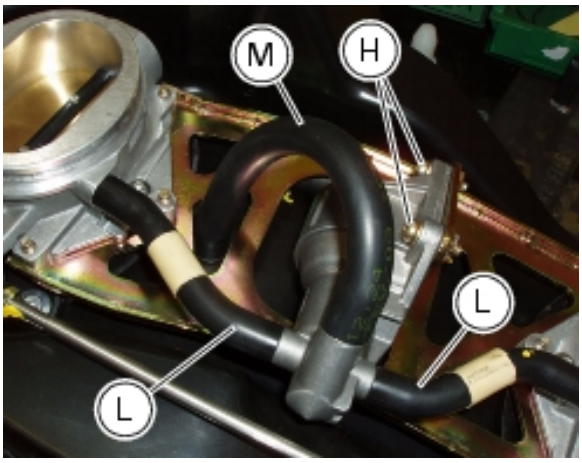






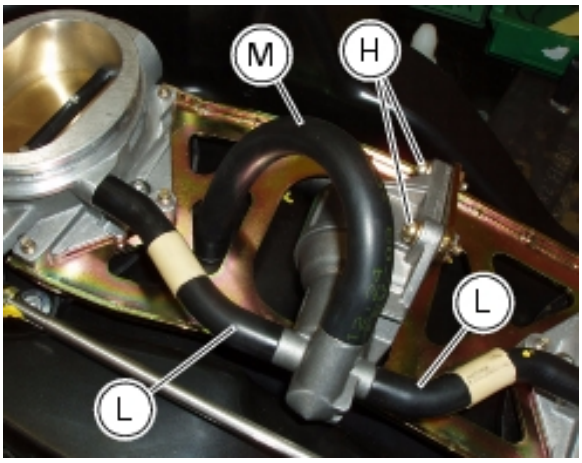
Removal of the stepper motor

The stepper motor is installed in the central part of the throttle body:
to remove it, unscrew the two bolts (H) and disconnect the hoses (L) and (M) from the airbox. Refer to Sect. M 3, Stepper motor for details of stepper motor operation.



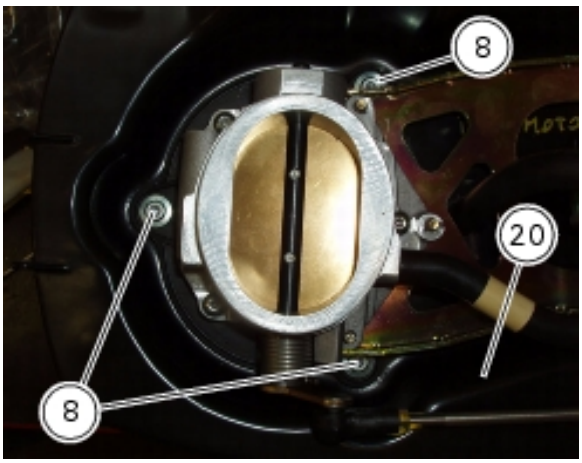
Refitting the stepper motor

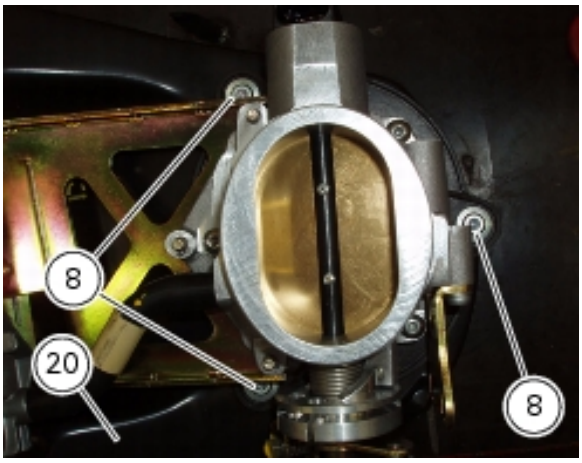
Reconnect the hoses (L) on the throttle body and the hose (M) to the airbox.
Locate the stepper motor with its support on the throttle body, inserting the bolts (H).
Tighten the bolts (H).

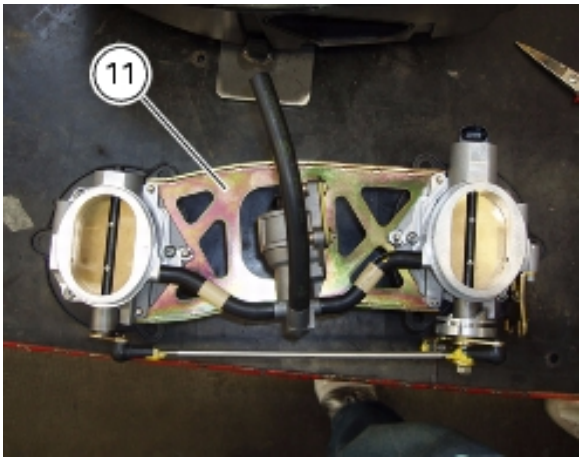


Disassembly of the airbox – throttle body

Unscrew the six bolts (8) and remove the throttle body (11) from the airbox (20).

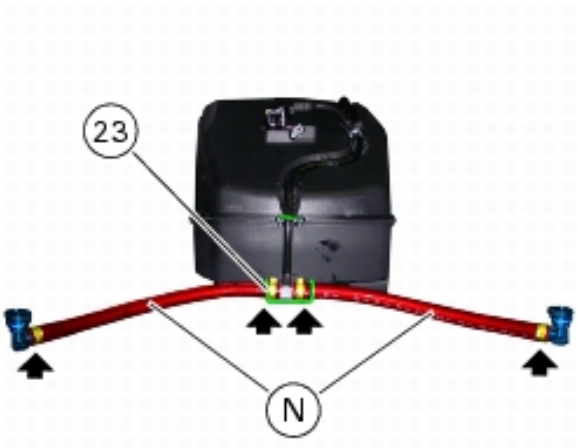




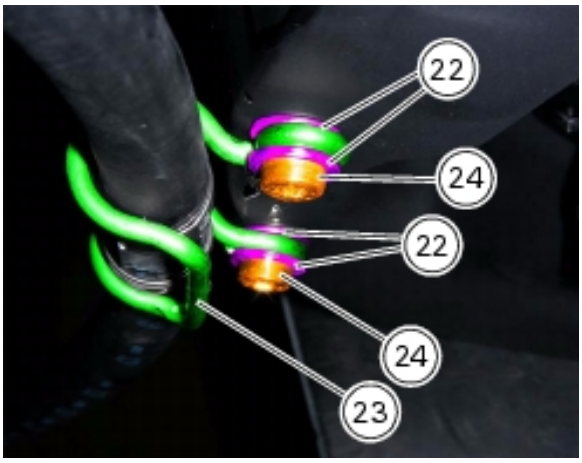


Reassembly of the airbox – throttle body

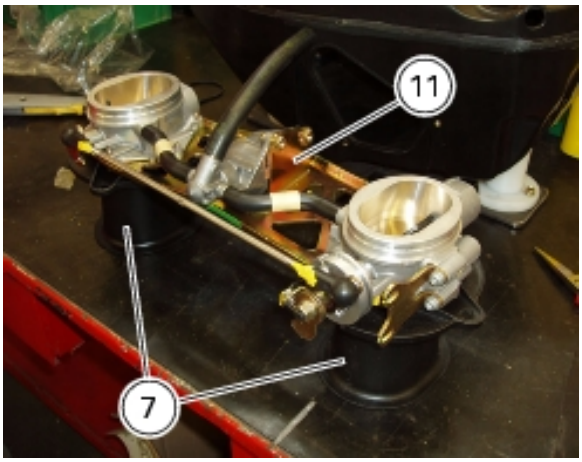
If removed, refit the fuel hoses (N) with relative quick-release fittings, the hose clamps to the airbox and the cable guide (23) as shown.



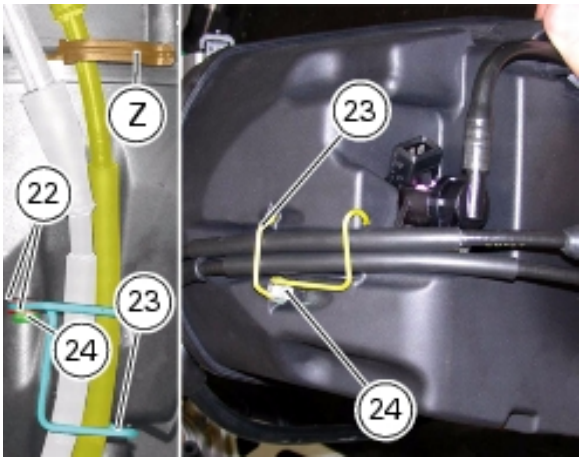
Fit the cable guide (23) with two bolts (24) and four washers (22) as shown.



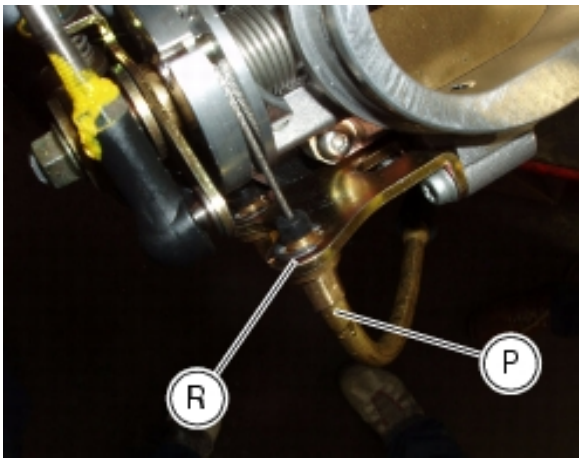
If removed, refit the air intake funnels (7) to the throttle body (11) and tighten the bolts (12) to the specified torque (Sect. C 3, Frame torque settings).

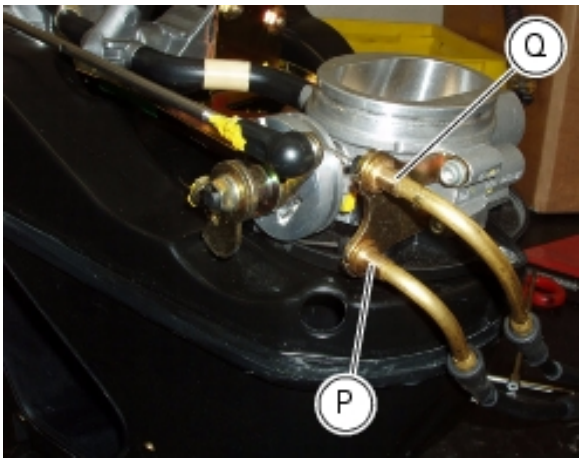


Check that the throttle closing cable is located under the tab (Z) on the airbox.
If previously removed, refit the cable guide (23) and tighten the bolt (24) with the two washers (22). Tighten the bolt (24) to the specified torque (Sect. C 3, Frame torque settings).

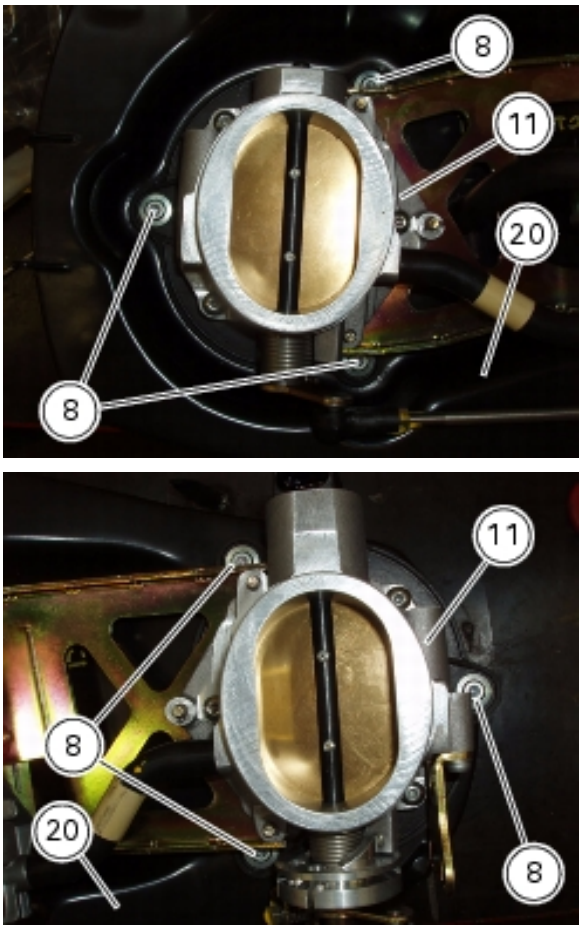


If removed, refit the throttle cables to the throttle body as indicated: insert the throttle opening cable (P) and the throttle closing cable (Q) in the throttle body plate, as shown in the figure. Secure the throttle cables with two circlips (R).



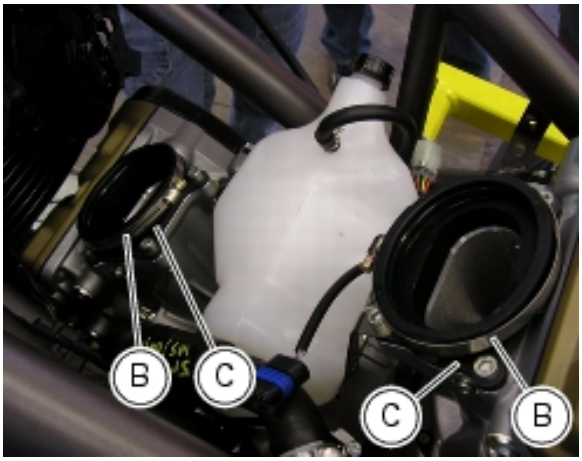


Refit the throttle body (11) to the airbox (20).
Tighten the six bolts (8) to the specified torque (Sect. C 3, Frame torque settings).



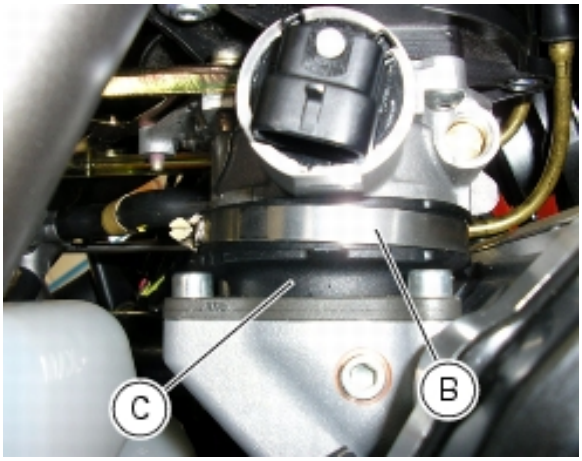
Refitting the airbox and throttle body

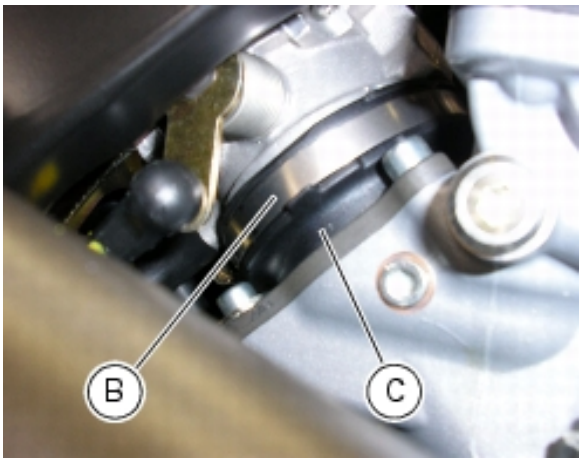
Locate the hose clamps (B) in their seats on the air intakes (C).



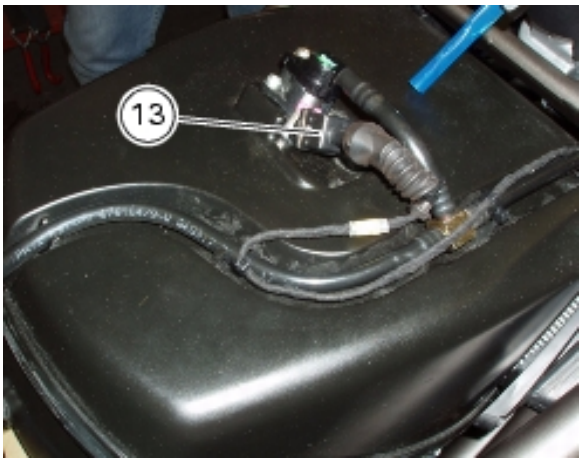
Position the airbox (20) and the throttle body (11) on the motorcycle.

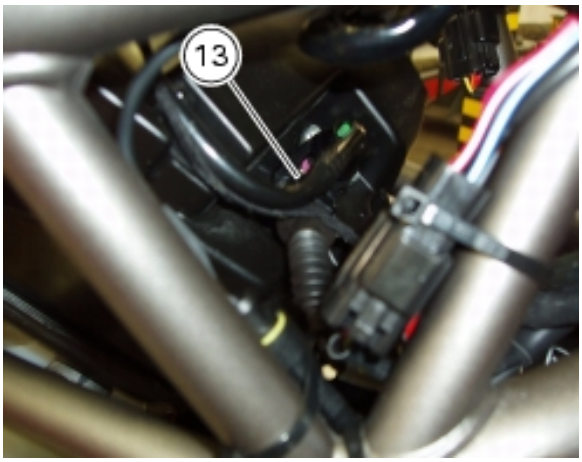
Tighten the hose clamps (B) to the specified torque (Sect. C 3, Frame torque settings).



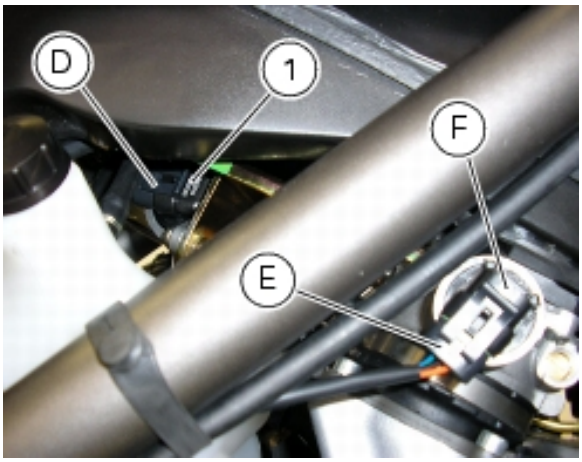


Reconnect the wiring connectors connecting the injectors (13) to the main wiring loom.

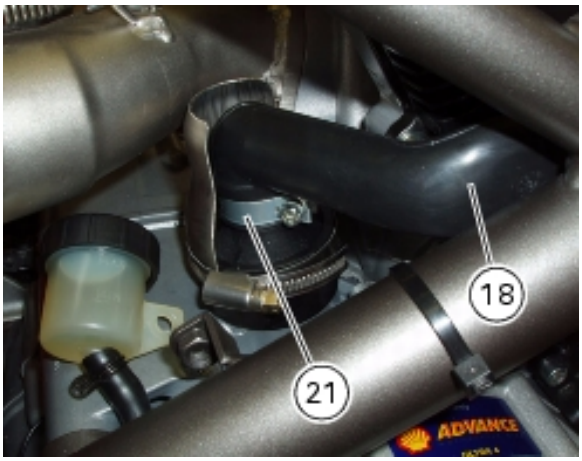




Connect the wiring connector (D) to connect the main wiring loom to the stepper motor (1).
Connect the wiring connector (E) of the main wiring loom to the throttle position sensor (F).



Reconnect the hose (18) to the blow-by valve and tighten the clamp (G).



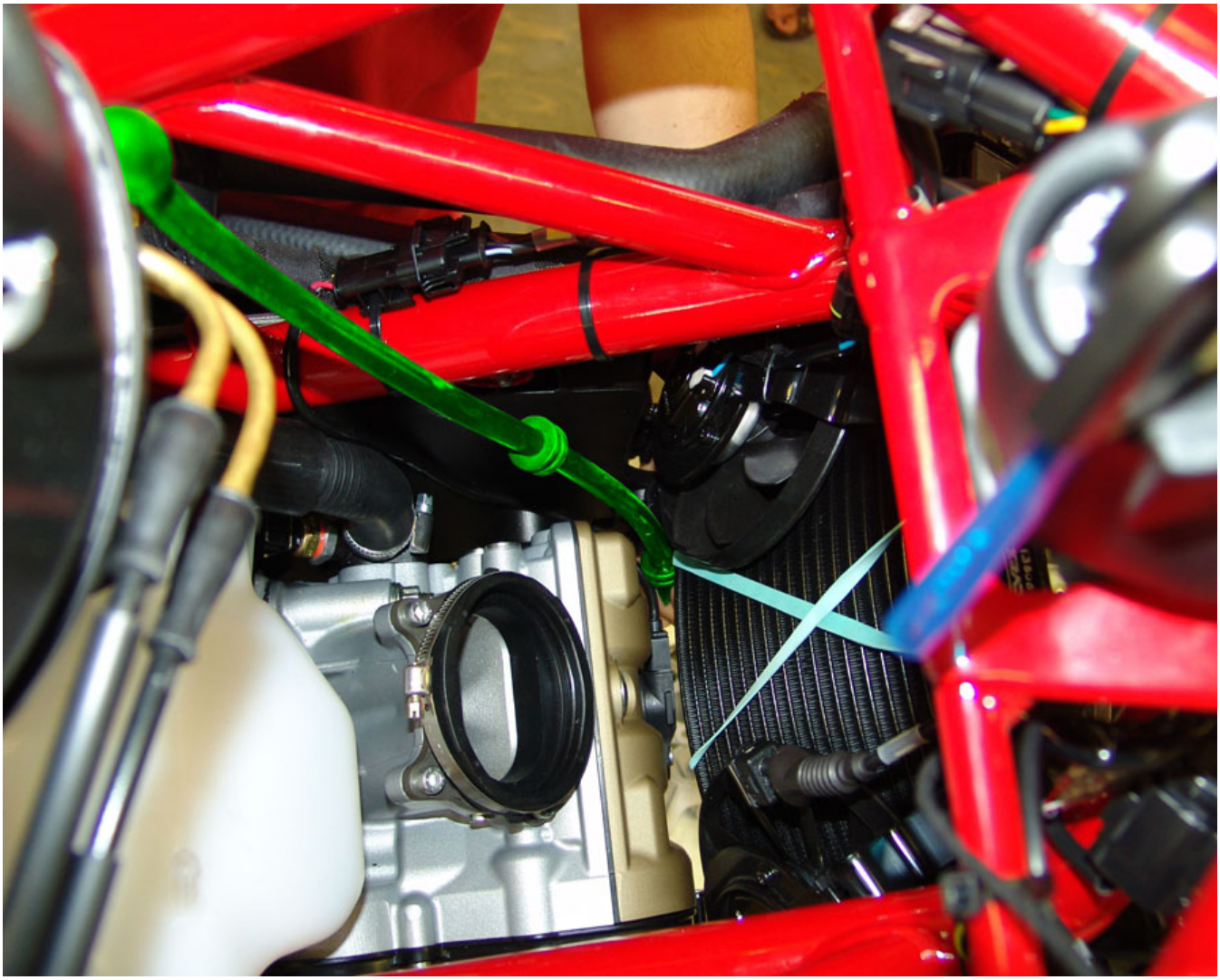
Important

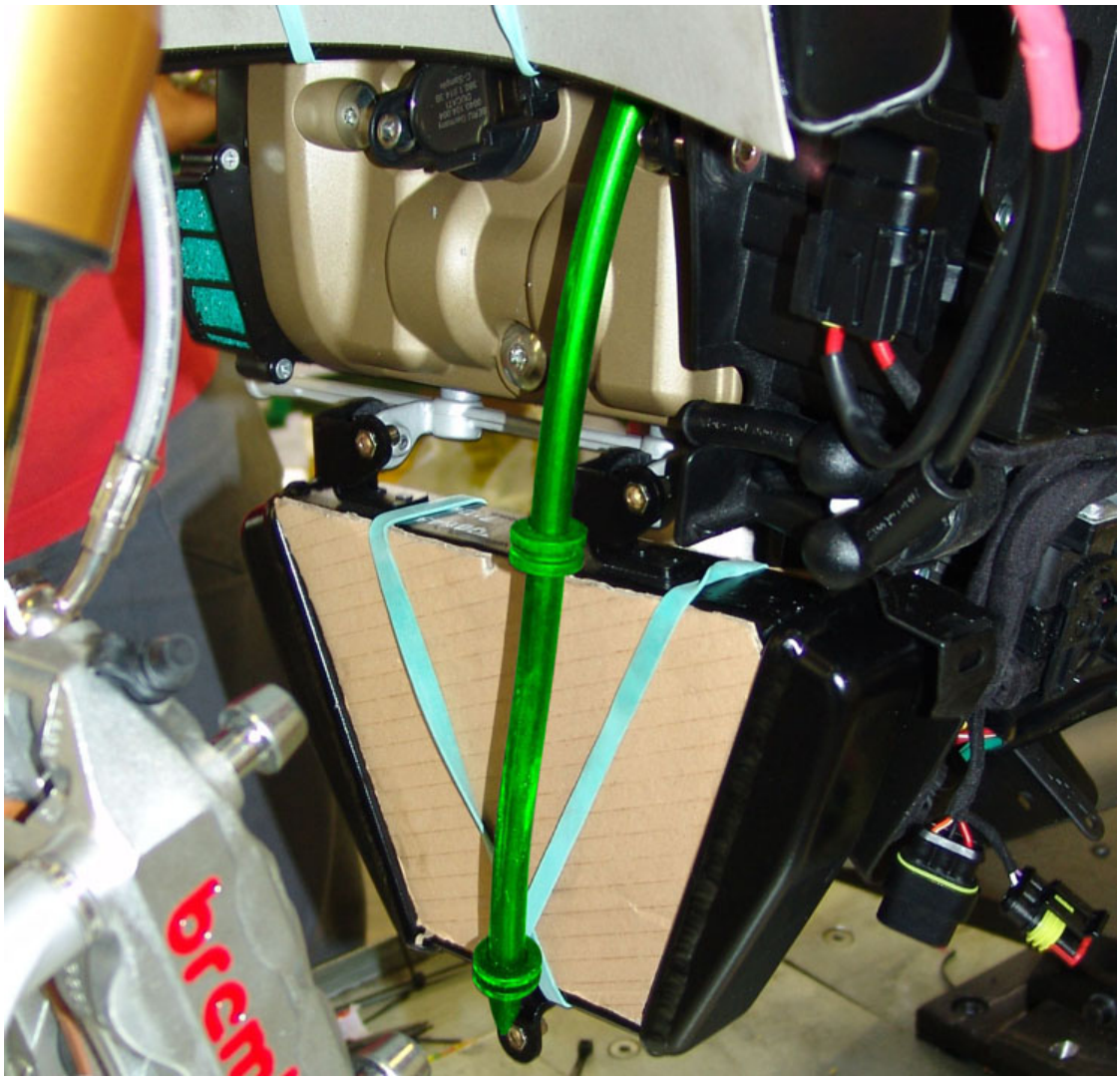
If the throttle body is renewed, carry out the procedure to reset the TPS (Sect. D 5, Resetting the throttle position sensor (TPS)).

Operation	Section reference
Connect the throttle cable	F 1, Refitting the throttle twistgrip
Refit the air intake scoops	L 7, Refitting the air filters
Refit the fuel tank	L 2, Refitting the fuel tank

Refit the headlight shell	E 1, Refitting the headlight shell
Refit the fairings	E 2, Refitting the side fairings

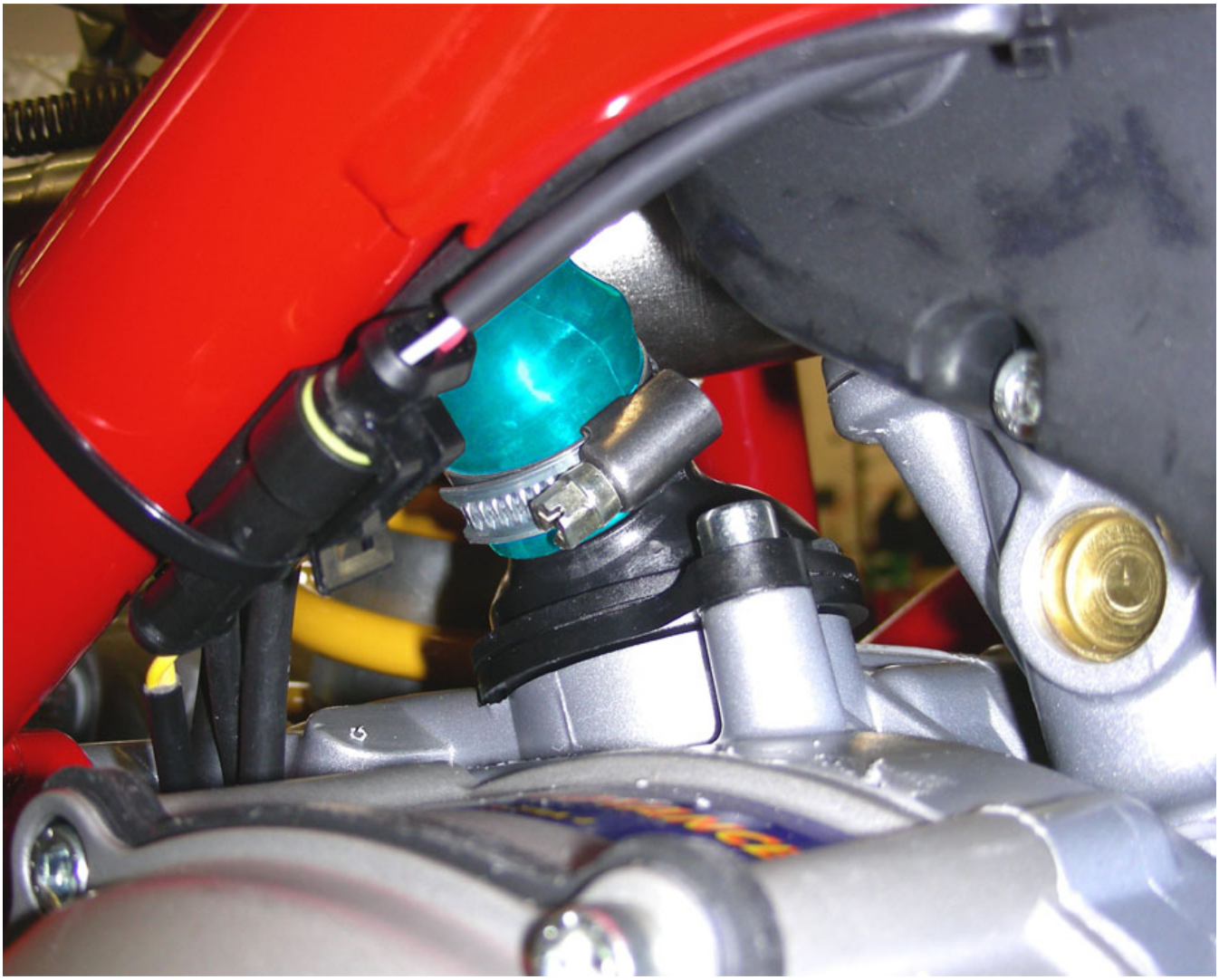
Positioning of the airbox drain hose



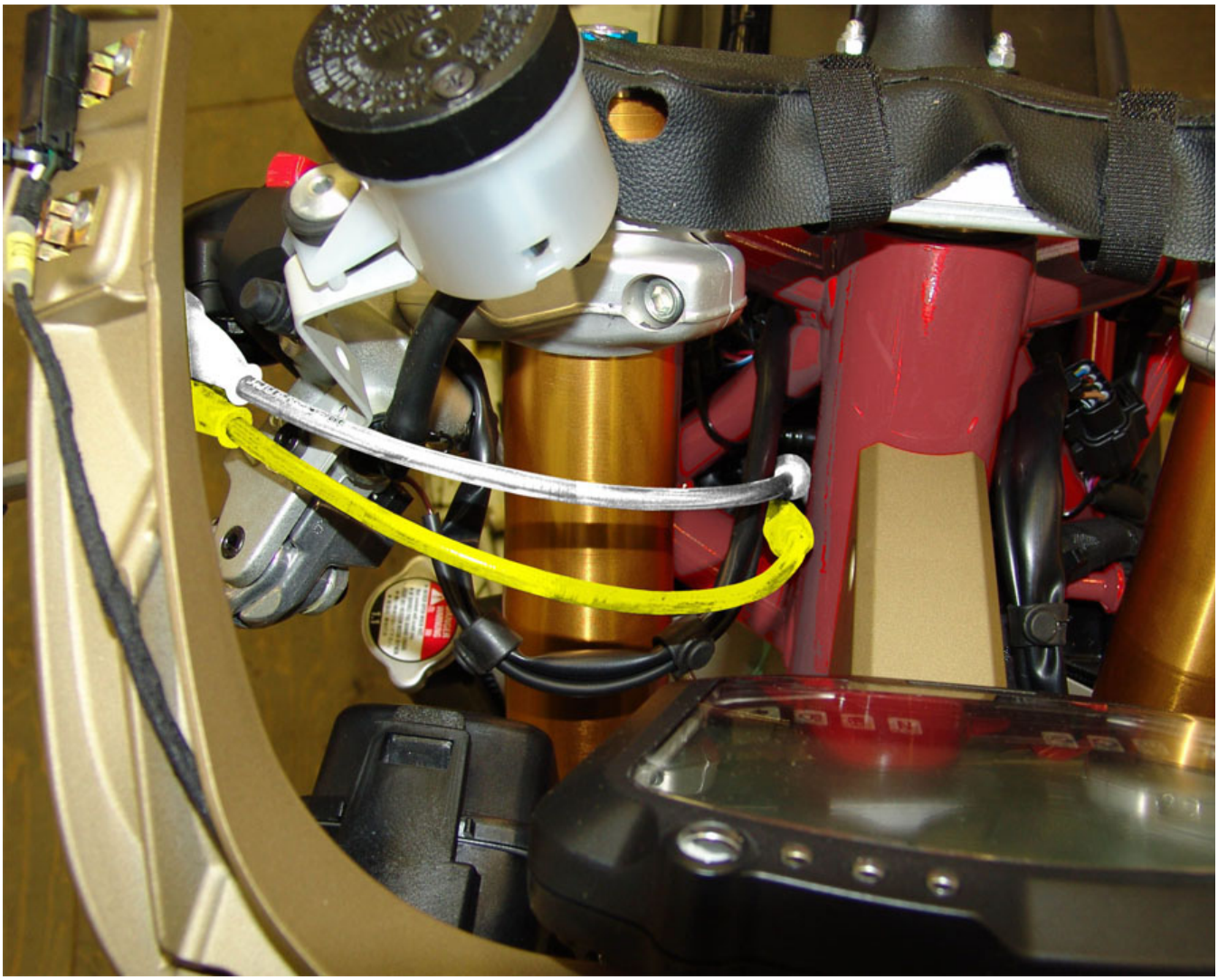


Positioning of the blow-by hose

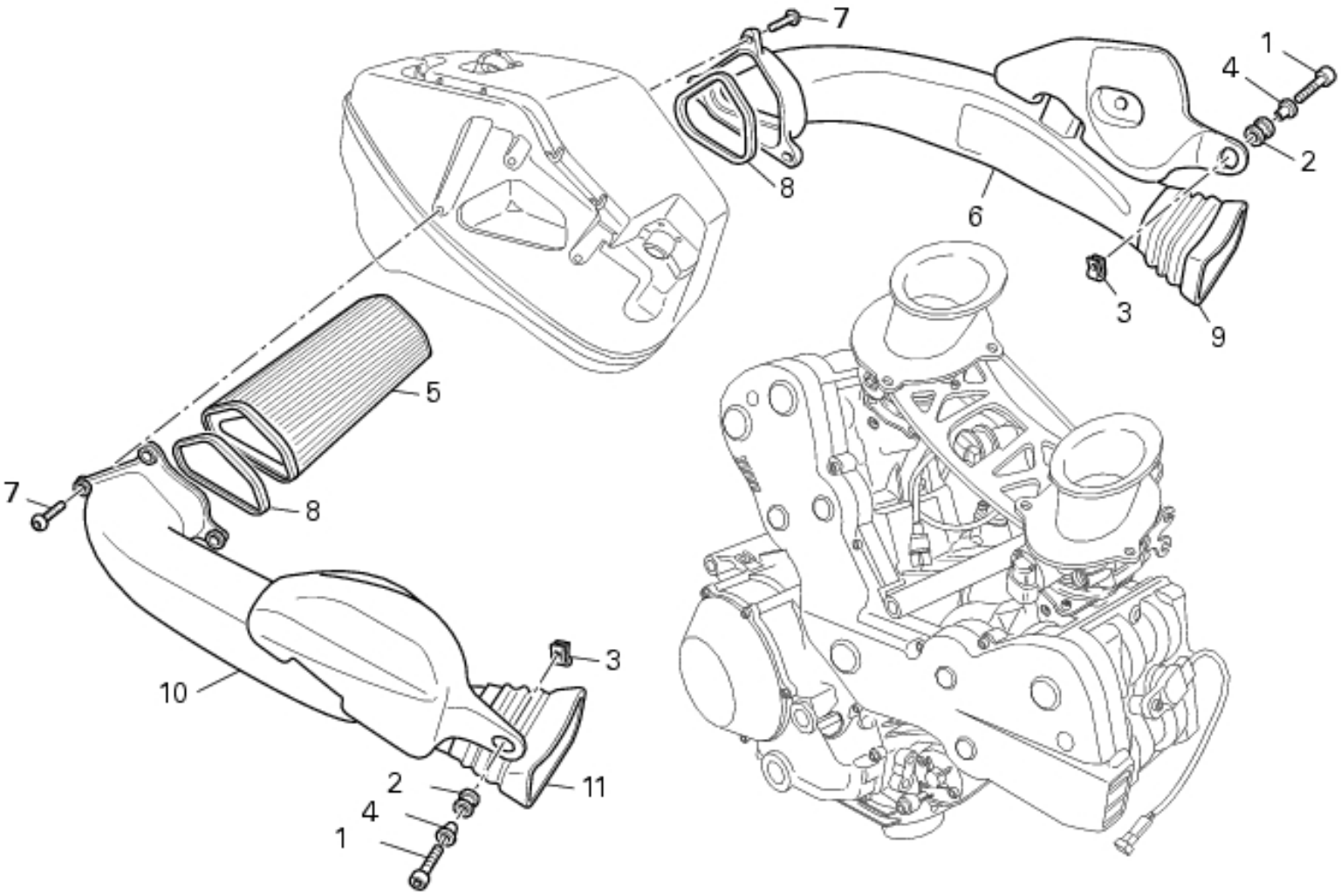
Use Only
ADVANCE
ULTRA 4



Positioning the throttle cables



7 - Air intake



1 Bolt
2 Rubber
3 Quick-release fastener
4 Spacer
5 Air filter
6 Left air scoop
7 Bolt
8 Seal
9 Left intake hose
10 Right air scoop
11 Right intake hose

Parts catalogue

AIR INTAKE - OIL BREATHER

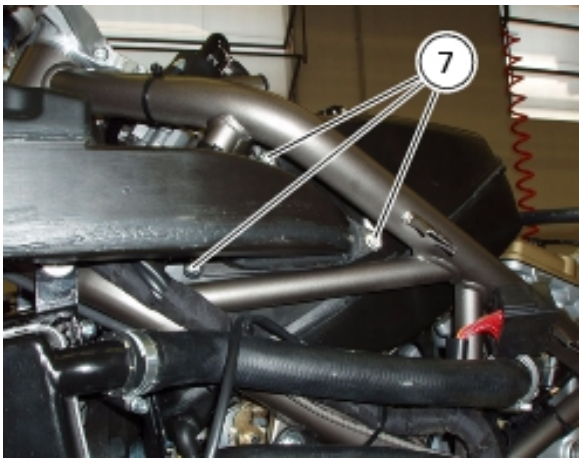
Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

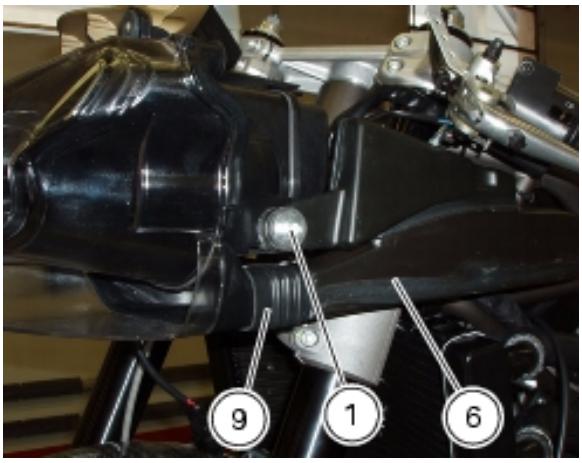
Removal of the air filters

Operation	Section reference
Remove the side fairings	E 2, Removal of the side fairings
Remove the headlight shell	E 1, Removal of the headlight shell

Undo the bolts (7) securing the air scoops to the airbox.

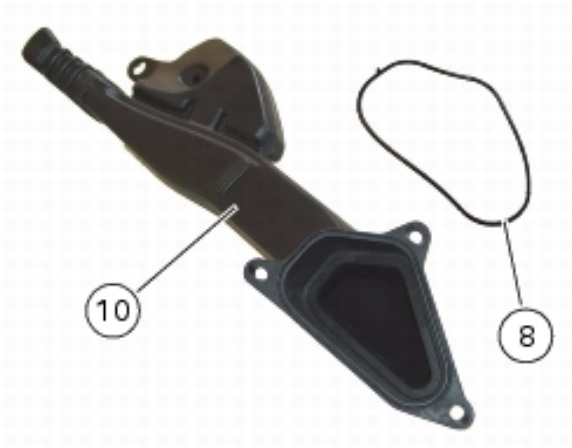


Unscrew the bolts (1) securing the air scoops to the headlight assembly and withdraw the intake hoses (9) and (**11**) with the air scoops (6) andd (**10**) from the headlight assembly.

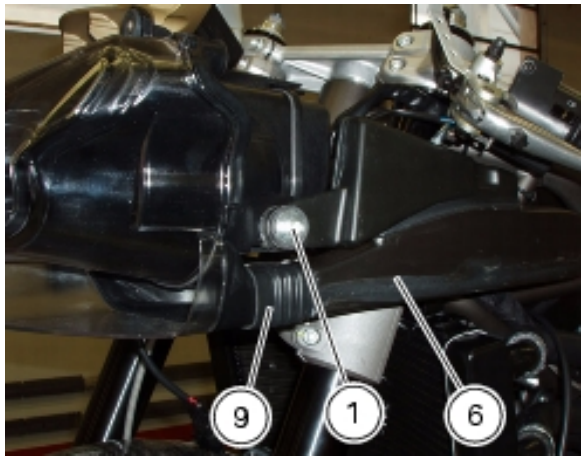


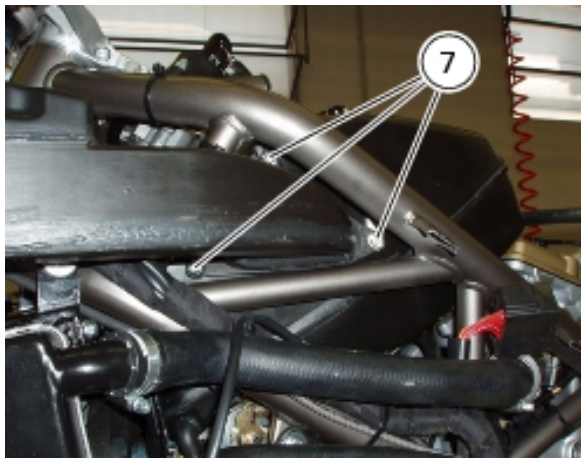
Refitting the air filters

If removed, refit the gaskets (8) to the air scoops (**6**) and (10), positioning the locating nib in the relative notch on the air scoop.



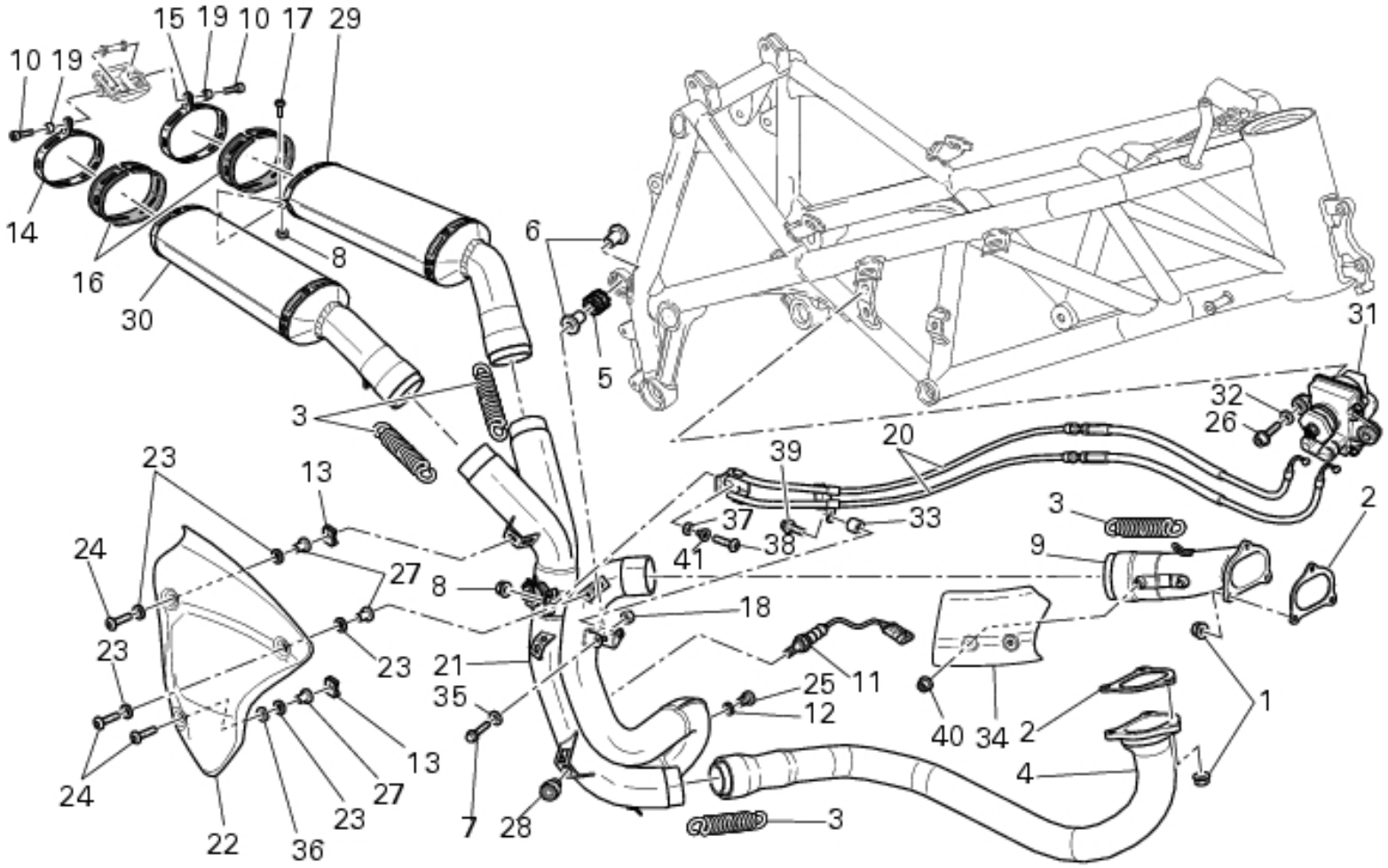
Reposition the hoses (9) and (**11**) with the air scoops (6) and (10) on the headlight assembly.
Insert the bolts (1) securing the air scoops to the headlight assembly and the bolts (7) securing the air scoops to the airbox.
Tighten the bolts (1) and (7) to the specified torque (Sect. C 3, Frame torque settings).





Operation	Section reference
Refit the headlight shell	E 1, Refitting the headlight shell
Refit the fairings	E 2, Refitting the side fairings

8 - Exhaust system



1 Nut
2 Exhaust gasket
3 Spring
4 Horizontal cylinder head exhaust pipe
5 Rubber mounting
6 Spacer
7 Bolt
8 Nut
9 Exhaust manifold
10 Bolt
11 Lambda sensor
12 Seal
13 Quick-release fastener
14 Right-hand clamp
15 Left-hand clamp
16 Clamp rubber
17 Bolt
18 Nut
19 Washer

20 Cables assembly
21 Vertical cylinder head exhaust pipe
22 Heat shield
23 Washer
24 Bolt
25 Plug
26 Bolt
27 Spacer
28 Rubber
29 Left-hand silencer
30 Right-hand silencer
31 Exhaust valve motor
32 Washer
33 Spacer
34 Heat shield
35 Washer
36 Washer
37 Belleville washer
38 Bolt
39 Bolt
40 Nut
41 Spacer

Parts catalogue

Exhaust SYSTEM

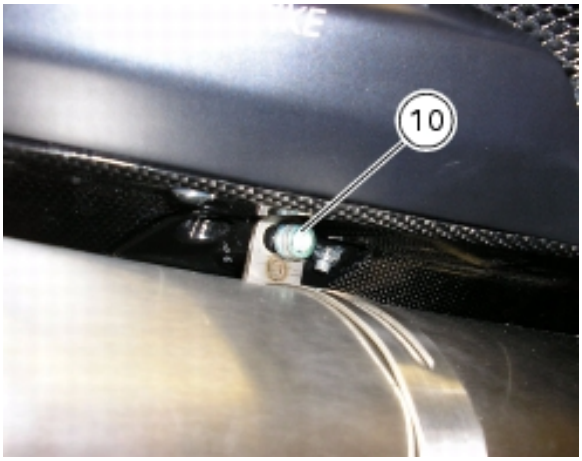
Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

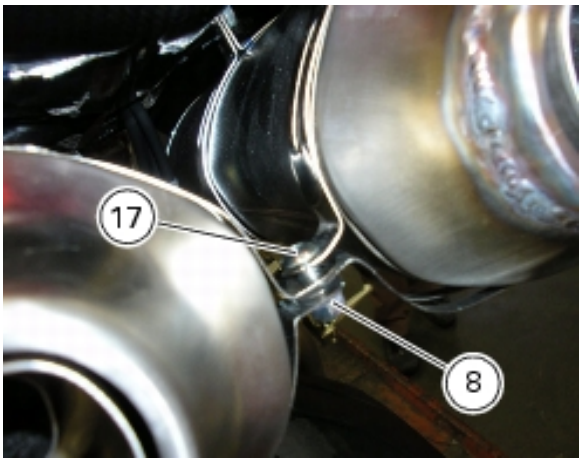
Removal of the exhaust system

Operation	Section reference
Remove the side fairings	E 2, Removal of the side fairings

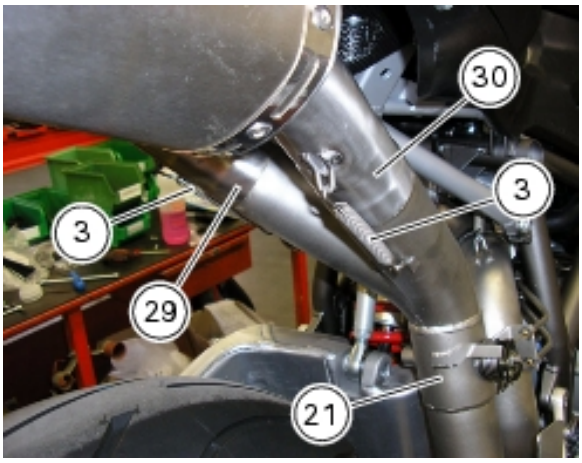
Unscrew the bolts (10) and recover the gaskets (**19**).



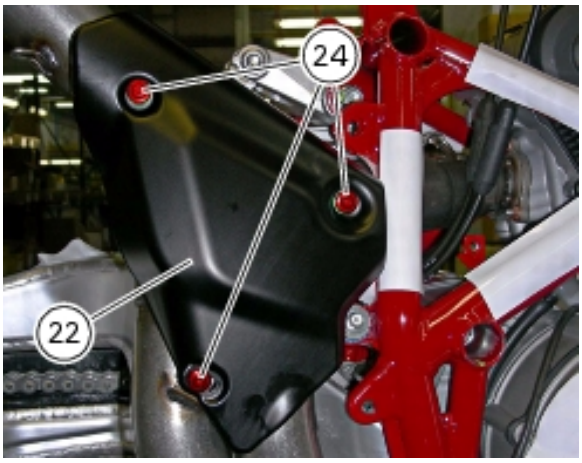
Unscrew the bolt (17) and the nut (8).



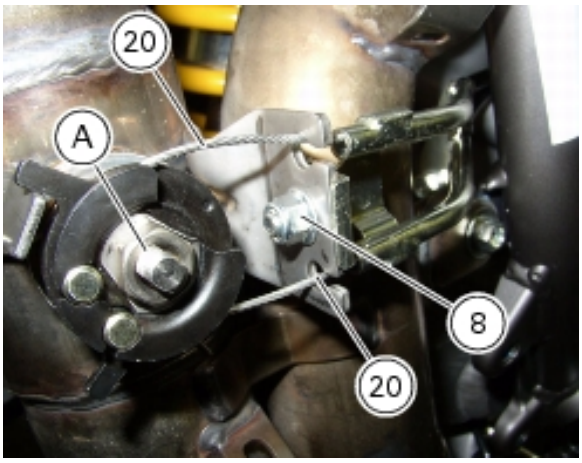
Remove the springs (3) and slide the silencers (29) and (30) from the vertical cylinder head exhaust pipe (21).

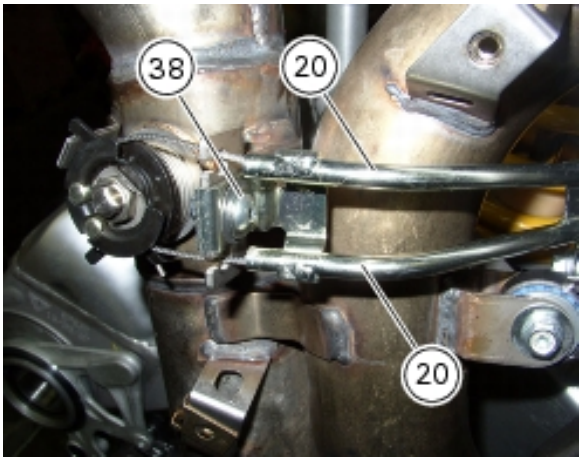


Remove the heat shield (22) by unscrewing the bolts (24) and recover the washers (**23**) and (**36**).

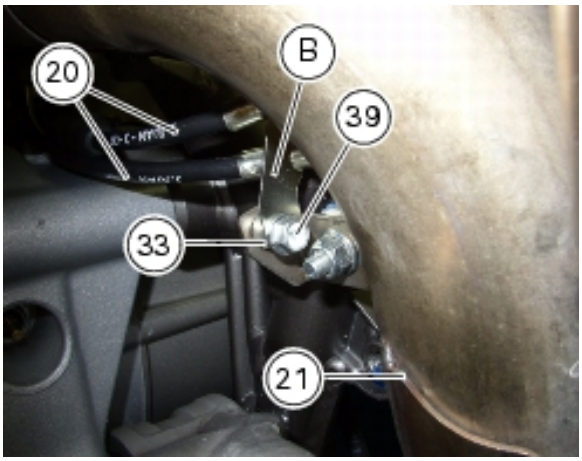


Unscrew the bolt (38) and the bolt (8) securing the cables (20) to the exhaust valve (B).
Recover the spacer (**41**) and the Belleville washer (**37**).
Remove the cables (20) from the exhaust valve (A).

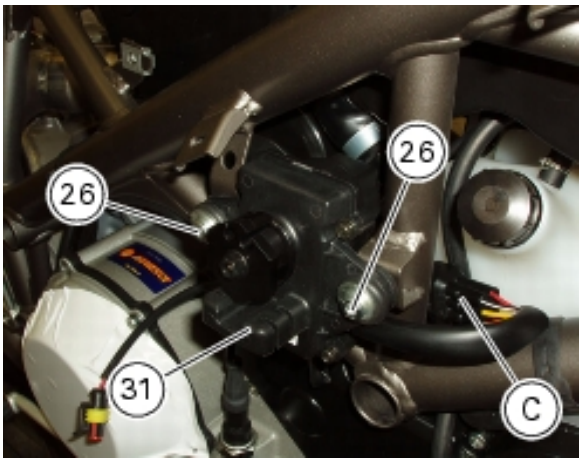




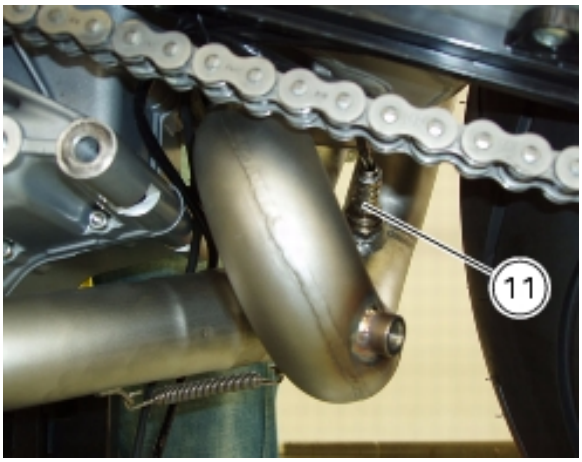
Unscrew the bolt (39) to release the plate (B) of the cables (20) from the plate of the exhaust pipe (21).

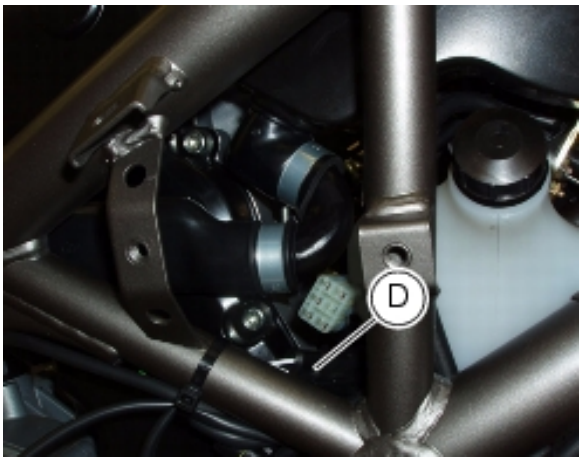


Unscrew the bolts (26) to remove the exhaust valve motor (31) from the frame and disconnect the wiring (C) from the motor (31).

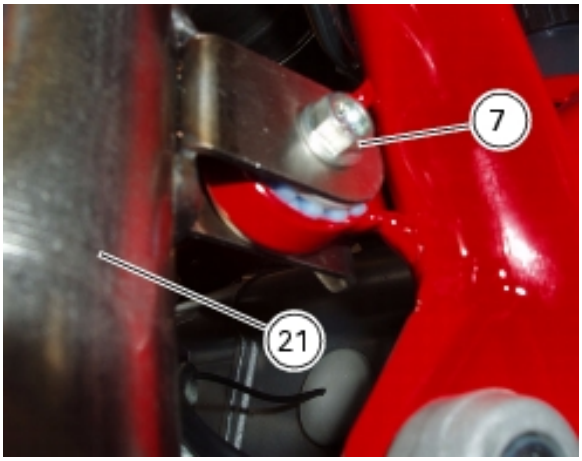


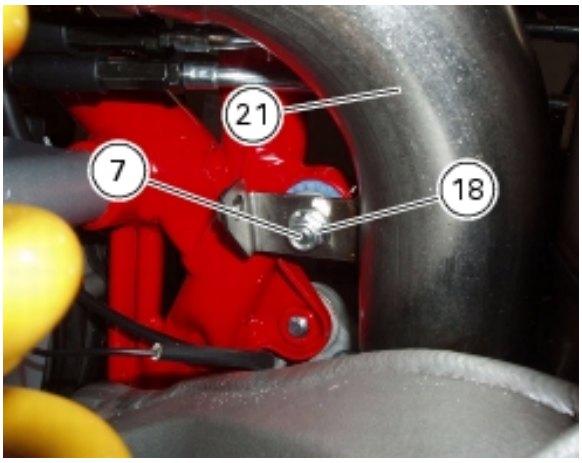
Disconnect the lambda sensor (11) from the wiring (D).



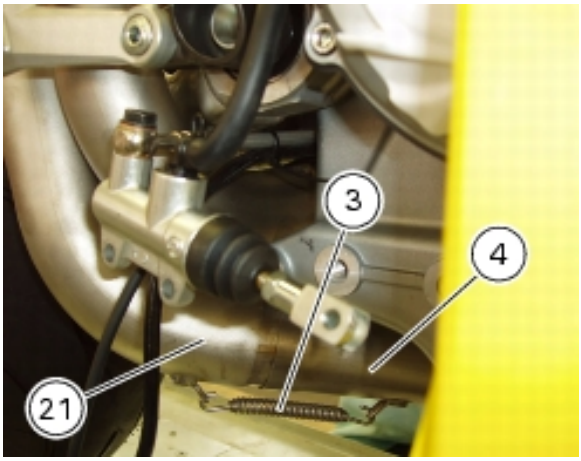


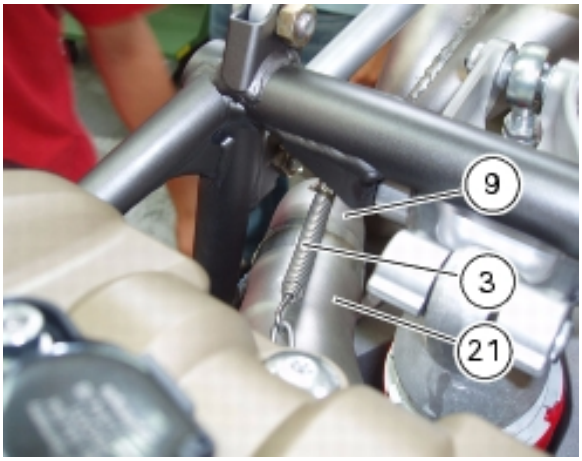
Unscrew the bolt (7) and the nut (18) securing the pipe (21) to the frame.



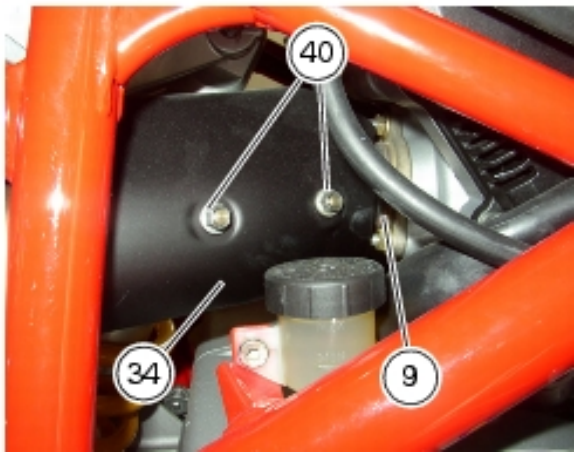


Remove the springs (3) and withdraw the vertical cylinder head exhaust pipe (21) from the horizontal cylinder head exhaust pipe (4) and the exhaust manifold (9).

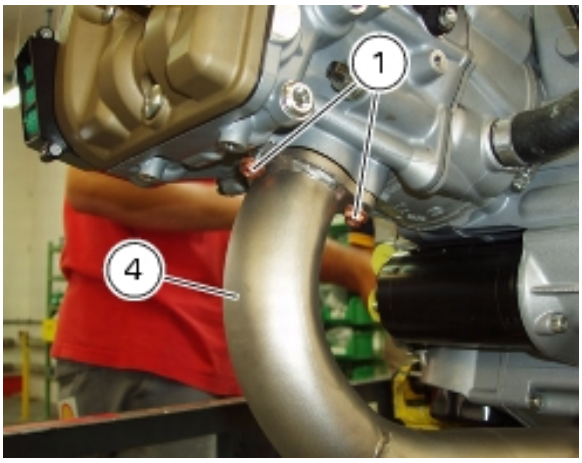


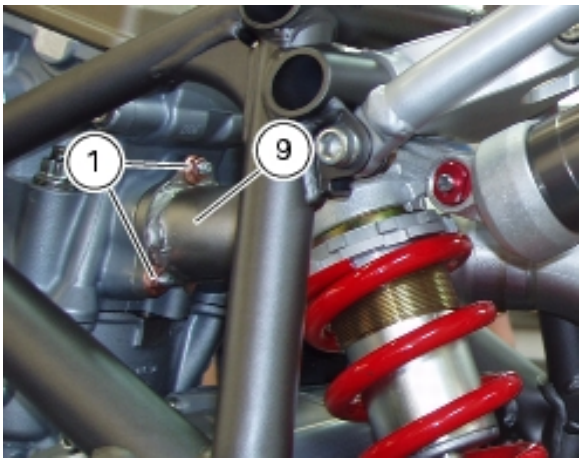


Unscrew the bolts (40) and remove the heat shield (34) from the exhaust manifold (9).



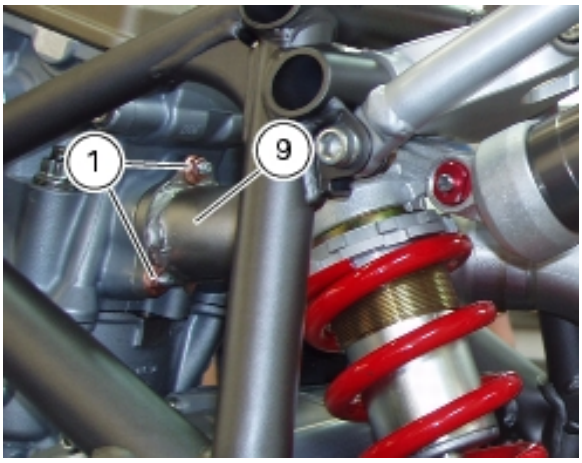
Unscrew the bolts (1) and remove the exhaust manifold (9) from the vertical cylinder head exhaust pipe and the horizontal cylinder head exhaust pipe (4) from the horizontal cylinder head.

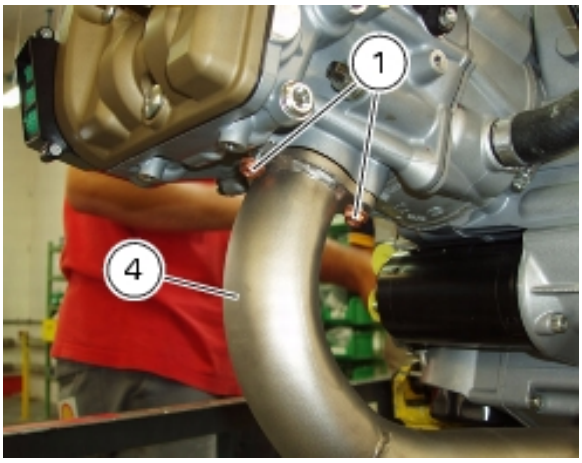




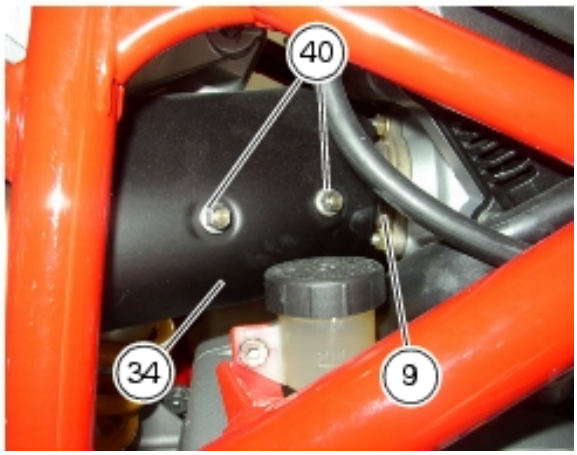
Refitting the exhaust system

Position the exhaust manifold (9) on the vertical cylinder head and the horizontal head exhaust pipe (4) on the horizontal cylinder head along with the gaskets (**2**).
Tighten the nuts (1) to the specified torque (Sect. C 3, Frame torque settings).

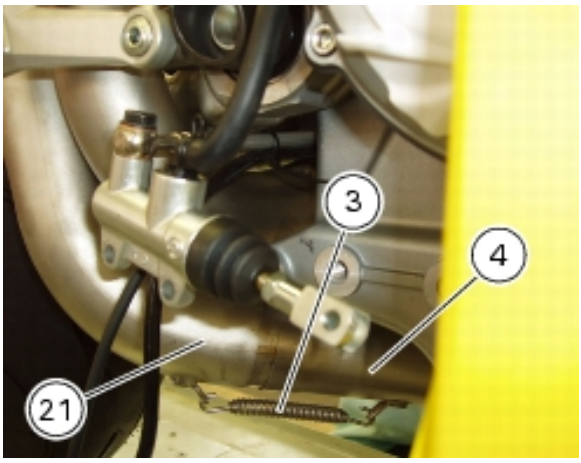


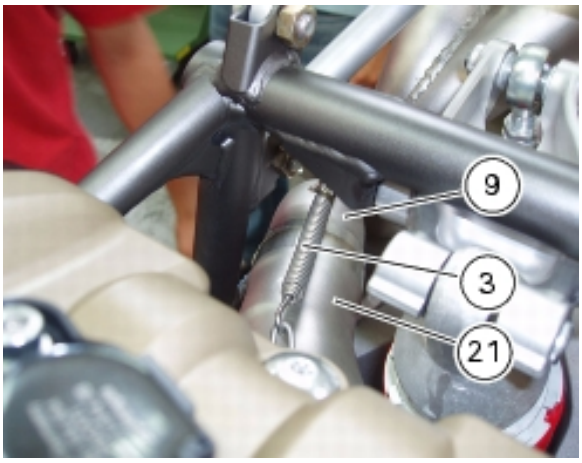


Refit the heat shield (34) to the exhaust manifold (9), tightening the nuts (40).

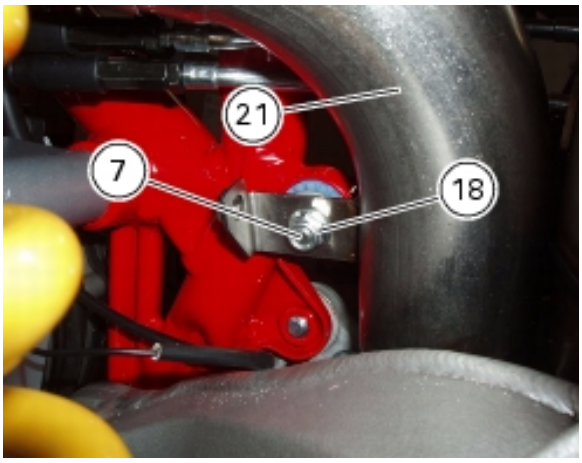


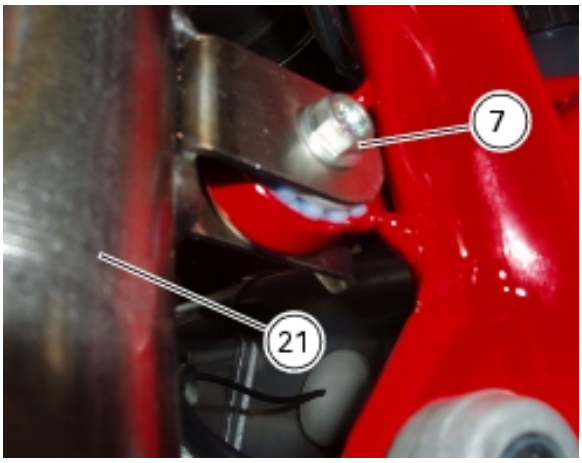
Connect the vertical cylinder head exhaust pipe (21) to the horizontal cylinder head exhaust pipe (4) and to the exhaust manifold (9) with the springs (3).



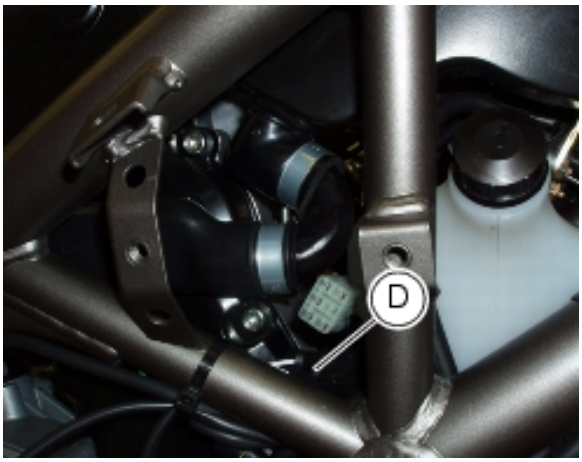


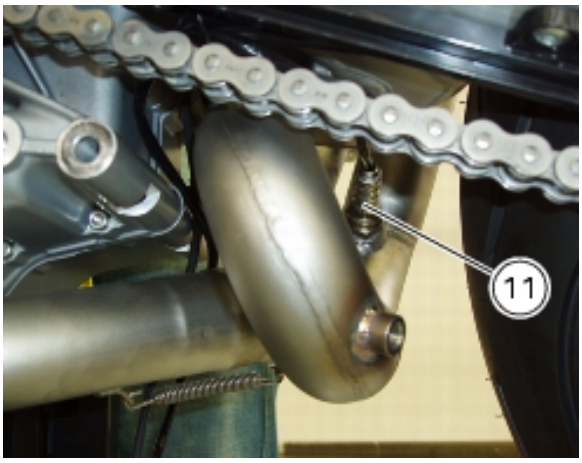
Secure the vertical head exhaust pipe (21) to the frame with the bolt (7) and nut (18) and tighten the bolt (7) to the specified torque (Sect. C 3, Frame torque settings).



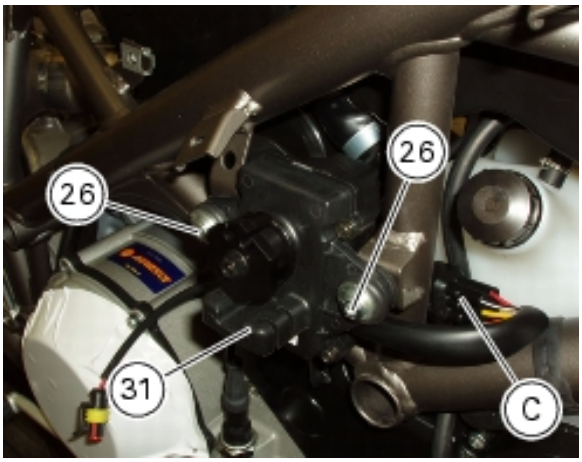


Connect the lambda sensor (11) to the wiring (D).

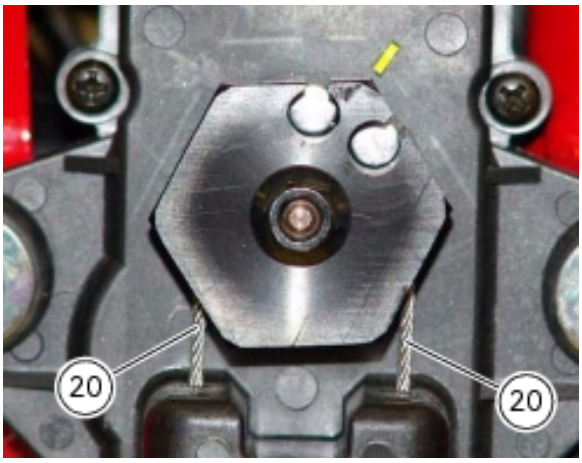


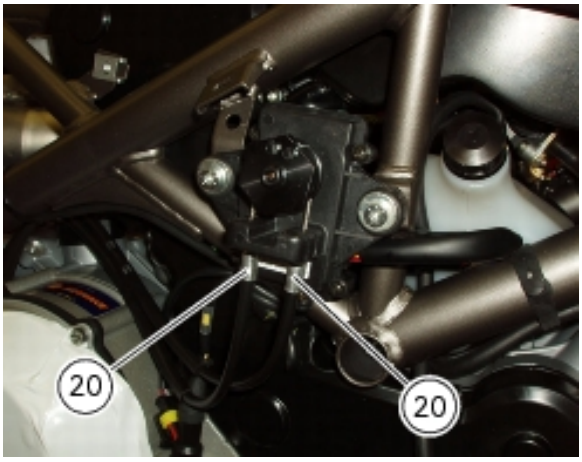


Locate the engine (31) on the frame and tighten the bolts (26) to the specified torque (Sect. C 3, Frame torque settings).
Connect the motor to the wiring (C).

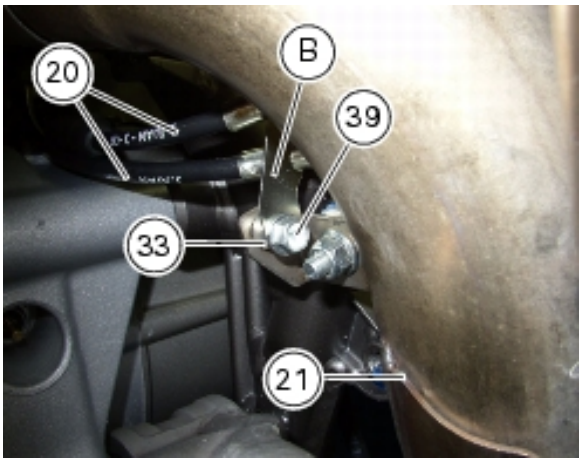


If the cables (20) have been removed from the motor, position them so that the top corner of the pulley race (located between the two cable end fittings) is aligned with the notch. To facilitate cable fitting, use the respective instrument panel function to turn the motor (Sect. P 7, Operating the valve motor to facilitate cable fitting).

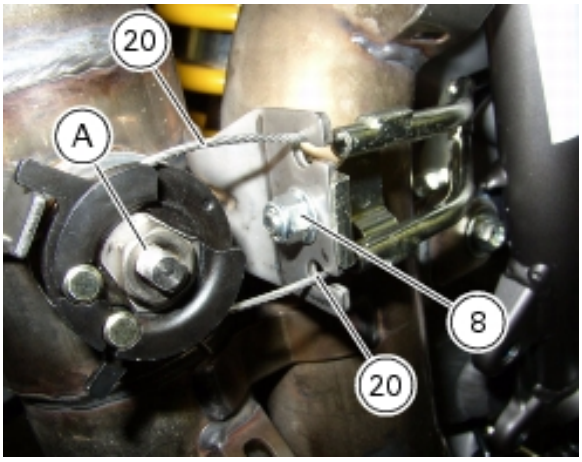


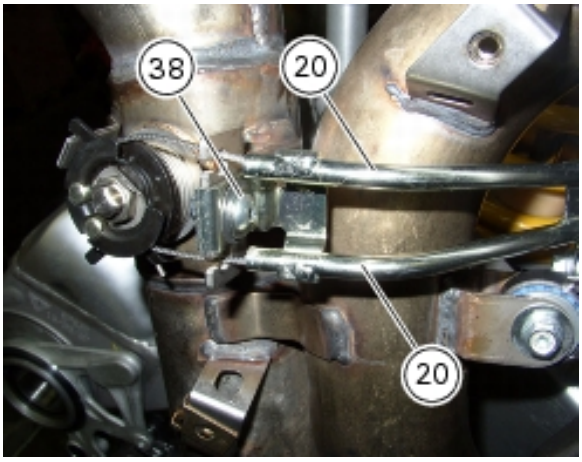


Start the nut (39) with the spacer (33) to secure the plate (B) of the cables (20) to the plate of the exhaust pipe (21). Tighten the nut (39).

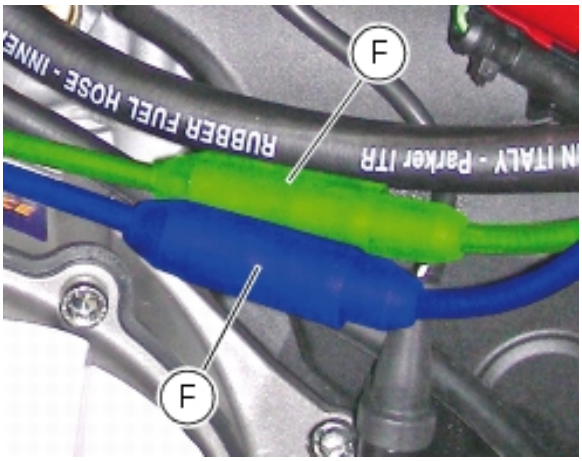


Position the cables (20) on the exhaust valve (A). Start the bolt (38) with the spacer (**41**) and the Belleville washer (**37**) and start the nut (8). Tighten the bolt (38) while counterholding the nut (8).
Refer to the figures at the end of the chapter for correct routing of the cables (20).
The cables must have no free play.

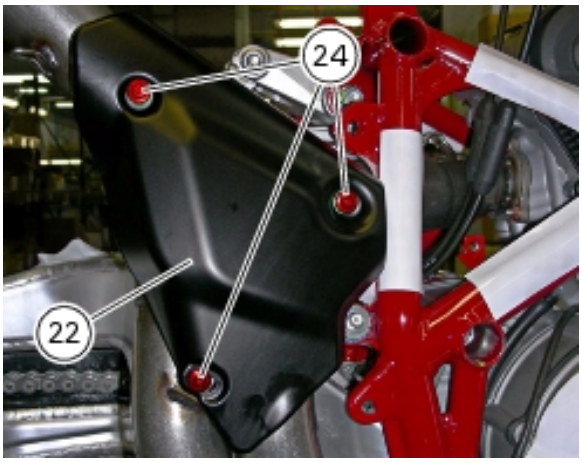




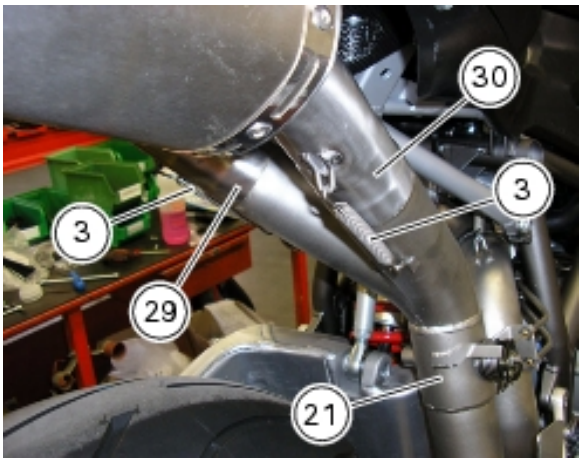
To adjust the cables, remove the covers (F) and turn the adjusters.



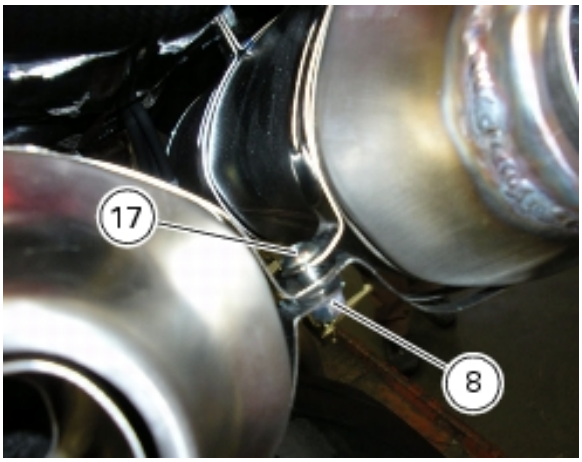
Refit the heat shield (22).
Fit the lower bolts (24) with their washers (**23**) and (**36**).
Tighten the bolts (24) to the specified torque (Sect. C 3, Frame torque settings).



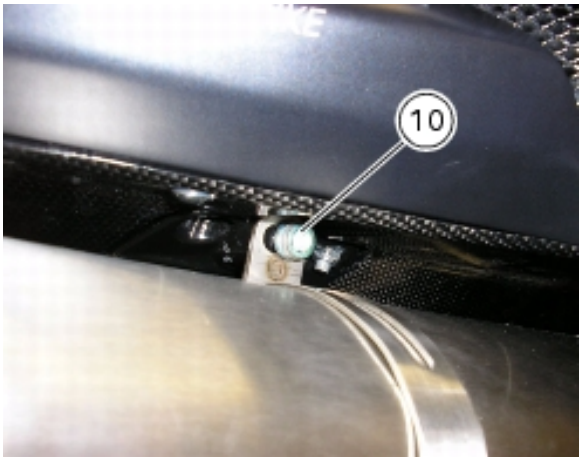
Connect the silencers (29) and (30) to the pipe (21) and locate the springs (3).



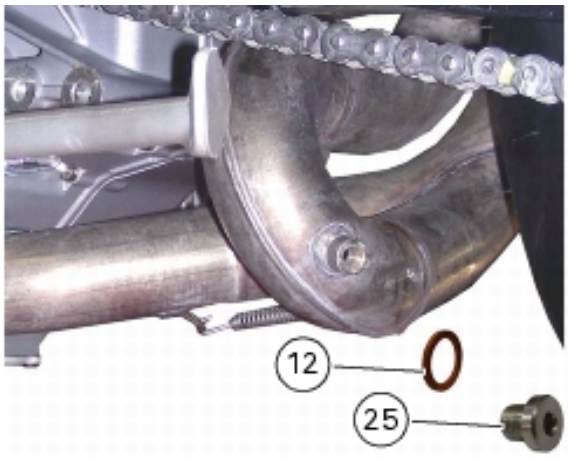
Fit the bolt (17) and the nut (8) to the specified torque (Sect. C 3, Frame torque settings).

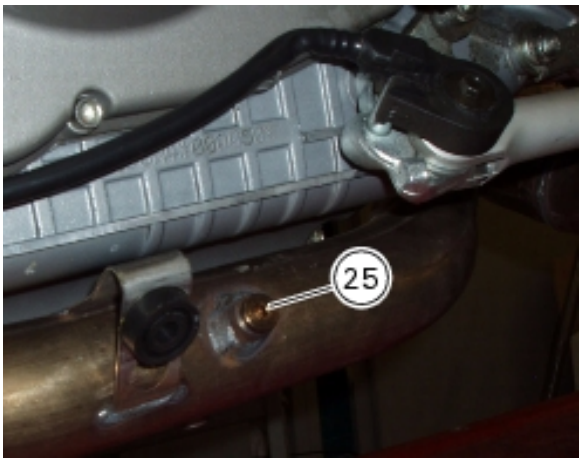


Insert the bolts (10) with the washers (**19**) and tighten to the specified torque (Sect. C 3, Frame torque settings).



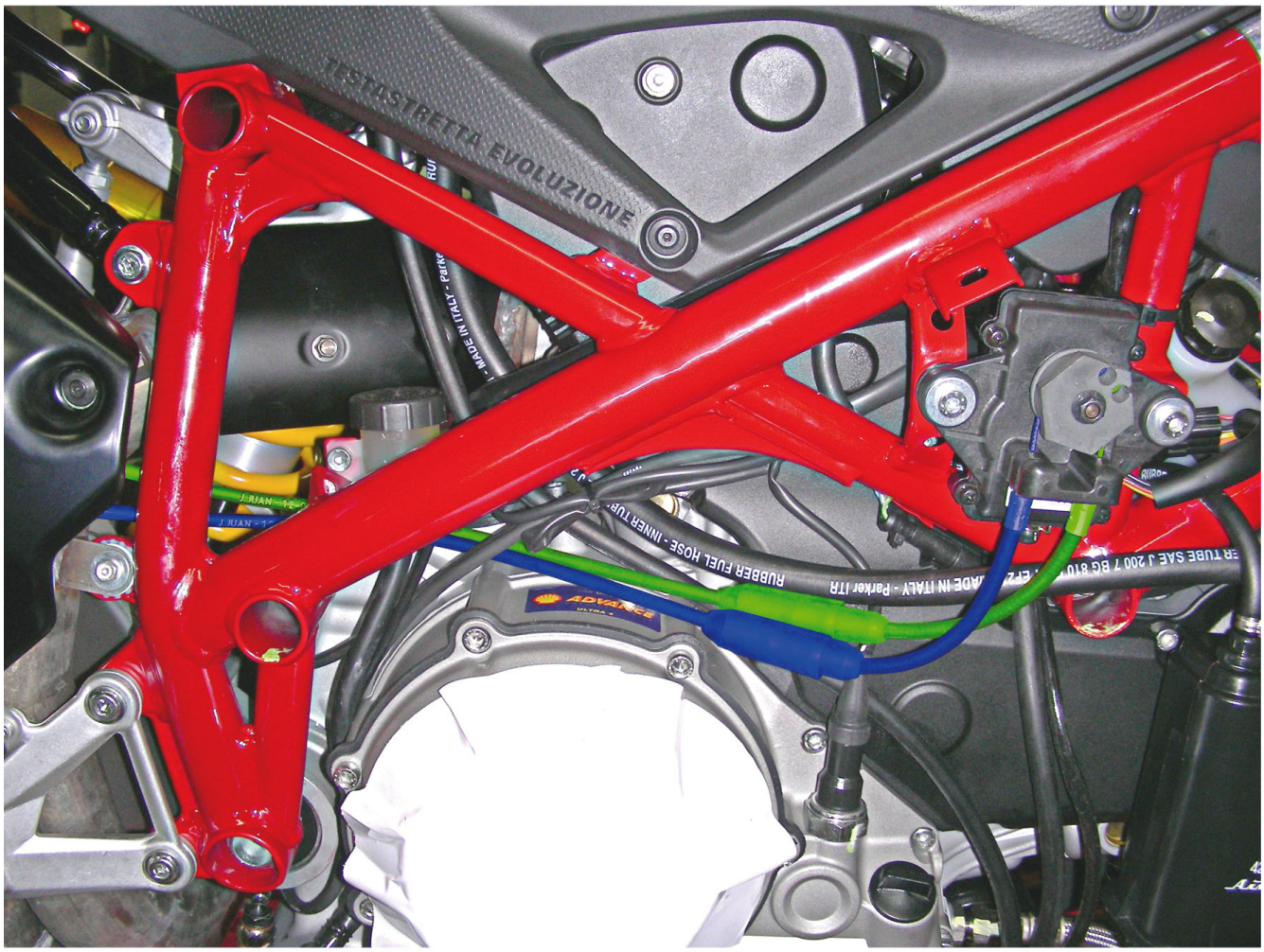
If removed, fit the copper washers (12) to the plugs (25), screw the plugs into the vertical and horizontal head exhaust manifolds and tighten them to the specified torque (Sect. C 3, Frame torque settings).

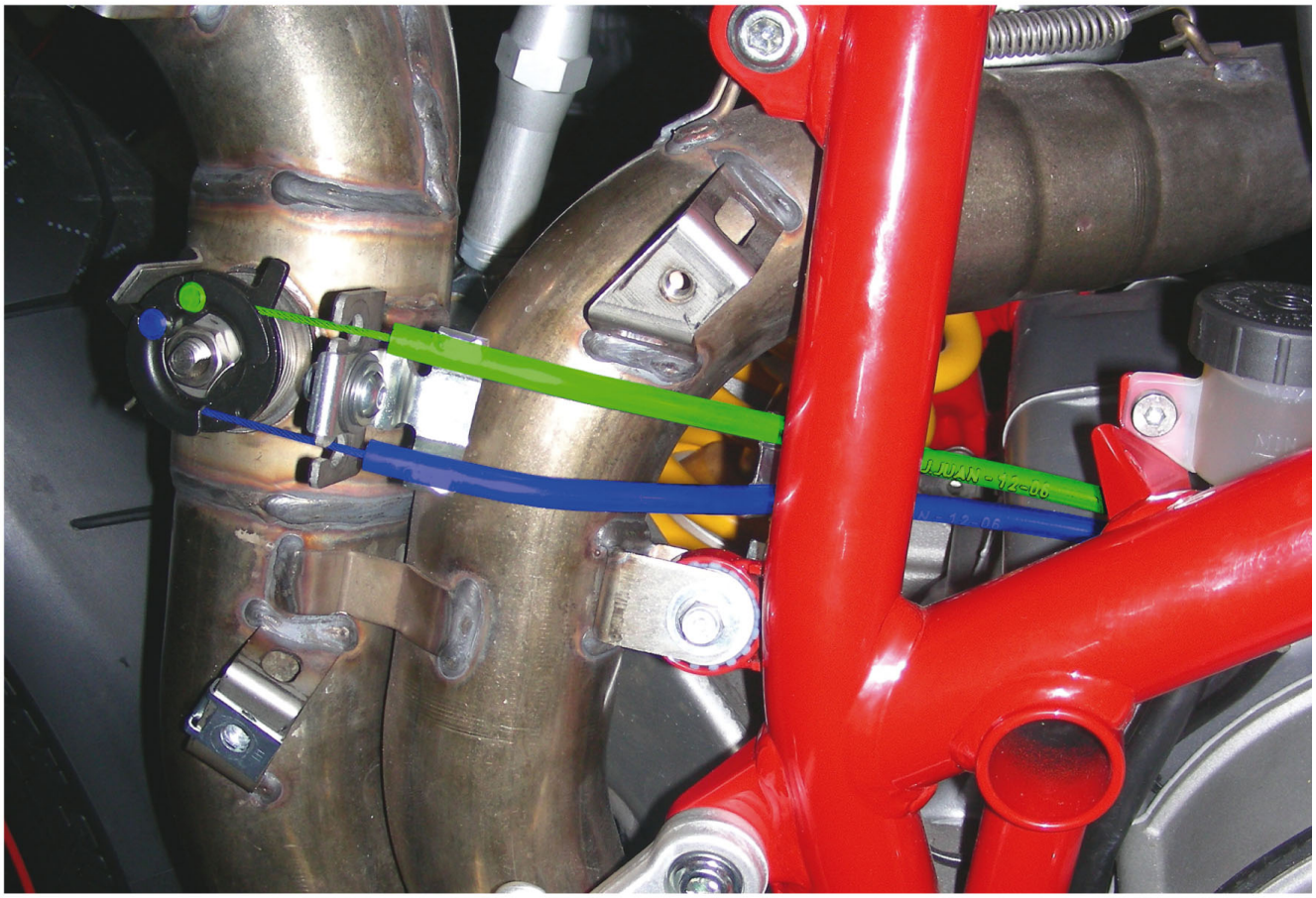




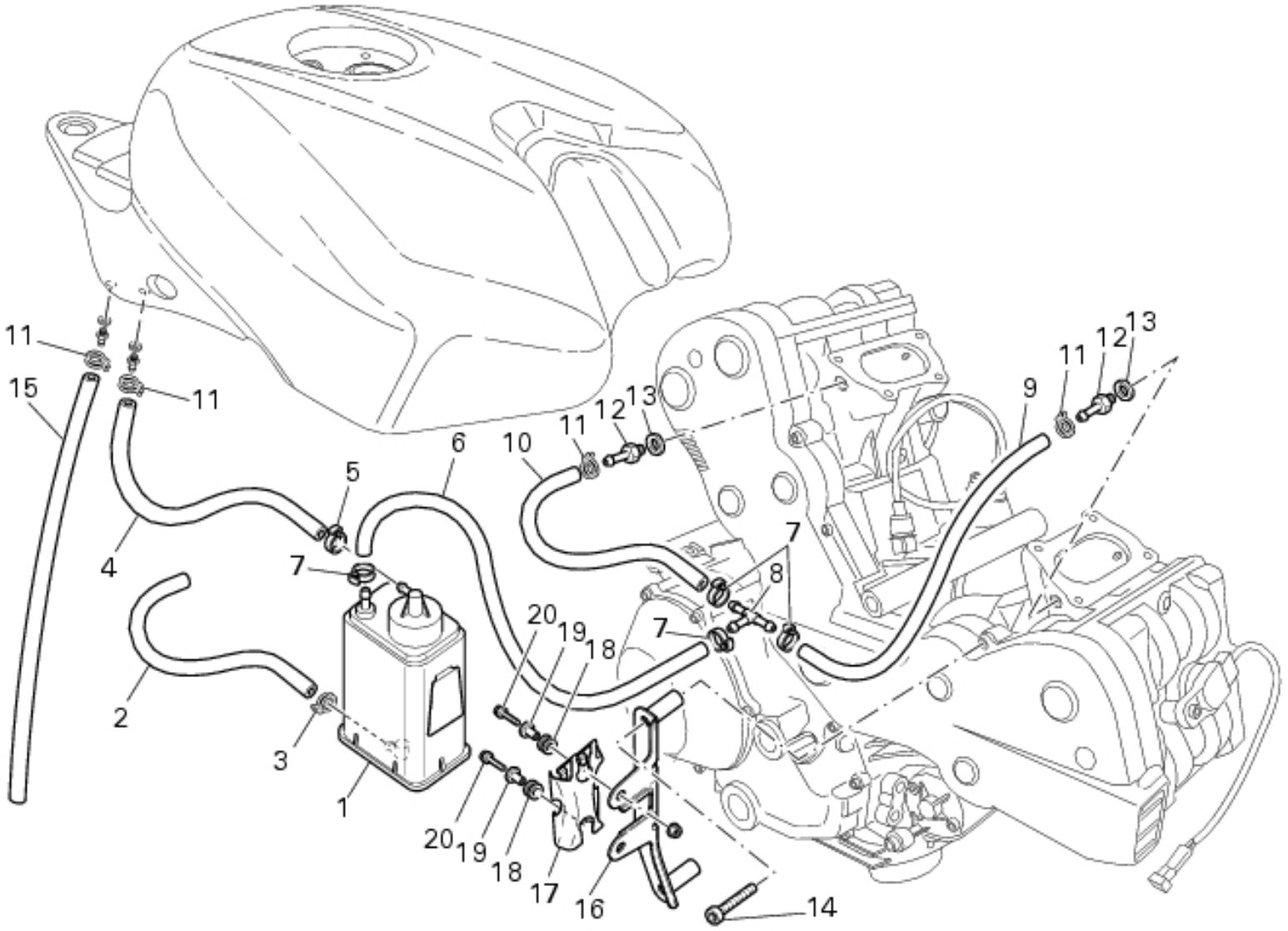
Operation	Section reference
Refit the fairings	E 2, Refitting the side fairings

Positioning the control cables of the exhaust valve motor


TESTASTRETTA EVOLUZIONE
RUBBER FUEL HOSE - INNER TUBE SAE J 200 7 BG 810
MADE IN ITALY - Parker ITR



10 -Evaporative emissions canister



1 Evaporative emissions canister
2 Hose
3 Hose clip
4 Filter/oil reservoir hose
5 Hose clip
6 Hose
7 Hose clip
8 Tee fitting
9 Hose
10 Hose
11 Hose clip
12 Union
13 Seal
14 Bolt
15 Breather hose
16 Bracket
17 Plate
18 Rubber

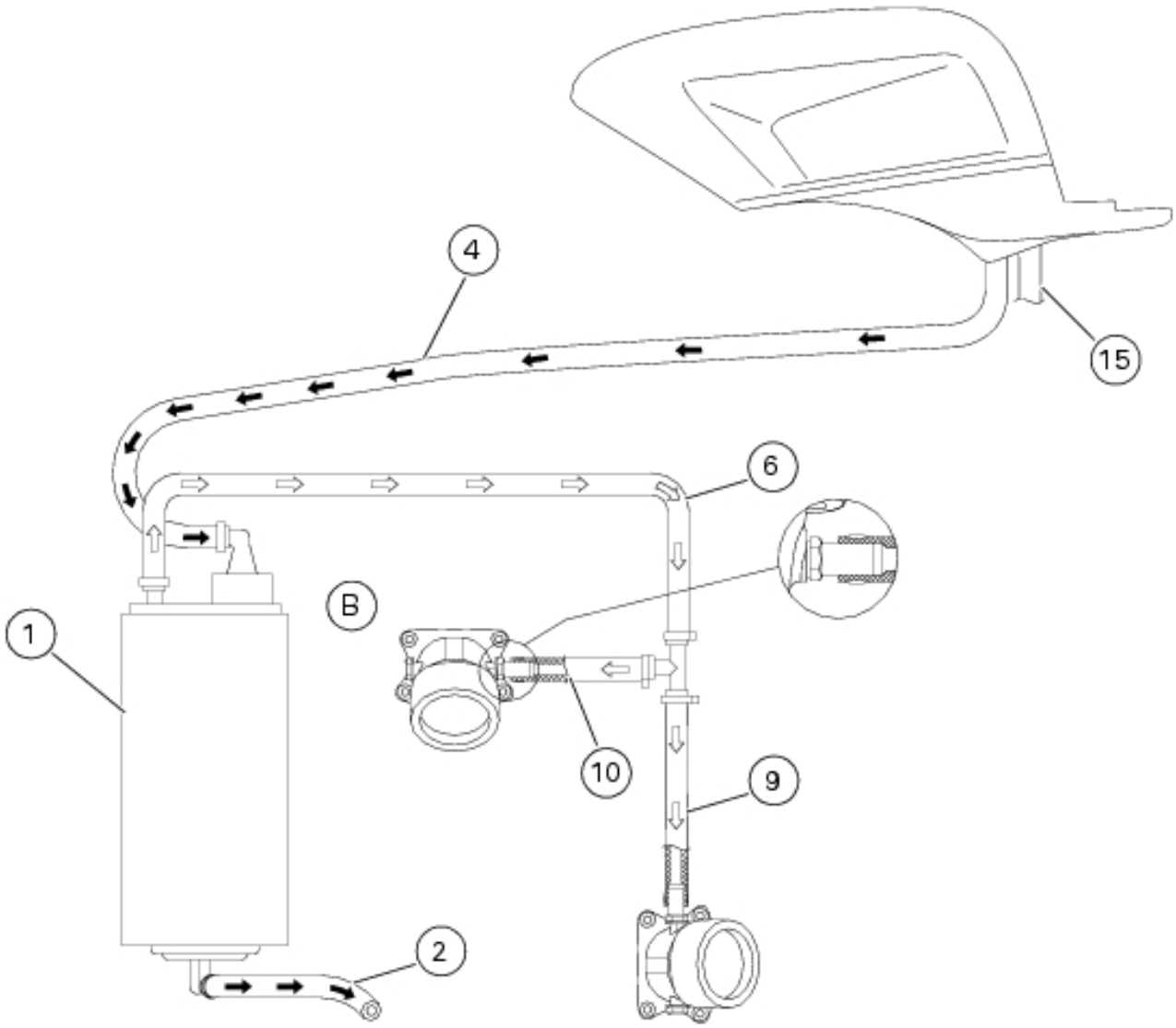
19 Spacer
20 Bolt

Parts catalogue

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

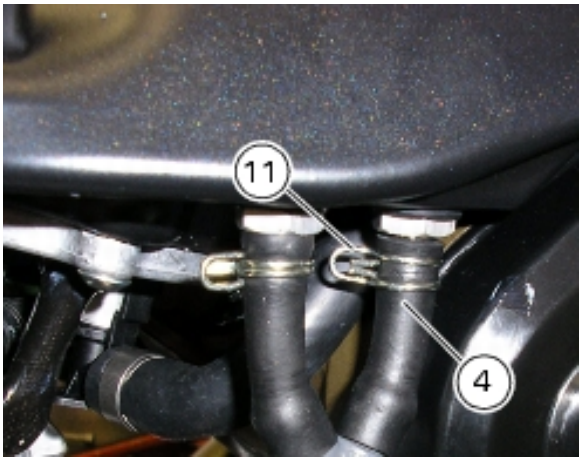
Evaporative emissions canister system (USA versions only)

USA models are equipped with an additional system with an evaporative emissions canister that prevents fuel fumes from being discharged into the atmosphere.
The hose (4) is connected to the canister (1); when the fuel has been filtered, it is returned through the hose (6) to the horizontal (A) and vertical (B) cylinder intake manifolds via the hoses (9) and (10). Hoses (15) and (2) vent to the ground.
For correct positioning of the connection hoses consult the indications given below.



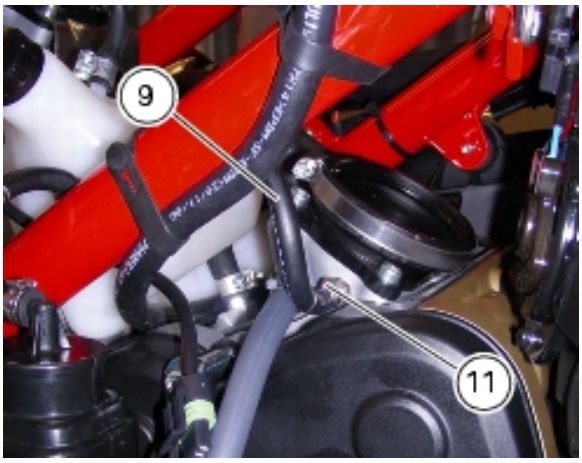
Removal of the evaporative emissions canister

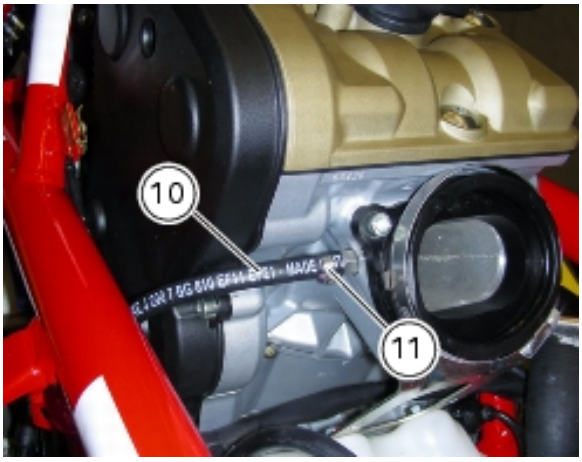
Before removing the canister (1) it is first necessary to remove the fairings (Sect. E 2, Removal of the side fairings) and raise the fuel tank (Sect. L 2, Removal of the fuel tank).
Disconnect the hose (4), removing the clip (11).



Remove the clips (7) and (5) and withdraw the canister filter (1) upwards along the guides of the plate (17).

To remove the hoses which deliver fuel to the intake manifolds, first remove the clips (7) and withdraw the hoses (9) and (11).



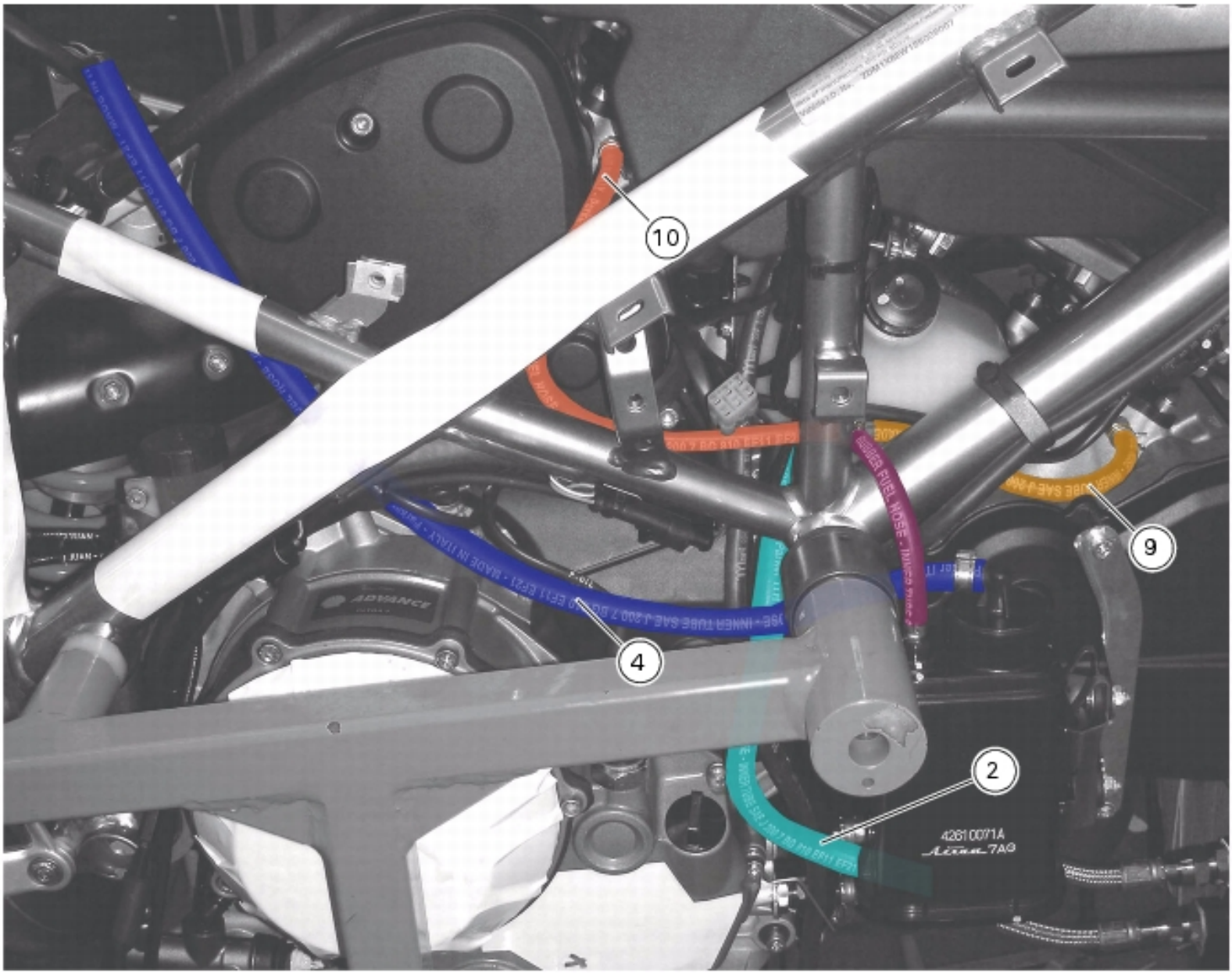


Refitting the evaporative emissions canister

To refit, carry out the removal operations in reverse order, making sure to locate the hoses as shown in the figures at the end of the chapter.

Operation	Section reference
Reposition the fuel tank	L 2, Refitting the fuel tank
Refit the fairings	E 2, Removal of the side fairings

Positioning the hoses, clips and canister


10
9
4
2
42810071A

0M - Fuel injection - ignition system

2 - Fuel injection-ignition system 3

3 - System components 4
Electronic Control Unit (ECU) 4
Removal of the battery support 6
Refitting the battery support 9
Fuel injectors 13
Stepper motor 14
Air pressure sensor 15
Coolant temperature sensor 16
Air temperature sensor 17
Ignition coils 18
Throttle Position Sensor (TPS) 21
Rpm/timing sensor 22
Injection relay 23
CAN Line 24

2 - Fuel injection-ignition system

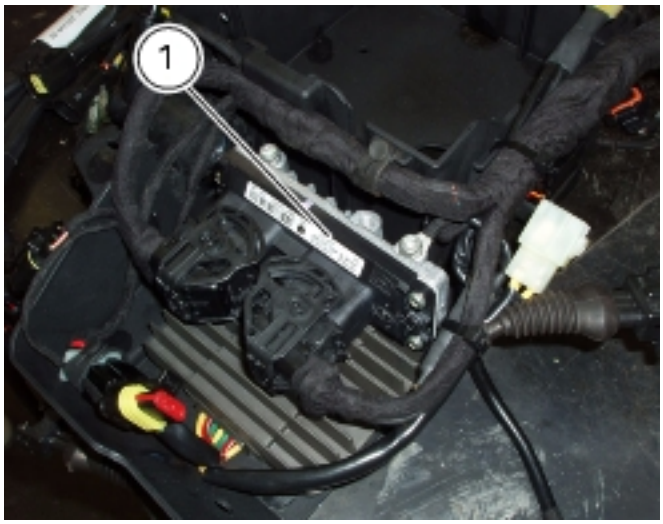
The electrical components of the fuel injection-ignition system are listed below: the reference next to each component is that shown in the diagram in Sect. P 1, Wiring diagram.

2 Ignition switch
3 Left cooling fan
4 Right cooling fan
5 Starter motor
6 Starter contactor
7 Battery
8 Regulator fuse
9 Regulator
15 Fuel tank
16 Stepper motor
17 Injection relay
18 Self-diagnosis
19 Horizontal cylinder coil
20 Vertical cylinder coil
21 Horizontal cylinder spark plug
22 Vertical cylinder spark plug
23 Horizontal cylinder injector
24 Vertical cylinder injector
25 Throttle position sensor
26 Rpm/timing sensor
27 Coolant temperature sensor
28 Speed sensor
29 Sidestand
31 Neutral switch
32 Oil pressure switch
34 ECU
35 Fuses
40 Air temperature sensor

3 - System components

Electronic Control Unit (ECU)

The engine ECU (1) is an electronic digital microprocessor-based unit.



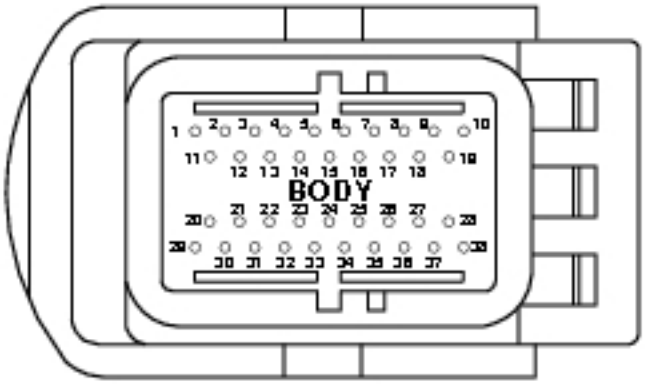
It controls both the injectors and the coils, thus controlling fuel injection and ignition in accordance with the engine operating conditions detected by the following sensors:
- Absolute pressure sensor (measures atmospheric pressure)
- Air temperature sensor (measures intake air temperature)
- Engine temperature sensor (measures coolant temperature)
- Timing/rpm sensor (measures engine rotation speed and cylinder timing relative to TDC)
- Throttle position sensor (measures the throttle opening angle).

The ECU also monitors battery voltage so that it can adjust injector opening time and ignition coil charging time accordingly.
The ECU determines the following values:
- Amount of fuel delivered to each cylinder with a sequential non-parallel control
- Injector closing time and therefore injection timing relative to the end of the induction stroke for each cylinder
- Ignition advance.

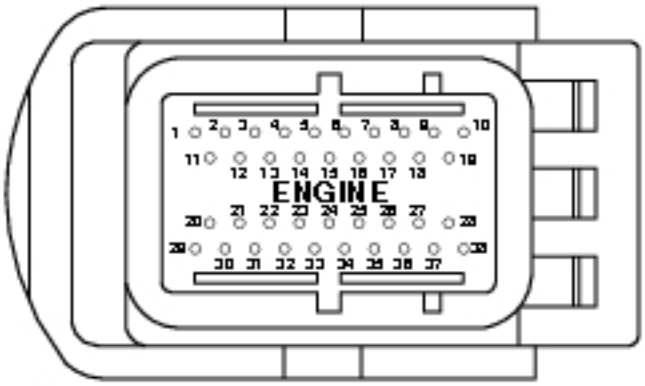
Important

The maps, which include ignition advance values, injection times, crankshaft angle for injector closing and all correction curves as a function of temperature and atmospheric pressure values, are stored in the Flash Eprom of the ECU. The above values are preset by the Manufacturer after testing the motorcycle under different riding conditions. These settings cannot be changed.

CO content can be adjusted using software on the "DDS" tester, which should be connected to the ECU diagnostic socket.
For this procedure, refer to Sect. D 5, Adjusting the idle speed.
There are two types of ECU connector, one has a grey terminal block (Telaio-Body), and one has a black terminal block (Motore-Engine).



Grey



Black

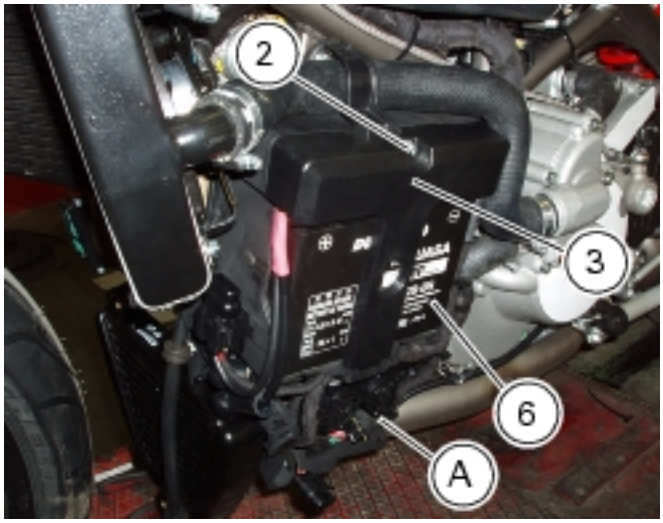
Warning

If the ECU is changed, it will be necessary to follow the procedure for "Resetting the throttle position sensor (TPS)", Sect. D 5.

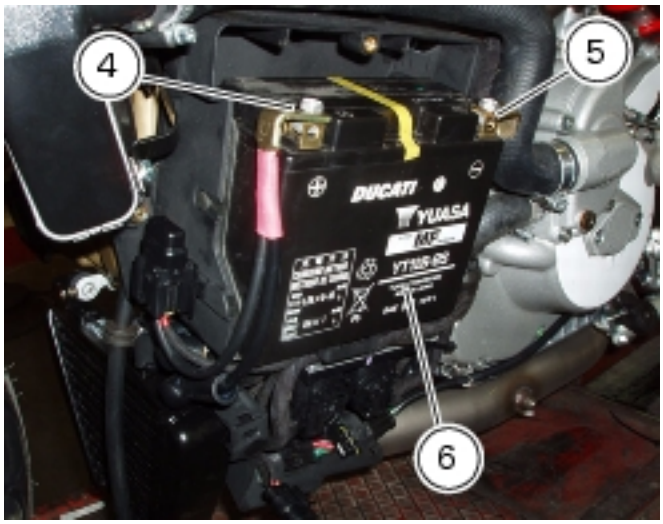
For removal and refitting of the ECU, refer to the chapters "Removal of the battery support" and "Refitting the battery support" in this section.

Removal of the battery support

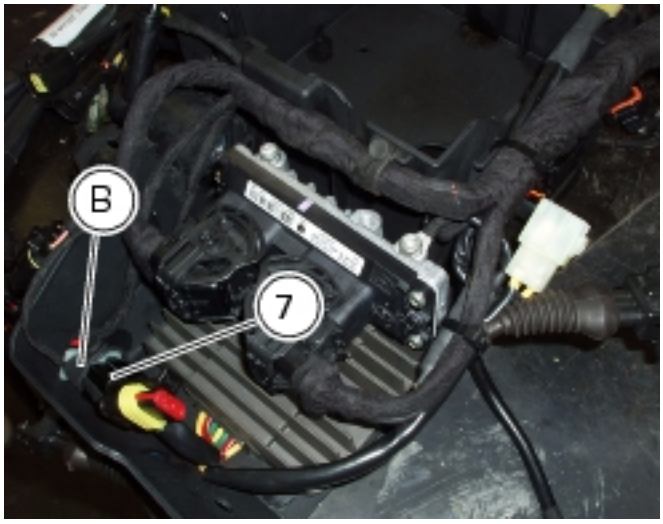
To remove the battery support, you first need to remove the left-hand side fairing (Sect. E 2, Removal of the side fairings) and disconnect the sidestand wiring connector (A) from the main wiring loom (Sect. P 1, Plate 31).
Unscrew the bolt (2) and remove the battery retaining bracket (3).



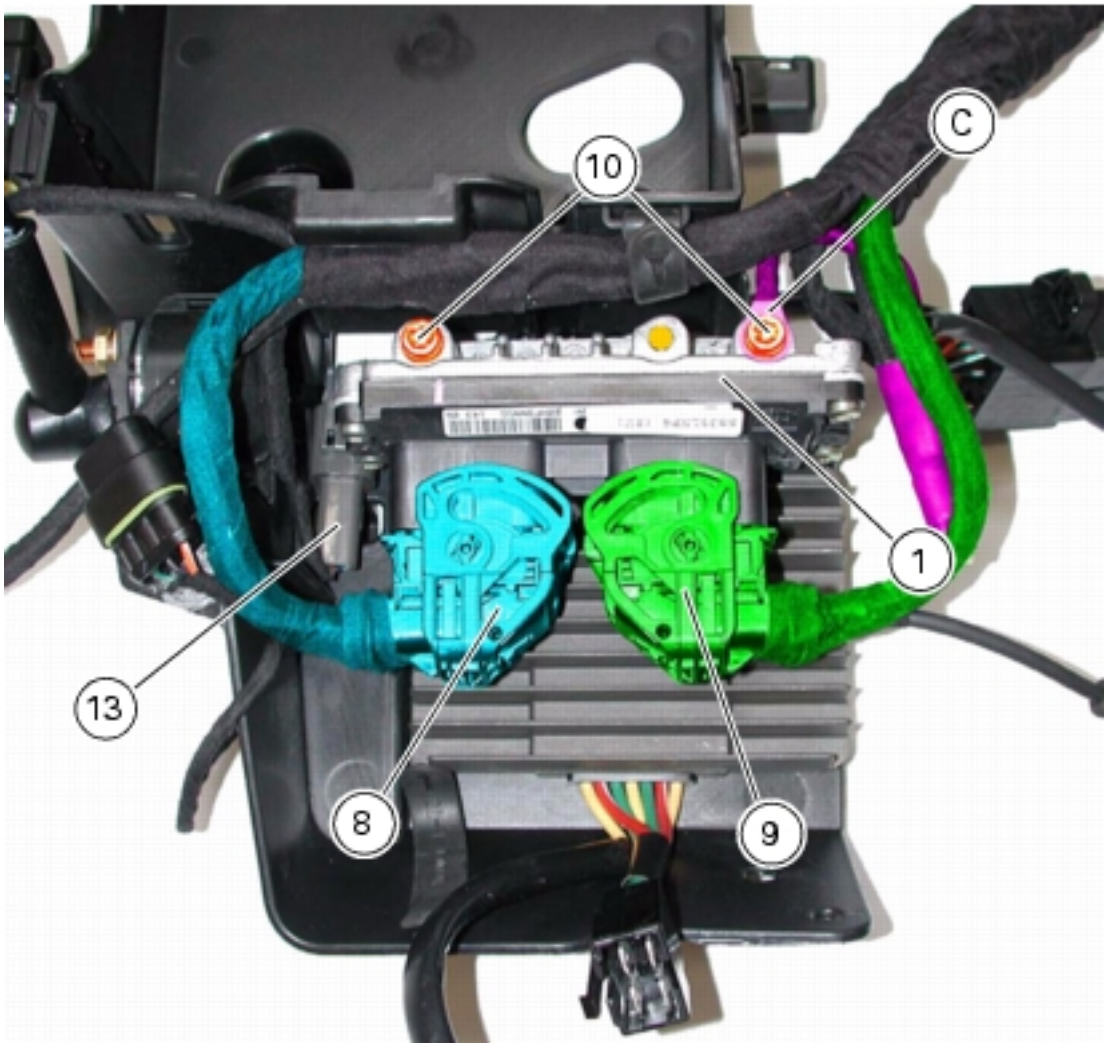
Disconnect the battery terminal clamps (5) and (4). Always disconnect the negative terminal clamp (5) first.
Remove the battery (6).



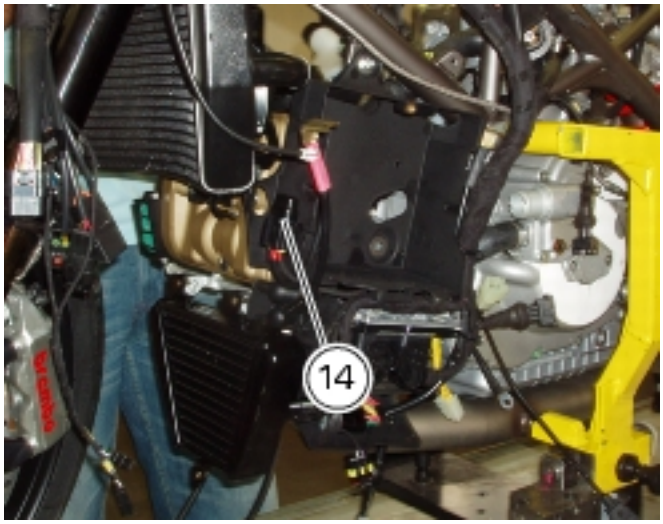
Remove the clamp (B) and disconnect the regulator wiring connector (7) from the wiring loom.



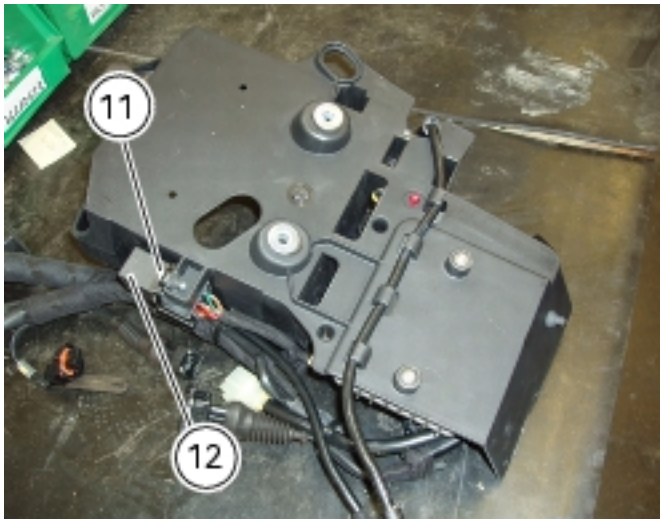
Disconnect the two wiring connectors (8) and (9) from the ECU.
Undo the screws (10) and remove the ECU (1), freeing it from the ECU earth lead (C).
Detach the wiring connector of the contactor (13) with the fixing device from the battery support.
To remove the contactor, proceed as described in Sect. P 3, Starter contactor.



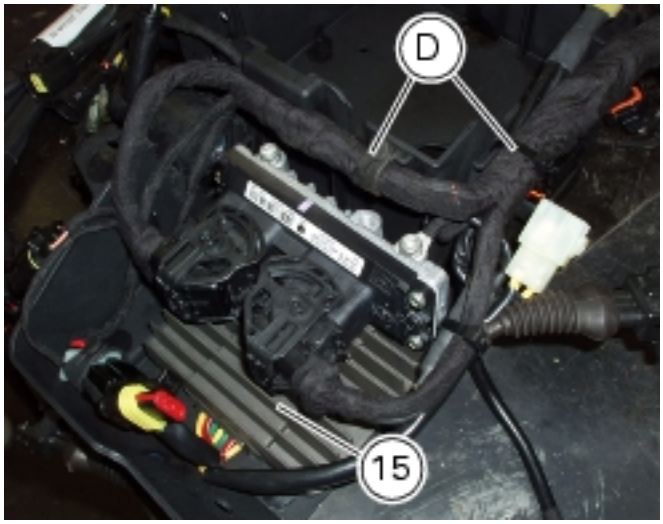
Remove the regulator fuse (14) from the battery support, withdrawing it through the holes provided.



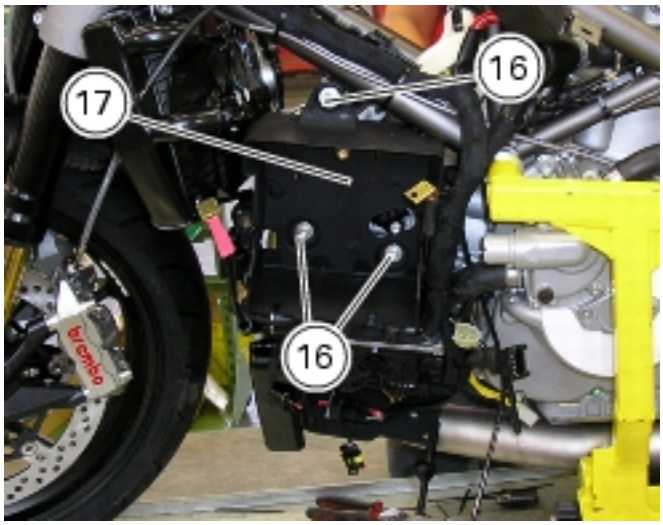
Undo the screw (11) and remove the injection and fans relay (12).



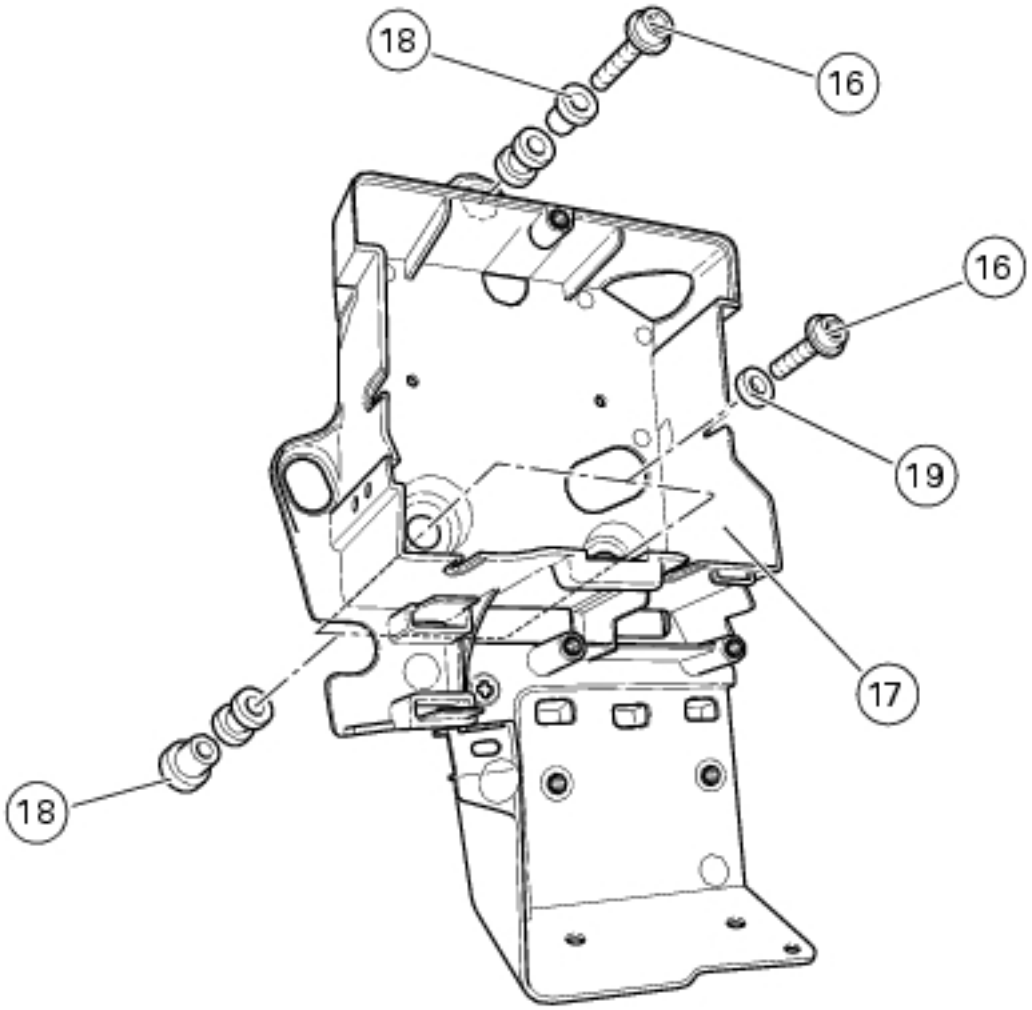
Release the wiring from any cable ties (D).
To remove the regulator/rectifier (15), proceed as described in Sect. P 2, Regulator/rectifier.



Undo the bolts (16) securing the battery support (17) to the frame.

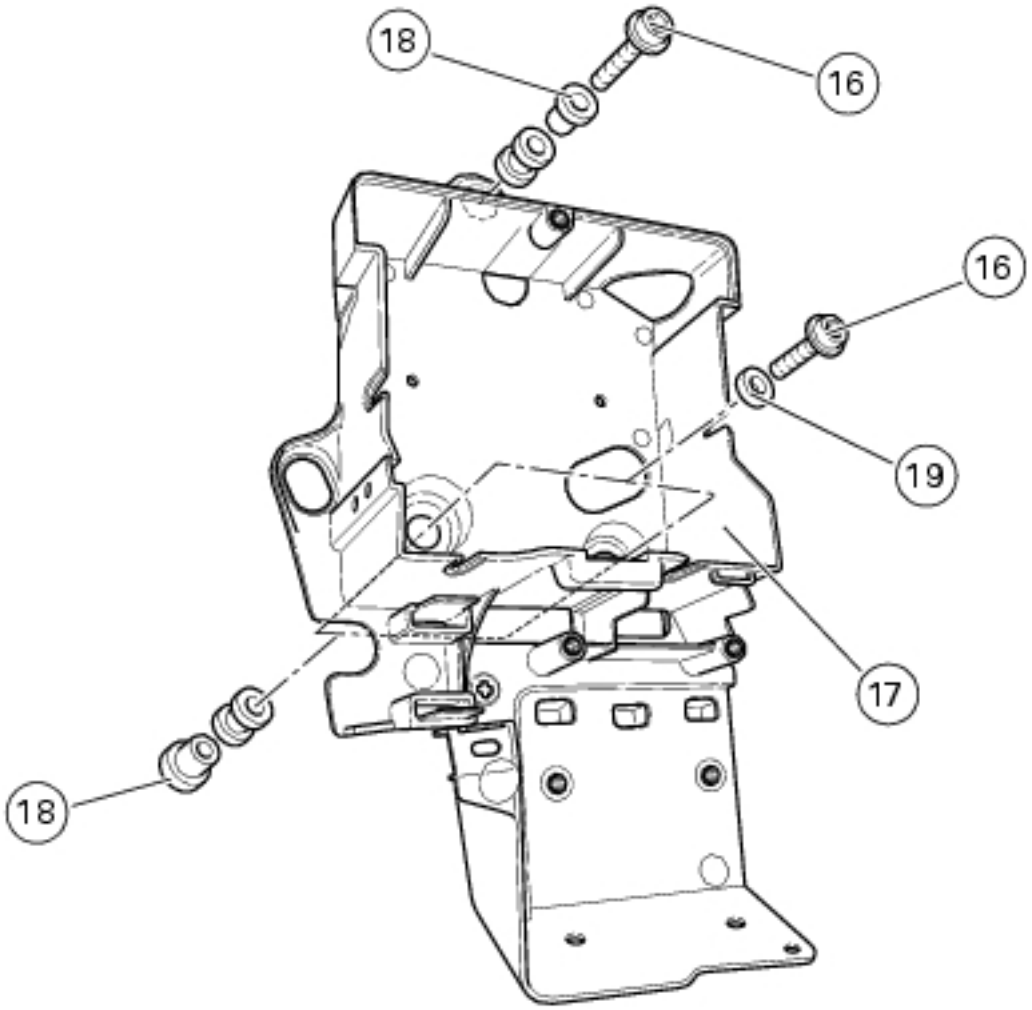


Recover the spacers (18) and the washer (19).
Remove the battery support from the motorcycle.

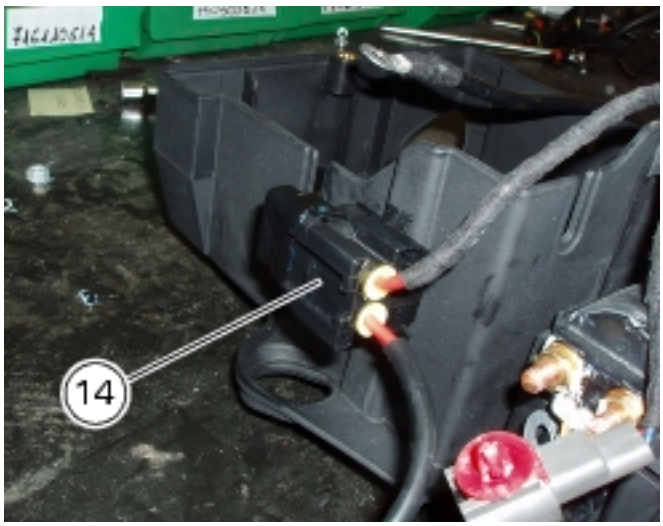


Refitting the battery support

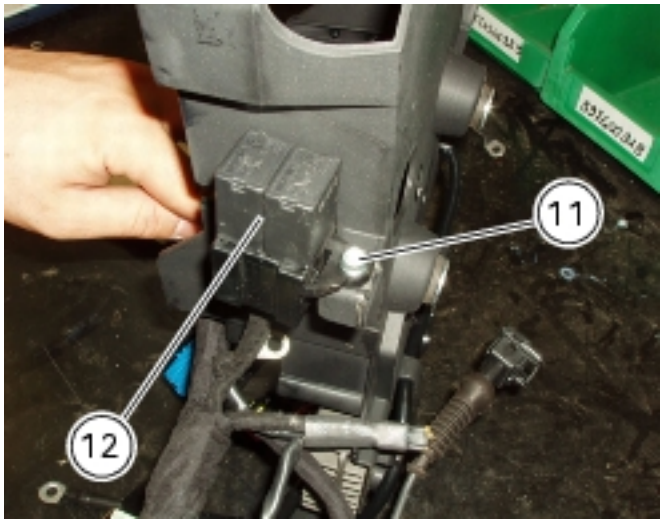
Check the condition of all rubber components and replace them if necessary.
Insert the small diameter side of the spacers (18) into their rubbers.



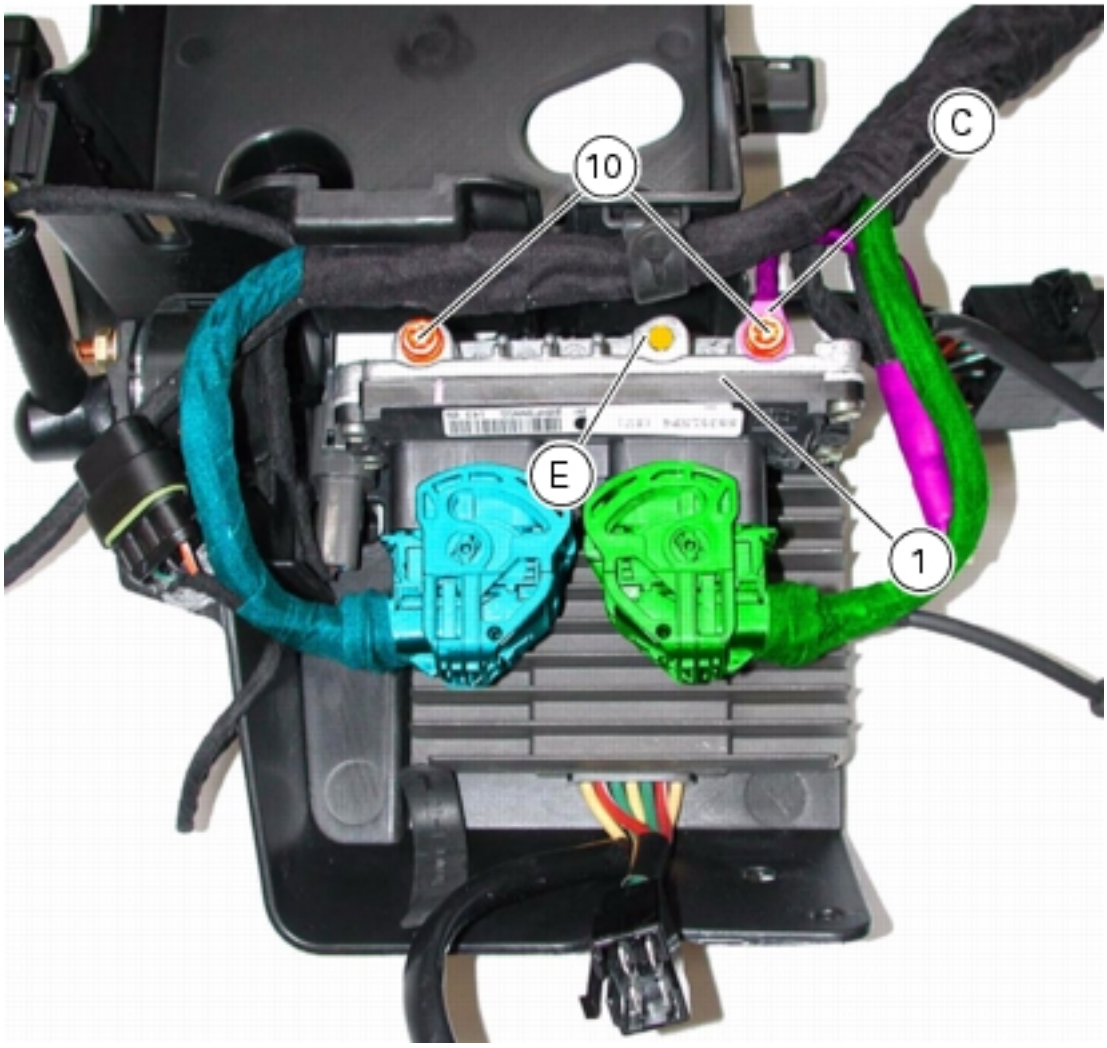
For the positioning of the wiring on the battery support, refer to Sect. P 1, Plate 35.
Refit the regulator/rectifier (Sect. P 2, Regulator/rectifier) and the contactor (Sect. P 3, Starter contactor).
Fit the regulator fuse (14) inserting it through the holes in the battery support.



Fit the injection and fans relay (12), tightening the screw (11) to the specified torque (Sect. C 3, Frame torque settings).

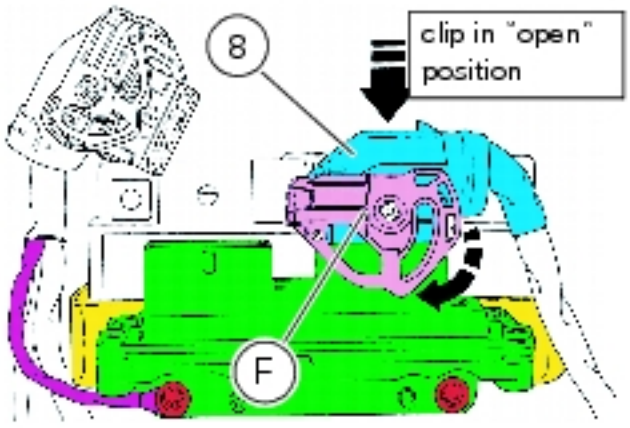


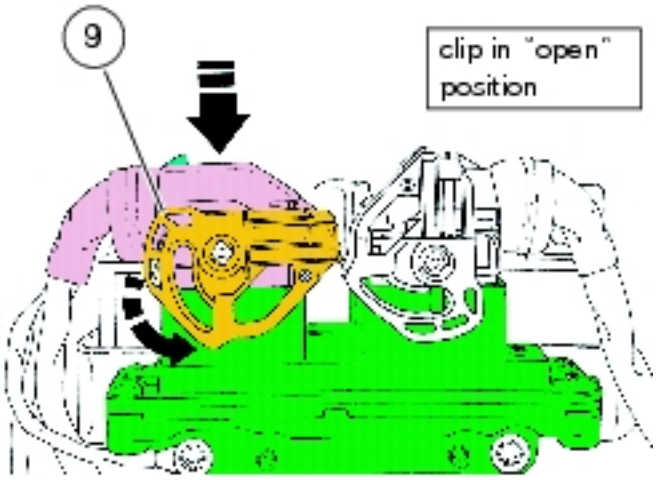
Position the ECU so that the threaded hole (E) is facing upwards; insert the retaining screws (10) with the ECU earth connector (C) under the right-hand screw, and tighten to the specified torque (Sect. C 3, Frame torque settings).

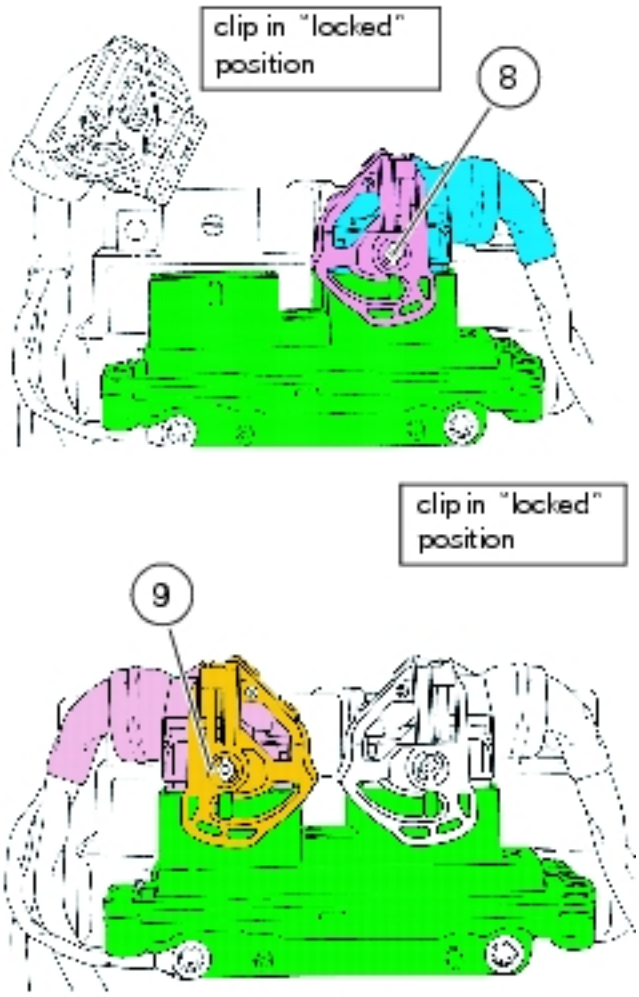


Make sure the clip (F) for the connector (8) is in its "open" position (as shown in the diagram).
Push the connector firmly into the ECU.
Rotate the clip (F) to secure the connector (clip in "locked" position).
Repeat the procedure for the other connector (9).
Make sure the connector clip is in the "open" position.
Push the connector firmly into the ECU.

Rotate the clip to secure the connector (clip in "locked" position).





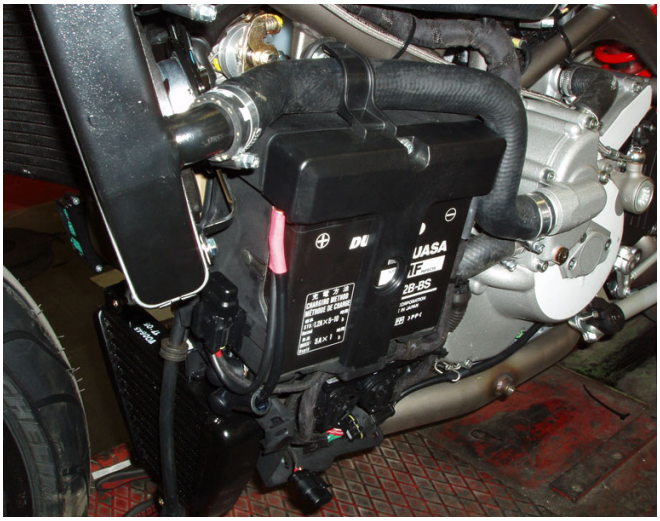


Important

If the ECU is changed, use the DDS tester to set the TPS to zero (Sect. D 5, Resetting the throttle position sensor (TPS)).

If it has been removed, refit the rubber mat (20) in its seat, locating the pins in the holes on the battery support.

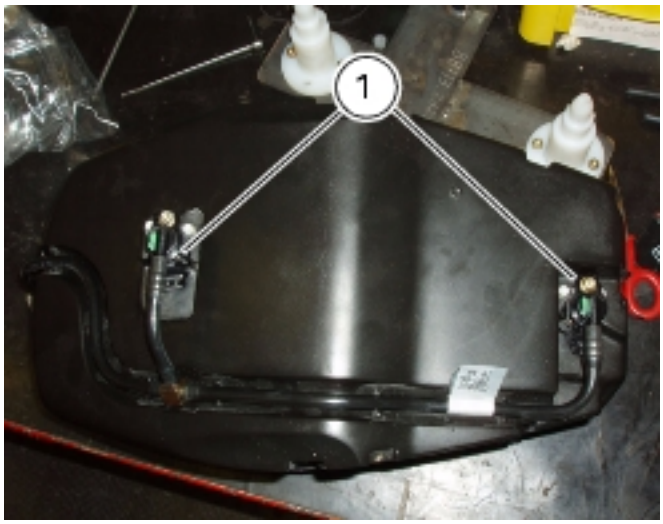
Refit the battery in the support and refit the support to the motorcycle by reversing the removal operations.



Reconnect the battery support wiring to the main wiring loom (Sect. P 1, Plate 35) and refit the left-hand side fairing (Sect. E 2, Refitting the side fairings).

Fuel injectors

The injectors (1) deliver the correct quantity of fuel required for optimal engine operation.



The ECU controls injector opening by feeding current to the coil of an electromagnet which creates a magnetic field to attract the armature, thereby generating fuel spray. If we take the physical characteristics of the fuel to be constant (viscosity, density), as well as the injector delivery and pressure head (controlled by the fuel pressure regulator), the amount of fuel injected depends on the duration for which the injector is open.
This time is determined by the ECU in accordance with the engine operating conditions.
In this way correct fuel delivery in ensured.
For removal or refitting of the injectors, refer to Sect. L 6, Removal of the fuel injectors.

Notes

To test the operation of the injector, use the DDS tester and follow the instructions given in the paragraph "Guided diagnosis", Sect. D 5.

The fuel output must be even and the jet should be fully atomised, without droplets.
Do not leave the engine stopped for a long time with the fuel circuit full.
The fuel could clog the injectors and render them inoperable.

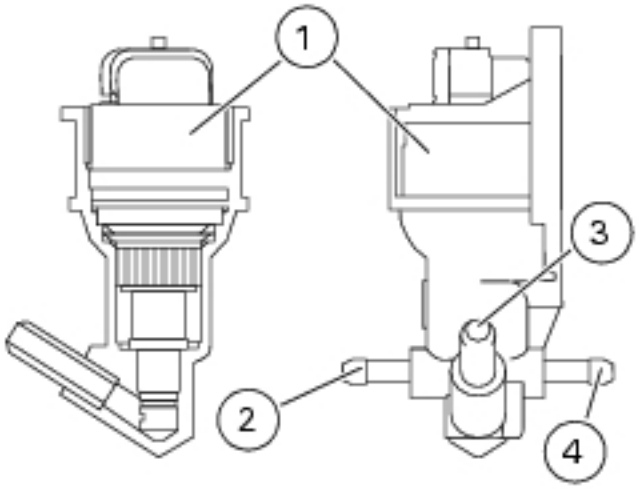
Periodically, after lengthy periods without running the engine, we recommend adding TUNAP 231 to the fuel in the tank to help clean critical sections of the fuel circuit.

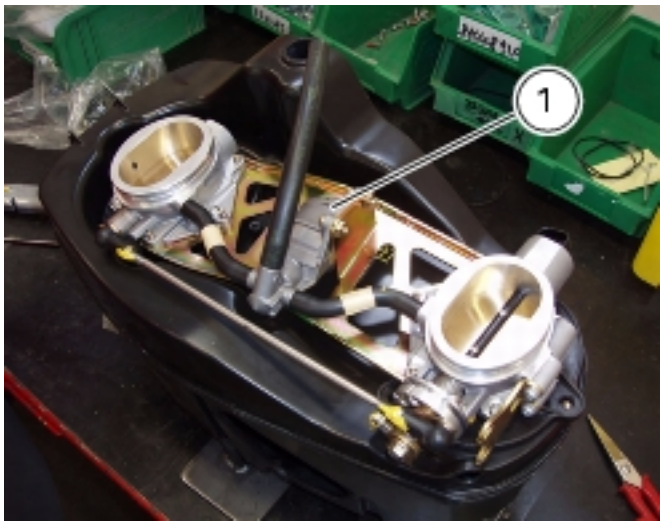
Notes

Electric injectors are only supplied as part of the "Injectors and pipes" kit, and must not be replaced individually.

Stepper motor

The throttle body incorporates an automatic choke function performed by a stepper motor (1).
The stepper motor shaft is fitted with a valve which opens a communicating passage between two ports; one of these ports (2) is connected to the intake manifold of the vertical cylinder while the other (4) is connected to the intake manifold of the horizontal cylinder. A third port (3) is connected to the airbox.





The stepper motor simultaneously controls two by-pass ports having an air flow capacity of around 6 kg/h.
The by-pass ports with adjuster screws are present because it is necessary to balance the air flow to the two cylinders.
In order to compensate for the quantity of supplementary air supplied by the stepper motor and consequently deliver the correct amount of fuel, the ECU converts the stepper motor steps into angular degrees of the throttle: this system means that opening the stepper motor is equivalent to opening the throttle.

Notes

The influence of the stepper motor air flow is present to approximately 30° throttle angle; no correction is required for greater angles.

The opening of the stepper motor opening is controlled by 2 strategies:
Strategy 1) controlled solely by engine temperature (stepper motor opening/closing is determined by engine temperature alone).
Strategy 2) controlled by engine temperature and status. This strategy is applied only in the engine starting phase; the system determines a quantity of steps, to be added to those of the previous strategy, which are immediately decreased to zero, in accordance with the number of engine cycles, once the system has detected that the engine has started.

Air pressure sensor

This sensor is integrated in the instrument panel and indicates the atmospheric air pressure. This information is sent to the ECU by a serial line (CAN line), and is used to correct the calibrations stored in the Flash Eprom.

Notes

To test the operation of the injector, use the DDS tester and follow the instructions given in the paragraph "Guided diagnosis" (Sect. D 5).

Coolant temperature sensor

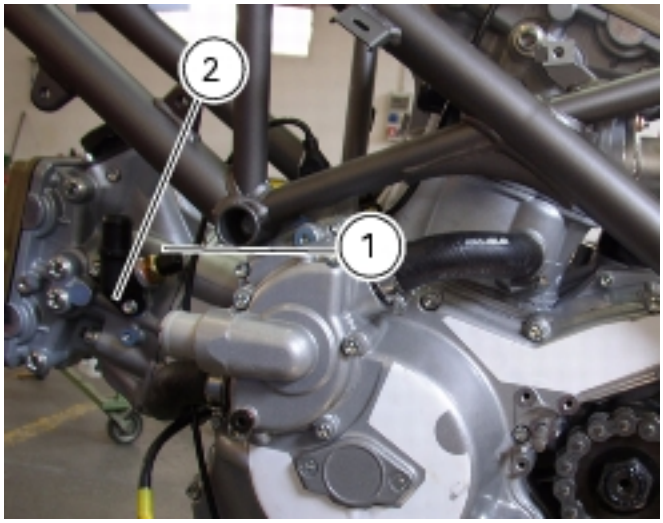
This sensor is mounted on the horizontal cylinder head coolant outlet union and measures the coolant temperature. This information is sent to the ECU and used to correct the calibrations stored in the Flash Eprom so as to ensure optimal ignition and fuel supply at all times. The same information is sent to the instrument panel via the CAN line for the coolant temperature display. It is composed of a body containing an NTC thermistor (the resistance of the thermistor decreases as the temperature increases).

Notes

To test the operation of the coolant temperature sensor, use the DDS tester and follow the instructions given in the paragraph "Guided diagnosis" (Sect. D 5).

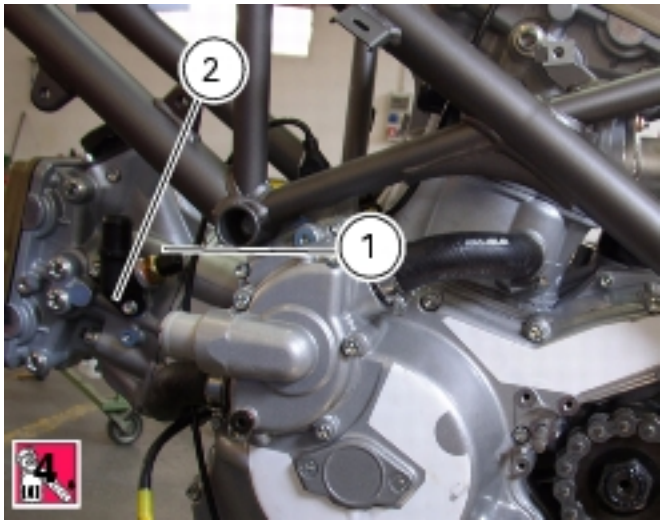
Removal of the coolant temperature sensor

To remove the coolant temperature sensor, first remove the LH side fairing (Sect. E 2, Removal of the side fairings) and the battery support (as explained in this section).
Disconnect the wiring connector.
Unscrew the sensor (1) from the coolant manifold (2) (Sect. P 1, Plate 12).



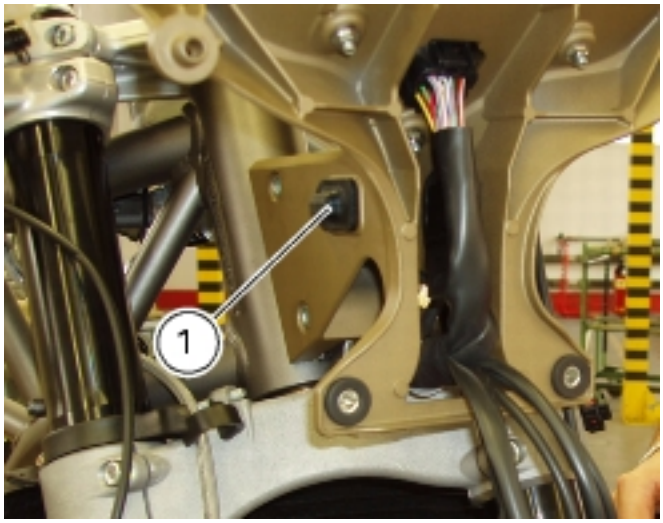
Refitting the coolant temperature sensor

Refit by reversing the removal operations, securing the sensor to the union with the specified torque (Sect. C 3, Frame torque settings) and applying the recommended threadlocker.
Refit the left-hand side fairing (Sect. E 2, Refitting the side fairings).



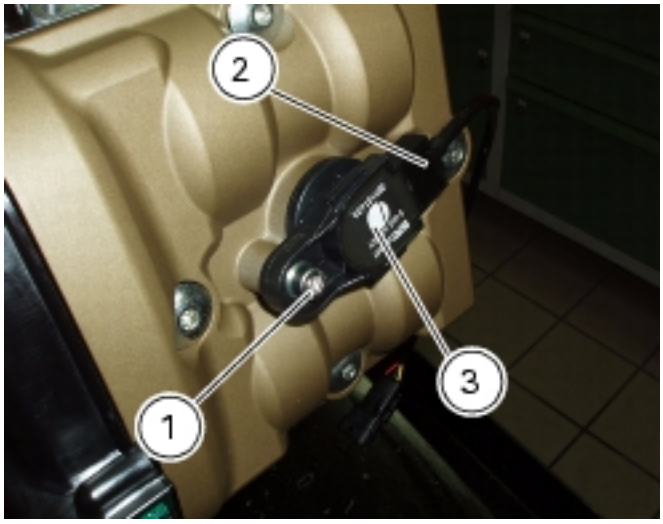
Air temperature sensor

The sensor (1) is located on the right-hand side of the instrument panel and measures the external air temperature:
the temperature signal is sent to the ECU integrated in the instrument panel for display and sent over the CAN line to the engine ECU which uses it to make corrections to the map.



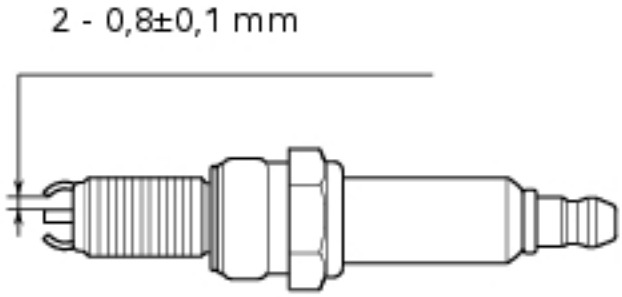
Ignition coils

Raise the fuel tank (Sect. L 2, Removal of the fuel tank).
Undo the nut (1) securing the coil to the cylinder head.
Remove the connector (2) and remove the coils (3) from the spark plugs on both cylinder heads.
Clean the area around the spark plug bores with a compressed air jet before removing the spark plugs themselves.
Remove the spark plugs, making sure that dirt does not fall into the combustion chambers.



Spark plugs

Check the colour of the ceramic insulation around the central electrode:
an even, light brown colour indicates the engine is in good condition and running at the right temperature.
Secondly, they will check the central electrode for wear and measure electrode gap. Electrode gap should be: **2-0.8±0.1** mm.



Important

Check the gap between the central and side electrodes. If the gap is not as specified or if the spark plug has heavy sooty deposits, renew it.

Refit the spark plug in the cylinder head, first tightening it fully by hand.
Tighten to the specified torque (Sect. C 3, Frame torque settings).
Refit the fuel tank (Sect. L 2, Refitting the fuel tank).

Important

Do not use spark plugs with inadequate thermal rating or incorrect thread length.
The spark plug must be securely installed.
If a spark plug is loose, it can overheat and damage the engine.

Spark plug type
Make: NGK
Type: MAR10A-J

Checking the coils

The coils used on this model are known as "cigar" coils.
They are similar in appearance to a spark plug cap. They transform the low voltage from the ECU into high voltage for the spark plugs.
To test the coils, proceed as follows:
Measure the resistance between the two pins (1-15).
The resistance should be 650 mΩ±50; if not, replace the coil.

Notes

To check the coils for faults, use the DDS tester and follow the instructions given in the paragraph "Guided diagnosis" (Sect. D 5).

Throttle Position Sensor (TPS)

The TPS is powered by the ECU to which it sends a signal indicating the throttle position. This information is an indirect measure of the engine load and is used by the ECU as one of the main

parameters for defining the fuel flow rate and spark advance.

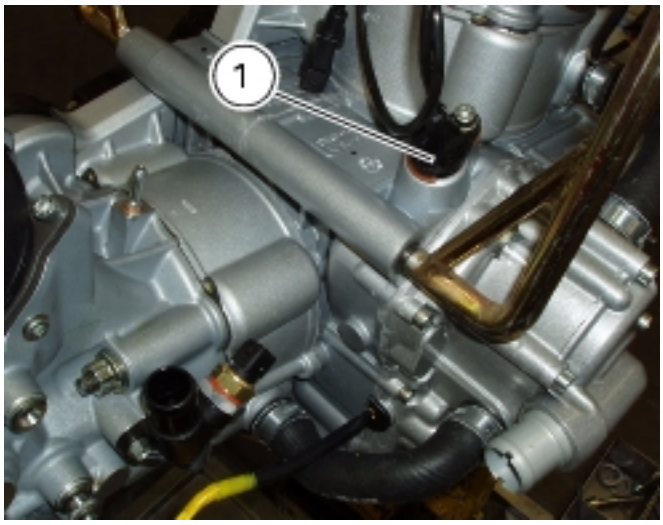
Notes

To check this component, use the DDS tester following the instructions given in the paragraph "Guided diagnosis" (Sect. D 5).

It is not possible to change the throttle position sensor as a single component. In the event of a fault with this component, it will be necessary to replace the entire throttle body assembly (Sect. L 6, Refitting the airbox and throttle body) and then reset the TPS (Sect. D 5, Resetting the throttle position sensor (TPS)).

Rpm/timing sensor

This sensor (1) is of the inductive type: it faces the timing gear and is capable of reading the 46 teeth and the 2-tooth gap.



The signal coming from the pickup on the camshaft gear is used by the ECU to determine the engine speed and as a timing reference point.

Notes

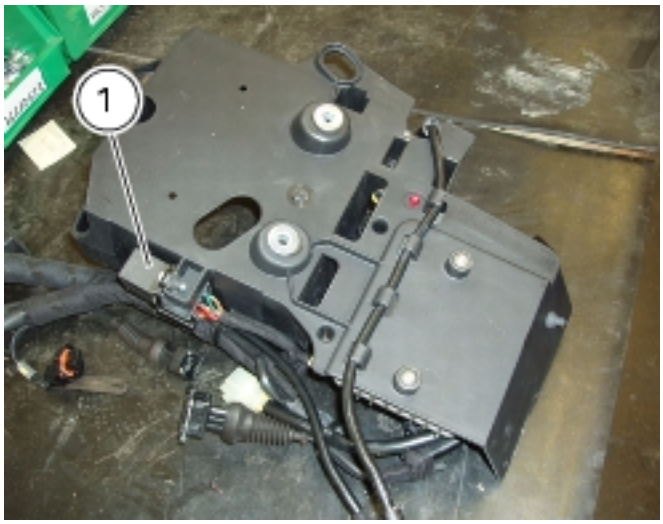
To check these components for faults, use the DDS tester and follow the instructions given in the

paragraph "Guided diagnosis" (Sect. D 5).

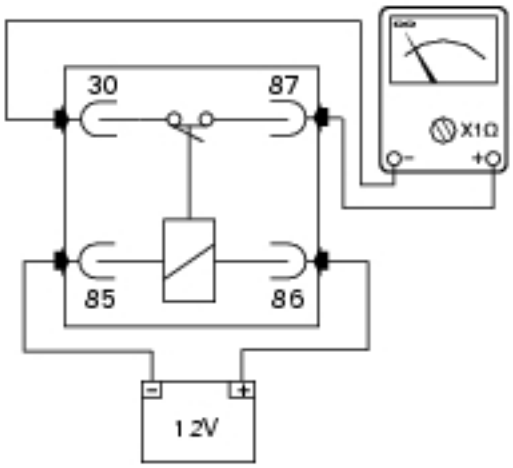
For instructions on how to renew the sensor and check the air gap, see the chapter "Flywheel-alternator" (Sect. N 8).

Injection relay

The relay (1) is positioned next to the battery and fixed to the battery support.



To remove the relay (1), first remove the battery support as described previously in this section. Disconnect the relay from the electrical system and apply 12 V (battery voltage) between contacts (86) and (85) (small contacts): you should hear a click that confirms that the internal electromagnet has switched.
Connect a multimeter to contacts (30) and (87) (big contacts) to check for electrical continuity (see Sect. P 9, Diagnostic instruments concerning operation of the multimeter). The resistance reading should be near zero and, if present, the continuity sound signal should be emitted. If this does not occur, the part must be renewed.



CAN Line

This model utilises a CAN line (Controller Area Network) which has made it possible to greatly simplify the layout of the electrical system and consequently reduce its overall weight.
The CAN line is connected to two nodes:
the instrument panel and the Magneti Marelli engine ECU (I.A.W. 5 AM 2). This network makes it possible to avoid

superfluous duplications of the sensors on the motorcycle, since their signals are shared by the two nodes and hence the two processing units.
The sensors are connected to the nearer of the two units (instrument panel or ECU), which then transmits their signal to the network so that it can be used by the ECUs.
The CAN line is composed of only two wires carrying series of digital signals, each of which contains precisely defined and decodable information. The nodes connected to the line (instrument panel and engine ECU) are equipped with hardware to determine when the signals are of interest to them and should be used by their processors.
The signals exchanged over the CAN line between the instrument panel and engine ECU are as follows:
- Motorcycle speed (input to engine ECU)
- Neutral selected (input to engine ECU)
- Engine oil pressure (input to engine ECU)
- Coolant temperature (input to engine ECU)
- Oil temperature (input to engine ECU)
- Starter motor actuation (starter button) (input to engine ECU)
- First level diagnostics generated by ECU
- Engine oil pressure (input to engine ECU)
- Scheduled service limit (light on instrument panel illuminates)
- Intake air temperature (input to instrument panel)
- Battery voltage
- Motorcycle model identification
- EOBD LED control
- Immobilizer recovery
- Atmospheric pressure (sensor integrated in the instrument panel).

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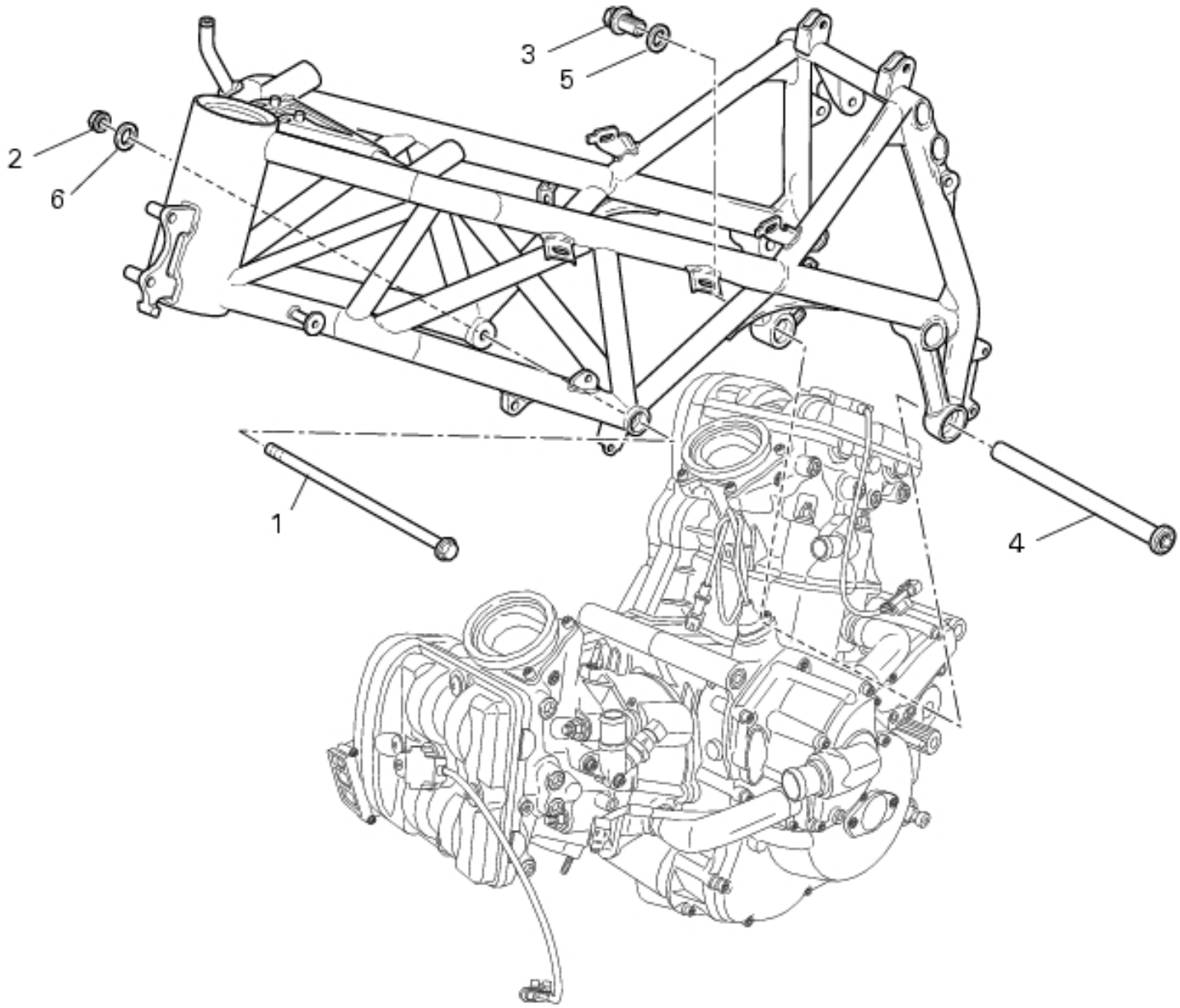
1 - Removal–refitting of the engine assembly



1 Bolt
2 Nut
3 Bolt
4 Swingarm pivot shaft
5 Washer
6 Washer

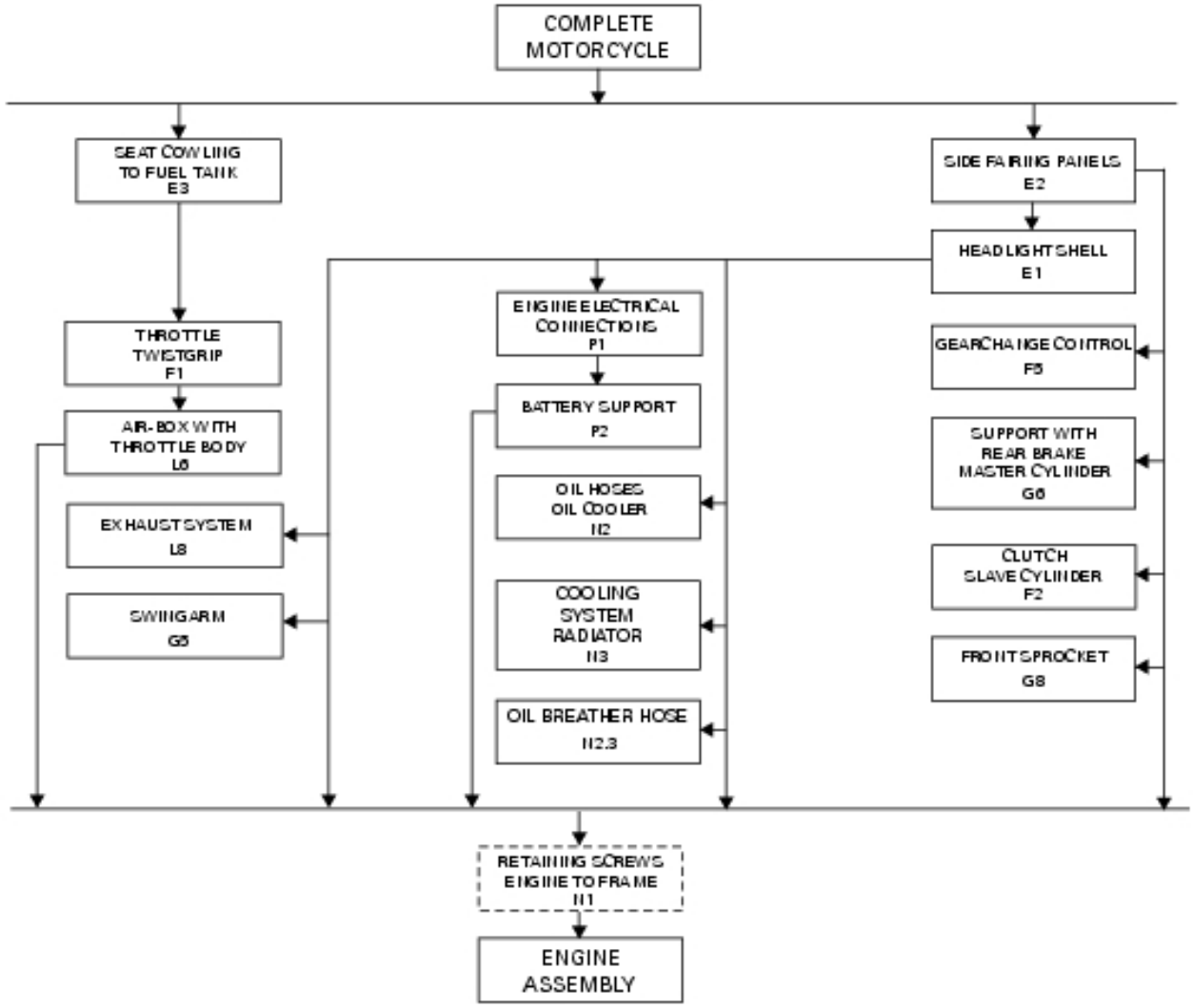
Parts catalogue

Frame
swingarm

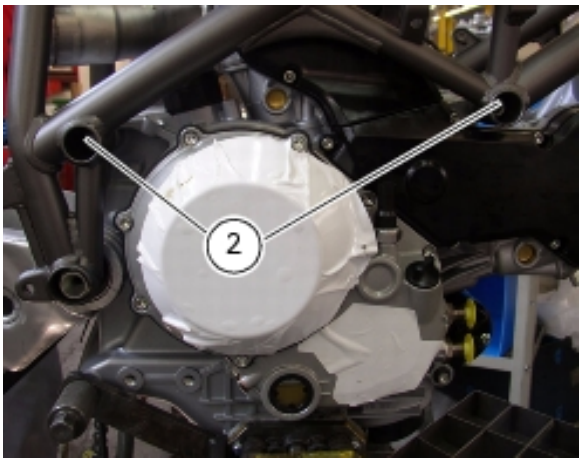
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

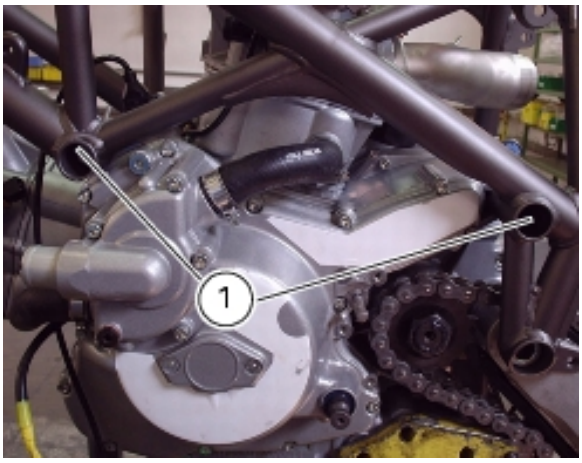
Removal of the engine

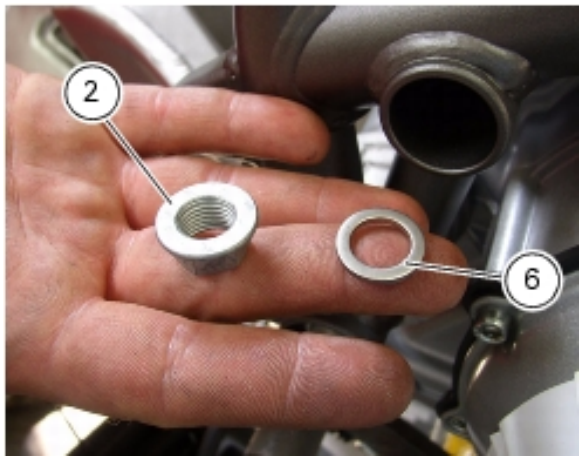
In order to remove engine you must first remove a series of other components from the motorcycle.
Most of these removal procedures are described in the relative sections of this manual.
The following flow chart illustrates the logical sequence in which the parts are to be removed from the motorcycle and a reference to the section where the removal procedure is described.
This section describes only the operations to be carried out after having removed all the parts listed in the diagram.



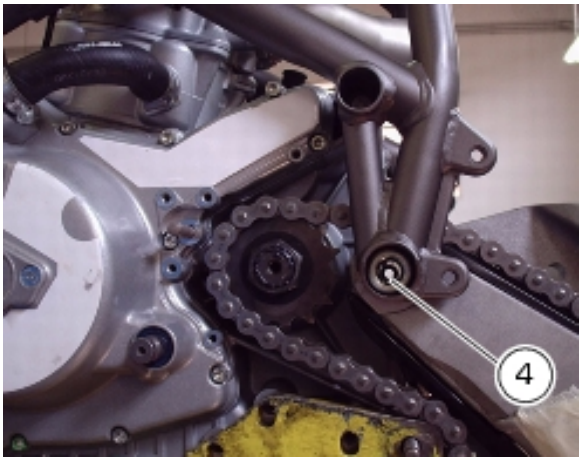
Place a stand beneath the engine to support it during removal from the frame.
Unscrew the nuts (2) on the right-hand side of the frame, on the two upper engine bolts (1) and recover the washers (6).

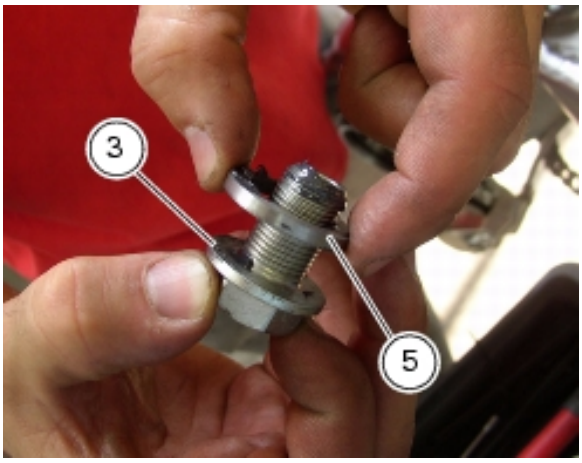




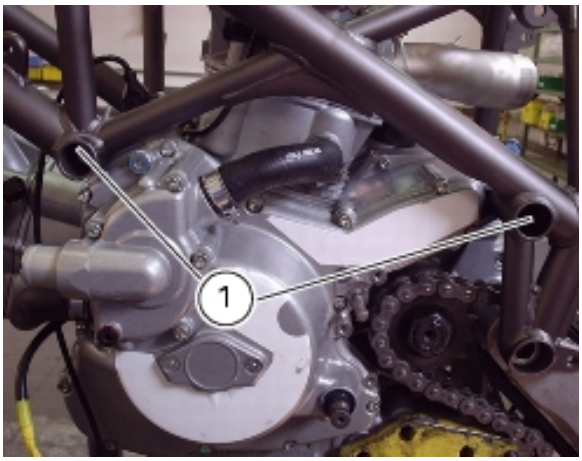


Restrain the swingarm pivot shaft (4) from the left side of the motorcycle while undoing the bolt (3) with washer (5) on the opposite side.
Using drift **88713.1074**, fully extract the swingarm pivot shaft.
This frees the swingarm from the engine and therefore it can be left attached to the frame.





Remove the two upper bolts (1).



Withdraw the complete engine assembly from the frame by lowering it and pushing it forwards.

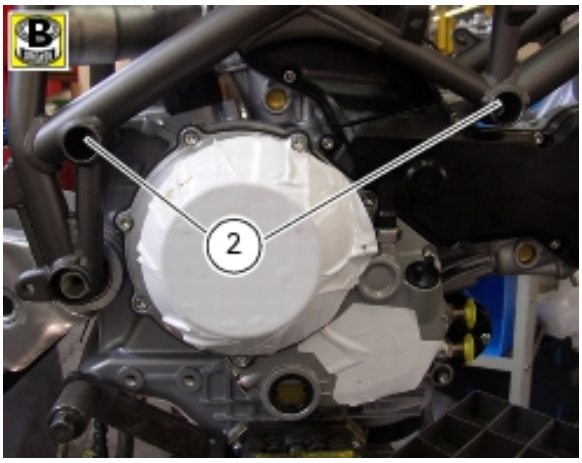
Refitting the engine

Refitting is the reverse of removal.

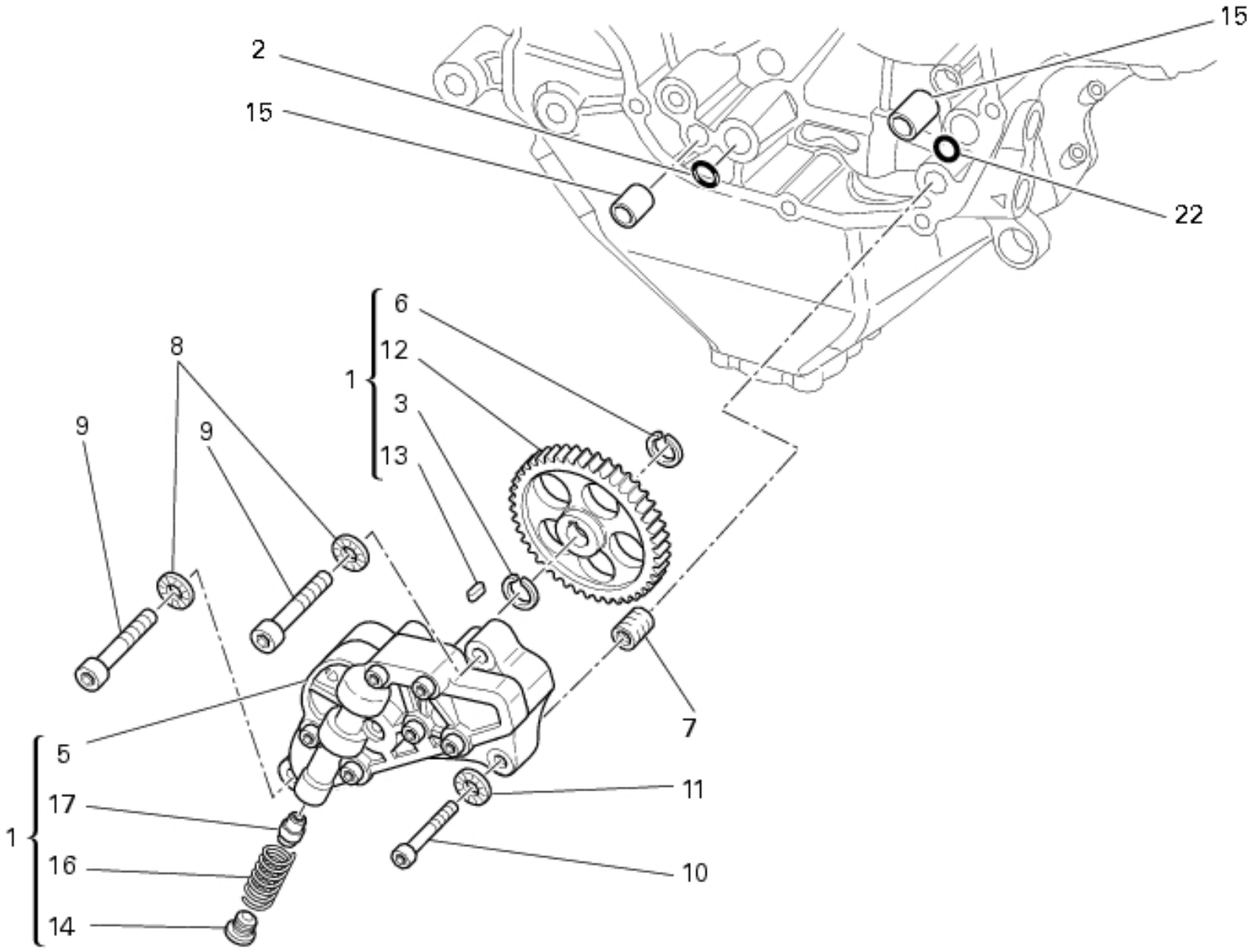
Important

Apply the recommended grease to the nuts (2) and tighten to the specified torque (Sect. C 3, Frame torque settings).

Refit the removed parts by performing the steps shown in the table and in the specific sections of the manual in reverse order.


2

2.1 - Lubrication system: oil pump



1 Complete oil pump assembly
2 O-ring
3 Circlip
4 O-ring
5 Pump body
6 Circlip
7 Reducer bush
8 Spring washer
9 Bolt
10 Bolt
11 Spring washer
12 Pump drive gear
13 Key
14 By-pass plug
15 Locating bush
16 By-pass spring
17 By-pass valve

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Parts catalogue

Filters and oil pump

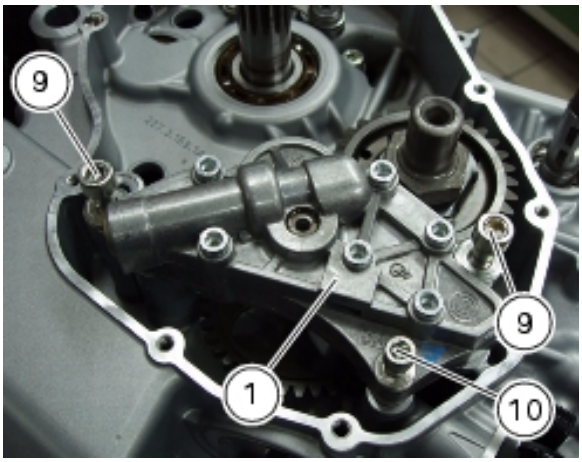
Important

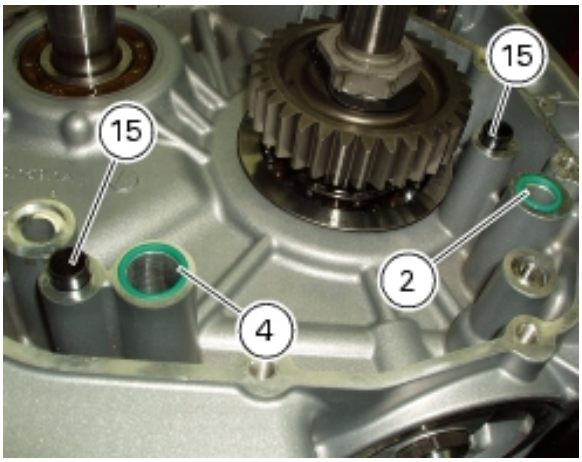
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the oil pump

Operation	Section reference
Drain the oil from the lubrication system	D 4, Changing the engine oil and filter cartridge
Remove the engine from the frame	N 1, Removal of the engine
Remove the clutch-side crankcase cover	N 6.2, Removal of the clutch-side crankcase cover

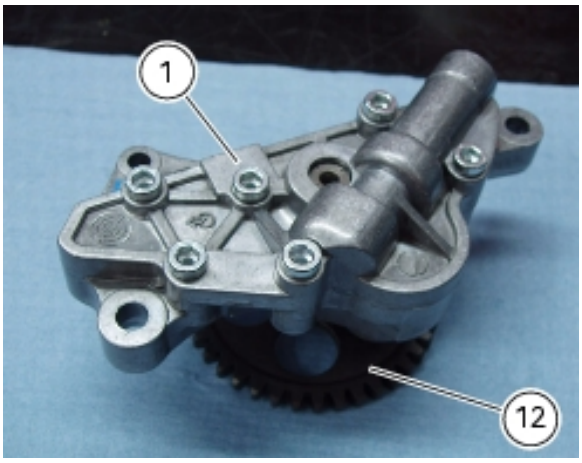
Undo and remove the bolts (9) and (10) securing the pump assembly.
Remove the oil pump assembly (1) and extract the O-rings (2) and (4) from the crankcase half together with two locating bushes (15).





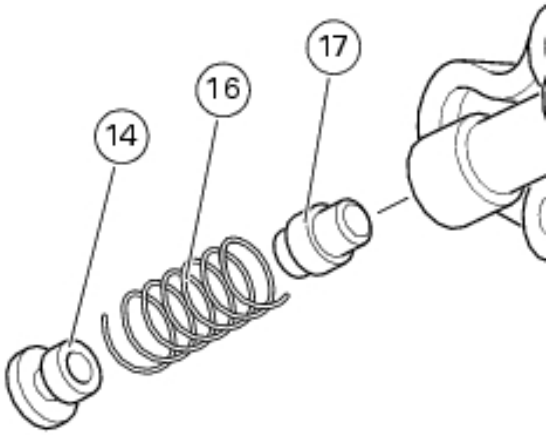
Disassembly of the oil pump

Hold the oil pump (1) in a vice taking care not to damage the drive gear (12).

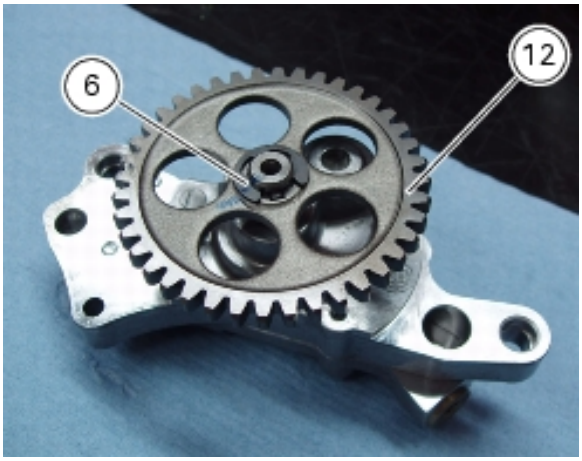


Warning
Make sure that vice jaws are faced with soft material.

Remove the plug (14) and extract the spring (16) and by-pass valve (17).

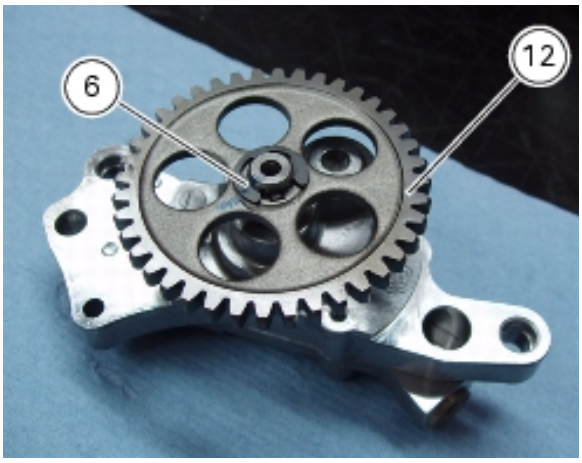


Check the condition of the above components.
Remove the circlip (6) and withdraw the pump drive gear (12).

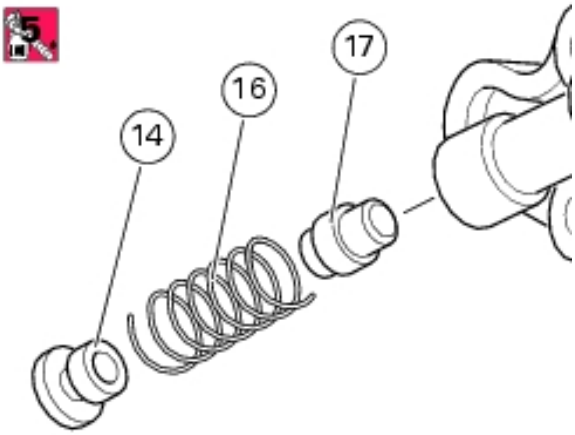


Reassembly of the oil pump

Check that the circlip (**3**) and Woodruff key (**13**) are both present on the pump.
Fit the pump drive gear (12) on to the oil pump and secure it by installing the circlip (6) in its groove.

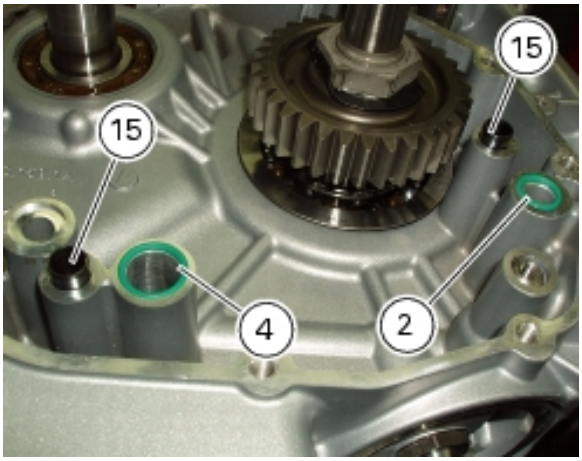


Install in the pump the by-pass valve (17) and the spring (16); screw in the plug (14) and tighten to the specified torque (Sect. C 3, Engine torque settings) after applying a medium strength threadlocker.

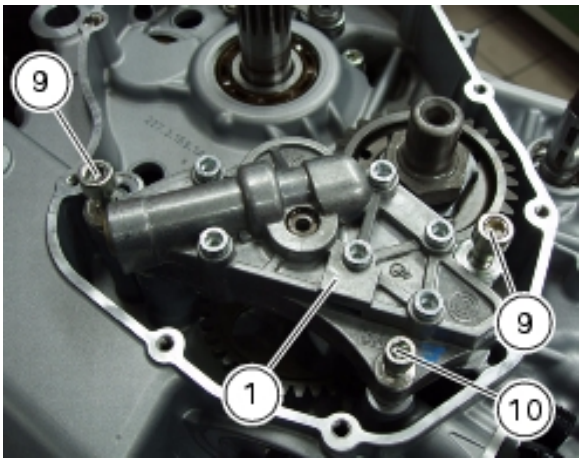


Refitting the oil pump

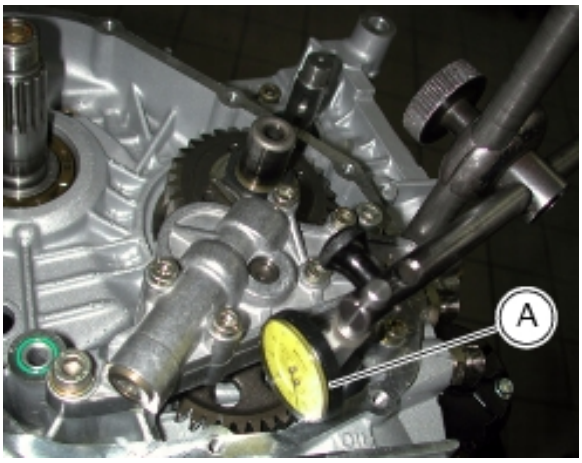
Position the locating bushes (15) and the O-rings (2) and (4) in correspondence with the crankcase lubrication oilways.



Position the oil pump on the crankcase and tighten the bolts (9) and (10) to the specified torque (Sect. C 3, Engine torque settings).

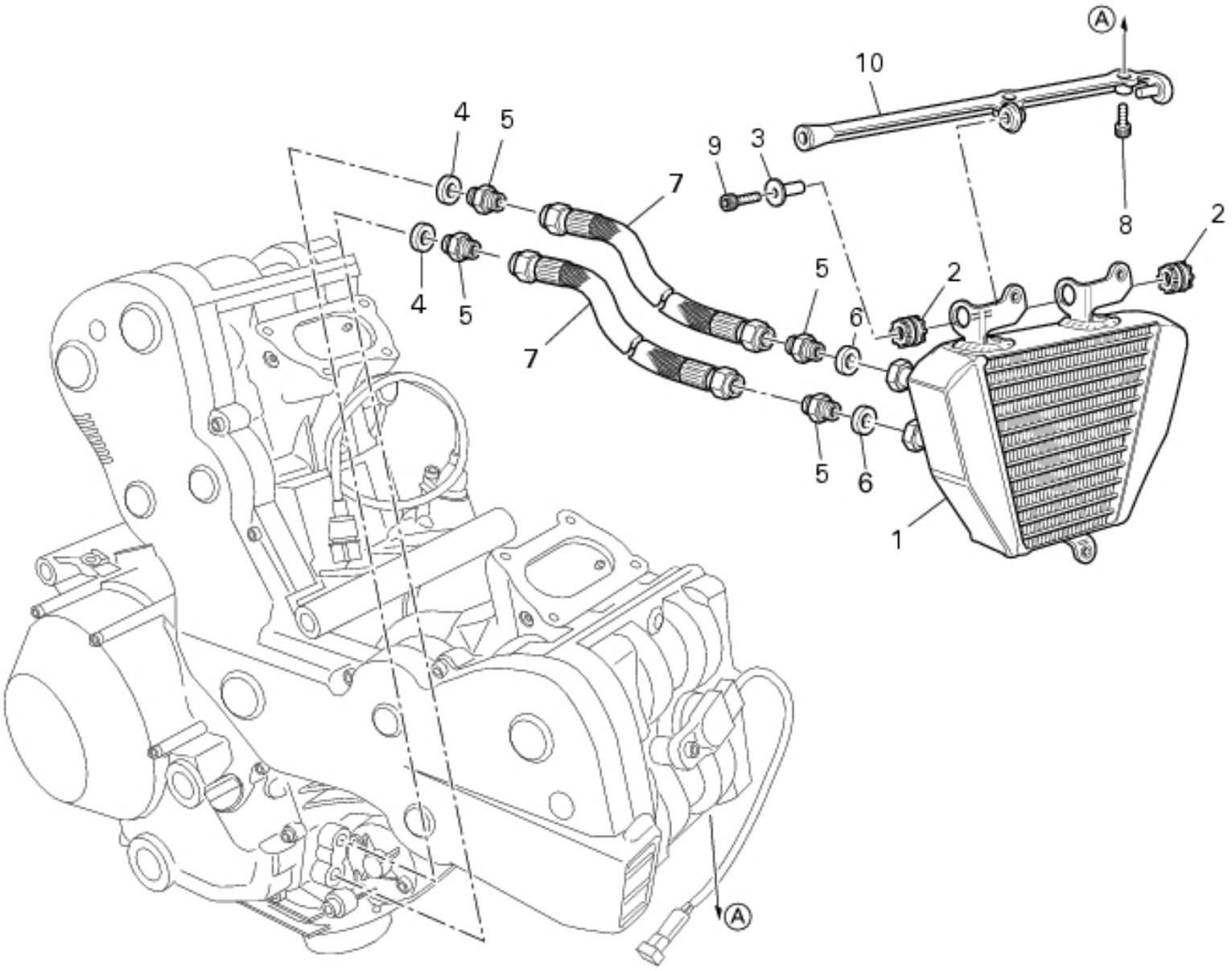


Check the gear backlash with the driving pinion by fixing a dial gauge (A), equipped with the appropriate stylus, to the crankcase half.
Position the dial gauge stylus on one tooth of oil pump gear and set the gauge to zero in this position.
Move the gear slightly to measure the backlash; take four readings in diametrically opposed positions of the gear.
The backlash should be **0.10** mm.



Operation	Section reference
Refit the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
Refit the engine to the frame	N 1, Refitting the engine
Fill the lubrication system with oil	D 4, Changing the engine oil and filter cartridge

2.2 - Lubrication system: oil cooler



1 Oil cooler
2 Rubber mounting
3 Spacer
4 Aluminium gasket
5 Nipple
6 O-ring
7 Oil hose
8 Bolt
9 Bolt
10 Support

Parts catalogue

OIL COOLER

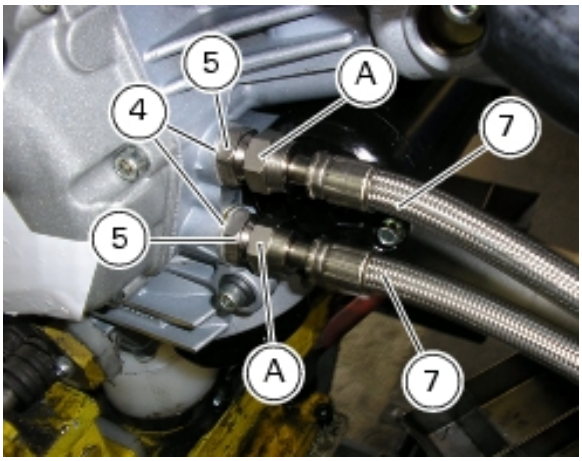
Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

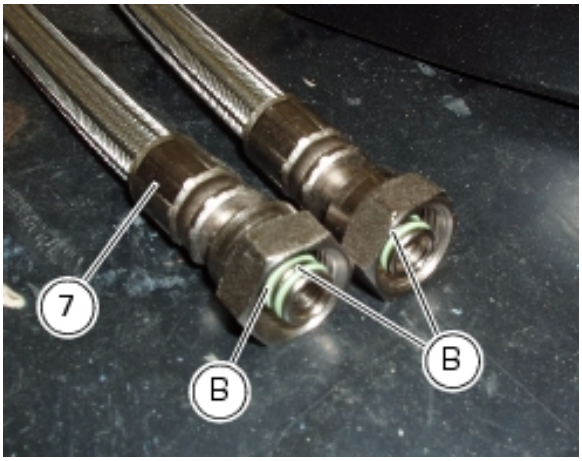
Removal of the lubrication system

Operation	Section reference
Remove the side fairing panels	E 2, Removal of the side fairings
Drain the oil from the lubrication system	D 4, Changing the engine oil and filter cartridge

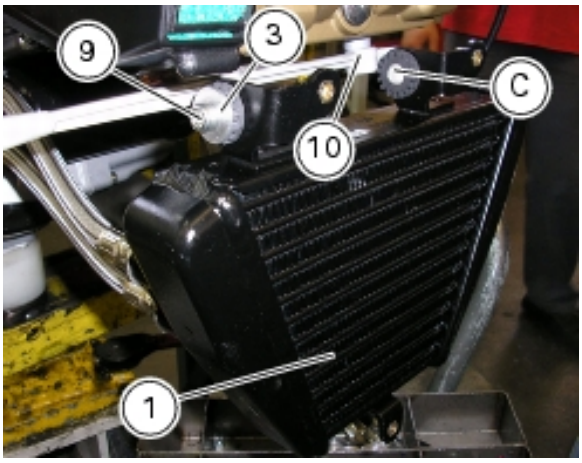
Undo the nuts (A) on the feed and return hoses (7) and the nipples (5) and disconnect the hoses from the engine. Unscrew the nipples (5) on the crankcase and recover the gaskets (4).

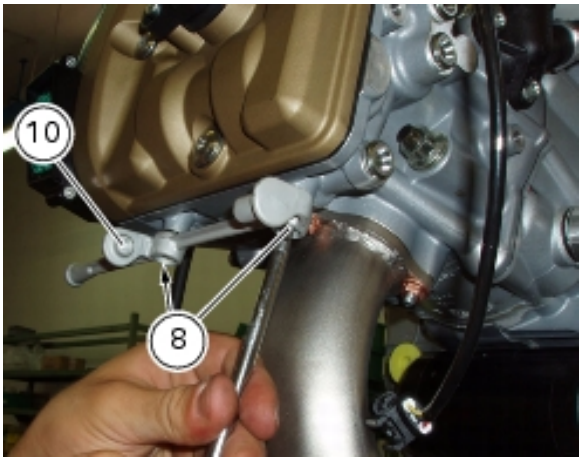


During removal, take care not to lose the O-rings (B) which ensure a tight seal.

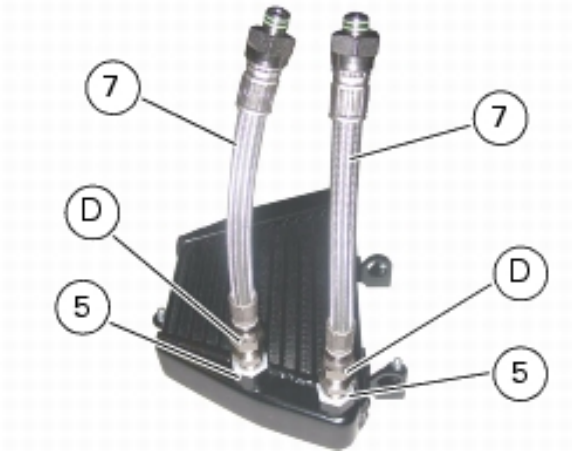


Unscrew and remove the bolt (9) with the spacer (3) securing the oil cooler to the support (10). Remove the oil cooler, withdrawing the pin (C) of the support (10).
The support (10) can now be removed by unscrewing the bolts (8).





Unscrew the nuts (D) of the hose unions (7) from the nipples (5) and disconnect the hoses from the cooler. Unscrew the nipples (5) on the cooler and recover the gaskets (**6**).



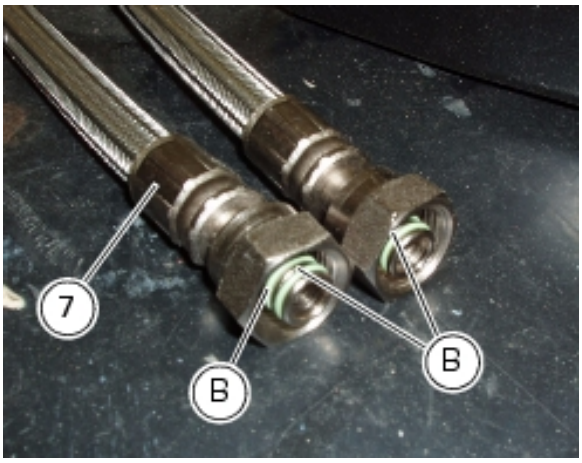
Oil cooler inspection

Visually inspect the cooler. Renew the cooler at any sign of damage or leaks.

Refitting the lubrication system

Notes

Before refitting the hoses (7), check that the O-rings (B) are installed and lubricate them with engine oil.

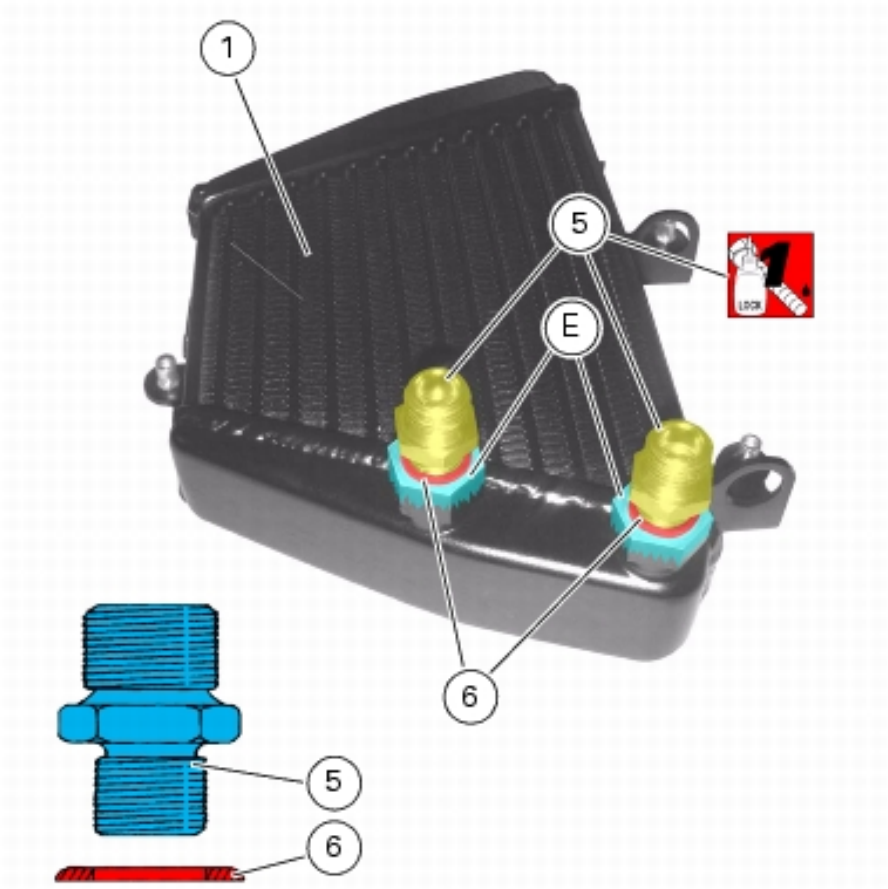


Insert a washer (6) on each nipple (5) and apply the recommended threadlocker to the threads on the cooler side.

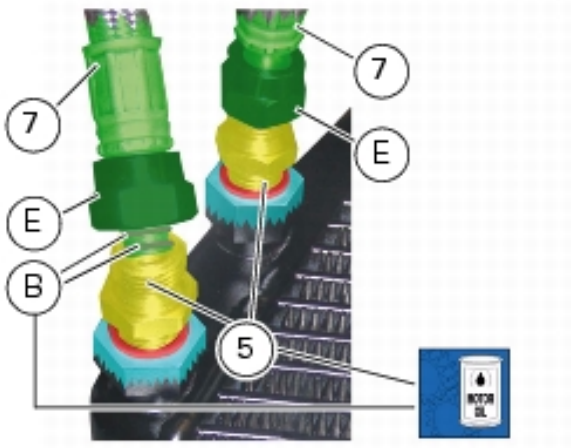
Notes

The washer (6) should be positioned with the square edge side facing the cooler.

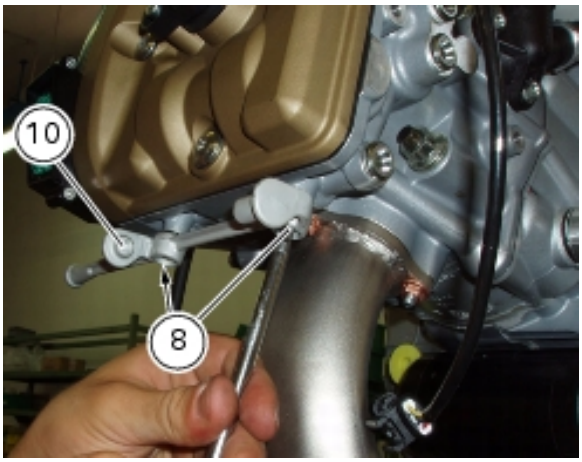
Fit the nipples (5) to the oil cooler (1) and, while counterholding the hex nuts (E), tighten them to the specified torque (Sect. C 3, Engine torque settings).



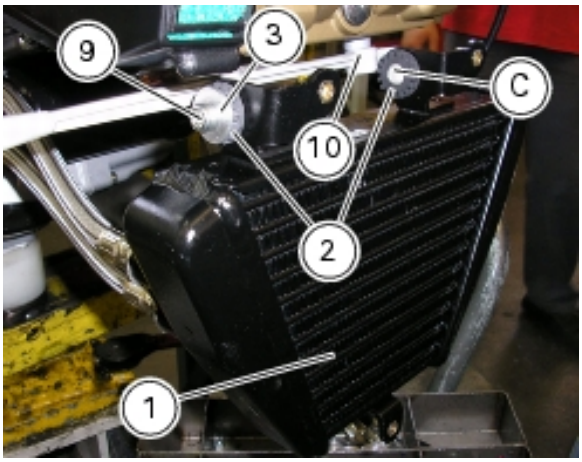
Lubricate the O-rings (B) of the two oil hoses (7) and the threads of the nipples (5) with engine oil.
Attach the hoses to the nipples (5) on the cooler, finger-tightening the union nuts (E).
Tighten the union nuts (E) to the specified torque (Sect. C 3, Engine torque settings) while counterholding the hex nuts on the nipples.



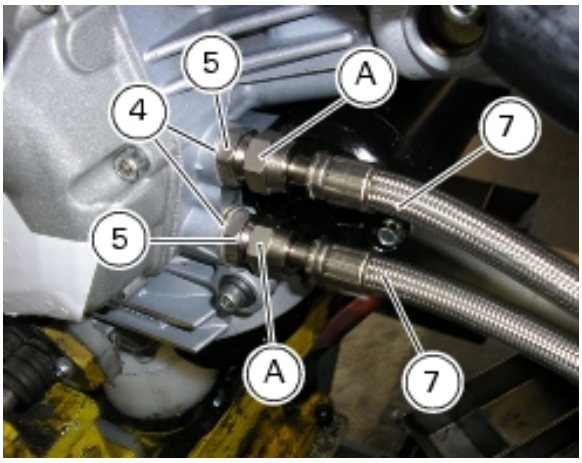
If removed, refit the support (10) securing it to the horizontal cylinder head with the two bolts (8).



Check that the rubber mountings are present on the oil cooler (2).
Fit the oil cooler (1), first inserting it in the pin (C) of the support (10).
Fit the spacer (3) and the bolt (9).
Tighten the bolt (9) to the specified torque (Sect. C 3, Engine torque settings).

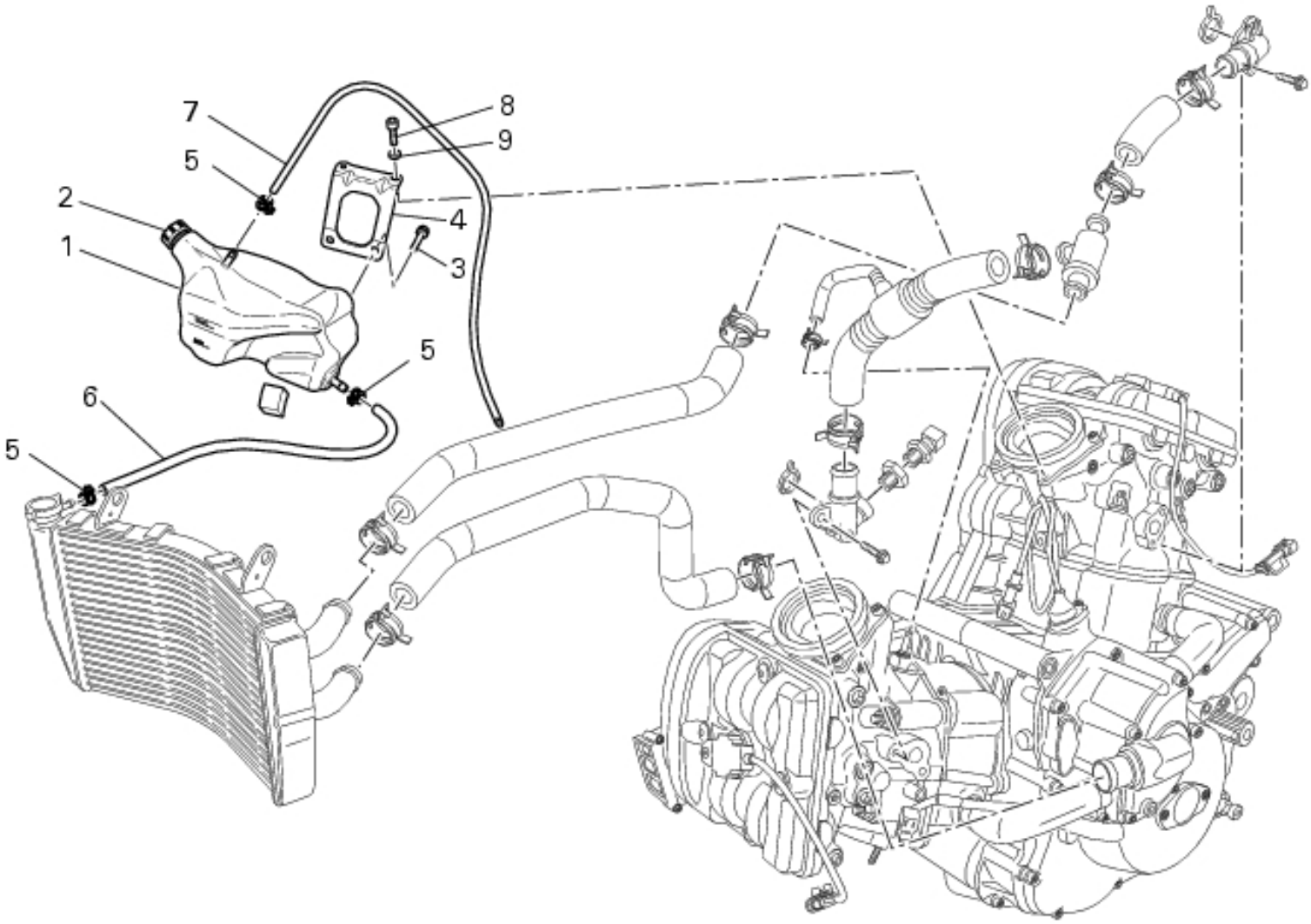


Locate the gaskets (4) and the nipples (5) in their bores in the crankcase.
Tighten the nipples (5) to the specified torque (Sect. C 3, Engine torque settings).
Locate the feed and return hoses (7) on the crankcase and tighten the nuts (A).



Operation	Section reference
Fill the lubrication system	D 4, Changing the engine oil and filter cartridge
Refit the side fairing panels	E 2, Refitting the side fairings

3.1 - Cooling system: coolant expansion tank



1 Coolant expansion tank
2 Filler cap
3 Bolt
4 Bracket
5 Hose clip
6 Breather hose
7 Breather hose
8 Bolt
9 Washer

Parts catalogue

COOLING SYSTEM

Important

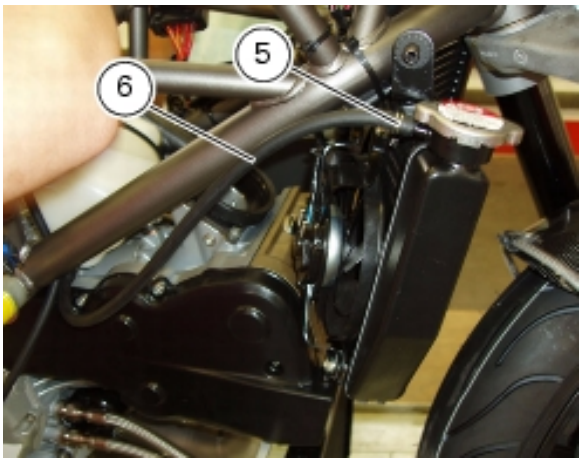
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the

exploded view diagram.

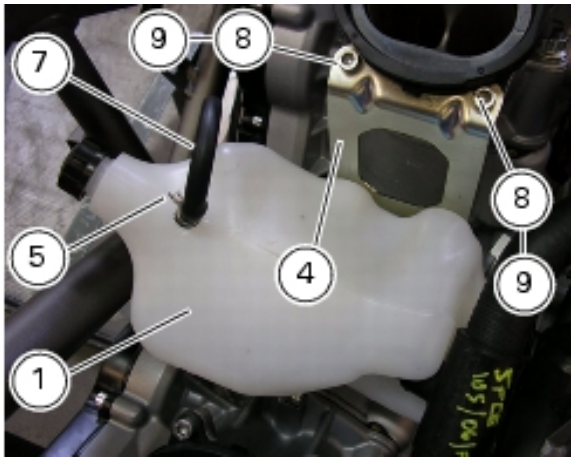
Removal of the expansion tank

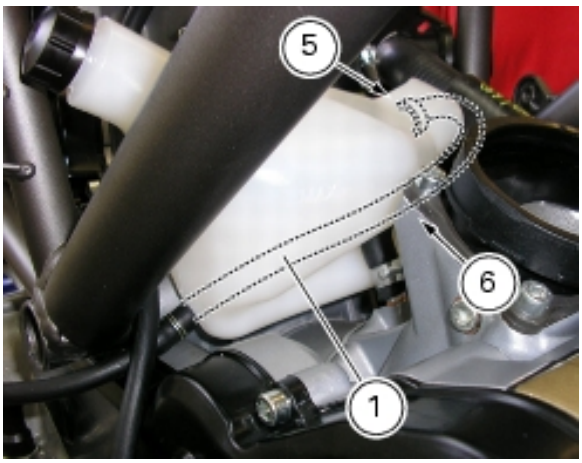
Operation	Section reference
Drain the cooling system	D 4, Changing the coolant
Remove the airbox	L 6, Refitting the airbox and throttle body

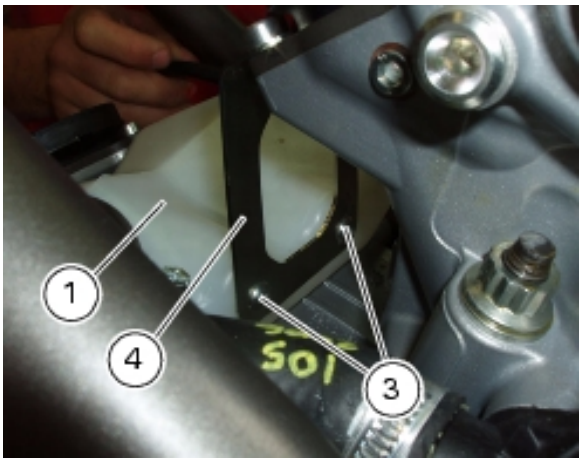
Loosen the clamp (5) and remove the hose (6) from the radiator.



Unscrew the two bolts (8) and recover the washers (9).
Remove the expansion tank (1) complete with the bracket (4) and the hoses (6) and (7).
Unscrew the bolts (3) to remove the tank (1) from the bracket (4).
Loosen the clamps (5) to remove the hoses (6) and (7) from the tank.

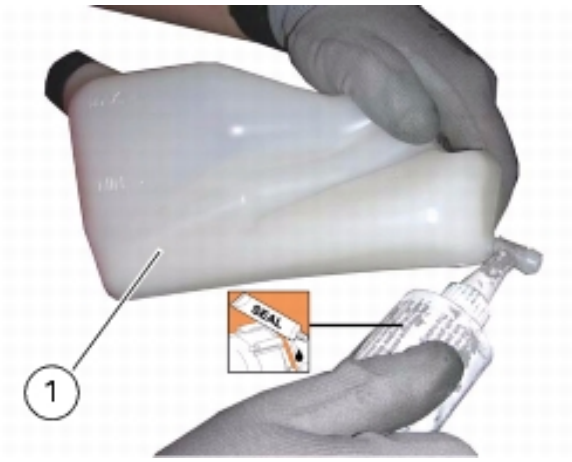




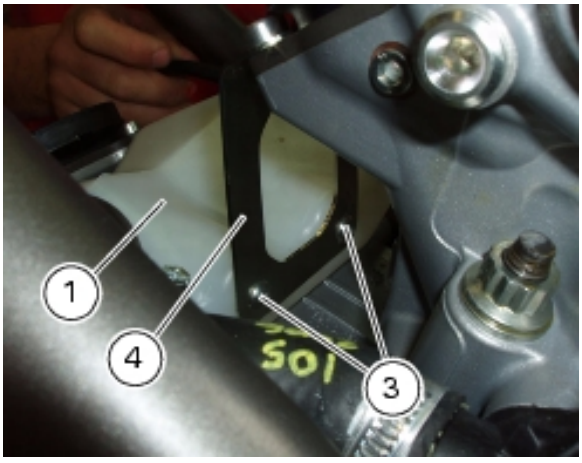


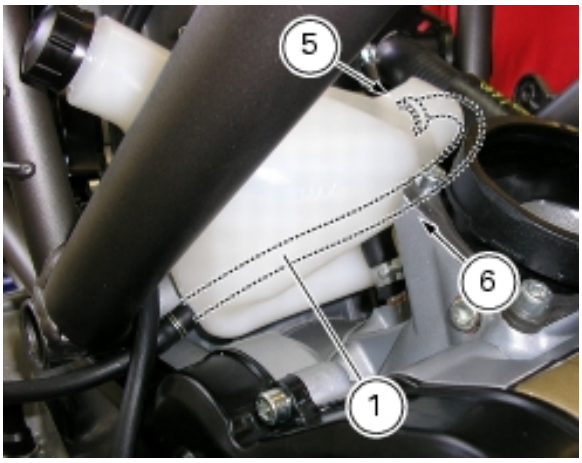
Refitting the expansion tank

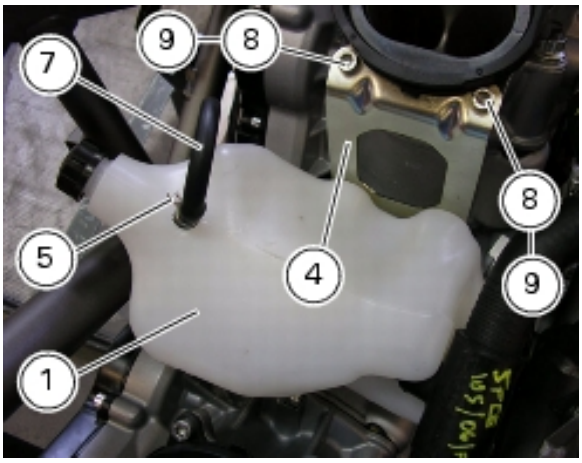
Apply liquid gasket to the lower lip of the expansion tank (1).



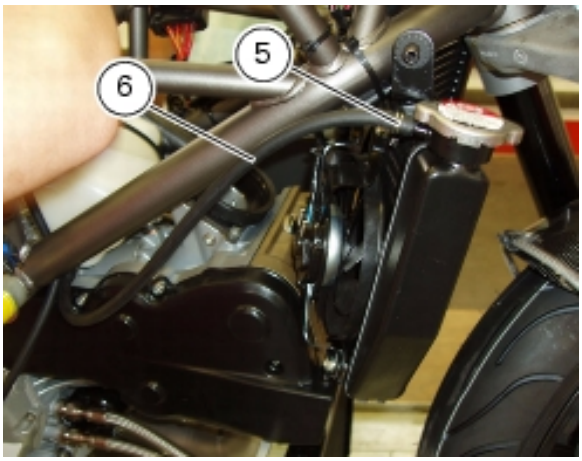
Locate the hoses (6) and (7) on the tank with the clamps (5).
Tighten the bolts (3) to the specified torque (Sect. C 3, Frame torque settings) to secure the tank (1) to the bracket (4).
Locate the expansion tank (1) complete with the bracket (4) and the hoses (6) and (7).
Fit the two bolts (8) with the washers (9) and tighten to the specified torque (Sect. C 3, Frame torque settings).





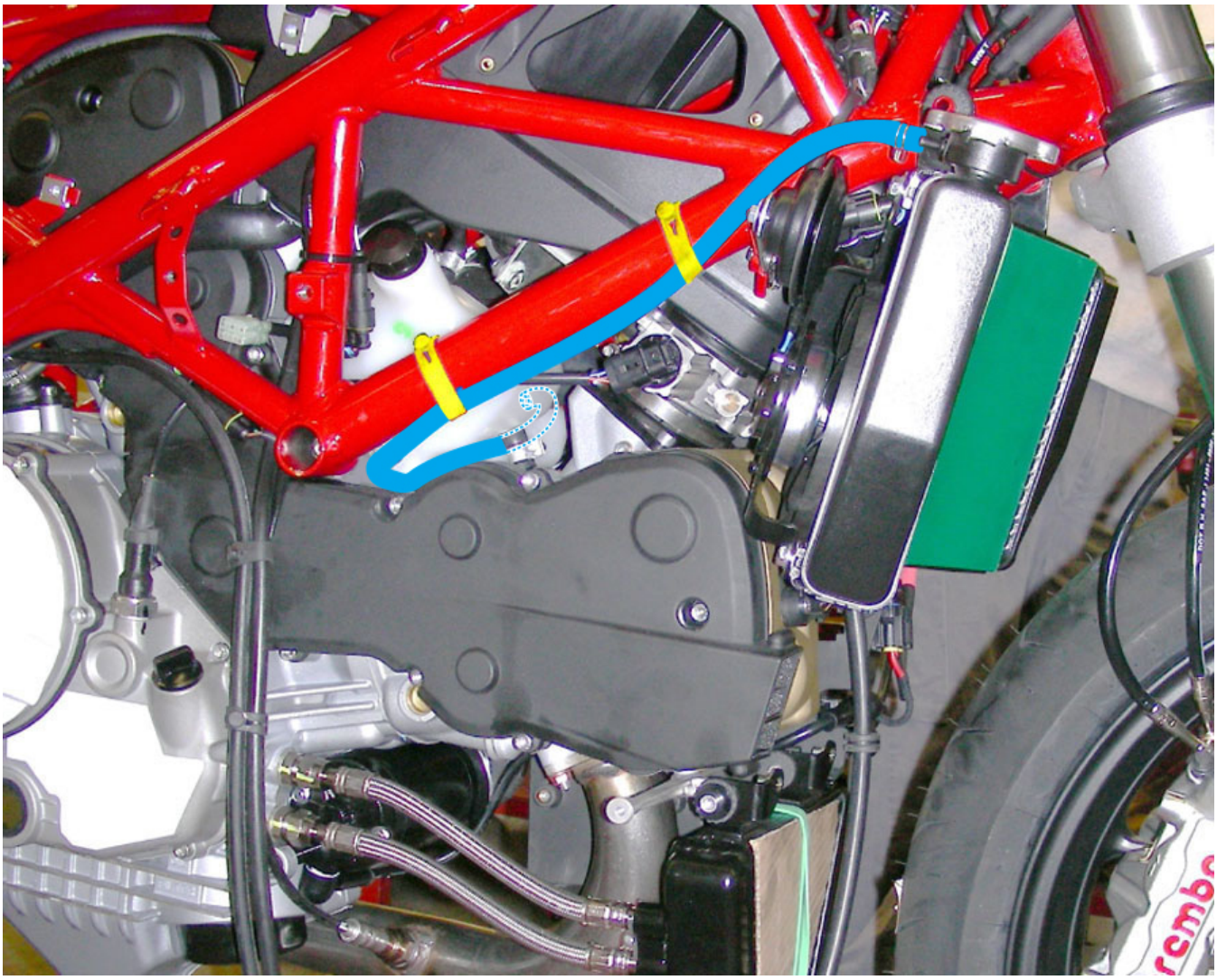


Attach the hose (6) to the radiator with the clamp (5).

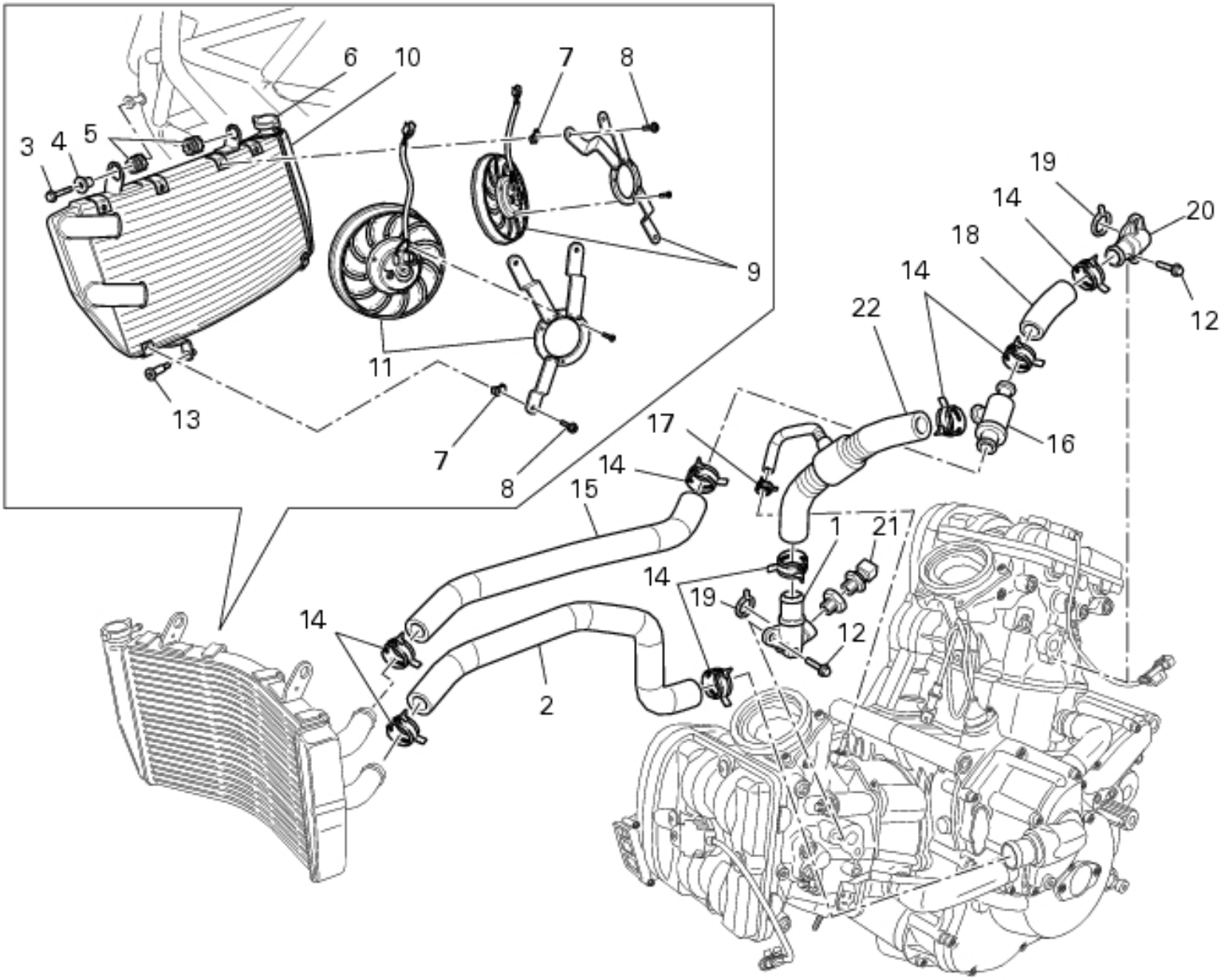


Operation	Section reference
Refit the airbox	L 6, Refitting the airbox and throttle body
Fill the cooling system	D 4, Changing the coolant

Positioning of the expansion tank-radiator connection hose



3.2 - Cooling system: radiator



1 Horizontal cylinder coolant outlet union
2 Pump/radiator hose
3 Bolt
4 Spacer
5 Rubber
6 Radiator cap
7 Clip
8 Bolt
9 RH cooling fan
10 Radiator
11 LH cooling fan
12 Bolt
13 Special bolt
14 Clamp
15 Radiator/thermostat hose
16 Thermostat
17 Clamp
18 Thermostat/cylinder head hose

19 Seal
20 Vertical cylinder coolant outlet union
21 Coolant temperature sensor
22 Thermostat/cylinder head hose

Parts catalogue

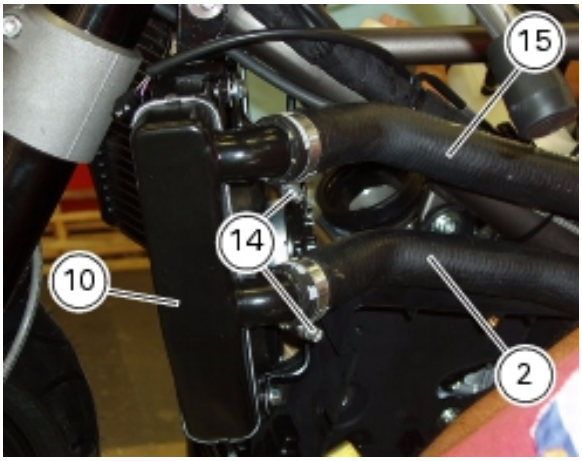
RADIATOR
COOLING SYSTEM

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

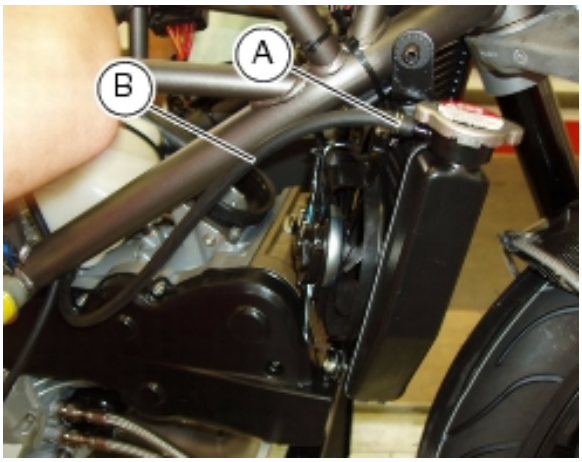
Removal of the radiator

Operation	Section reference
Remove the side fairing panels	E 2, Removal of the side fairings
Drain the cooling system	D 4, Changing the coolant
Remove the battery support	M 3, Removal of the battery support

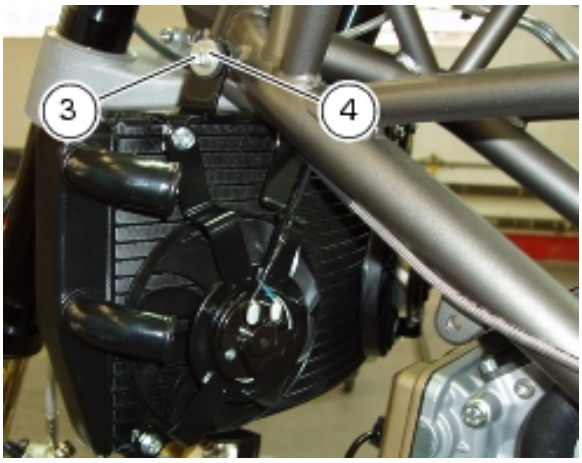
Loosen the clamps (14) on the coolant hoses (15) and (2); disconnect the hoses from the unions on the radiator (10).



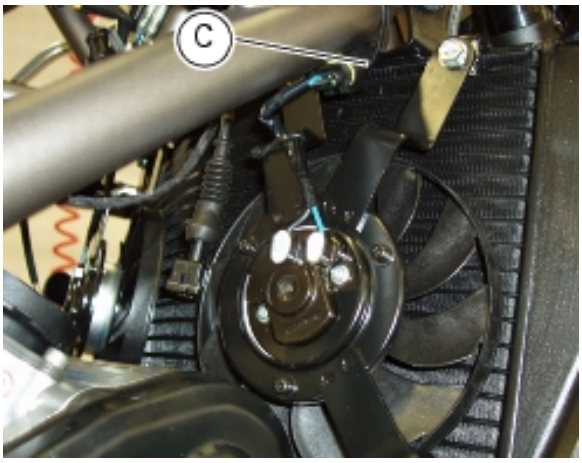
Loosen the clamp (A) and remove the expansion tank-radiator hose (B).



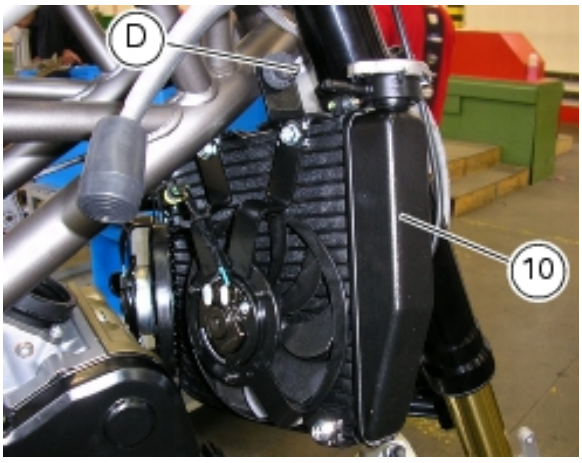
Unscrew the bolt (3) with the spacer (4) fixing the radiator to the left-hand side of frame.



Disconnect the wiring connectors of the main wiring loom (C) from both fans.



Remove the radiator (10) from the motorcycle, withdrawing it from the pin (D), on the upper right-hand side of the frame.



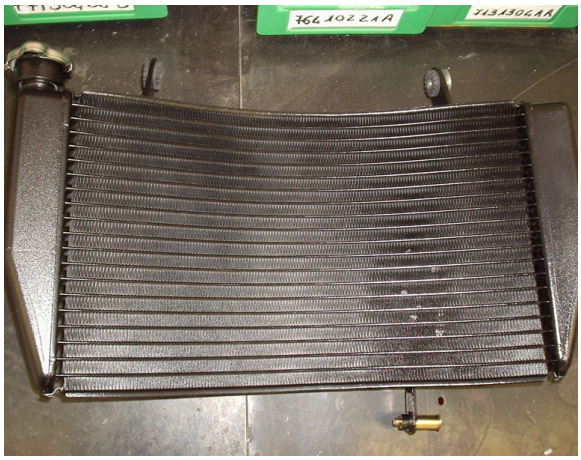
Radiator inspection

Visually inspect the radiator. If it shows signs of damage or leaks, the radiator must be renewed.
Check also that the air flow through the radiator core is not obstructed by leaves, insects, mud, etc.

Important

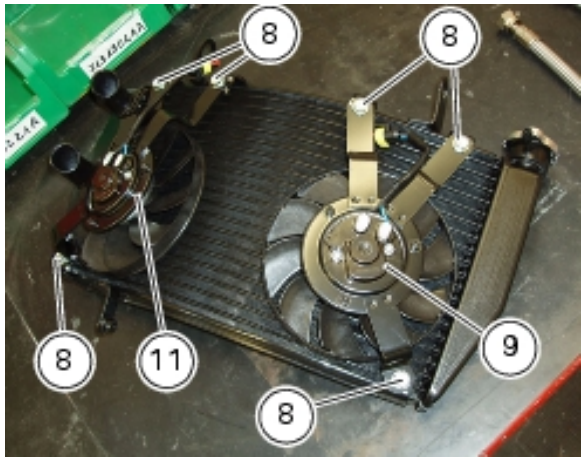
An excessively high coolant temperature may be caused by partial obstruction of the radiator core.

Carefully check the condition of the radiator core.



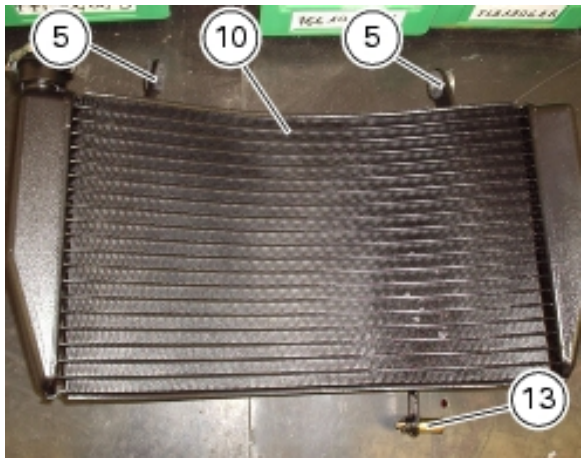
Renewal of the cooling fan

Unscrew the three fan retaining bolts (8) and remove the fan (11) from the radiator.
Repeat the above operation for the other cooling fan (9).
Tighten the bolts (8) to the specified torque (Sect. C 3, Frame torque settings).

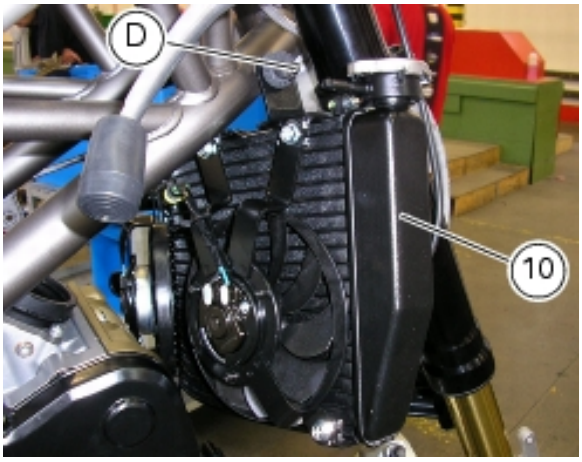


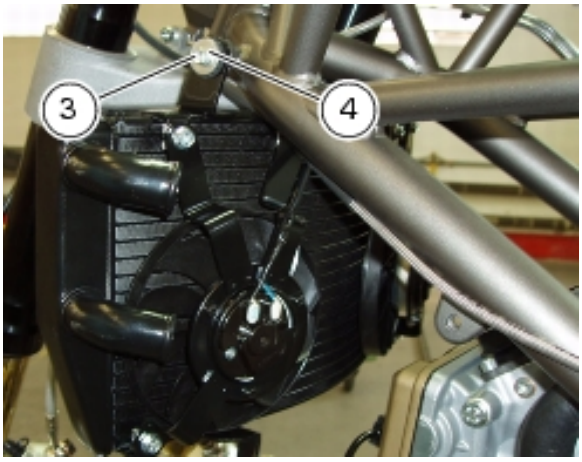
Refitting the radiator

Check that the rubber mountings (5) are present on the upper radiator brackets (10) and that the special bolt (13) is fitted.

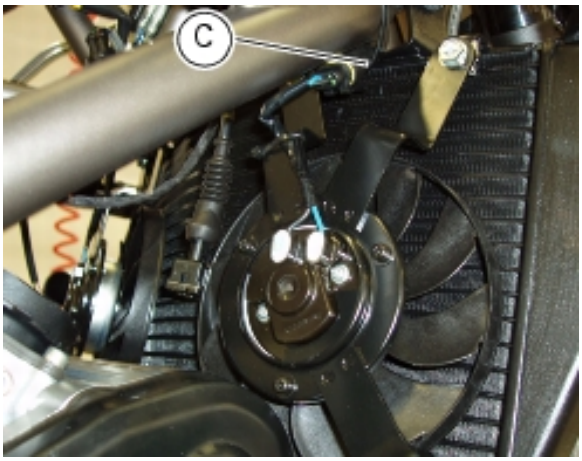


Insert the support of radiator (10) on the pin (A) on the right-hand side of the frame and then fit the bolt (3) with the spacer (4) on the left-hand side.
Tighten the bolt (3) to the specified torque (Sect. C 3, Frame torque settings).

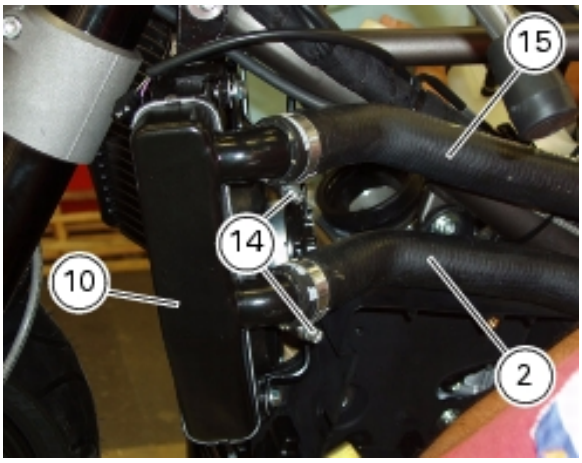




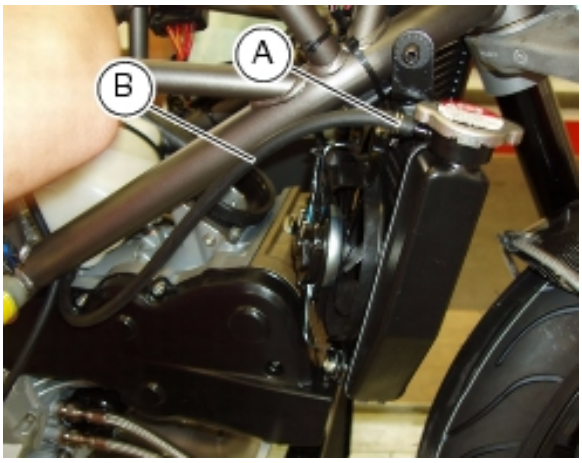
Reconnect the fan wiring to the main wiring loom (C).



Connect the cooling system hoses (15) and (2) to their respective unions on the radiator and tighten the clamps (14) to the specified torque (Sect. C 3, Frame torque settings).



Attach the expansion tank-radiator connection hose (B) to the inlet on the radiator cap with the clamp (A).

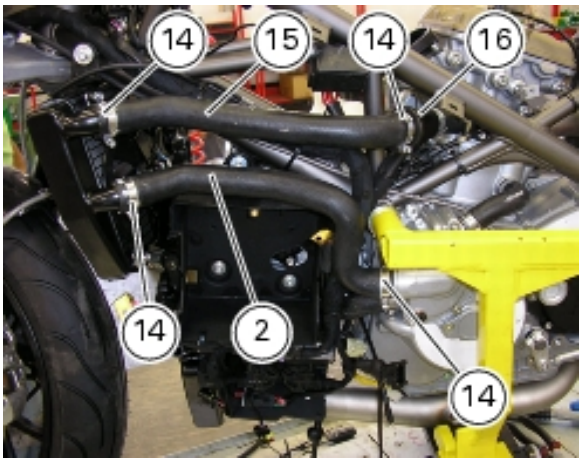


Operation	Section reference
Refit the battery support	M 3, Refitting the battery support
Fill the cooling system	D 4, Changing the coolant
Refit the side fairing panels	E 2, Refitting the side fairings

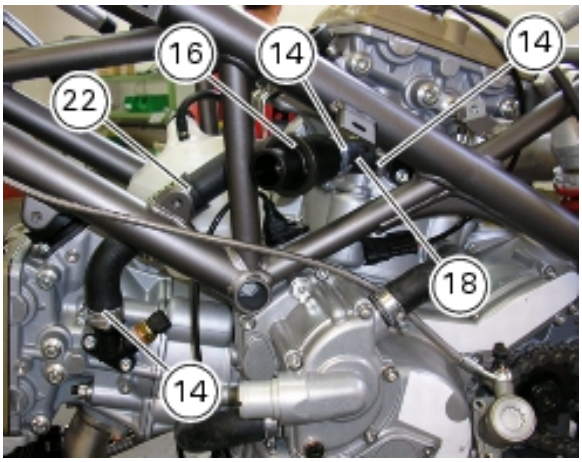
Removal of the cooling system hoses and unions

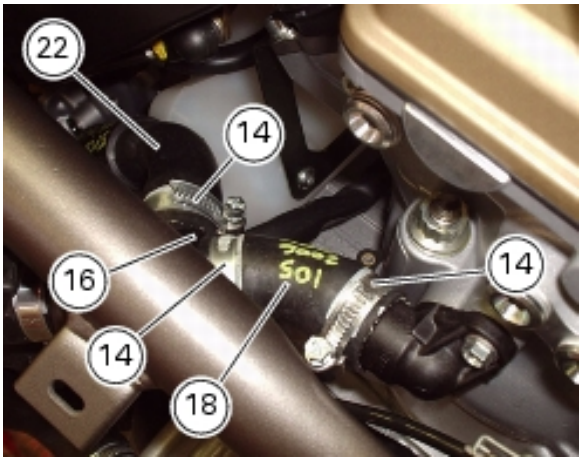
Operation	Section reference
Remove the side fairing panels	E 2, Removal of the side fairings
Drain the cooling system	D 4, Changing the coolant
Remove the battery support	M 3, Removal of the battery support

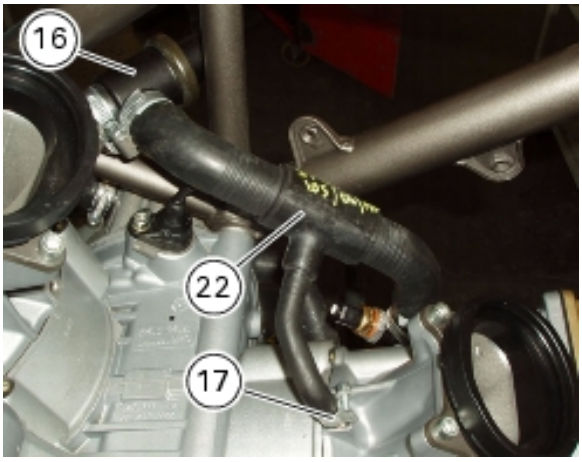
Loosen the clamps (14) securing the hose (2) connecting the radiator (10) to the pump and the radiator/thermostat hose (15) to the thermostat (16).



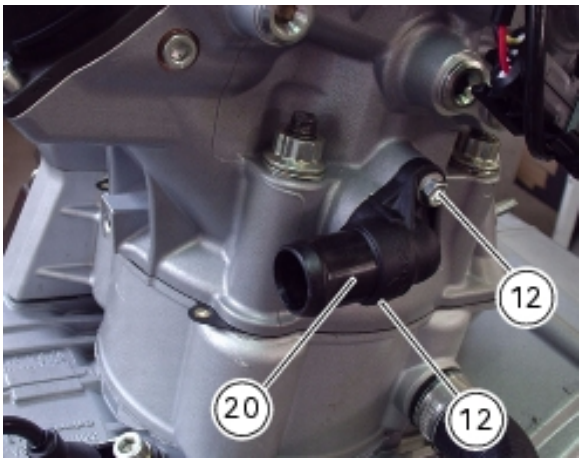
Loosen the clamps (14) and (17) securing the thermostat assembly (16) - thermostat/cylinder head hose (18) - thermostat/cylinder head hose (22).
Loosen the clamps (14) to dismantle the thermostat assembly (16) - thermostat/cylinder head hose (18) - thermostat/cylinder head hose (22).



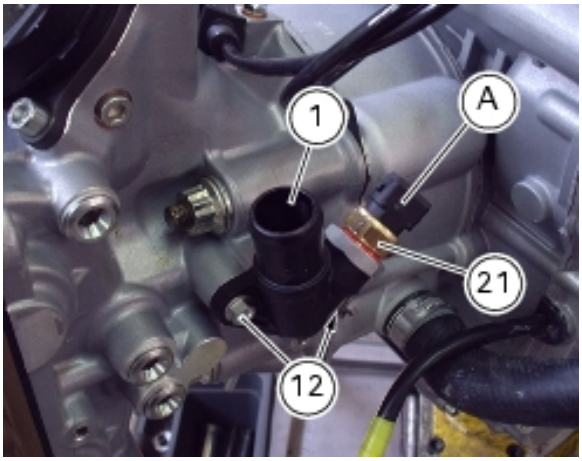




Unscrew the bolts (12) and remove the union (20).
Recover the O-rings (**19**) located between the union and the vertical cylinder head.



Disconnect the wiring connector (A) of the temperature sensor (21) on the horizontal cylinder head union (1) from the main wiring loom.
Unscrew the bolts (12) and remove the horizontal cylinder union (1).
Recover the O-rings (**19**) located between the union and the horizontal cylinder head.

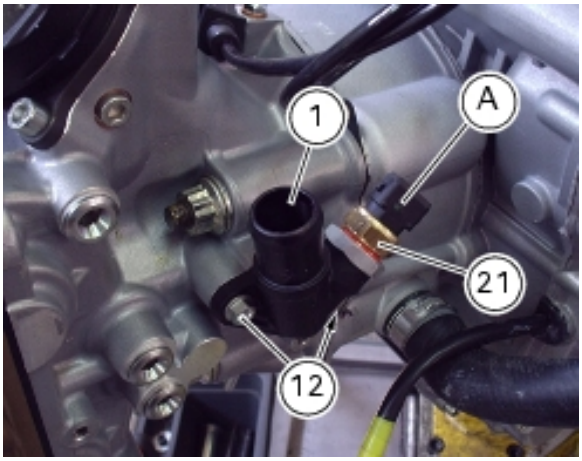


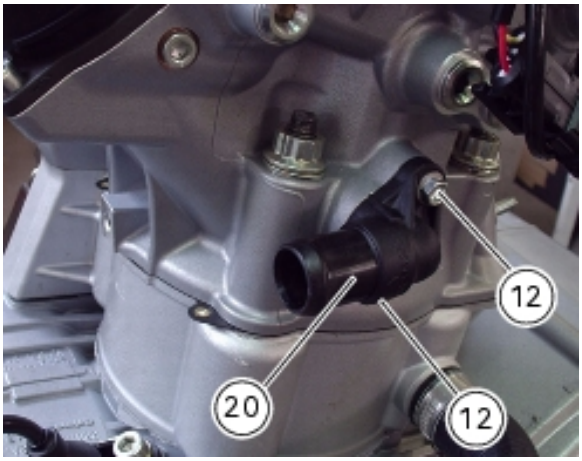
Important
Periodically check the connection hoses for leaks.
Hoses that are cracked, swollen, or hardened should be renewed.

Refitting the cooling system hoses and unions

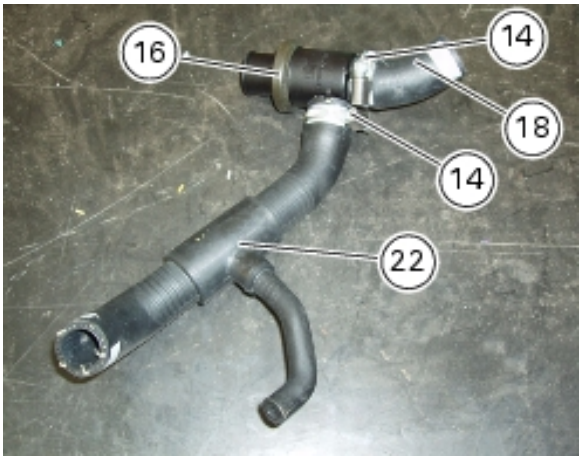
Install a seal (**19**) in the seat on the horizontal cylinder head union (1) and one in seat of the union (20).
Fix the union (1) to the horizontal cylinder head (12) and tighten the bolts to the specified torque (Sect. C 3, Frame

torque settings).
Fix the union (20) to the horizontal cylinder head (12) and tighten the bolts to the specified torque (Sect. C 3, Frame torque settings).
Reconnect the wiring connector (A) of the temperature sensor (21) on the horizontal cylinder head union (1) to the main wiring loom.

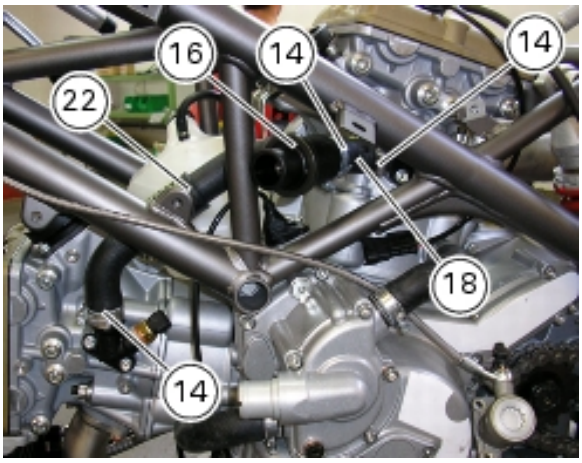


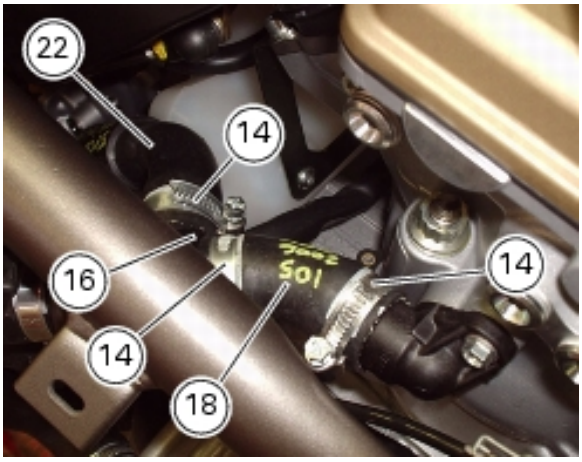


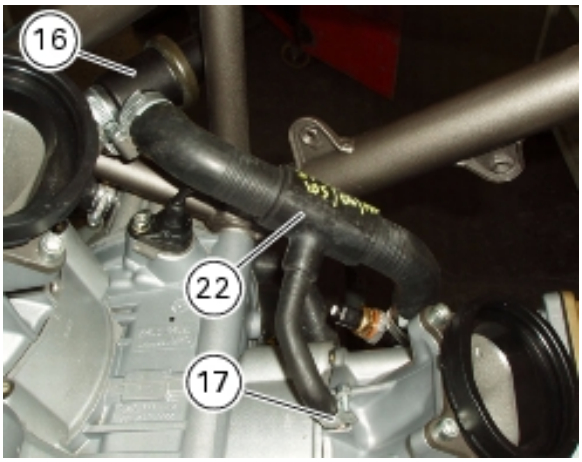
To reassemble the thermostat (16) - thermostat/cylinder head hose (18) - thermostat/cylinder head hose (22) assembly, locate the clamps (14) and tighten to the specified torque (Sect. C 3, Frame torque settings).



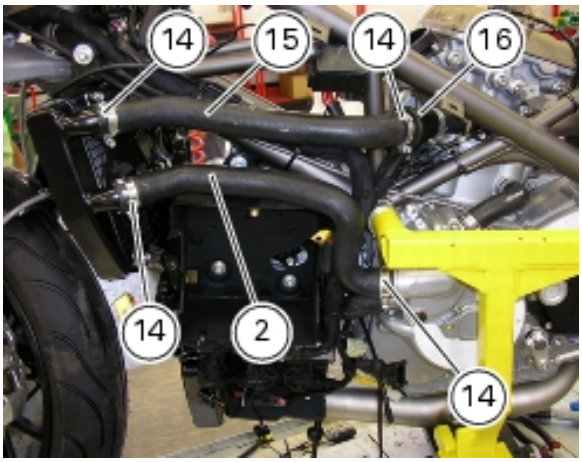
Locate the thermostat (16) - thermostat/cylinder head hose (18) - thermostat/cylinder head hose (22) assembly with the clamps (14) and (17) and tighten the clamps to the specified torque (Sect. C 3, Frame torque settings).





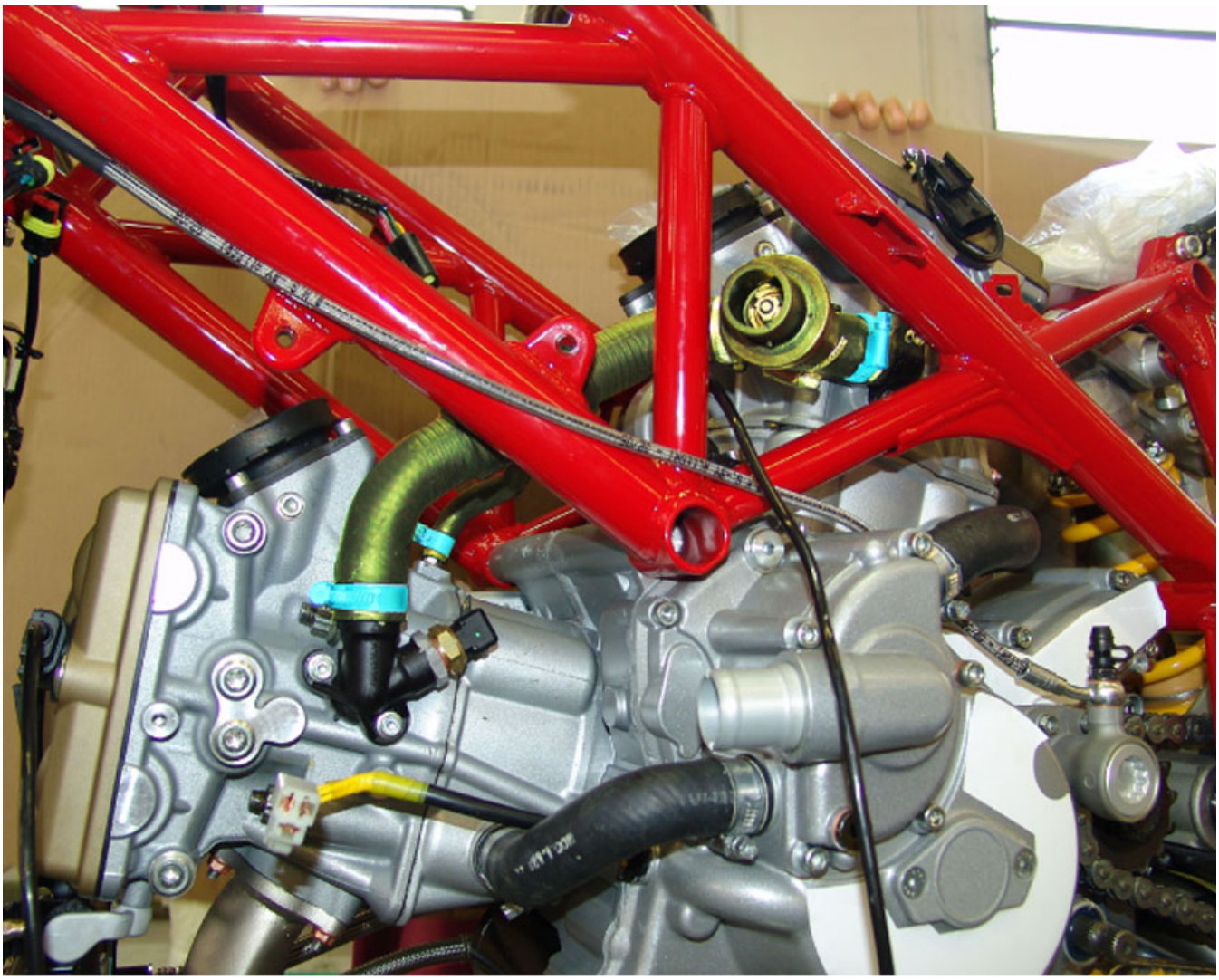


Locate the pump/radiator hose (2) and radiator/thermostat hose (15) with the clamps (14) and tighten the clamps to the specified torque (Sect. C 3, Frame torque settings).

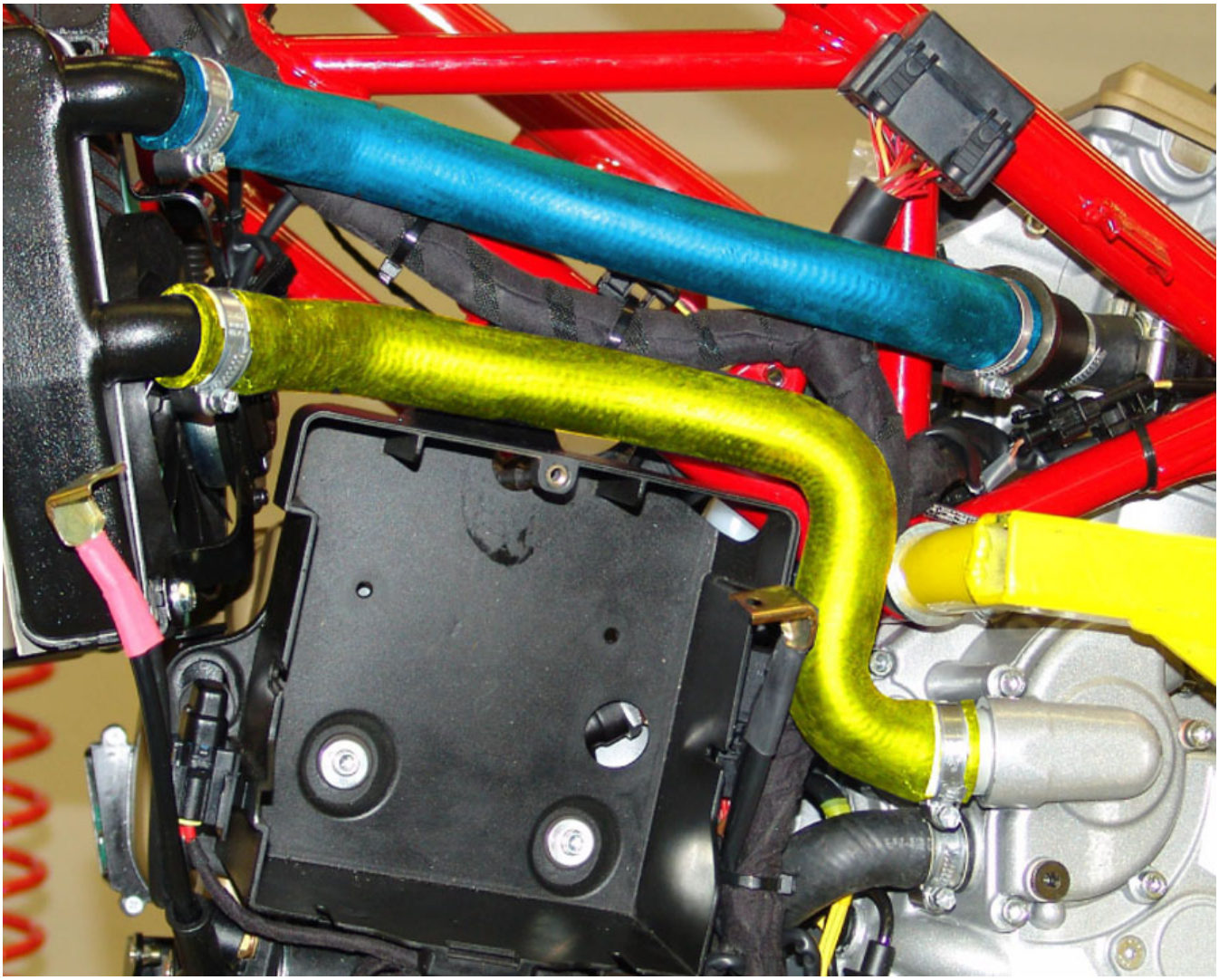


Operation	Section reference
Refit the battery support	M 3, Refitting the battery support
Fill the cooling system	D 4, Changing the coolant
Refit the side fairing panels	E 2, Refitting the side fairings

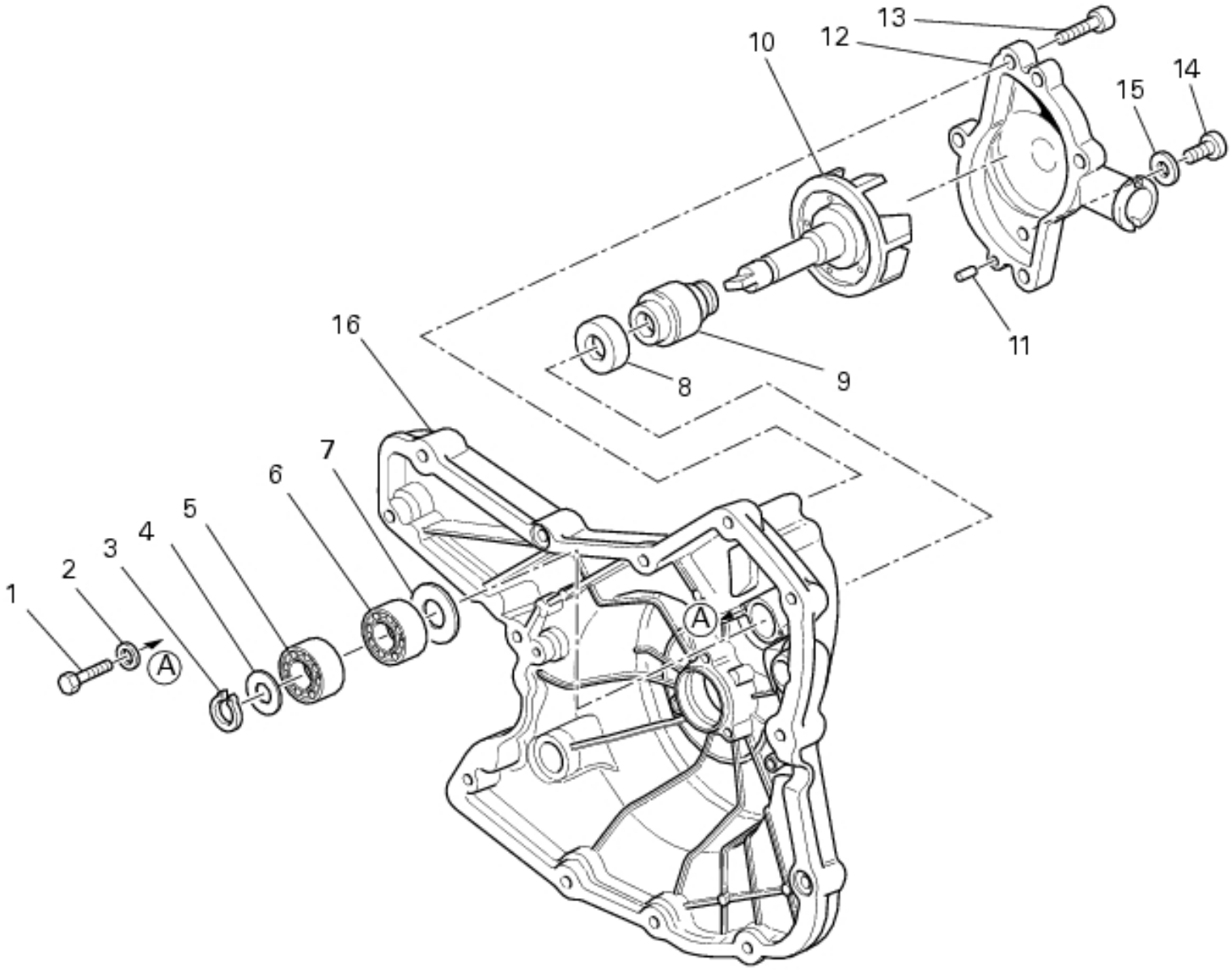
Positioning of the thermostat hose clamps



Positioning of the radiator hoses



3.3 - Cooling system: water pump



1 Bolt
2 Washer
3 Circlip
4 Washer
5 Outer bearing
6 Inner bearing
7 Spacer
8 Locating ring
9 Mechanical seal
10 Water pump impeller
11 Locating dowel
12 Water pump cover assembly
13 Bolt
14 Plug
15 Seal
16 Alternator-side crankcase cover

Parts catalogue

WATER PUMP-ALTR-SIDE CRANKCASE COVER

Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

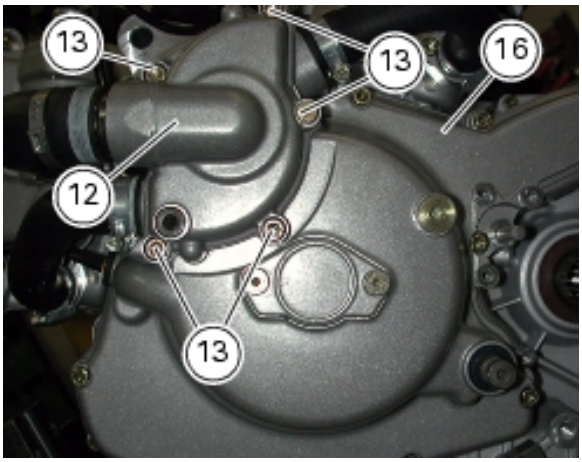
Removal of the water pump

Operation	Section reference
Remove the side fairing panels	E 2, Removal of the side fairings
Drain the cooling system	D 4, Changing the coolant
Remove the cooling circuit hoses from the water pump cover	N 3.2, Removal of the cooling system hoses and unions
Remove the alternator-side crankcase cover	N 8, Removal of the alternator-side crankcase cover

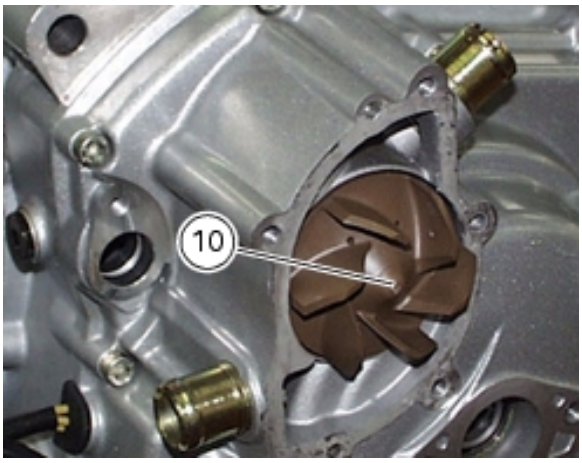
Notes

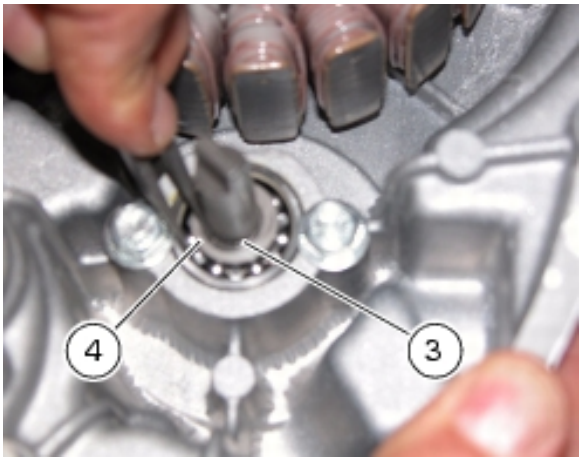
For clarity, the figures show the engine removed from the frame.

Unscrew and remove the five bolts (13) securing the water pump cover (12) to the alternator-side crankcase cover (16).
Remove the water pump cover (12).

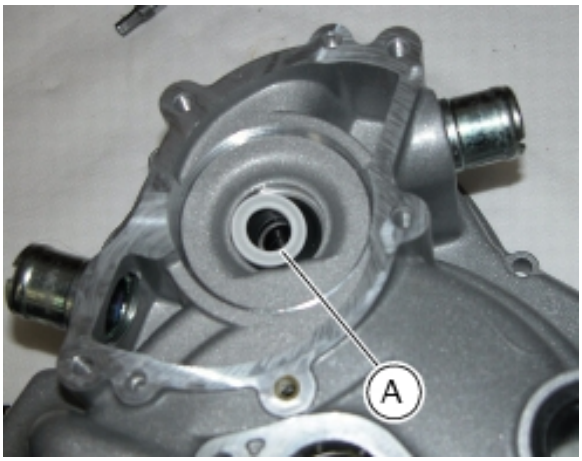


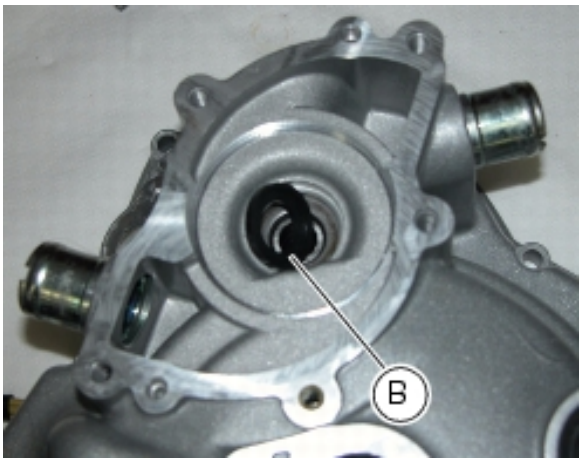
Clean the pump housing of any scale. Rotate the impeller shaft (10) to check the bearings for wear. If there is excessive play, renew the bearings as follows.
Remove the circlip (3) and washer (4) from the impeller shaft.
Withdraw the impeller (10) with the mechanical seal (**9**) from the outside.



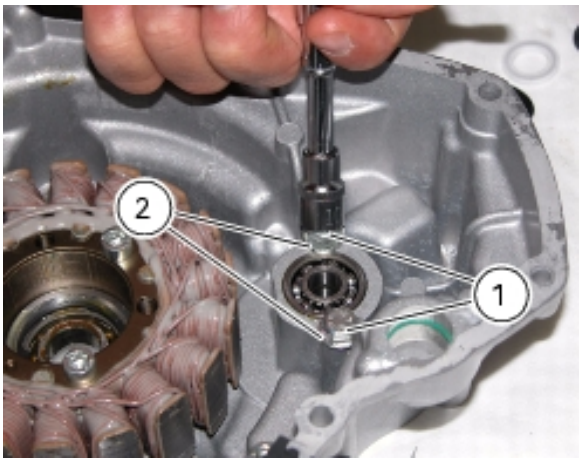


Recover the ceramic washer (A) and seal ring (B) located on the inner side.

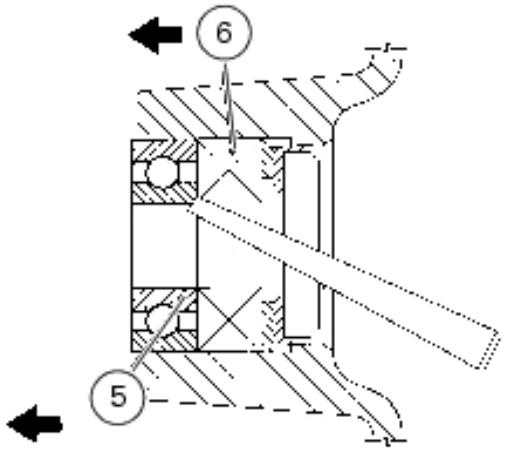




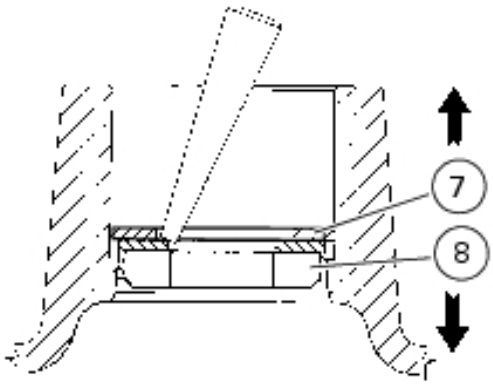
Undo and remove the bolts (1) with the washer (2).



Working from the impeller side, use a suitable drift to press on the inner race of end bearing (5) until it can be extracted from the cover.
Use the same technique to remove the other bearing (6).

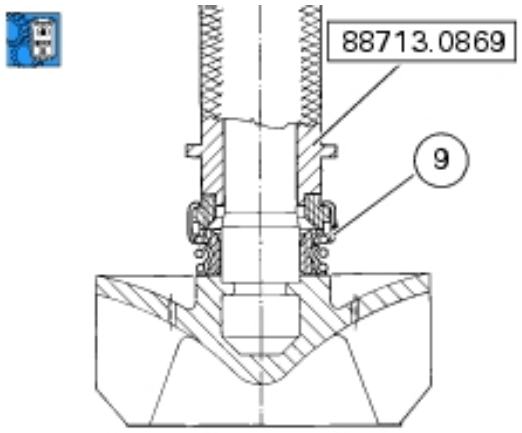


Working from the inside of the cover, remove the seat (8) of the mechanical seal (**9**).
Remove the inner spacer (7).
Check the condition of the components of the mechanical seal: there should be no signs of deformation, cracking, or excessive wear. In the case of damage, both components must be renewed.

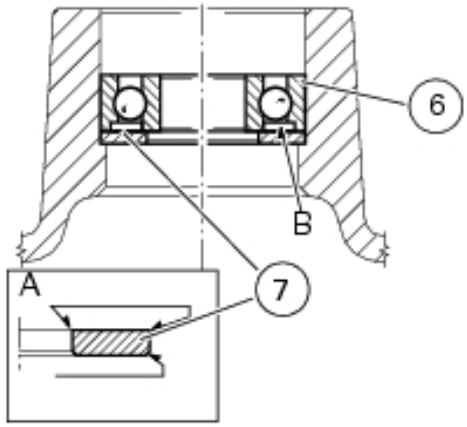


Refitting the water pump

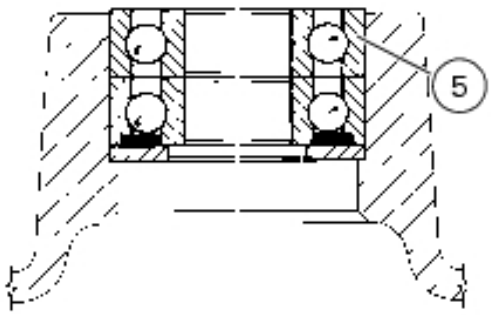
Clean the seat in the cover, any parts you intend to reuse, and the impeller shaft. Lubricate with engine oil and refit as follows.
Using drift part no. **88713.0869** fit the new seal (9) on the impeller shaft.



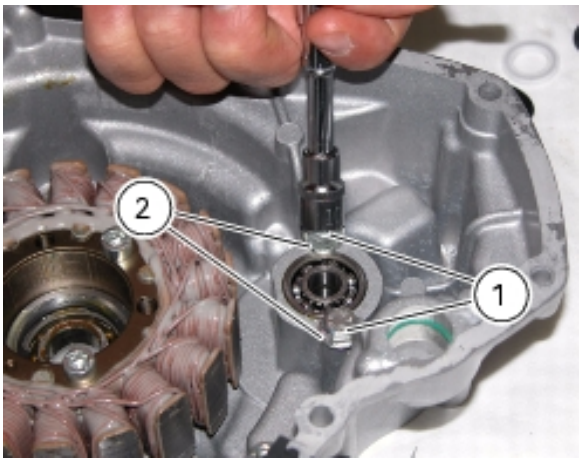
Working from the inside of the cover, fit the inner spacer (7) with its square edge (A) facing outwards.
Using a suitable drift that bears on the outer race, drive home the bearing (6) against the spacer (7) with the shield side (B) facing the cover.



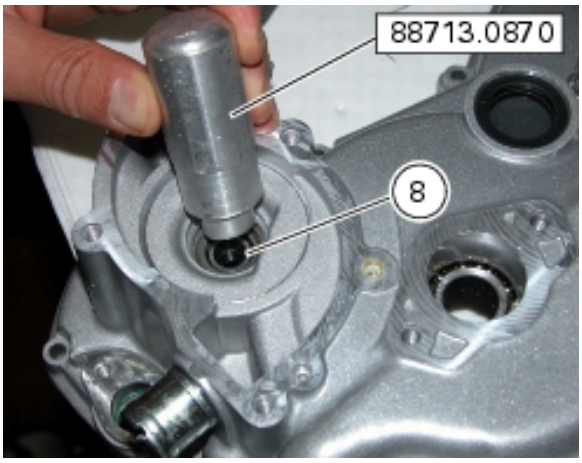
Fit the other bearing (5) and drive it fully home against the previously fitted bearing.

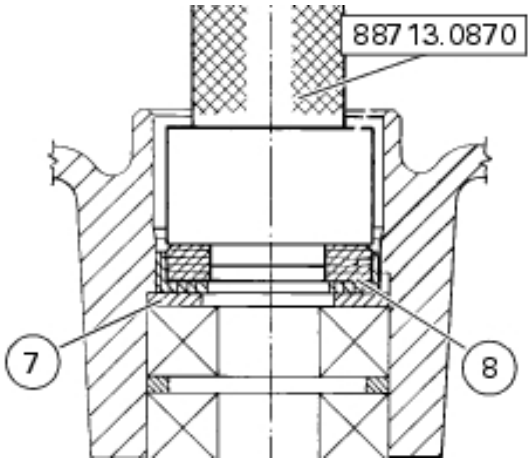


Fit the two bolts (1) with washers (2) and tighten them to the specified torque (Sect. C 3, Engine torque settings).

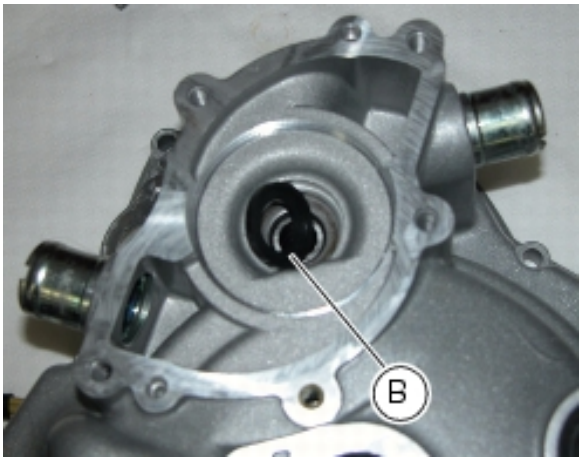


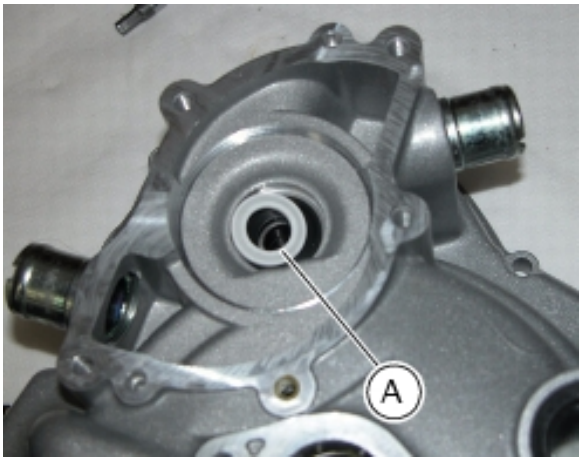
Turn over the cover and fit the locating ring (8) using tool no. **88713.0870**. Locate the ring as shown in figure and drive it in until it seats against the spacer (7).



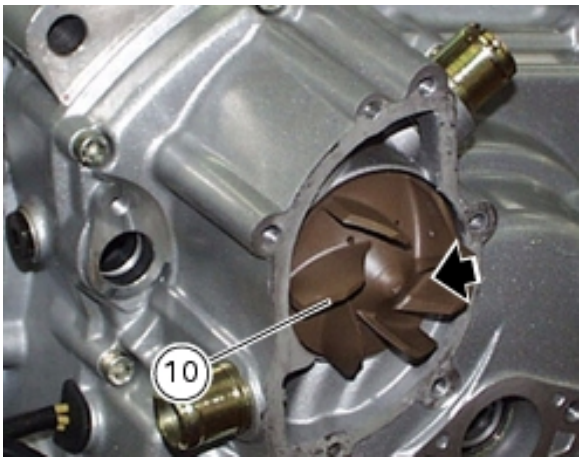


Fit the seal ring (B) and the ceramic washer (A).

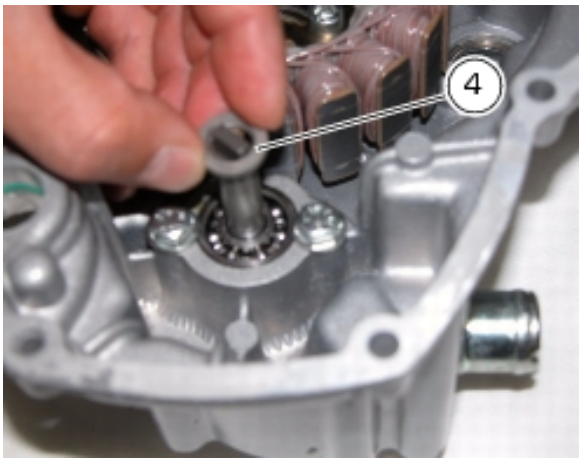


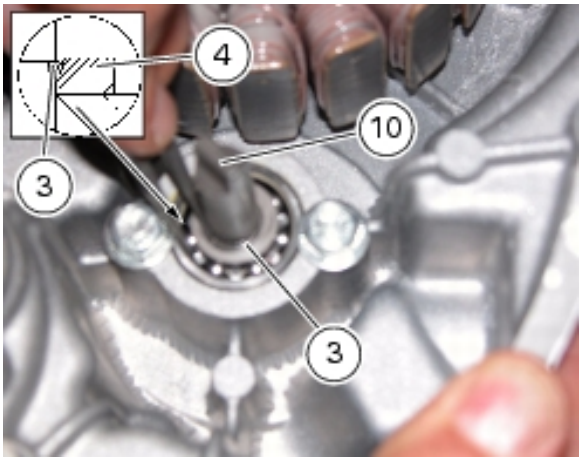


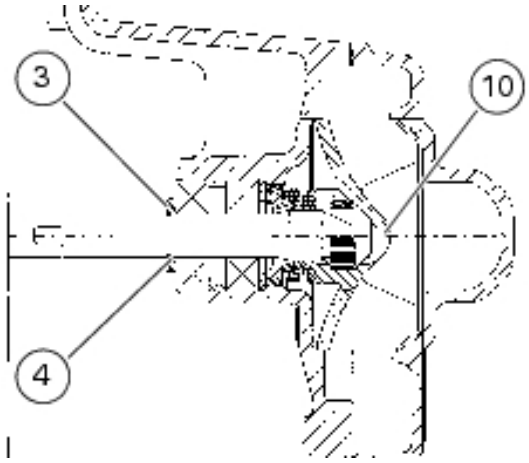
Insert the impeller shaft (10) with the mechanical seal (**9**). Turn the cover over.



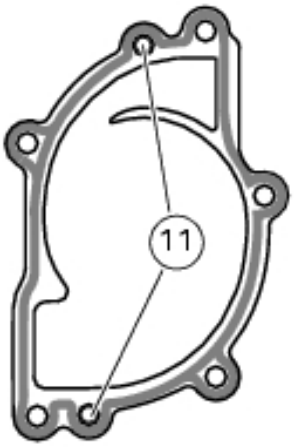
Fit the spacer (4), positioned as shown in the cross-sectional view, and lock the assembly in place with circlip (3).
Rotate the impeller (10) and make sure it turns smoothly without sticking.
Clean the mating surfaces thoroughly on the pump cover and on the alternator-side crankcase cover.

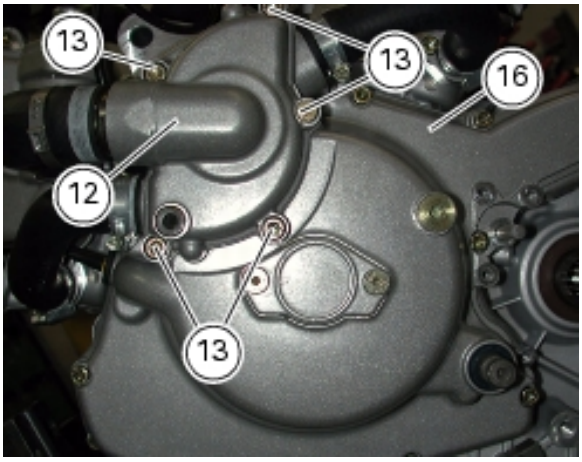






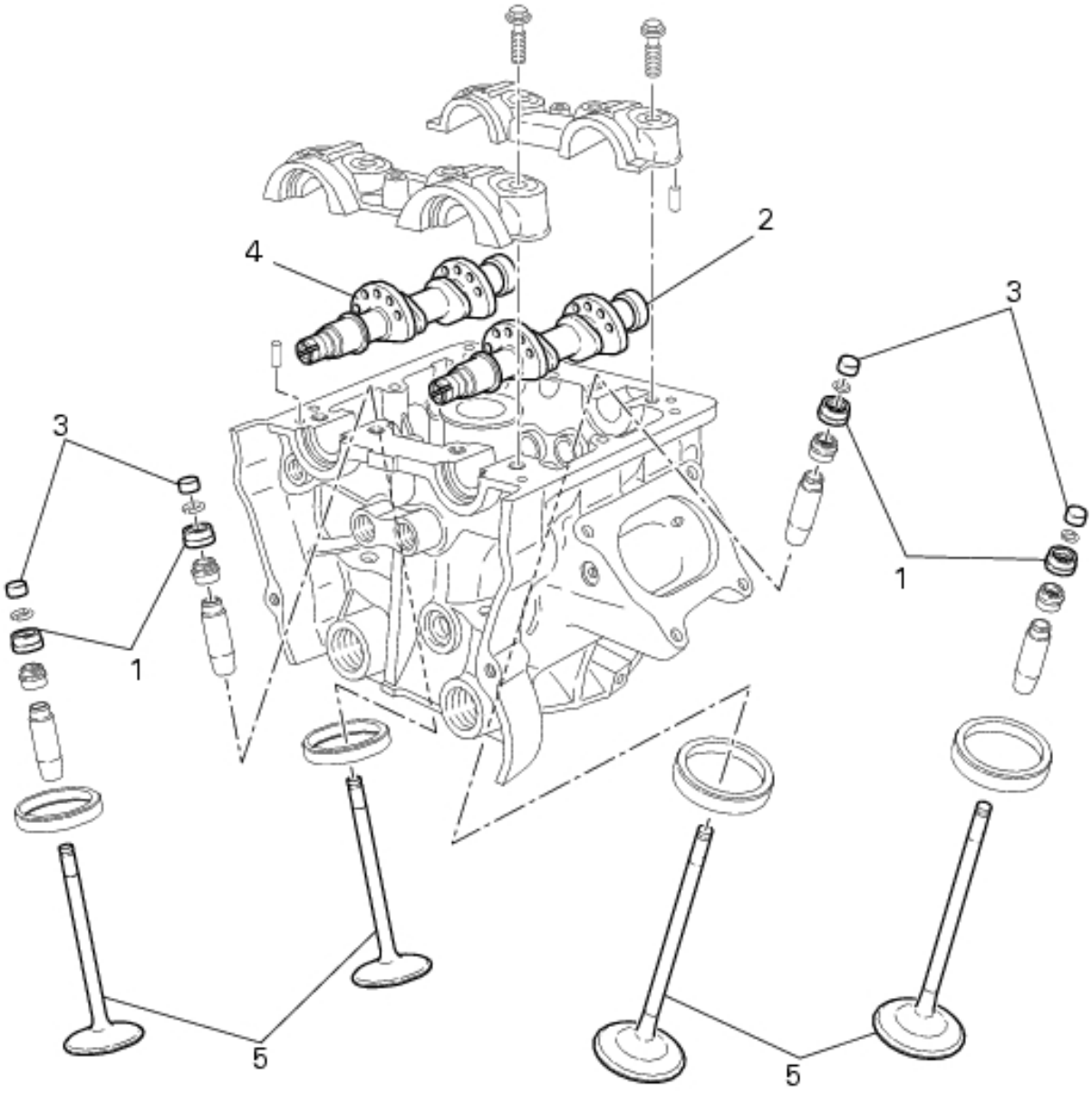
Apply a bead of liquid gasket to the water pump cover (12) as shown in the figure.
Fit the locating dowels (11) and position the pump cover (12) on the alternator-side crankcase cover.
Start the cover bolts (13) in their threads.
Tighten the bolts (13) to the specified torque (Sect. C 3, Engine torque settings).
Refit the components removed in the procedure.





Operation	Section reference
Refit the alternator-side crankcase cover and connect the cooling system hoses to the crankcase cover	N 8, Refitting the alternator-side crankcase cover
Refit the cooling system hoses to the water pump cover	N 3.2, Refitting the cooling system hoses and unions
Fill the cooling system	D 4, Changing the coolant
Fit the side fairing panels	E 2, Refitting the side fairings

4.1 - Cylinder head assemblies: checks and adjustments



1 Closing shim
2 Intake side camshaft
3 Opening shim
4 Exhaust side camshaft
5 Valve

Parts catalogue

Cylinder head: timing system
Vertical cylinder head
HORIZONTAL cylinder head

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Checking and adjusting the valve clearances

Operation	Section reference
Remove the side fairing panels	E 2, Removal of the side fairings
Remove the radiator	N 3.2, Removal of the radiator
Remove the airbox	L 6, Refitting the airbox and throttle body
Remove the timing belts	N 4.2, Removal of the tensioner pulley/timing belt
Remove the cylinder head cover	N 4.4, Removal of the camshafts

Notes

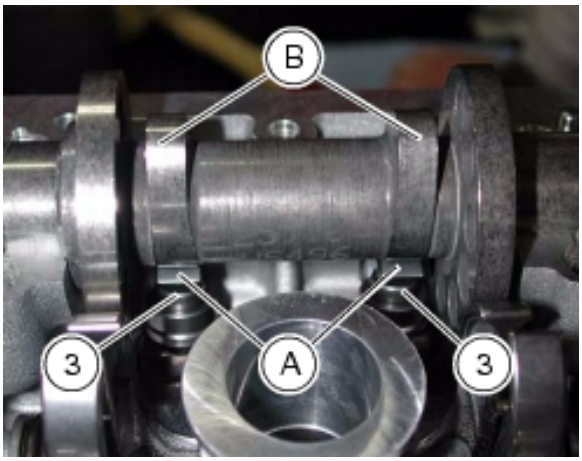
For clarity, the figures show the engine removed from the frame.

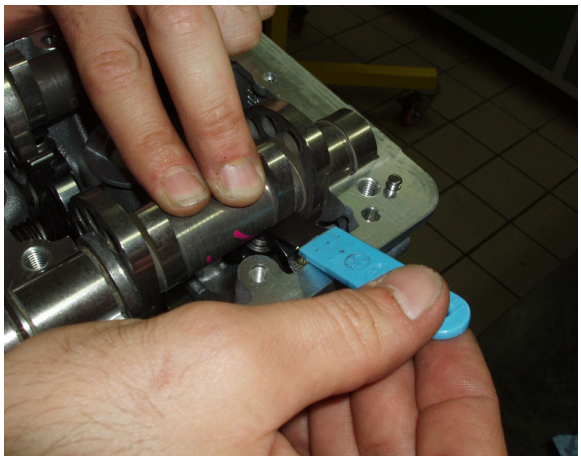
Checking the opening clearance

Move the piston of the cylinder being checked to TDC of the power stroke: in this condition all the valves are closed and the camshafts are in their rest position and thus free to rotate.
Using a feeler gauge, check the clearance between the opening rocker arm (A) and the lowest point of the camshaft lobe (B), taking care not to compress the rocker arm return spring.
The clearance must be within the specified limits (Sect. C 1.1, Timing system/valves).
If not, remove the opening shim (3), as described in the paragraph Removal of the valves", Sect. N 4.5, and replace it with a shim of appropriate thickness to obtain the specified clearance.

Notes

Opening rocker arm shims measuring 1.82 to 3.45 are available as replacement parts: each shim is marked with its size.





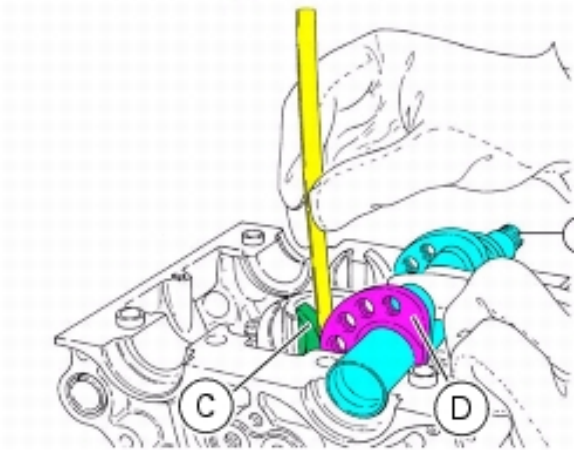
Checking the closing clearance

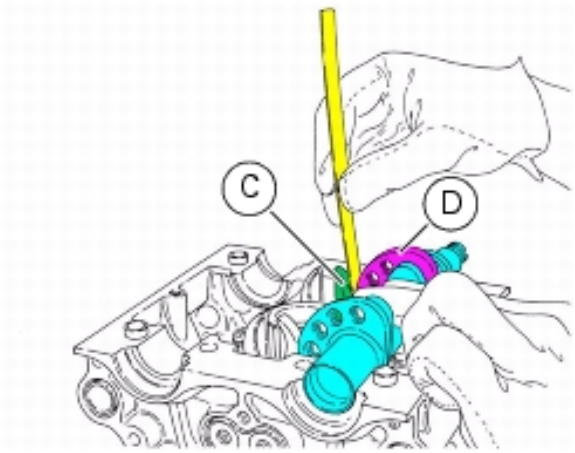
Using a feeler gauge, check the clearance between the closing rocker arm (C) and the highest point of the camshaft lobe (D).
The clearance must be within the specified limits (Sect. C 1.1, Timing system/valves).
If it is not, remove the closing shim (1), as described in the paragraph "Removal of the valves" (Sect. N 4.5), and replace it with a shim of suitable thickness to obtain the specified clearance.

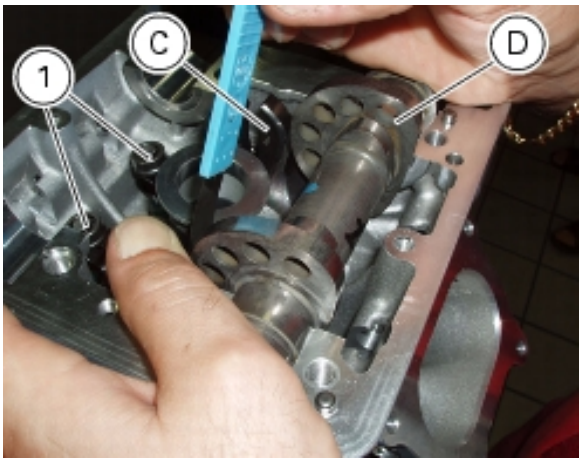
Notes

Closing rocker arm shims measuring from 2.2 to 4.5 are available as replacement parts: each shim is marked with its size.

Check and adjust the clearances of all valves.
Refit the opening and closing shims as described in the paragraph "Reassembly of the cylinder head" (Sect. N 4.5).

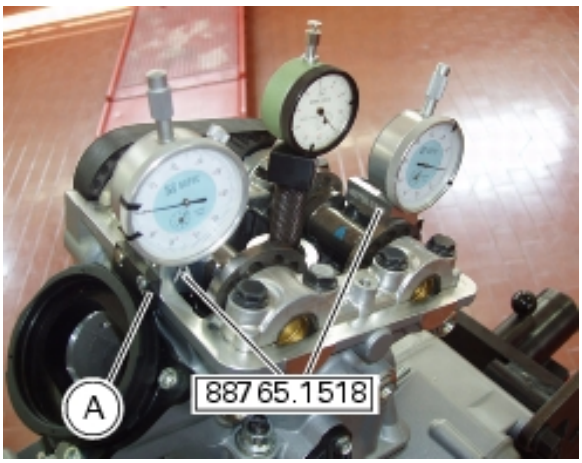


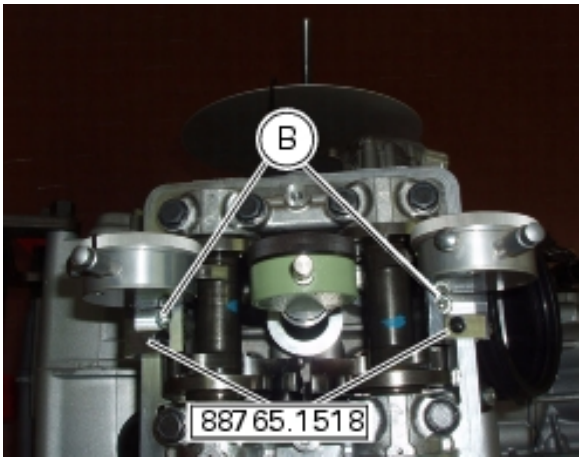




Checking valve lift

Put the engine in the condition described in "Checking and adjusting the valve clearances" above.
Locate the tool **88765.1518** on the cylinder head: the part marked "A" should be on the intake side and the part marked "S" should be on the exhaust side.
Seat the plate (A) and tighten the bolts (B).





Set the opening valve clearance to zero when the camshaft is in its rest position by fitting a feeler gauge between the upper rocker arm and the opening shim.
Lock the dial gauge into the seat of the stand marked "A" and position the fork probe against the face of the closing shim.
Set the dial gauge to zero when the valve is fully closed.
Rotate the intake camshaft so as to allow the intake valves to lift fully.
Check that the reading on the dial gauge corresponds to the specified value (Sect. C 1.1, Timing system/valves).
Repeat the oabove peration for the exhaust valves, using the dial gauge in the seating on the support **88765.1518** with the marking "S".

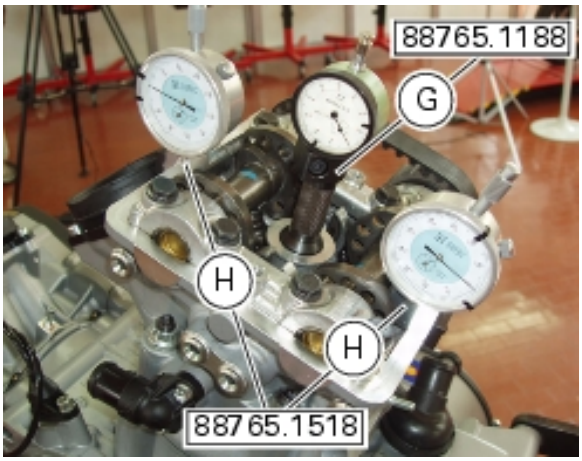
Refit following the procedure indicated in the previous paragraph "Checking and adjusting the valve clearances"
Refit the components removed in the procedure.

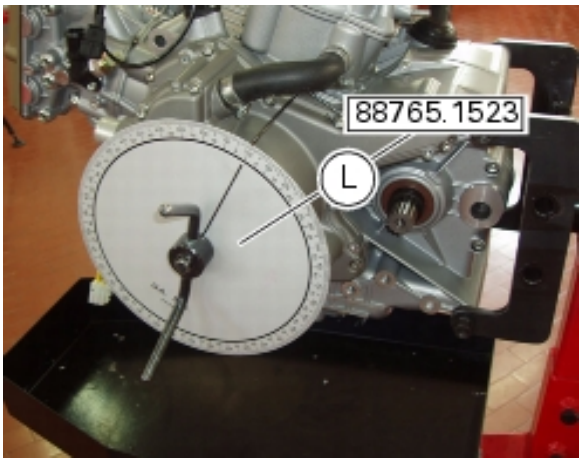
Operation	Section reference
Refit the timing belts	N 4.2, Refitting the timing belts
Refit the cylinder head cover	N 4.4, Refitting the camshafts
Refit the airbox	L 6, Refitting the airbox and throttle body
Refit the radiator	N 3.2, Refitting the radiator
Refit the side fairings	E 2, Refitting the side fairings

Checking the engine timing

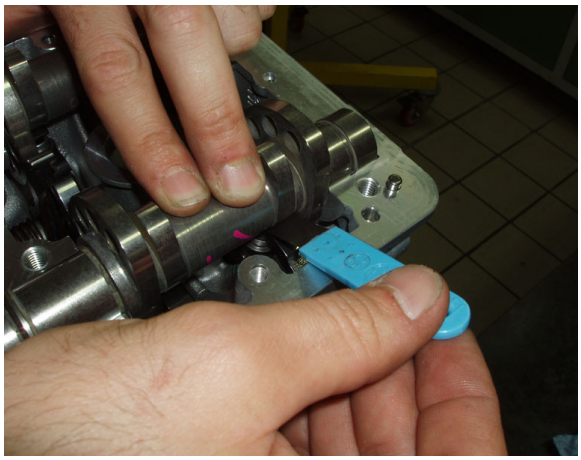
Operation	Section reference
Remove the side fairing panels	E 2, Removal of the side fairings
Remove the radiator	N 3.2, Removal of the radiator
Remove the airbox	L 6, Refitting the airbox and throttle body
Remove the timing belts	N 4.2, Removal of the tensioner pulley/timing belt
Remove the cylinder head cover	N 4.4, Removal of the camshafts
Remove the crankshaft inspection cover	N 8, Removal of the alternator-side crankcase cover

Put the engine the condition described previously for the operation "Checking and adjusting the valve clearances".
Install service tool (G) **88765.1188** in the spark plug bore to determine piston TDC, along with gauges (H) **88765.1518** and the timing check tool (L) (timing degree wheel **88765.1523** with graduated disk).

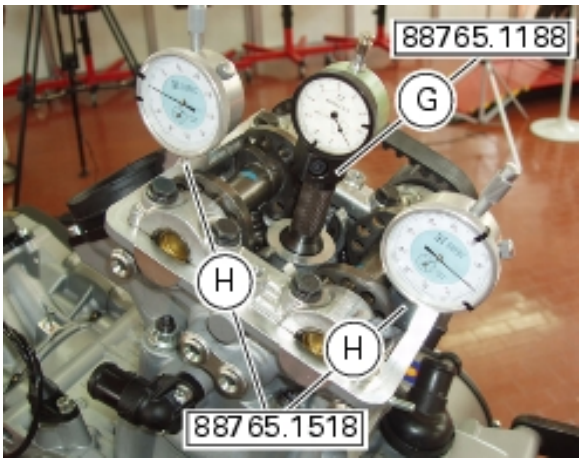


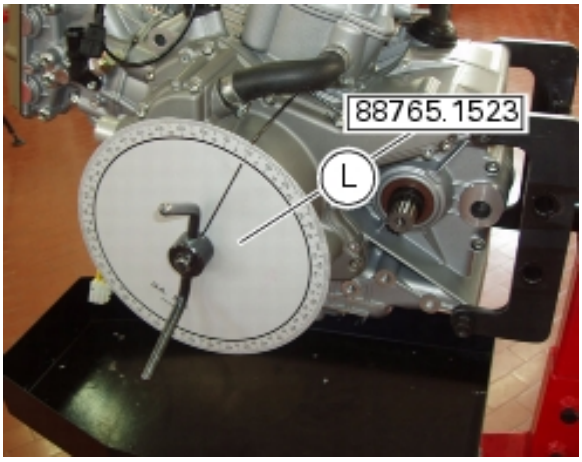


Set the opening valve clearance to zero when the camshaft is in its rest position by fitting a feeler gauge between the upper rocker arm and the opening shim.
Check that in this condition the camshaft can rotate. If it moves stiffly, use a thinner feeler gauge.



In this condition, with the piston of the horizontal cylinder at TDC with the valves fully closed as confirmed by the reading on gauge (G), set the gauges (H) to zero.
Refit the belts and tension them as described in Sect. N 4.2, Refitting the timing belts.
Turn the degree wheel (L) counterclockwise until the dial gauge (H) on the exhaust side reads a lift of **1** mm. Check that the angular displacement reading on the degree wheel (L) is as specified (Sect. C 1.1, Timing system/valves).
Continue to rotate in the same direction until you obtain a **1** mm lift on the intake side. Check the angular value on the degree wheel.
Continue turning the shaft until you reach total closure of the valve on the expansion stroke.
Now reverse the rotation (i.e. clockwise) of the degree wheel (L) until gauge (H) shows a **1** mm lift of the intake valve. Check that the angular displacement reading matches the specified value (Sect. C 1.1, Timing system/valves).
Rotate clockwise again until obtaining **1** mm lift of the exhaust valve. Check the angular displacement value against the specified value.
Repeat the procedure for the vertical cylinder.
The permissible tolerance for the measured values is **±3°** with respect to the specified values (Sect. C 1.1, Timing system/valves.

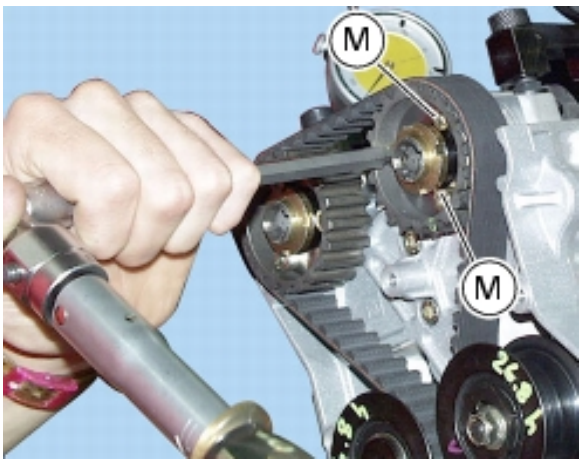


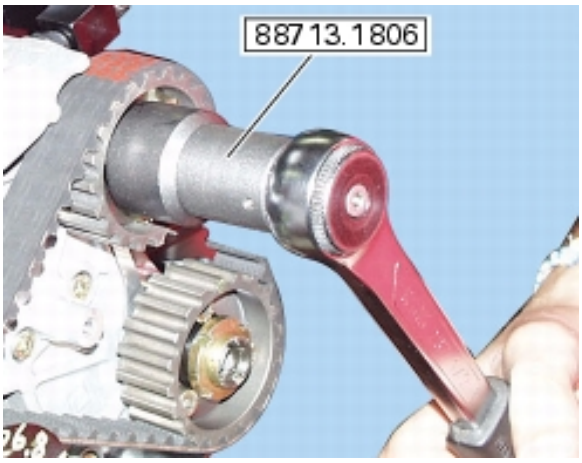


Remove all tools installed for the timing check and tension the belts to their prescribed operating tension, as described in Sect. D 5, Measuring timing belt tension.

If the values obtained are outside the specified tolerance ranges (Sect. C 1.1, Timing system/valves), loosen the timing pulley bolts (M) and correct the value by turning the camshaft nut with the wrench supplied with service tool no. **88713.1806**.

Then tighten the three timing pulley bolts (M) to the specified torque (Sect. C 3, Engine torque settings) and mark the new timing positions on the relative components.

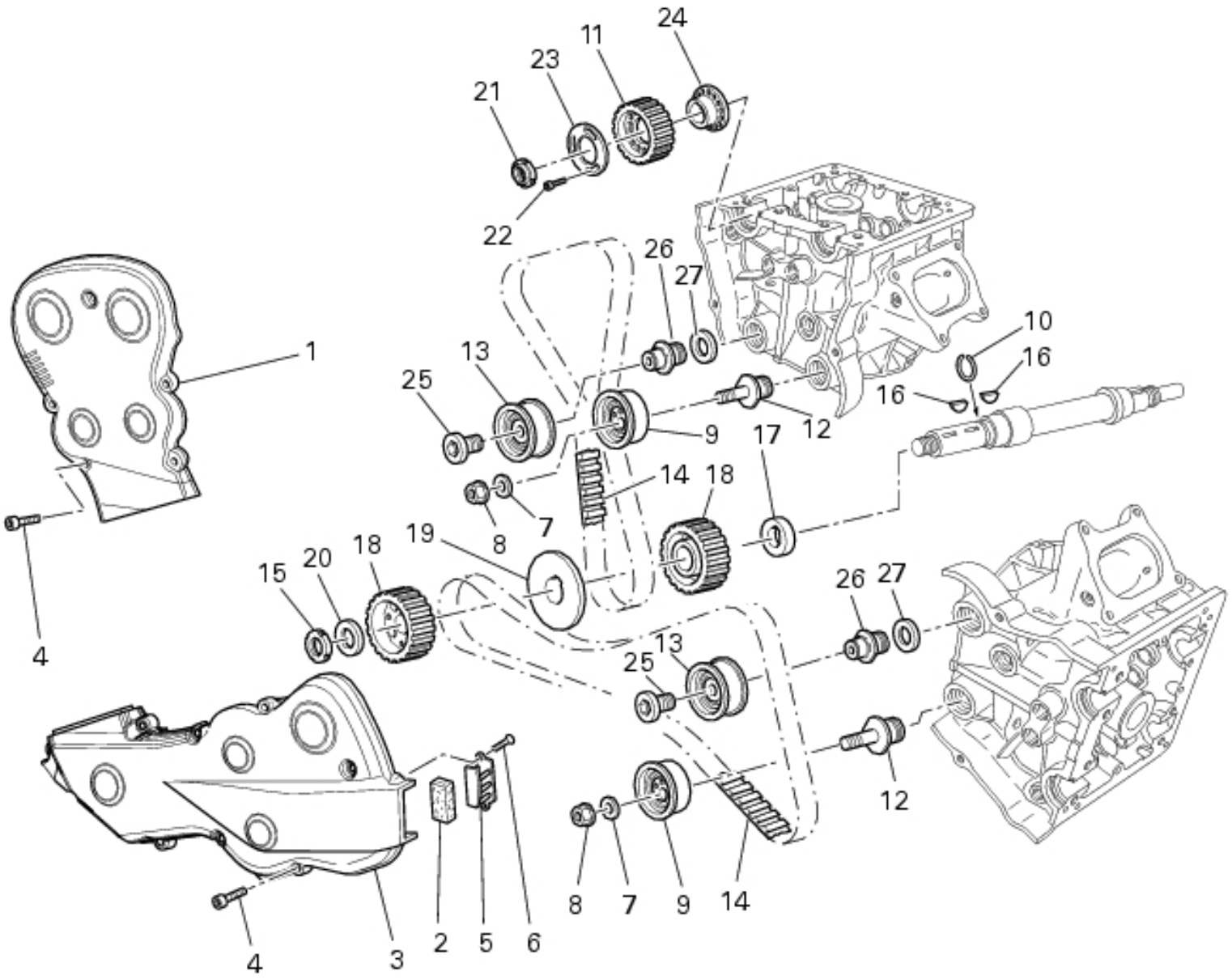




Refit the components removed in the procedure.

Operation	Section reference
Refit the crankshaft inspection cover	N 8, Refitting the alternator-side crankcase cover
Refit the timing belts	N 4.2, Refitting the timing belts
Refit the cylinder head cover	N 4.4, Refitting the camshafts
Refit the airbox	L 6, Refitting the airbox and throttle body
Refit the radiator	N 3.2, Refitting the radiator
Refit the side fairings	E 2, Refitting the side fairings

4.2 - Cylinder head assemblies: timing



1 Vertical cylinder timing belt cover
2 Air filter
3 Horizontal cylinder timing belt cover
4 Bolt
5 Filter cover
6 Bolt
7 Washer
8 Nut
9 Tensioner pulley assembly
10 Circlip
11 Camshaft pulley
12 Tensioner pulley mounting stud
13 Idler pulley assembly
14 Timing belt
15 Nut
16 Key
17 Spacer
18 Camshaft pulley

19 Driveshaft pulley spacer
20 Spacer
21 Nut
22 Bolt
23 Washer
24 Spacer flange
25 Bolt
26 Idler pulley mounting stud
27 Spacer

Parts catalogue

Timing system

Cylinder head: timing system

Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Notes

For clarity, the figures show the engine removed from the frame.

To work with the engine installed, first proceed as follows:

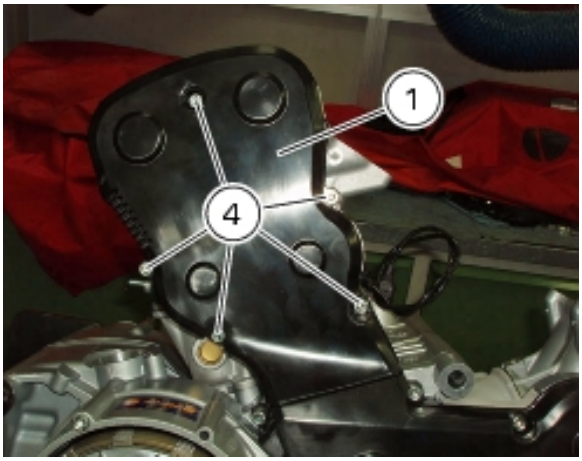
Operation	Section reference
Remove the side fairing panels	E 2, Removal of the side fairings
Disconnect the electrical system components on the right-hand side of the engine	P 1, Routing of wiring on frame

Notes

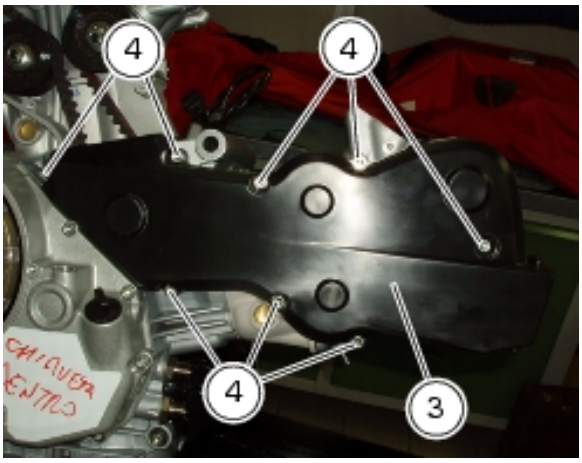
Remove also any parts which may impede the procedure in any way.

Removal of the timing belt covers

Undo the bolts (4) securing the timing belt cover (1) and remove it from the vertical cylinder assembly.



Undo the bolts (4) securing the timing belt cover (3) and remove the cover from the horizontal cylinder unit.

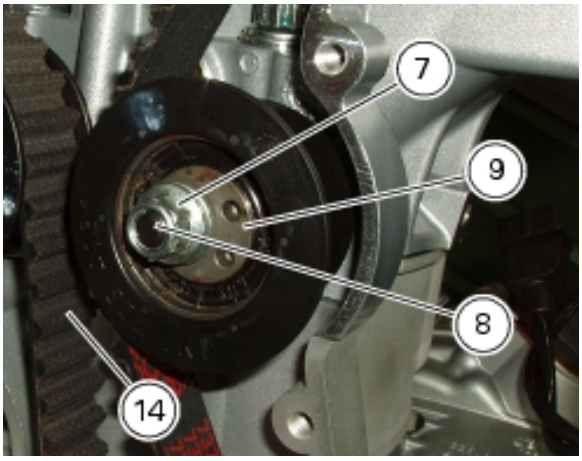


Removal of the tensioner pulley/timing belt

Loosen the nut (8) and remove the washer (7) and the tensioner pulley (9) from its mounting stud (**12**) on the cylinder head.
Remove the timing belt (14) from the horizontal cylinder assembly.

Important
If the belts are to be re-used, mark the direction of rotation with an arrow and also mark the cylinder they belong to.

Repeat the procedure for the other cylinder.

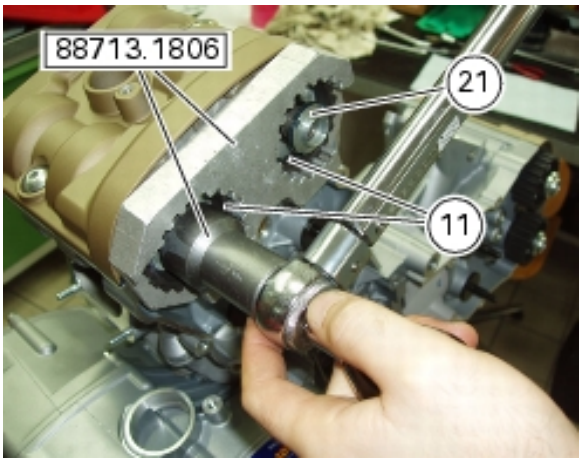


Removal of the camshaft pulleys/idler pulley

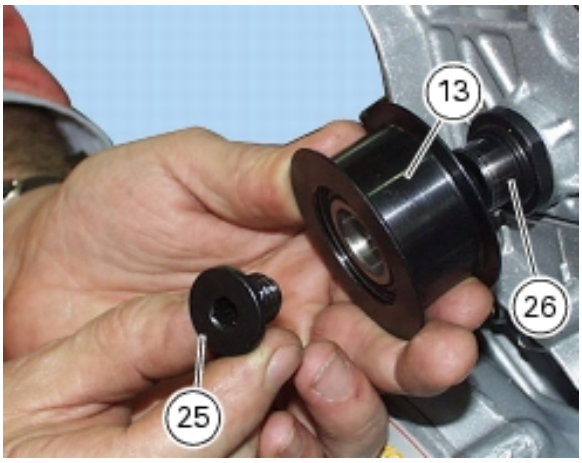
Fit tool part no. **88713.1806** to the pulleys to prevent them rotating and use the bush supplied with it to slacken off nuts (21) securing the pulleys.

Important
On reassembly, always use new nuts.

Remove the nuts (21) and the pulleys (11) from the camshafts.



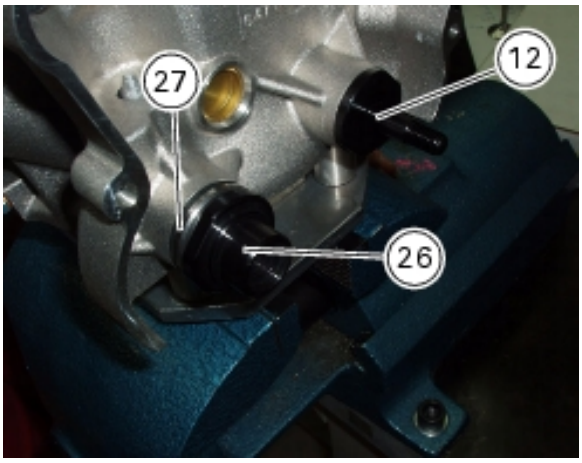
Unscrew the bolt (25) and remove the idler pulley (13) from its mounting stud (26).
Repeat the same procedure to remove the other pulley.

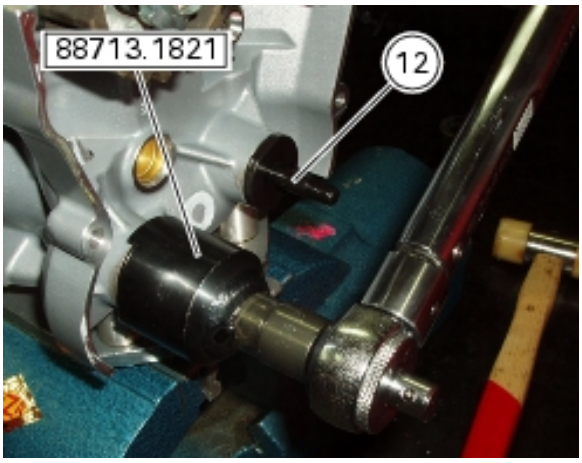


Removal of the tensioner and idler pulley mounting studs

Using service tool no. **88713.1821**, remove the tensioner pulley mounting studs (12) and (26) from the cylinder heads. Recover the spacer (27) on the pivot bolt (26).

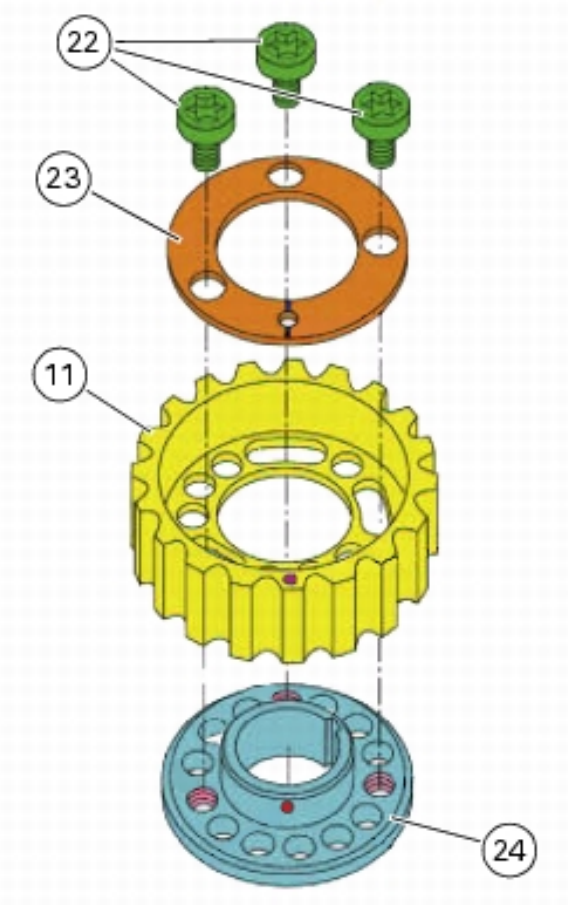
Important
On reassembly, make sure not to invert the positions of mounting studs (12) and (26).





Disassembly of the camshaft pulleys

Unscrew and remove the bolts (22).
Slide off the washer (23). Withdraw the camshaft pulley (11) from the spacer flange (24).



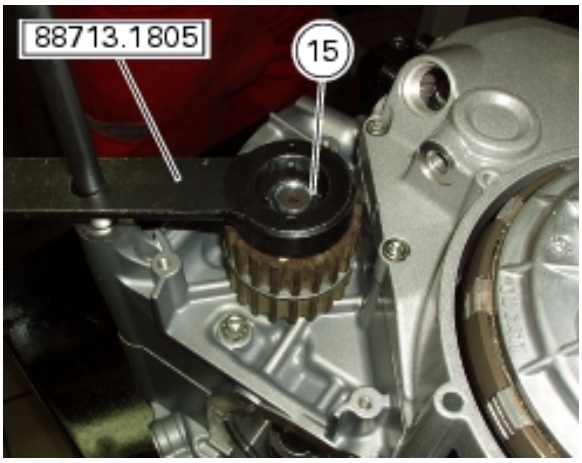
Removal of the timing belt driveshaft pulleys

Use the service tool no. **88713.1805** to hold the driving pulley against rotation.

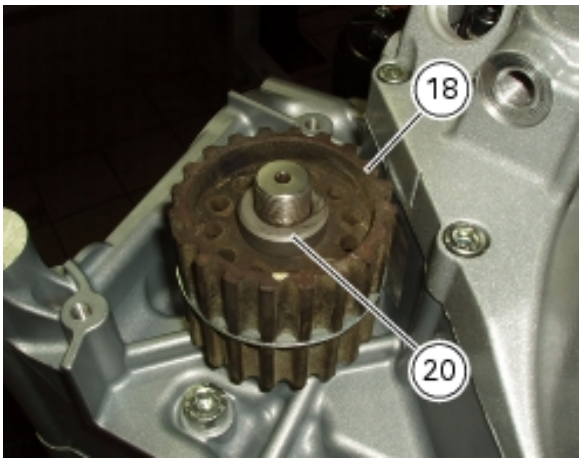
Important

If this operation is carried out with the engine installed in the frame, hold the driveshaft pulleys against rotation by using service tool no **88713.2011** mounted on the alternator-side crankcase cover.

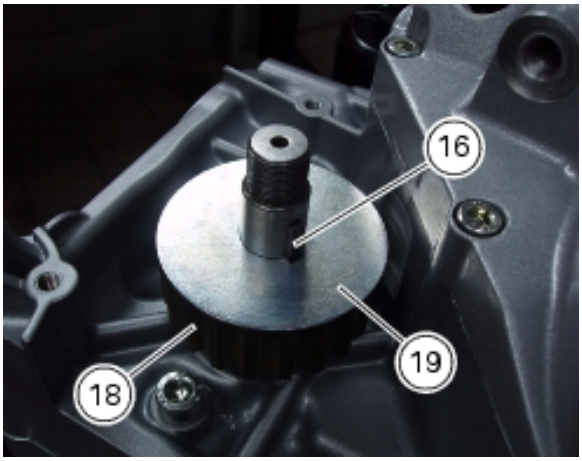
Loosen the nut (15) using the socket supplied with the service tool.



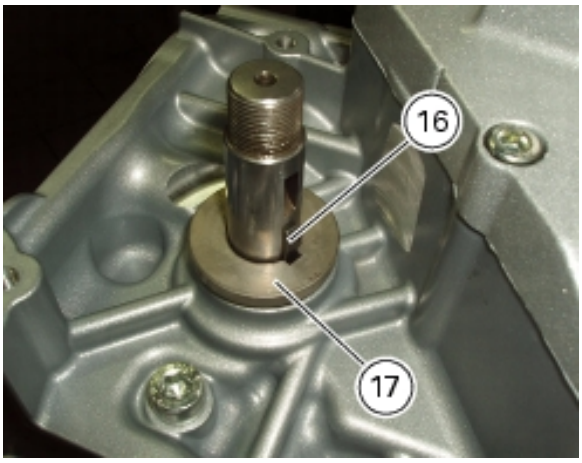
Remove the nut (15), the spacer (20) and the outer pulley (18).



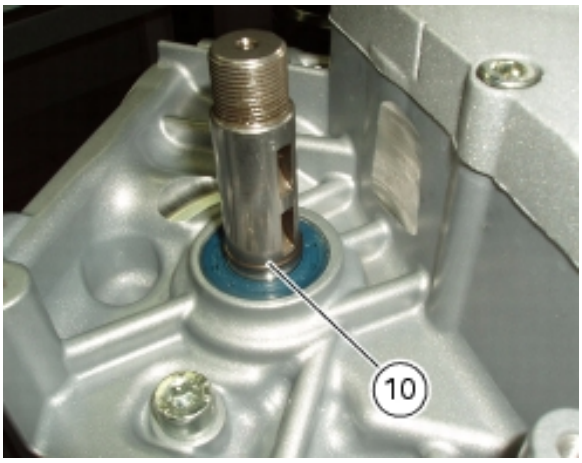
Remove the first Woodruff key (16) from the timing belt driveshaft.
Remove the intermediate spacer (19) and the inner pulley (18).



Remove the inner spacer (17) and second Woodruff key (16) on the timing belt driveshaft.

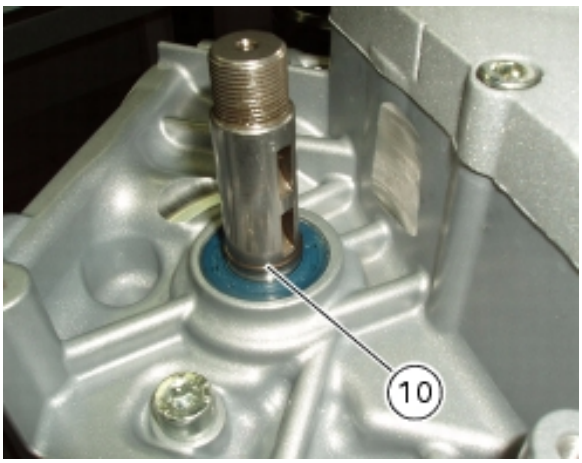


It is now possible to remove the circlip (10) on the driveshaft.

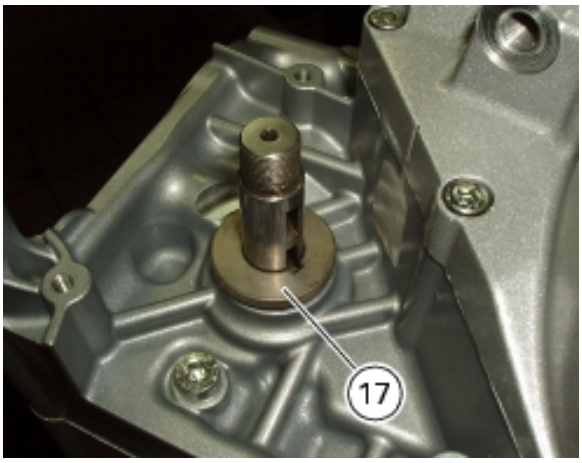


Refitting the timing belt driveshaft pulley

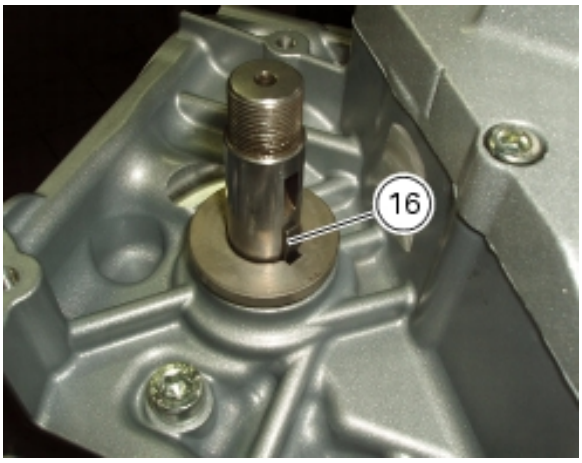
To fit the circlip (10) to the driveshaft, use the protective cap **88713.2834**.



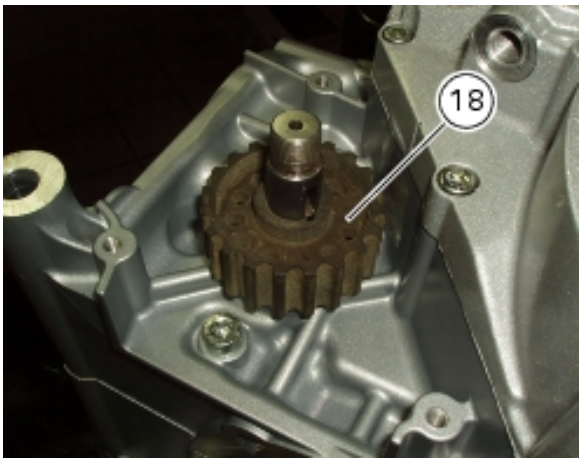
Install the inner spacer (17) on the driveshaft, taking care to align the notch in the spacer with the slot for the Woodruff key.



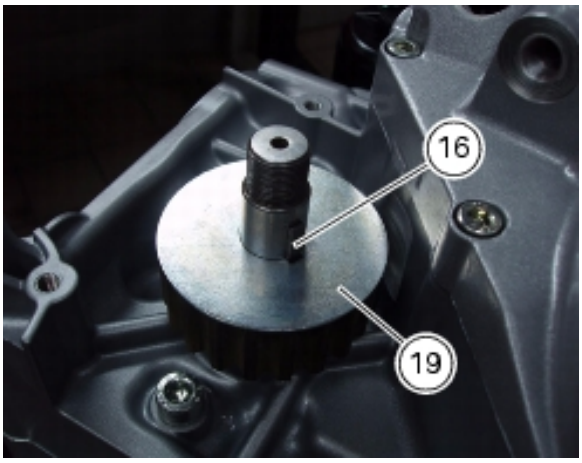
Fit the first Woodruff key (16) on the timing belt driveshaft.



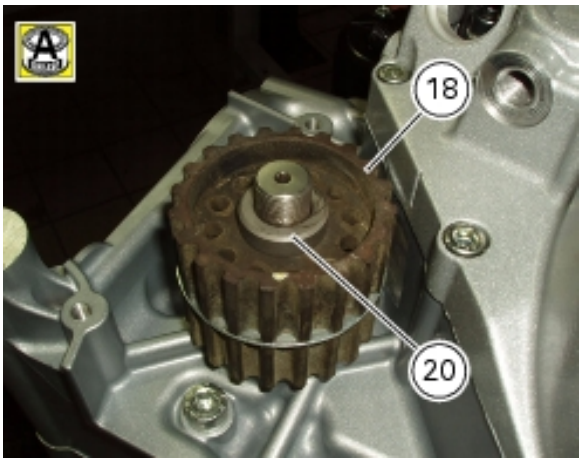
Locate the inner pulley (18).



Refit the second Woodruff key (16) and the washer (19).



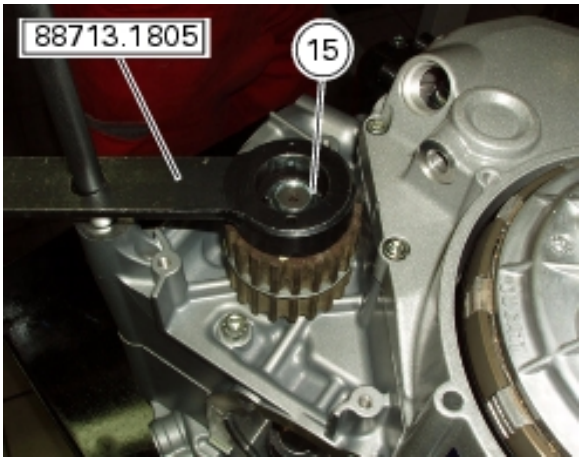
Locate the outer pulley (18) and the spacer (20).
Apply the recommended grease to the threads on the end of the driveshaft.



Fit the nut (15).

Important
To prevent the nuts working loose and consequent serious engine damage, always use new self-locking nuts on all the timing belt pulleys on reassembly.

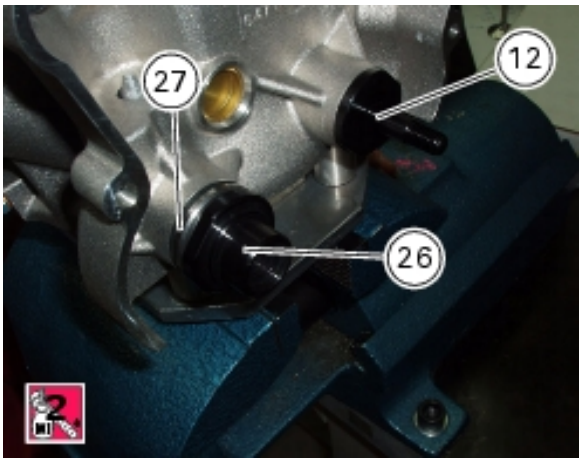
Lock rotation of the pulleys with service tool no. **88713.1805** and, using the insert supplied with the wrench in conjunction with a torque wrench, tighten the self-locking nut to the specified torque (Sect. C 3, Engine torque settings).

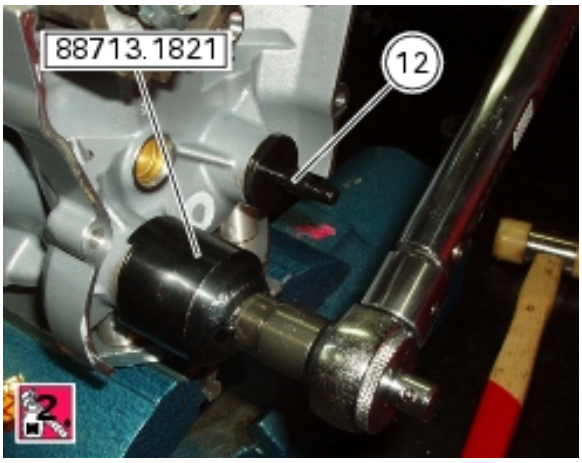


Refitting the idler and tensioner pulley mounting studs

Apply the recommended threadlocker to the threads of the studs.

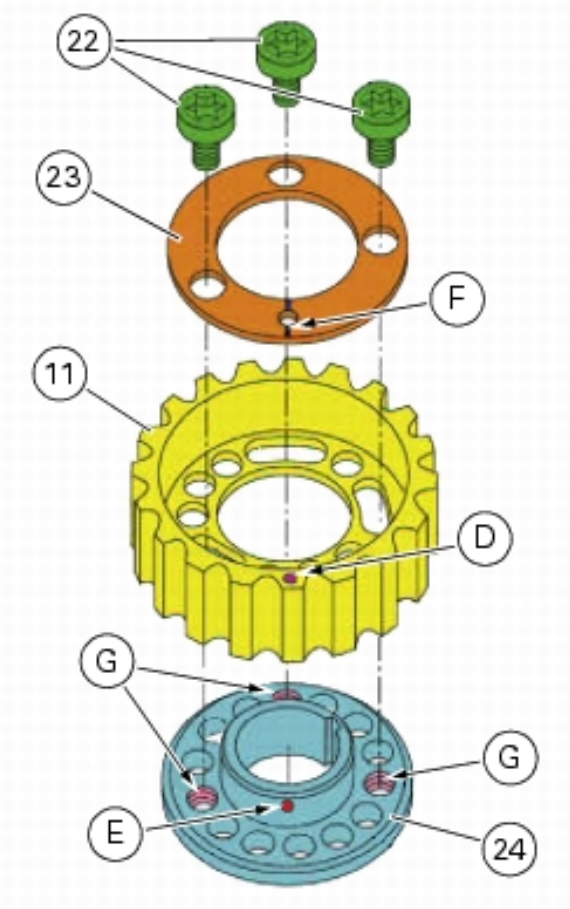
Insert the idler and tensioner pulley mounting studs (12) and (26) with the spacers (27) in the cylinder heads and tighten them using service tool no. **88713.1821**.
Tighten the pulley mounting studs to the specified torque (Sect. C 3, Engine torque settings).

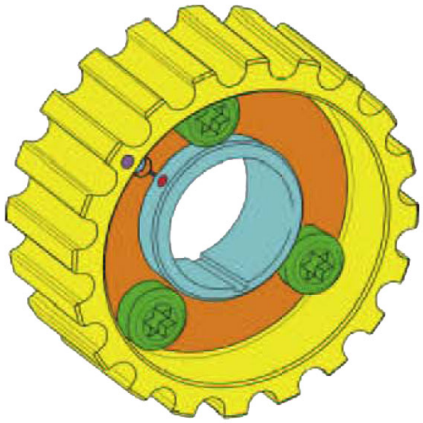




Reassembly of the timing pulleys

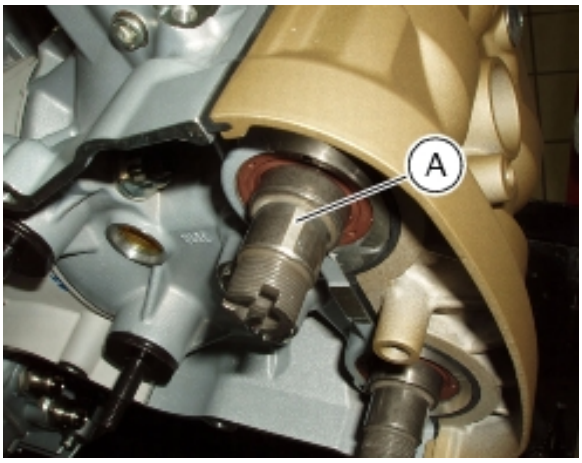
Fit the pulley (11) on the flange (24), aligning the timing mark (D) on the pulley with the timing mark on the (E) on the flange.
Install the washer (23) up aginst the pulley, aligning the timing notch (F) with the timing marks on the pulley and the flange.
Insert the three bolts (22) in the threaded holes (G) of the flange.
Tighten the bolt (22) to the specified torque (Sect. C 3, Engine torque settings).



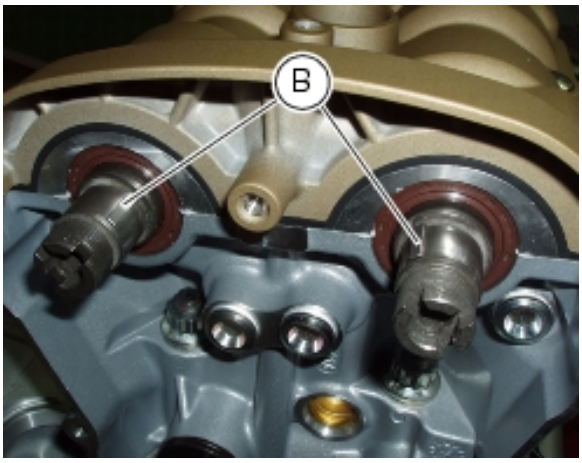


Refitting the camshaft pulleys/idler pulleys

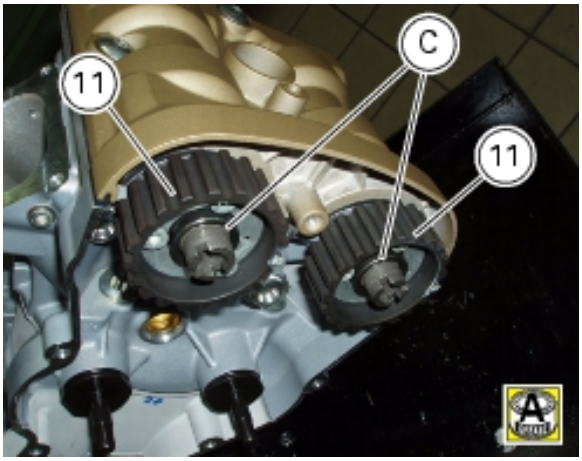
Check that the keyway on the end of the camshaft is in good condition and without burrs.



Fit a Woodruff key (B) in the keyway of each camshaft.

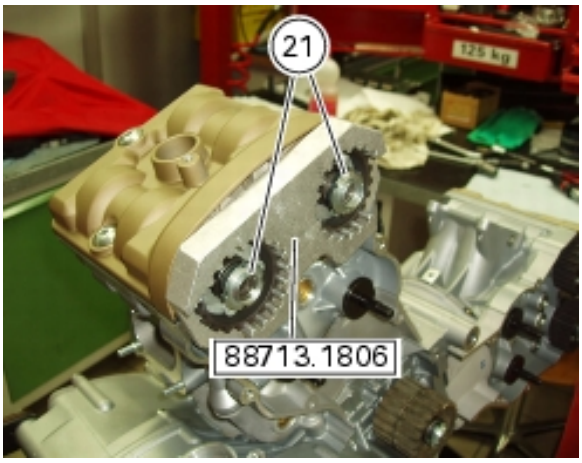


Fit the pulley (11) on the camshaft, inserting the Woodruff key in the in the slot (C) in the pulley.
Apply the recommended grease to the threads on the end of the camshaft.
Repeat the procedure on the other camshaft.

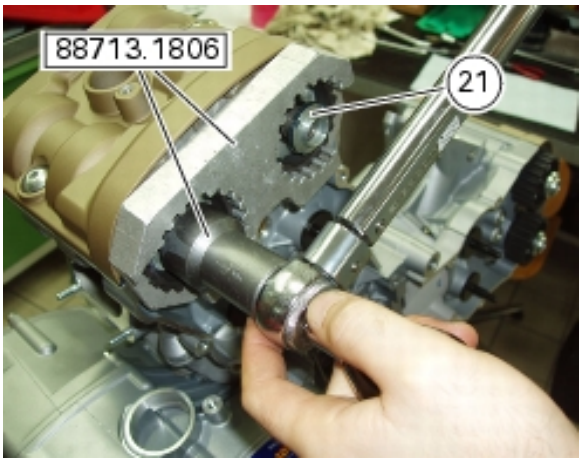


Fit the service tool no. **88713.1806** on to the pulleys to prevent rotation.
Apply the recommended grease to the mating face of the nut (21).
Fit the nut (21).
Carry out the same operations on the other camshaft.

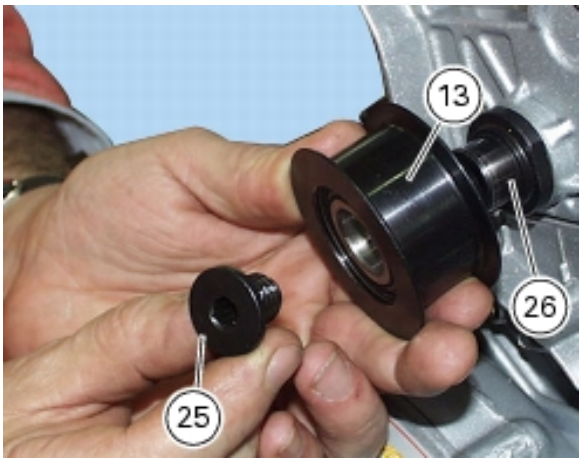
Important
Always fit new nuts on reassembly.



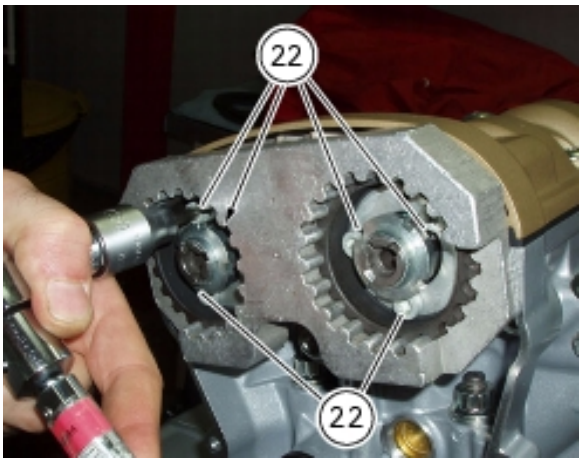
Using the bush supplied with service tool **88713.1806** and a torque wrench, tighten the nuts (21) to their specified torque (Sect. C 3, Engine torque settings).



Fit the idler pulleys (13), complete with bearings, onto the mounting studs (26) on the cylinder heads and tighten the bolts (25) to their specified torque (Sect. C 3, Engine torque settings).



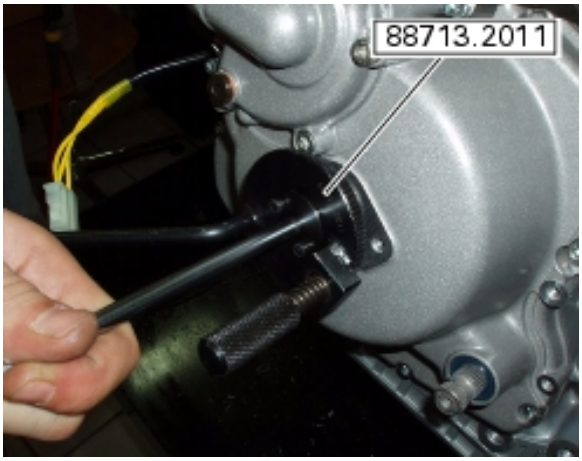
Back off the bolts (22) securing the pulleys, turning them anti-clockwise through 90° ±5°.
Check that the pulleys have no endfloat and can rotate freely at all points along the full length of the slots.



Refitting the timing belts

Rotate the pulleys on the timing belt driveshaft until the timing mark on the outer roller is aligned with the mark on the clutch-side crankcase cover.
In this condition, the horizontal cylinder piston will be at top dead centre.

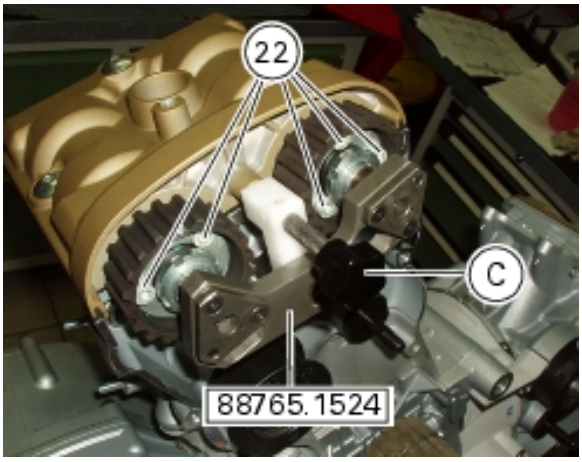
Install the service tool **88713.2011** in the alternator-side crankcase cover to hold the crankshaft against rotation and secure it with the relative pin.



Fit the service tool no. **88765.1524** to prevent rotation of the camshafts: one for the vertical cylinder head and one for the horizontal cylinder head.
Fix the tools to the rocker cover with the pin (C).

Important

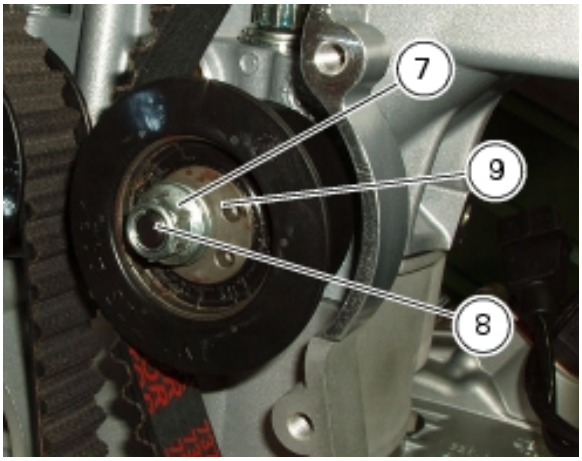
To achieve correct timing, the bolts (22) securing the pulleys to the hubs must be loose and positioned in the centres of their slots.



Fit the vertical cylinder timing belt around the camshaft pulleys and pass it behind the idler pulley.
Repeat the operation for the horizontal cylinder belt.

Notes

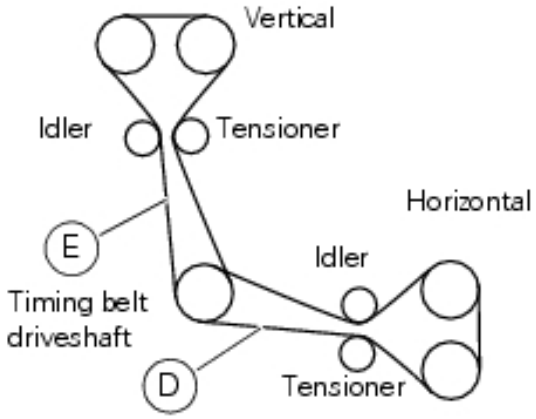
If the used belts are to be refitted, position them in their original direction of rotation and on their original cylinder.
Fit the tensioner pulleys (9) and the washers (7) on the mounting studs on the two cylinder heads.
Start the nut (8).



Check the timing belt tension and adjust if necessary as described in the paragraph "Measuring timing belt tension" (Sect. D 5).

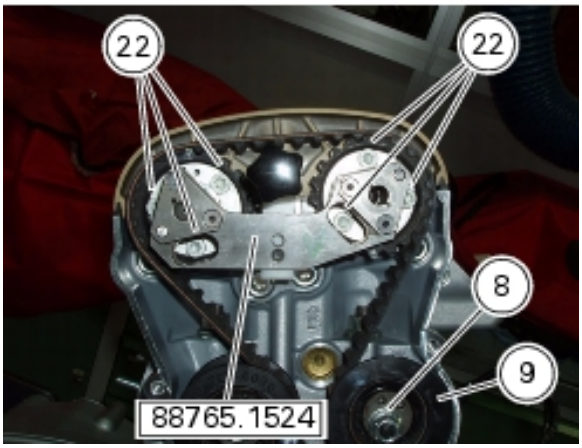
Warning

Check the tension on the belt sections (D) and (E) shown in the figure.



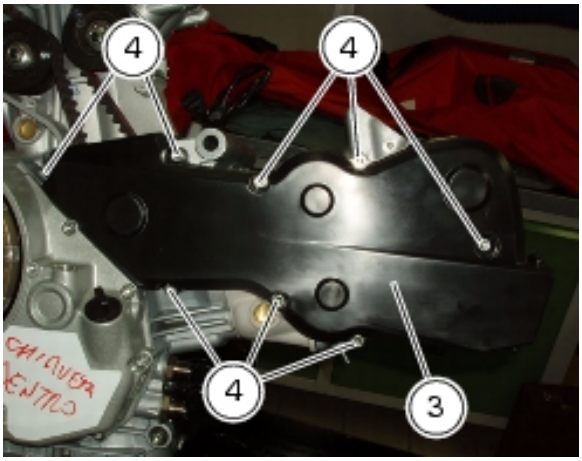
Once the belts are correctly tensioned, ensure that the nuts (8) securing the tensioner pulley (9) and the bolts (22)

are tightened to the specified torque (Sect. C 3, Engine torque settings).
Remove the camshaft holding tool **88765.1524** and the crankshaft holding tool **88713.2011**.

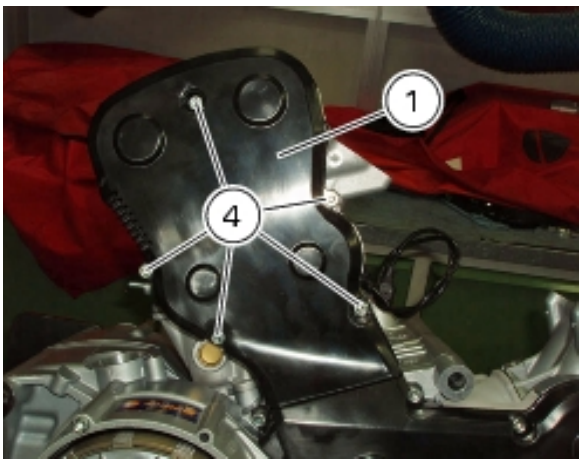


Refitting the timing belt covers

Locate the horizontal cylinder timing belt cover (3) and secure it in place with bolts (4).



Do the same with the vertical cylinder outer cover (1).
Tighten the bolts (4) progressively in a crosswise pattern to the specified torque (Sect. C 3, Engine torque settings).



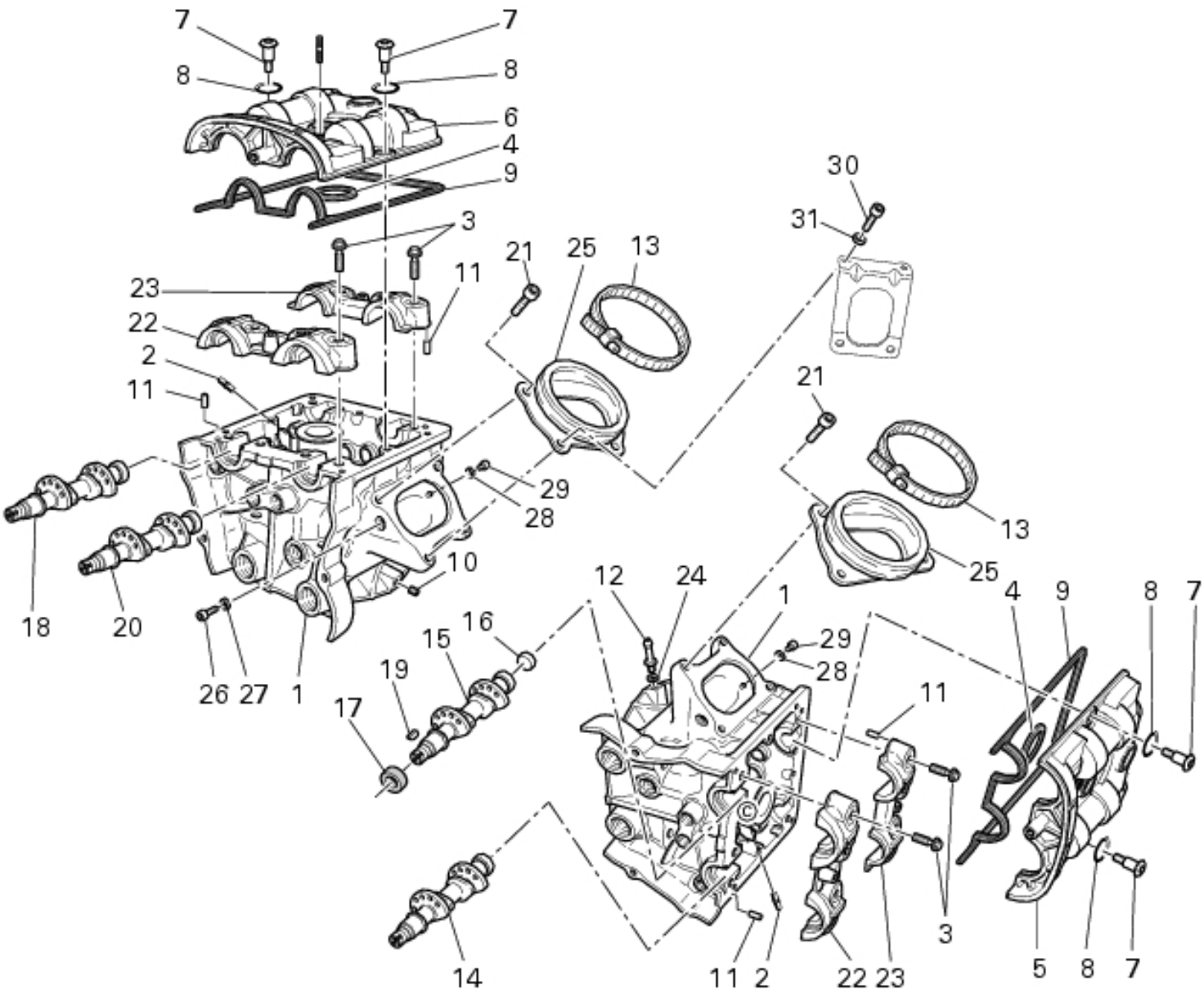
Notes

If the above operations have been carried out with the engine installed in the frame, refit the previously removed parts.

Operation	Section reference

Reconnect the electrical system components on right-hand side of engine	P 1, Routing of wiring on frame
Refit the side fairing panels	E 2, Refitting the side fairings

4.4 - Cylinder head assemblies: camshafts



1 Cylinder head
2 Stud bolt
3 Special bolt
4 Seal
5 Horizontal cylinder head cover
6 Vertical cylinder head cover
7 Special bolt
8 O-ring
9 Cylinder head gasket
10 Grub screw
11 Locating dowel
12 Union
13 Clamp
14 Horizontal cylinder exhaust camshaft
15 Horizontal cylinder intake camshaft
16 Plug
17 Oil seal
18 Vertical cylinder exhaust camshaft

19 Key
20 Vertical cylinder intake camshaft
21 Bolt
22 Timing side support
23 Opposite side support
24 Seal
25 Intake manifold
26 Bolt
27 Washer
28 Seal
29 Bolt
30 Bolt
31 Washer

Parts catalogue

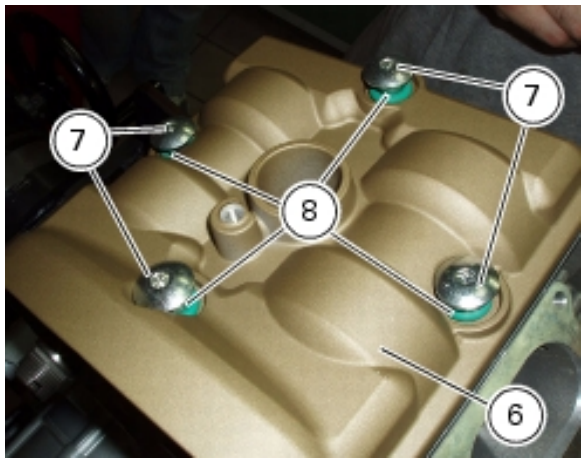
CYLINDER HEAD: TIMING SYSTEM
Vertical cylinder head
HORIZONTAL CYLINDER HEAD
THROTTLE BODY

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

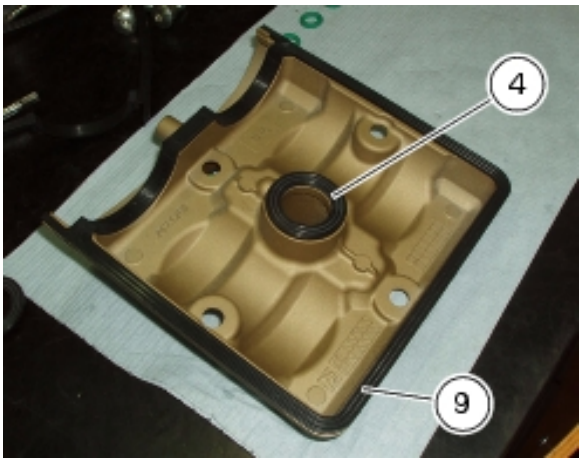
Removal of the camshafts

Operation	Section reference
Remove the coils	M 3, Ignition coils
Remove the engine from the frame	N 1, Removal of the engine
Remove the timing belt covers, the timing belts and timing belt pulleys	N 4.2, Removal of the timing belt covers

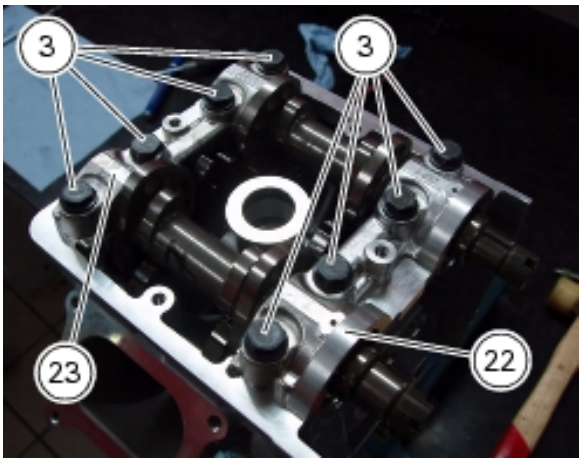
Unscrew and remove the bolts (7) together with the O-rings (8) from the cylinder head covers.
Remove the cylinder head cover (6).

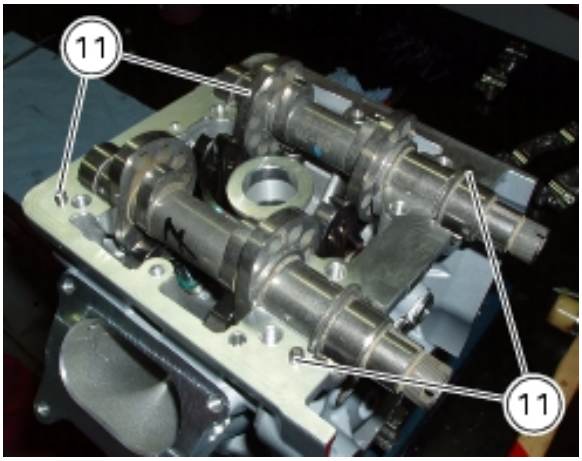


Remove the gaskets (4) and (9).

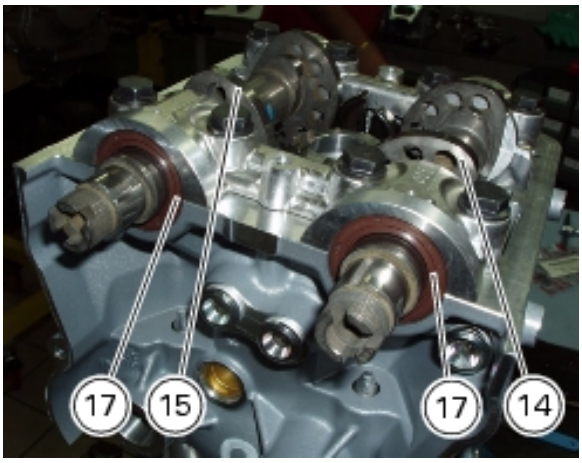


Repeat the same procedure for the other cylinder head cover (**5**).
Unscrew the bolts (3) securing the camshaft supports.
Withdraw the camshaft supports (22) and (23) straight out from the cylinder head, taking care not to damage the machined faces and locating dowels (11).

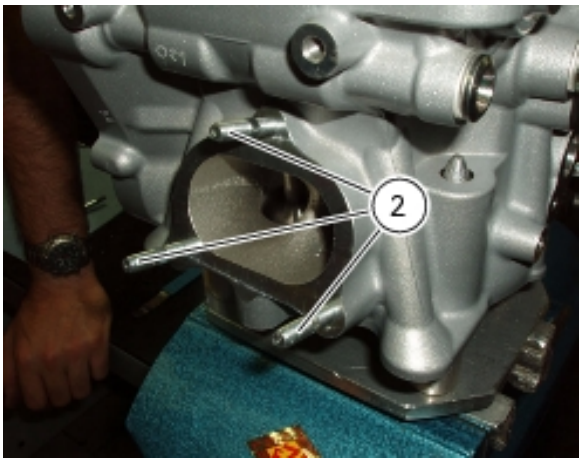




Remove the exhaust camshaft (14) and the intake camshaft (15), and slide off the seal rings (17) on their ends.
Repeat the same procedure for the other cylinder head.

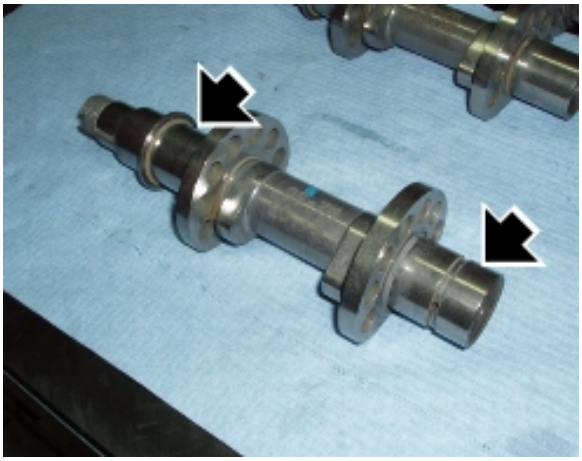


If necessary, unscrew the stud bolts (2) from the cylinder heads.

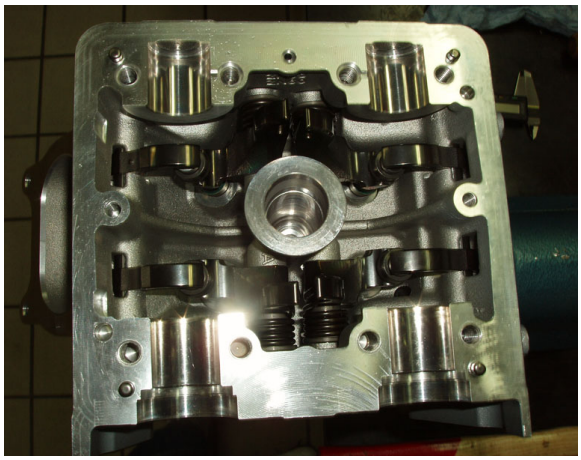


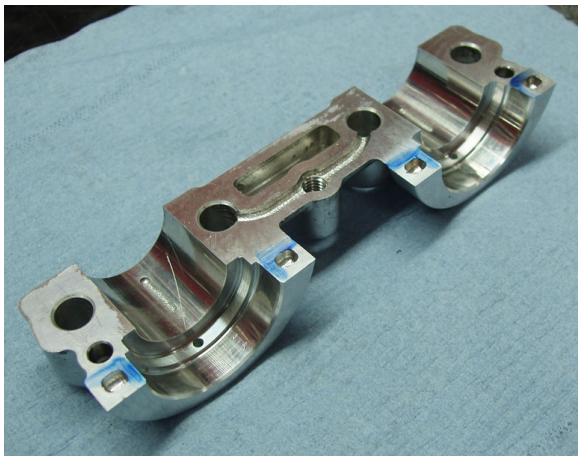
Checking the camshafts and supports

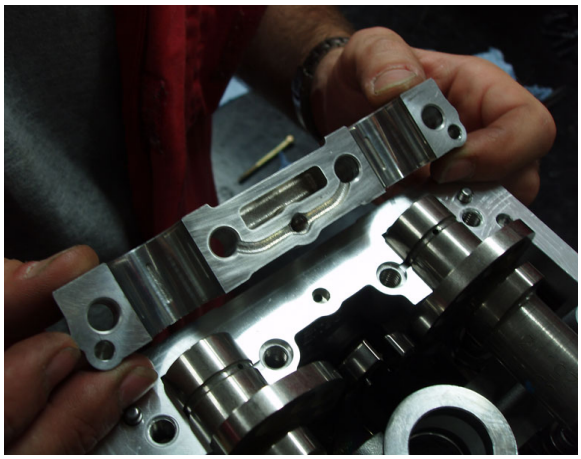
Check the cam contact surfaces for scratches, grooves, steps and waving.
Worn cams are frequently the cause of poor timing, which leads to loss of engine power.
Place the camshaft between two centres and check the runout on the areas indicated using two dial gauges.
Service limit: **0.1** mm.



Visually inspect the camshaft tracks for scoring and abnormal wear. If any of the above defects are found, the camshaft should be renewed.
If you find scoring or excessive wear, check the operation of the engine lubrication circuit.

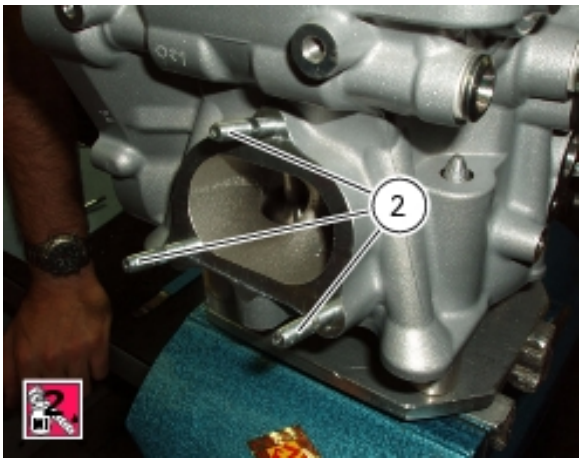




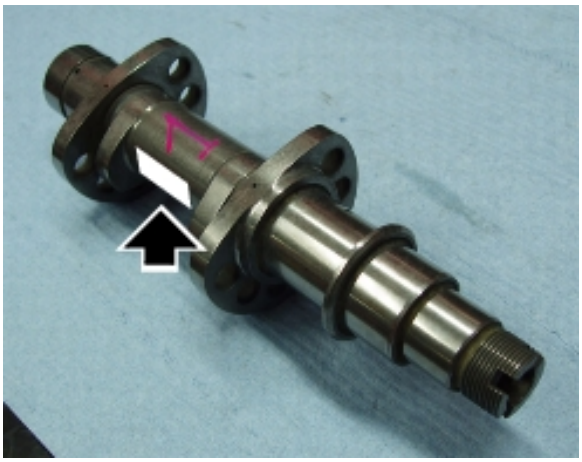


Refitting the camshafts

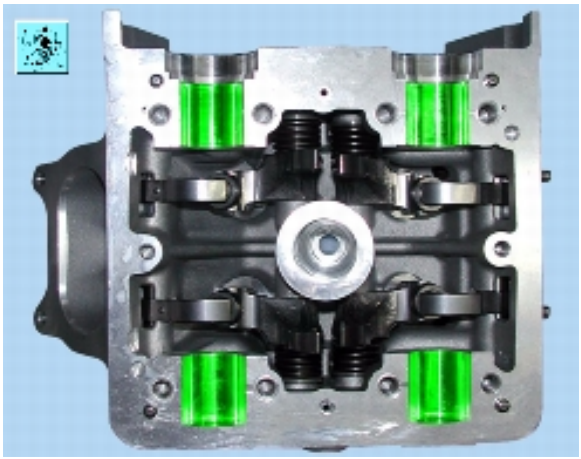
If the stud bolts (2) were removed, apply the recommended threadlocker to the short end of the stud bolts (2), i.e. the end that is to be screwed into the cylinder head.
Tighten the studs (2) to the specified torque (Sect. C 3, Engine torque settings).

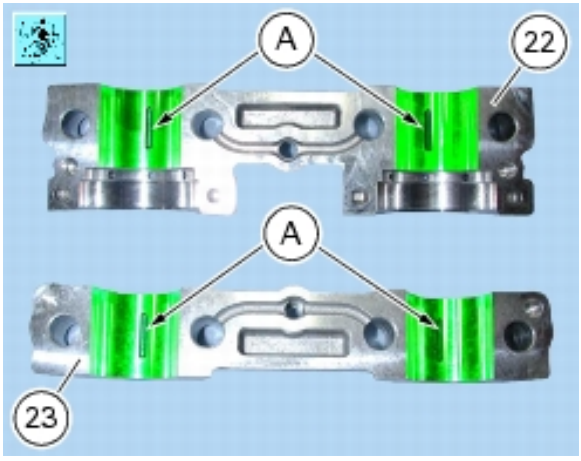


Check that the camshafts (marked "VA" and "VS" for the vertical cylinder head and "OS" and "OA" for the horizontal cylinder head) are clean and in good condition. If the camshafts are not new, use emery cloth to remove signs of wear on the cam and support surfaces, working on a flat surface.



Lubricate with the specified lubricant (Molycote M55 Plus), the camshaft seats on both the cylinder head and the supports (22) and (23) (green zone).
Fill the reservoirs (A) with the recommended lubricant (Molycote M55 Plus).

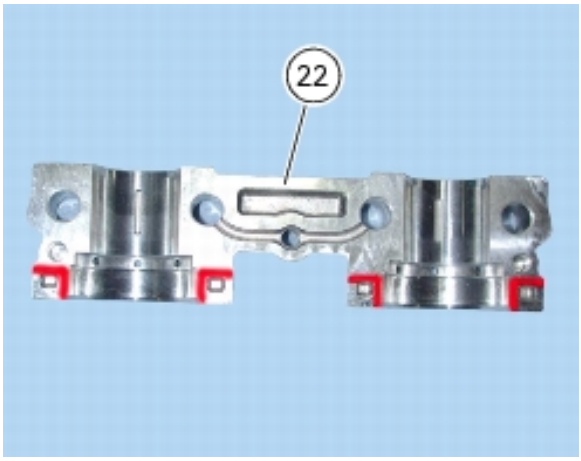




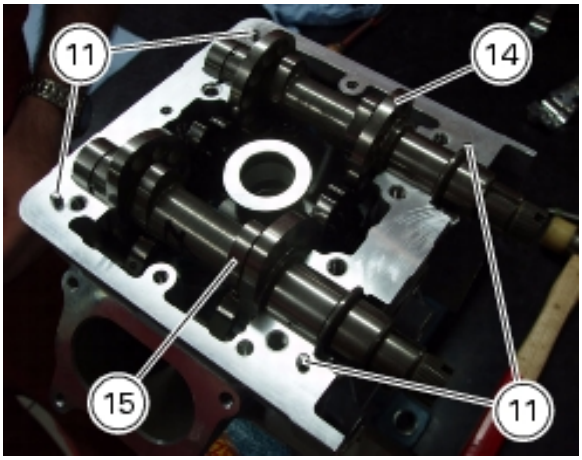
Apply sealant (Three Bond 1215 liquid gasket) at the four points of the support (22) shown in red in the photo. Clean off any excess sealant.

Notes

Only apply sealant to the timing side support (22): do not apply to support (23).



Install the camshafts (14) and (15) in the cylinder head, and rotate them to distribute the lubricant evenly. Check that the locating dowels (11) are present.

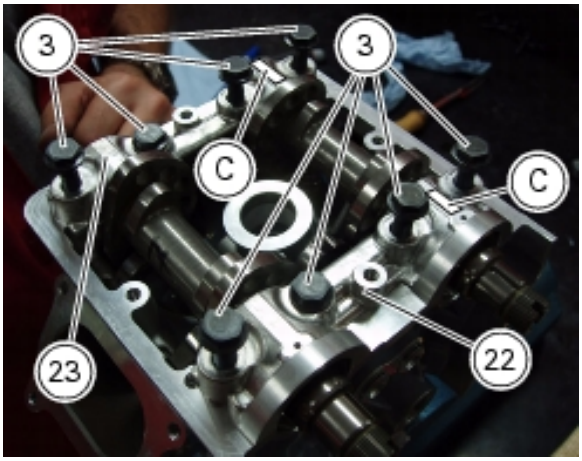


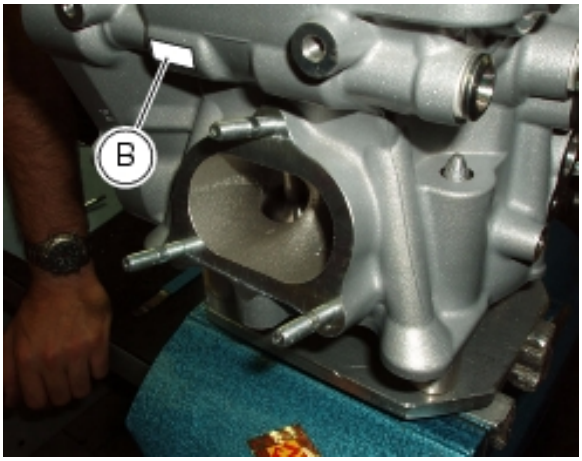
Fit the supports (22) and (23) so they are perfectly seated on the cylinder head, checking that the number stamped in zone (B) of the cylinder head is the same as the number stamped in zone (C) of the support.

Important

The support (22) must be installed on the timing side.

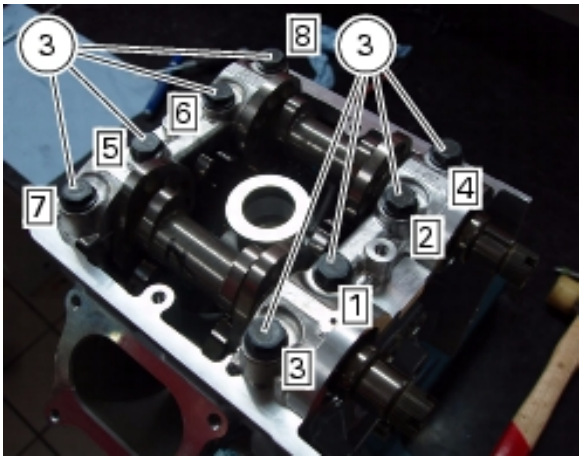
Bed down the supports.
Apply engine oil to the threads and undersides of the heads of the bolts (3).
Insert the bolts (3).





Pre-tighten the bolts (3) to the specified torque (Sect. C 3, Engine torque settings).
Pre-tighten one support at a time, working in the sequence 1-2-3-4-5-6-7-8.
Then finally tighten the bolts to the specified torque (Sect. C 3, Engine torque settings).
Tighten one support at a time, working in the sequence 1-2-3-4-5-6-7-8.
Remove any excess sealant from between the cylinder head and the support.
Turn the camshafts by hand to check that they rotate freely.

Notes
The bolt (3) in position 1 must always be installed on the intake and timing side.



Important

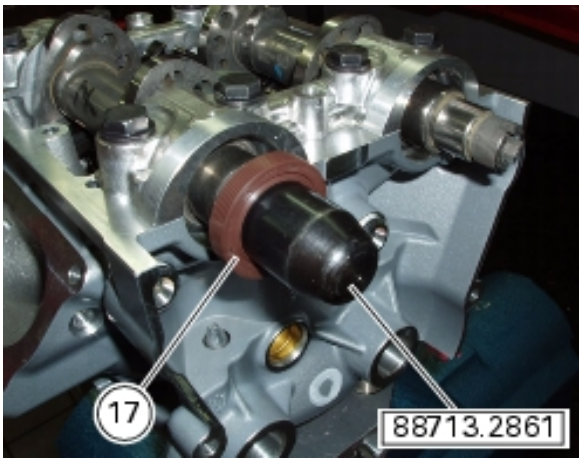
Check the valve lift as explained in Sect. N 4.1, Checking valve lift.

Oil seals

Lubricate the oil seals (17) with denatured alcohol.
Fit the installation tool supplied with service tool **88713.2861** on the camshaft and install the oil seal on the cylinder head with the spring side.

Important
Always fit new oil seals on reassembly.

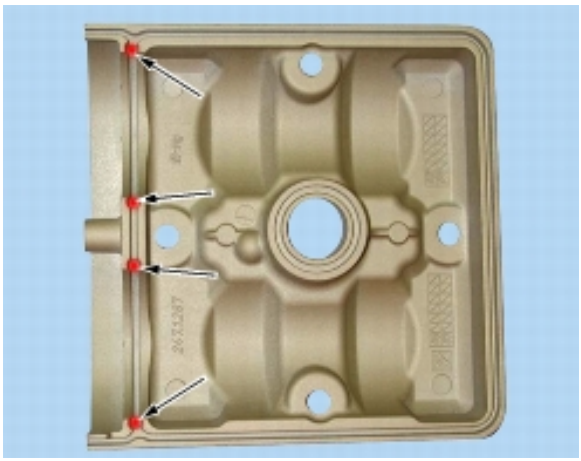
Use the drift provided with the tool and a mallet to seat the oil seals.



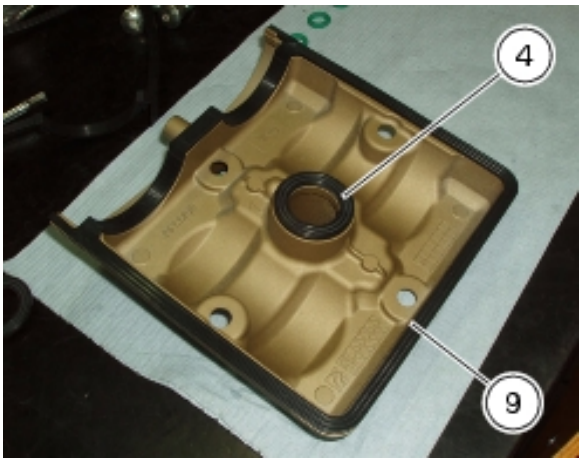
When correctly installed, the oil seal should be flush with the bevel of the cylinder head bore.

Cylinder head cover

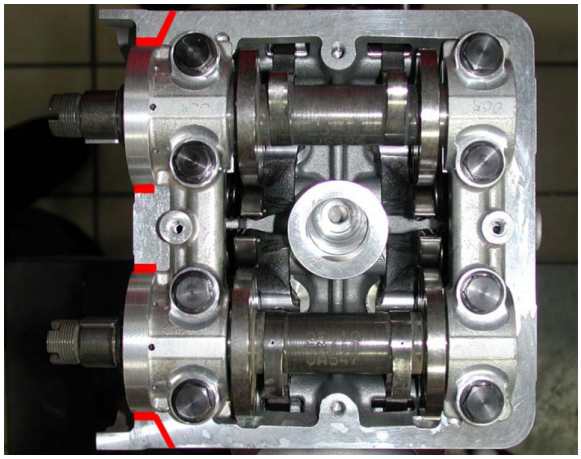
Apply sealant (Three Bond 1215 liquid gasket) at the four points of the cylinder head cover shown in red in the photo.



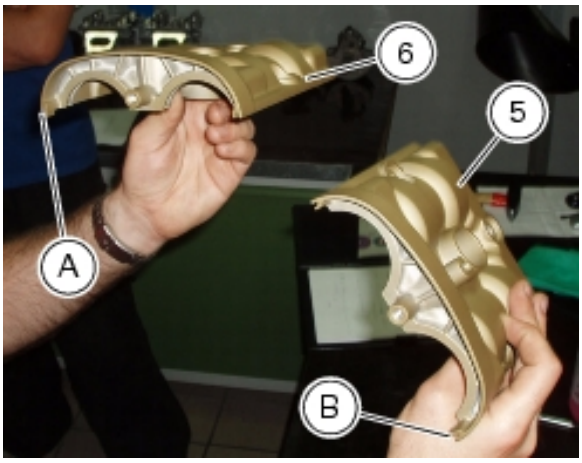
Fit the gaskets (4) and (9) on the cylinder head cover, as shown in the figure.



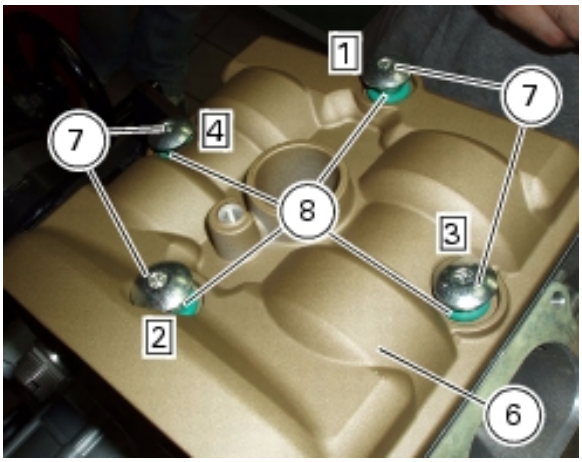
Apply sealant (Three Bond 1215 liquid gasket) at the four points of the cylinder head shown in red in the photo.



Cylinder head cover identification: the vertical head rocker cover (6) has a nib (A) on the left-hand side (exhaust side), whereas rocker cover (5) has a nib (B) on the right-hand side (exhaust side).



Locate the cover (6) on the cylinder head, aligning the four fixing holes.
Start the bolts (7) with the O-rings (8).
Tighten the bolts (7) to the specified torque (Sect. C 3, Engine torque settings) in the indicated sequence.



Remove excess sealant from the area of application.
Repeat the same procedure for the other cylinder head.
Refit all the components removed in the procedure.

Operation	Section reference
Refit the timing belt pulleys, timing belts and the timing belt covers	N 4.2, Refitting the timing belt driveshaft pulley
Refit the engine to the frame	N 1, Refitting the engine
Refit the coils	M 3, Ignition coils

Removal of the intake manifold and coolant union

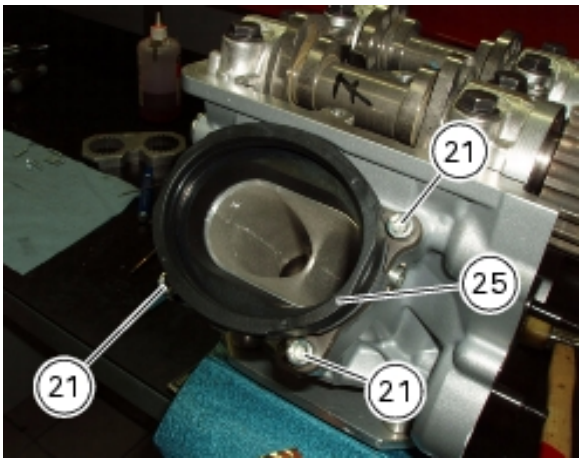
Operation	Section reference
Remove the side fairing panels	E 2, Removal of the side fairings
Remove the radiator	N 3.2, Removal of the radiator
Remove the airbox	L 6, Refitting the airbox and throttle body

Remove the manifolds (25) by undoing the bolts (21) and (**28**).

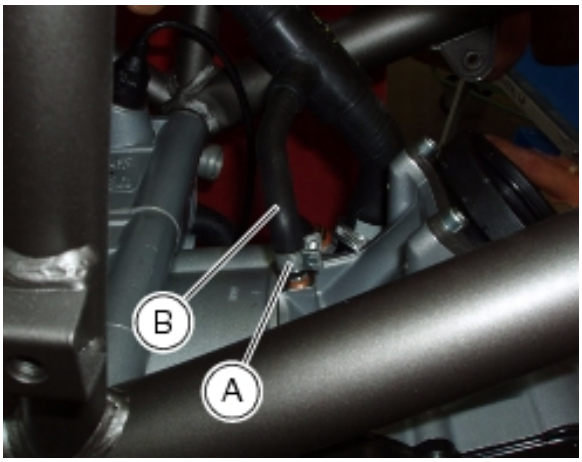
Notes

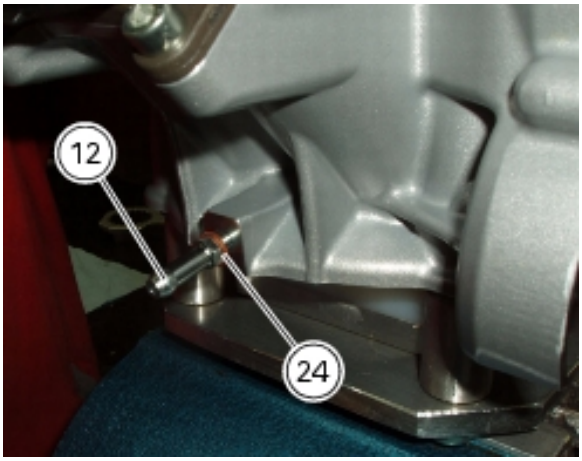
When the lower two bolts (**28**) of the vertical cylinder head manifold are unscrewed, the expansion tank support will

come free.



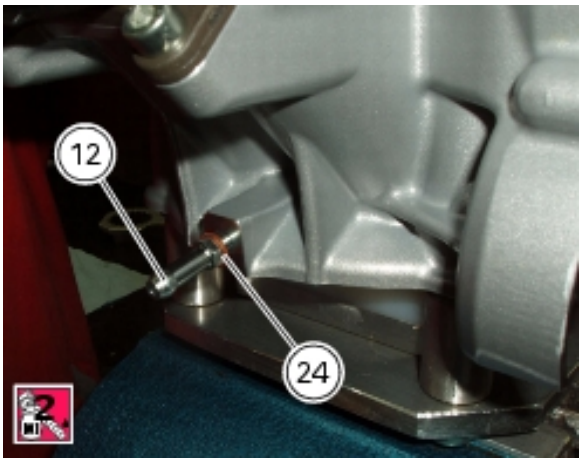
Loosen the clamp (A) and remove the hose (B).
Remove the union (12) and recover the seal (24).

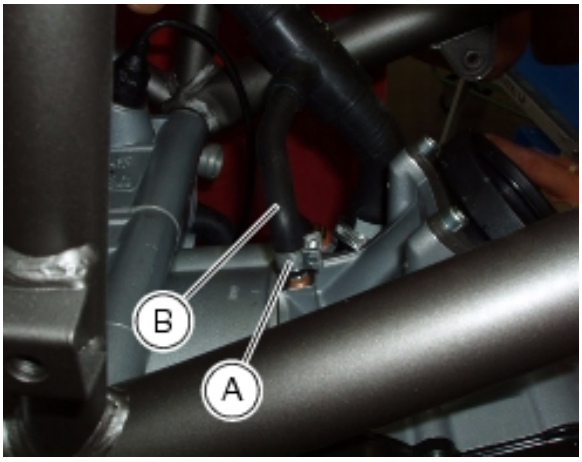




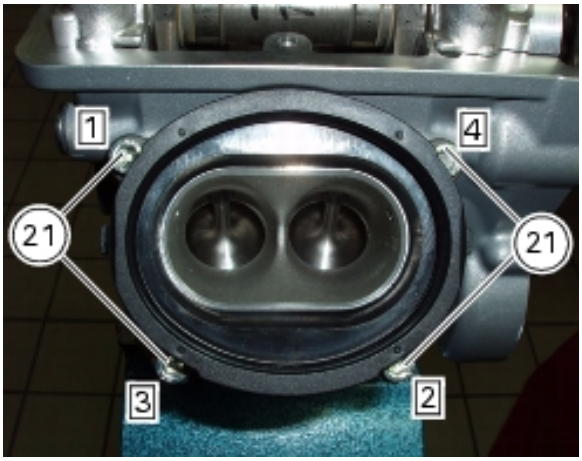
Refitting the intake manifold and coolant union

Apply the recommended threadlocker to the union (12), fit the seal (24) and tighten to the specified torque (Sect. C 3, Engine torque settings).
Refit the hose (B) and tighten the clamp (A) to the specified torque (Sect. C 3, Engine torque settings).



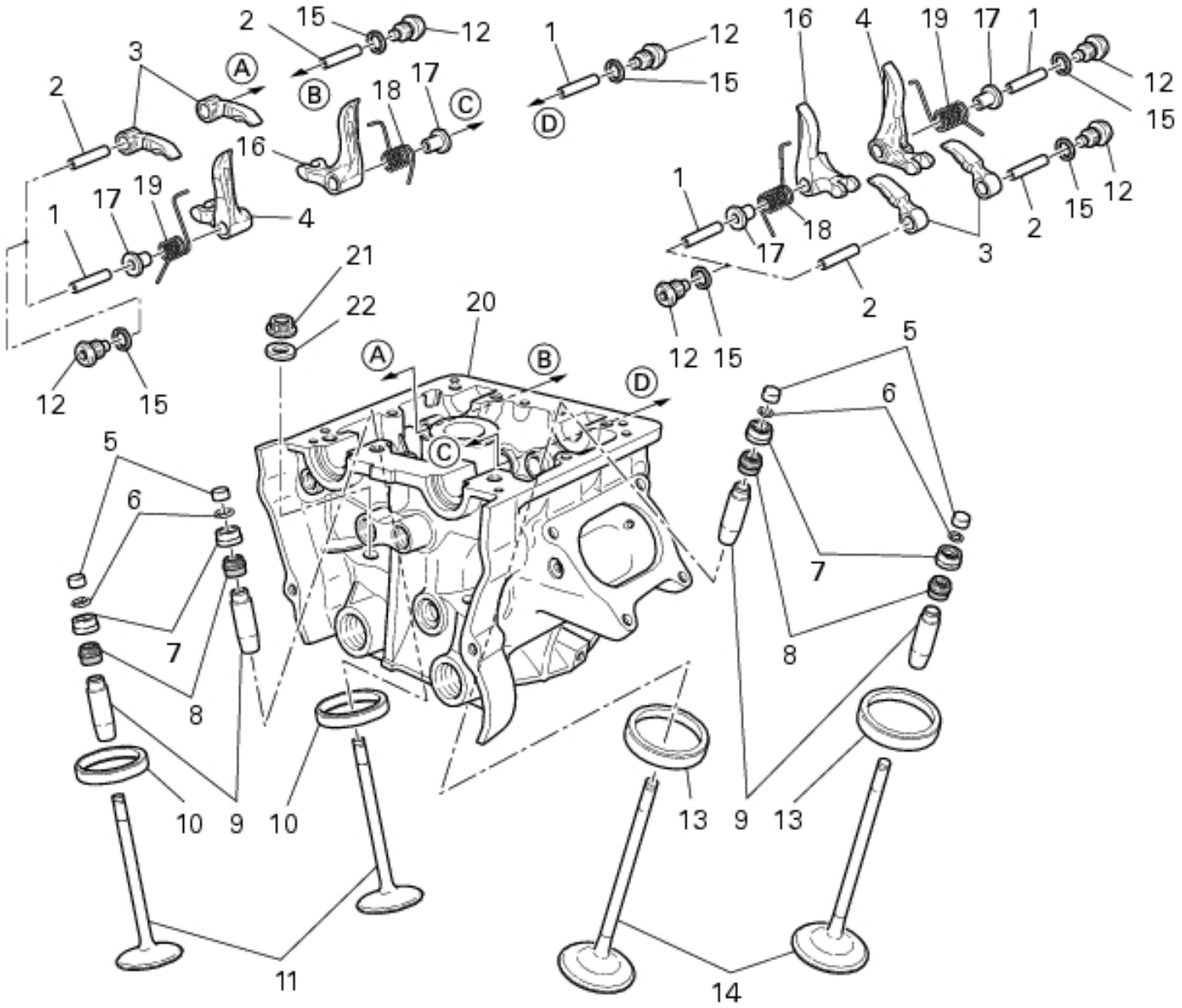


Check that the mating surfaces of the cylinder head and manifold are perfectly flat and clean and install the intake manifold (25) on the cylinder head.
Relocate the expansion tank support (Sect. N 3.1, Refitting the expansion tank).
Tighten the bolts (21) to the specified torque (Sect. C 3, Engine torque settings) in a crosswise pattern (1-2-3-4).



Operation	Section reference
Refit the airbox	L 6, Refitting the airbox and throttle body
Refit the radiator	N 3.2, Refitting the radiator
Refit the side fairings	E 2, Refitting the side fairings

4.5 - Cylinder head assemblies: valves - rocker arms



1 Closing rocker arm shaft
2 Opening rocker arm shaft
3 Opening rocker arm
4 Closing rocker arm (left)
5 Valve opening shim
6 Half rings
7 Valve closing shim
8 Seal
9 Valve guide
10 Exhaust valve seat
11 Exhaust valve
12 Plug
13 Intake valve seat
14 Intake valve
15 Aluminium gasket
16 Closing rocker arm (right)
17 Spacer
18 Valve return spring (right)

19 Valve return spring (left)
20 Cylinder head
21 Cylinder head nut
22 Washer

Parts catalogue

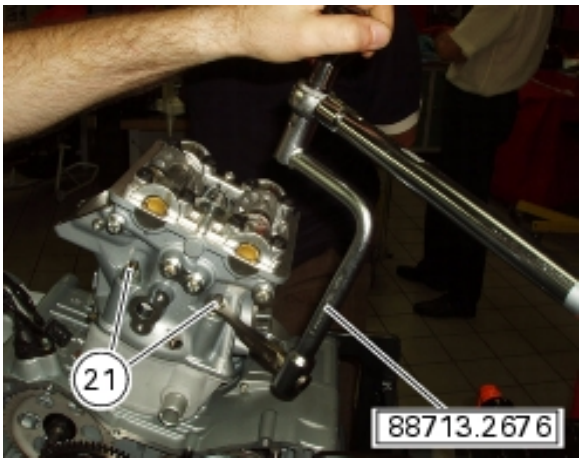
Crankcase halves
Vertical cylinder head
HORIZONTAL CYLINDER HEAD

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

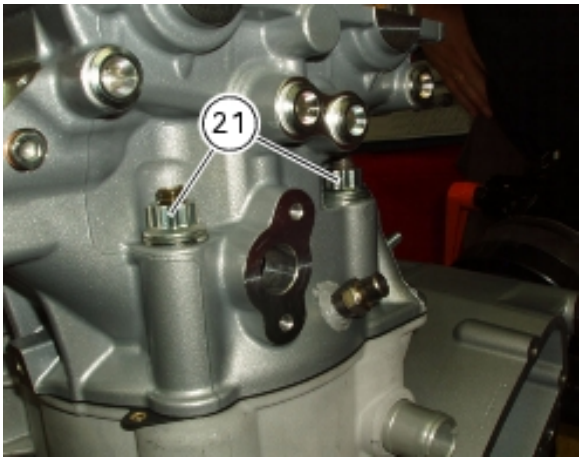
Removal of the cylinder heads

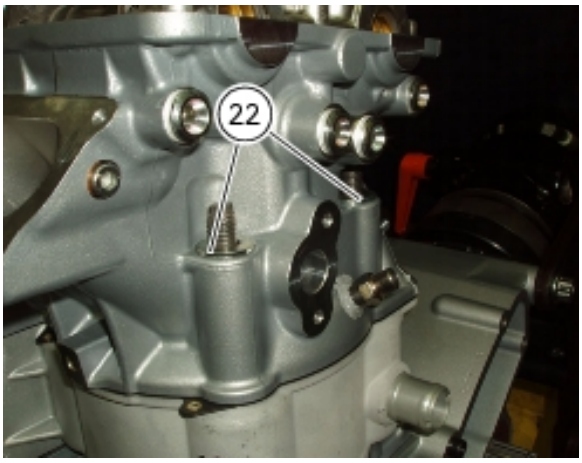
Operation	Section reference
Remove the engine from the frame	N 1, Removal of the engine
Remove the coolant hoses	N 3.2, Removal of the cooling system hoses and unions
Remove the timing belt covers and the timing belts	N 4.2, Removal of the timing belt covers

Using the service tool no. **88713.2676**, undo the nuts (21) on the cylinder head studs.



Remove the cylinder head nuts (21) and special washers (22).



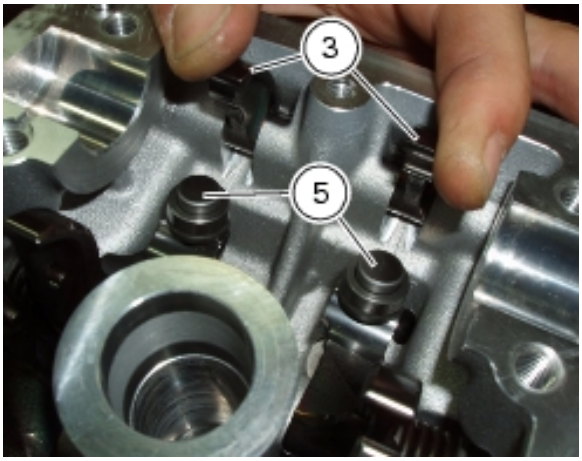


Remove the cylinder head assembly by lifting it off the engine studs.
Repeat the same procedure for the other cylinder head.

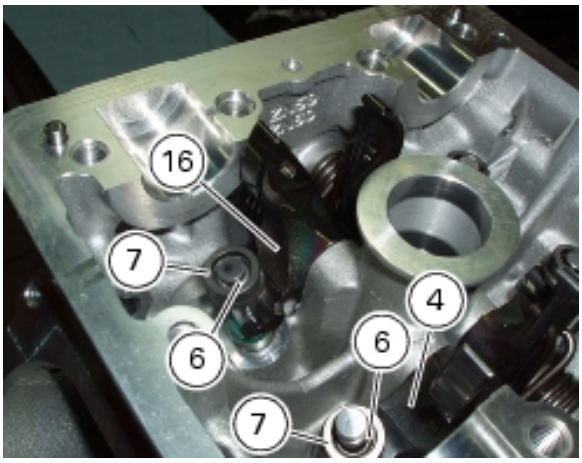
Removal of the valves

Operation	Section reference
Remove the cylinder head assembly from the engine	N 4.5, Removal of the cylinder heads
Remove the timing belt pulleys	N 4.2, Removal of the camshaft pulleys/idler pulley
Remove the camshafts	N 4.4, Removal of the camshafts

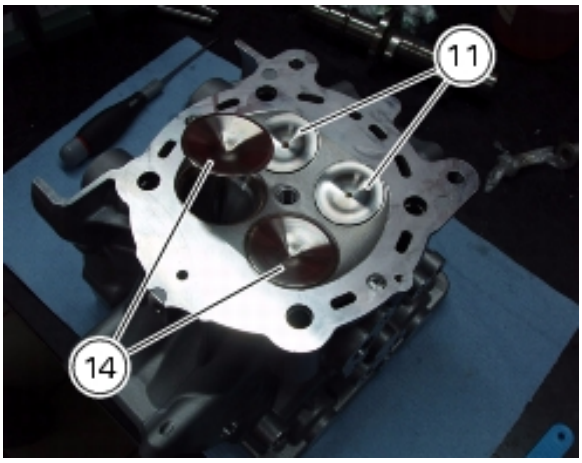
Raise the rocker arm (3) and remove the opening shim (5) from the valves with a pair of pliers.



Push down the closing rocker arms (16) and (4) and the closing shim (7).
Remove the half rings (6) from the valves with a magnetic screwdriver. Extract the closing shims (7) from the valve using a pair of pliers.



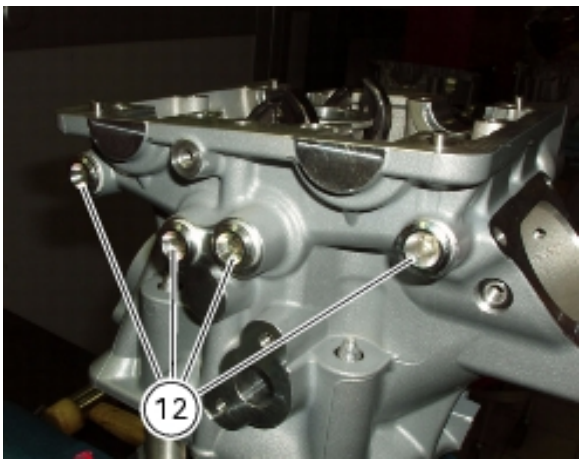
Withdraw the valves (14) and (11) from underside of the cylinder head.

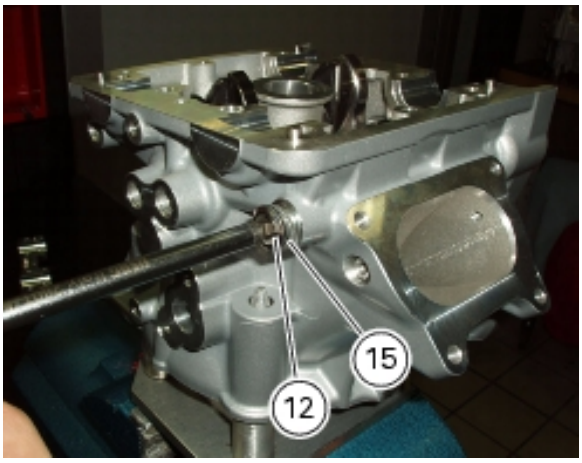


Repeat the same procedure for the other cylinder head.

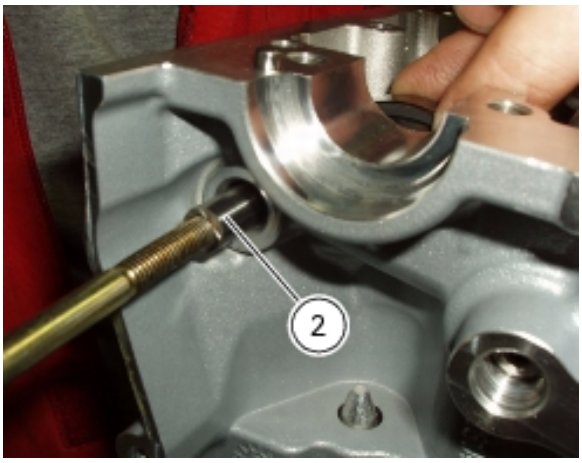
Removing the valve rocker arms

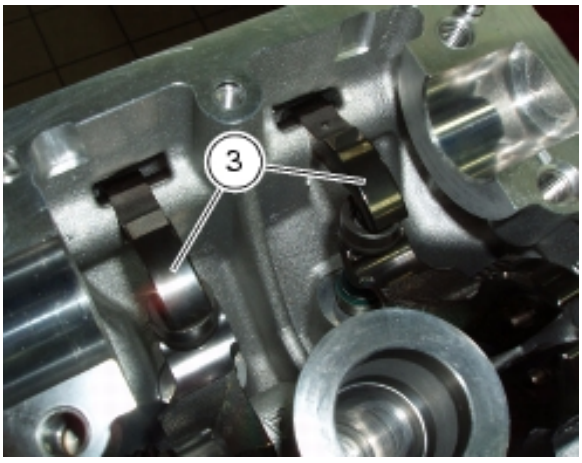
With the cylinder head in the condition described in the previous paragraph, remove the rocker arms. Unscrew the eight plugs (12) and recover the seals (15).



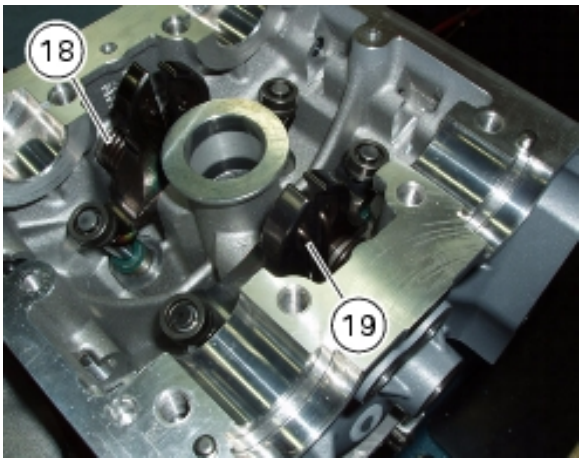


Using an M6 bolt, withdraw the shafts (2) of the opening rocker arms (3) on the exhaust and intake sides. Remove the opening rocker arms (3).

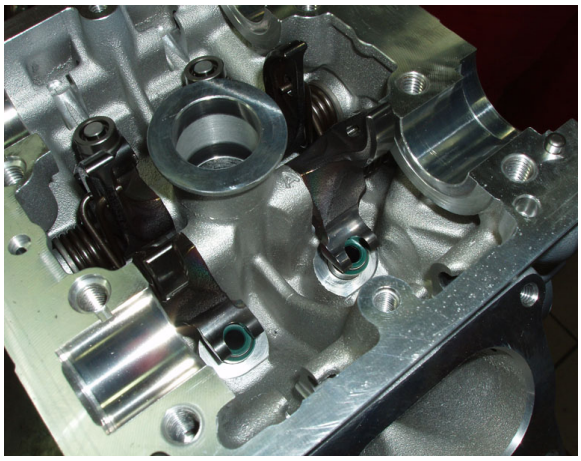




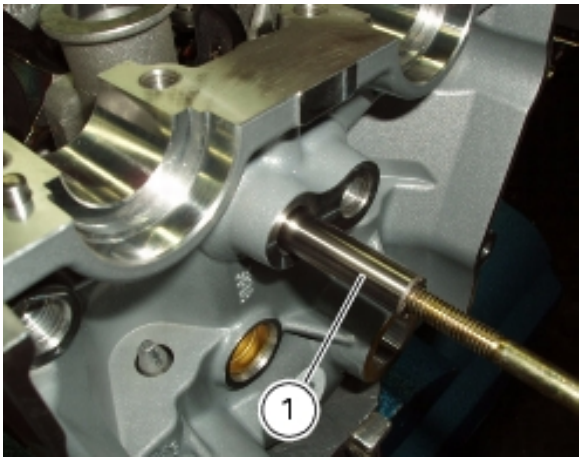
Using accessory of the rocker arm spring tensioning kit **88713.2069** installed between the spring and the inner wall of the cylinder head, move the straight end of the rocker arm return spring (19) and (18) and insert it in the drilled shaft.



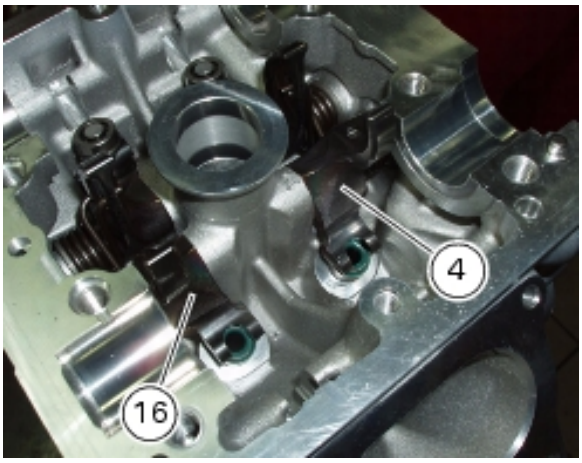
Use the shaft to slide the end of the spring into its final position.

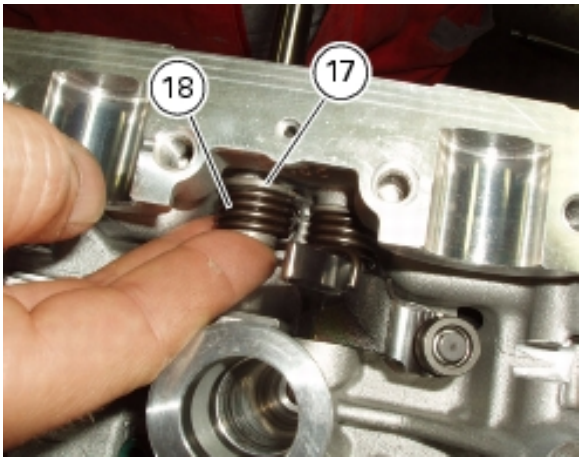


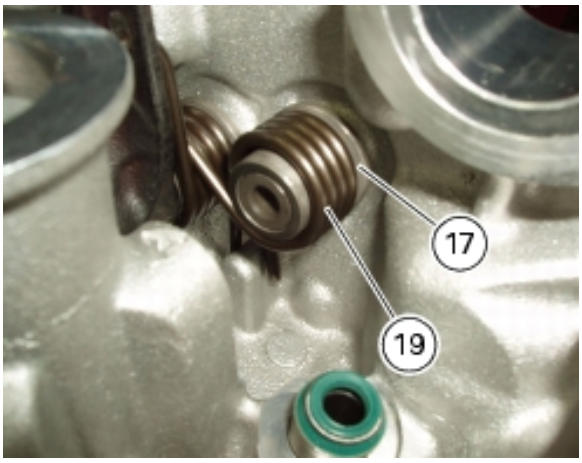
Using an M6 bolt, withdraw the shafts (1) of the closing rocker arms on the exhaust and intake sides.



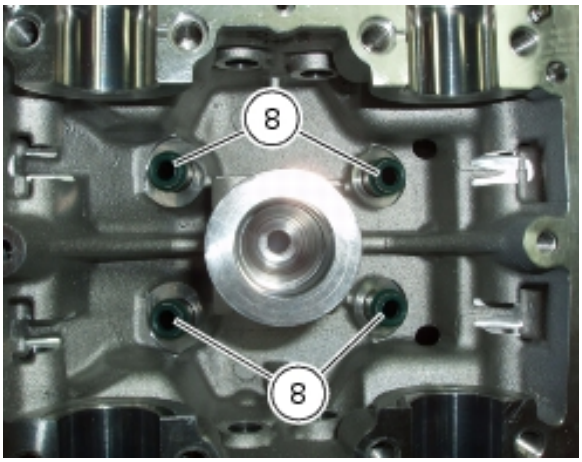
Remove the closing rocker arms (4) and (16), the springs (18) and (19) with the spacers (17).







Remove the seal rings (8) from the ends of the valve guides.

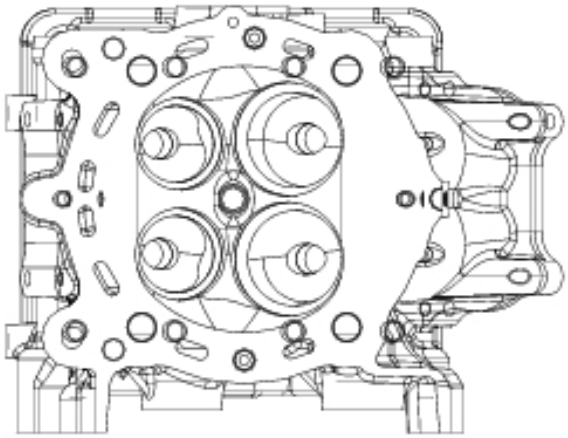


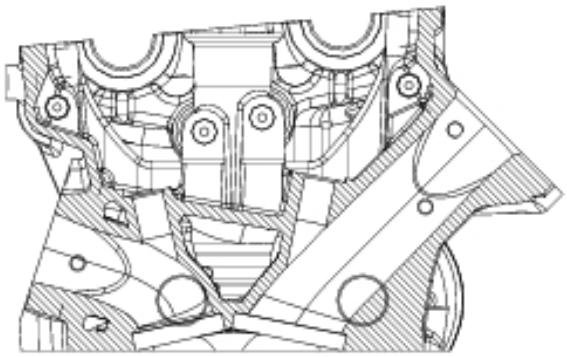
Repeat the same procedure for the other cylinder head.

Overhaul of cylinder head components

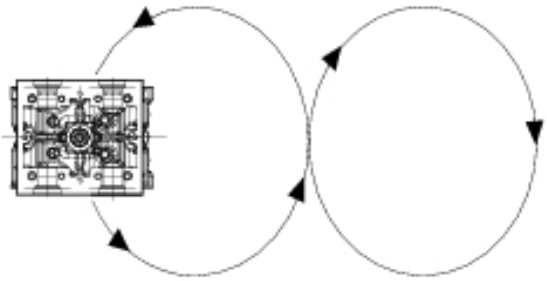
Cylinder heads

Remove any carbon deposits from the combustion chamber and its ducts.
Remove any scale from the coolant ducts.
Check for cracking and inspect the sealing surfaces for scoring, ridges or other damage.



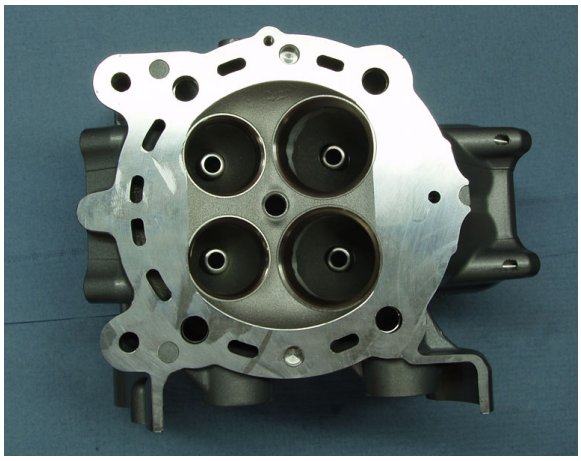


Check that the cylinder barrel mating surfaces of the cylinder head are free of carbon deposits and scale. If this is not the case, spread diamond dressing compound (6-12 micron thickness) on a reference surface and slide the cylinder head on the surface as shown in the figure until a flat finish is obtained.

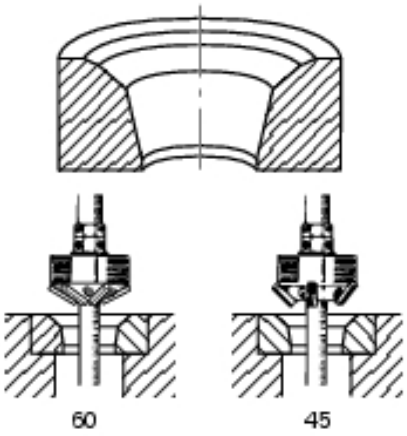


Valve seats

Visually inspect the valve seats: for cracking or pitting.



Minor damage can be repaired by grinding with special 45° and 60° single-blade grinders. Grind the valves and check the seal.

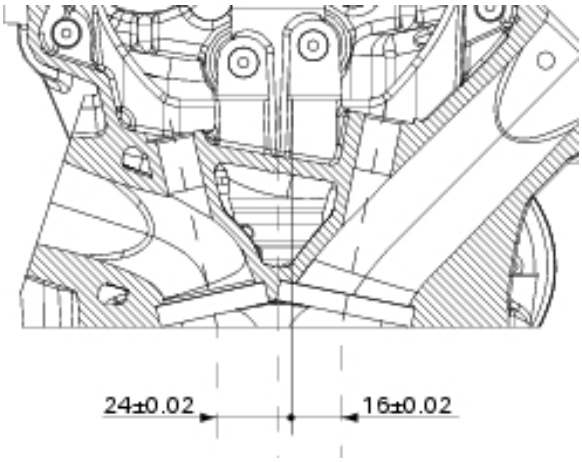


If the valve seats are excessively damaged, fit oversize seats. Replacement seats are available with **0.03** and **0.06** mm oversized outside diameters.

Important

When you change the valve seats, change the valve guides as well.

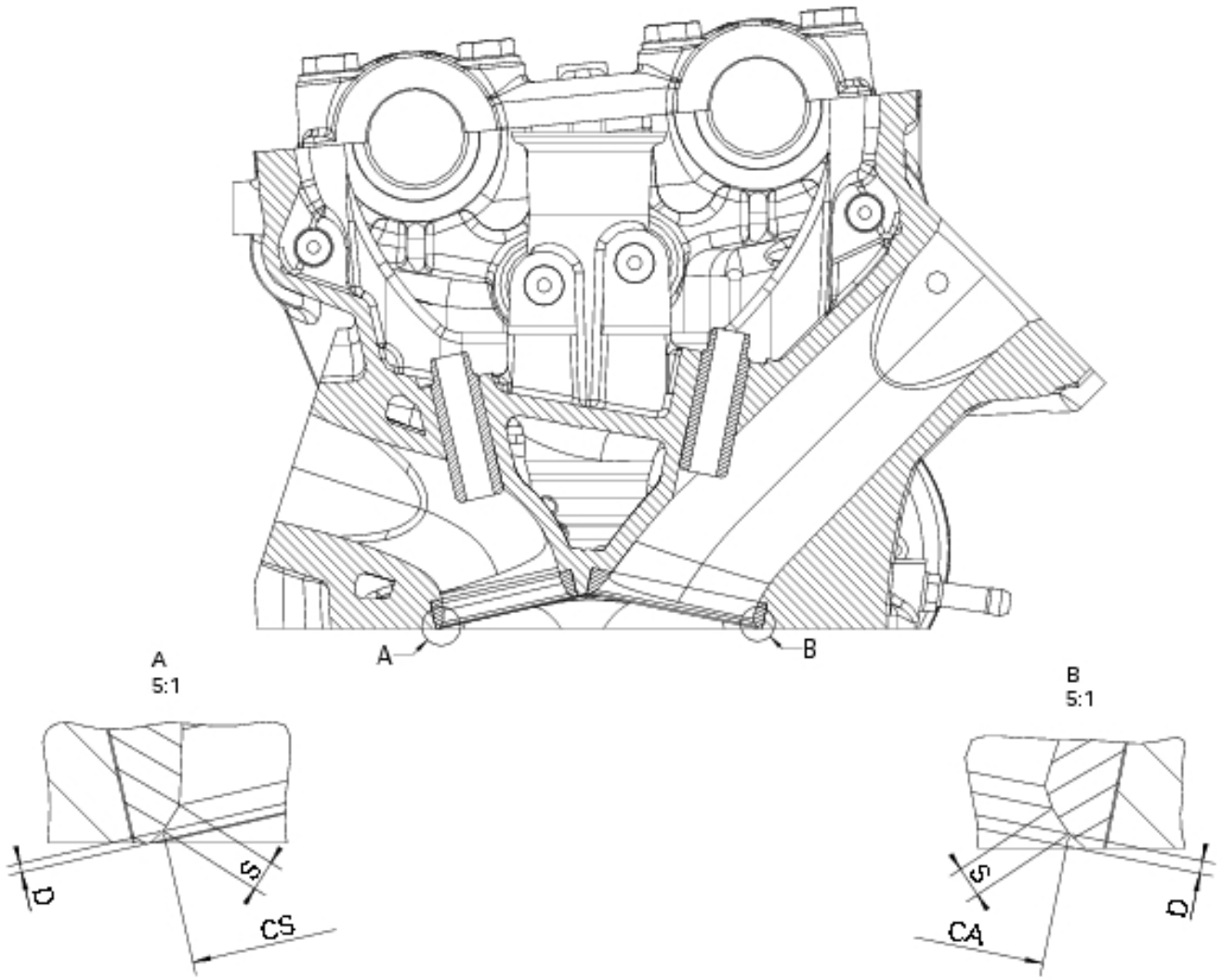
Proceed as follows:
Remove the worn seats, grinding carefully to avoid any damage to cylinder head bores.
Check the diameter of head bores and choose the oversized valve seat that will give an interference fit of **0.04** to **0.10** mm.



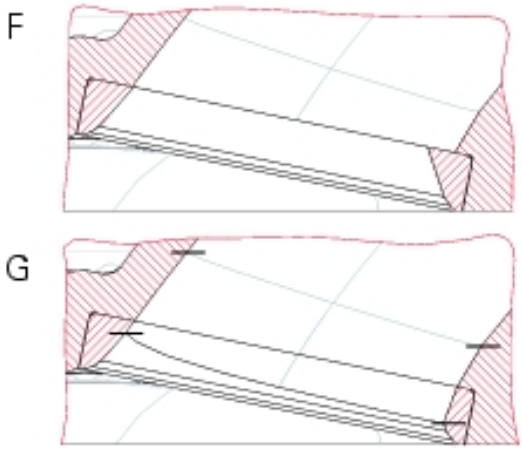
Heat the cylinder head gradually and evenly up to **150** °C and chill the new valve seats in dry ice.
Drive the seats perfectly square into the head bores using the appropriate valve guide seat installer **88713.2846** and **88713.2847**.

Allow the cylinder head to cool down and grind the seats to the following dimensions:
CA = Ø 41.6±0.025 mm.
CS = Ø 33.6±0.025 mm.
S = 1.2 mm.
D = 0.2 to 0.4 mm.

Important
Do not use any lapping compound after final grinding.

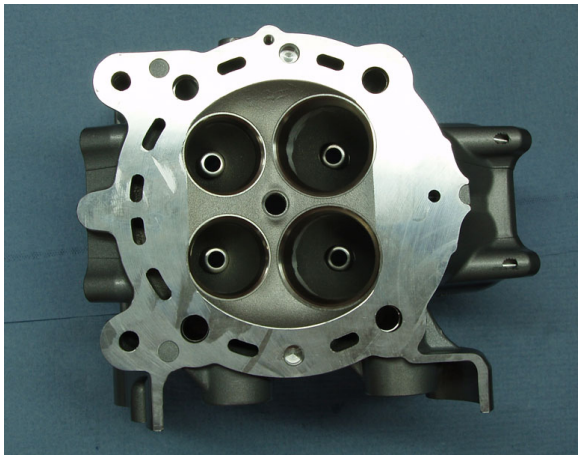


It is advisable to smooth the joint between the intake valves seats and the intake ducts (F = before; G = after).

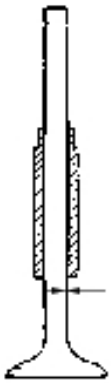


Valve guides

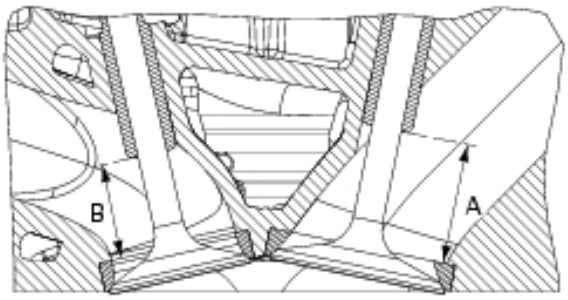
Check the inner surface of the valve guides for cracking or distortion.



Thoroughly check the dimensions of the inner surface of the valve guide. Measure the inside diameter with a bore diameter gauge. Measure the diameter at different positions of the valve guide.



The assembly clearance must be:
highest measured value − lowest measured value = **0.03** to **0.045** mm.
The maximum permissible wear limit is **0.08** mm.
Change the valve guides when the ovality exceeds permissible limit or the clearance to the valve stem is outside the tolerance range.
When you change the valve guide, you must also change the valve.
Replacement valve guides are available with outside diameter oversized by **0.03**, **0.06** and **0.09** mm.
Change the valve guides as follows:
heat up the cylinder head gradually and evenly up to **150** °C;
remove the original valve guides using service tool no. **88713.2842**;
allow the cylinder head to cool down and check the condition of the seats;
choose suitable valve guides to obtain an interference fit in the cylinder head of **0.022-0.051** mm;
heat up the cylinder head again and chill the new valve guides in dry ice;
lubricate the bores in the cylinder head and install the valve guides using the appropriate service tools and in reference to the dimensions given in the figure;
A= 22.4±0.15 mm.
B= 28.45±0.15 mm.
Hone the mating surface with a reamer.

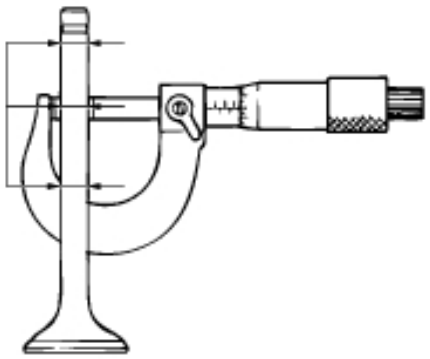


Checking the valve

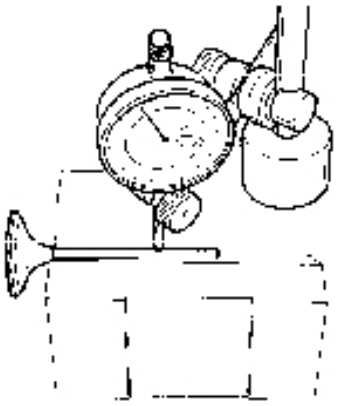
Check that the stem and the valve seat contact surface are in good condition.
There must be no pitting, cracks, deformations or signs of wear.

Warning
The valves cannot be ground.

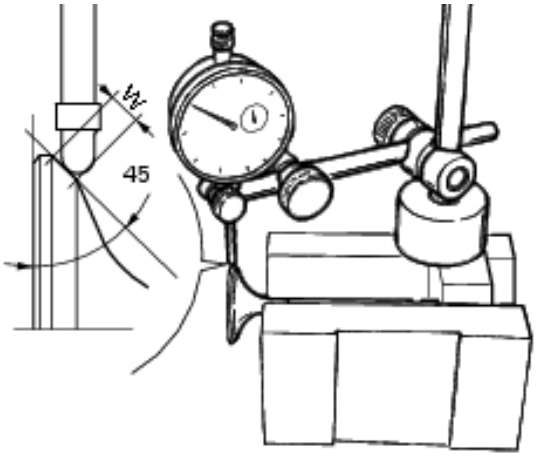
Perform the following checks.
Measure the diameter of the valve stem at various points along the section that runs in the valve guide.

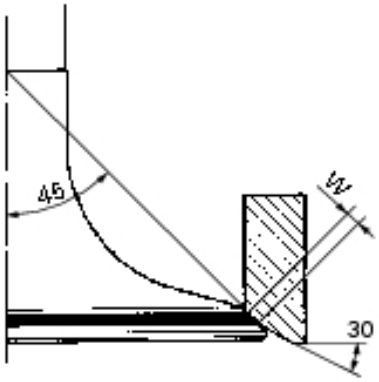


Check the valve stem for buckling. Place it on a "V" block and measure deformation with a dial gauge.
Service limit: **0.053** mm.
Check that valve head band (at 45° to valve head top face) is concentric to the valve stem as follows: place valve on a V block, set a dial gauge at right angles to head and rotate valve.
Nominal concentricity: **0.01** mm.
Service limit: **0.03** mm.



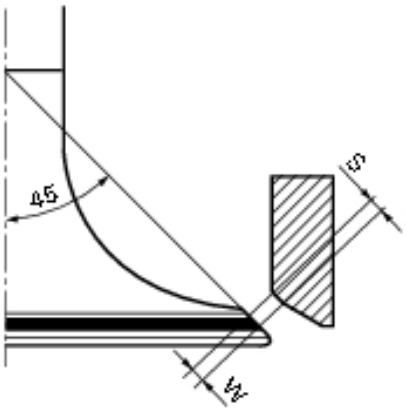
Use Prussian blue or a mixture of minium and oil to check that the contact surface (W) between the valve and seat is **1.4** to **1.6** mm (**1.05** to **1.35** mm when new). Grind the seat if the dimension measured is greater than the above limit.





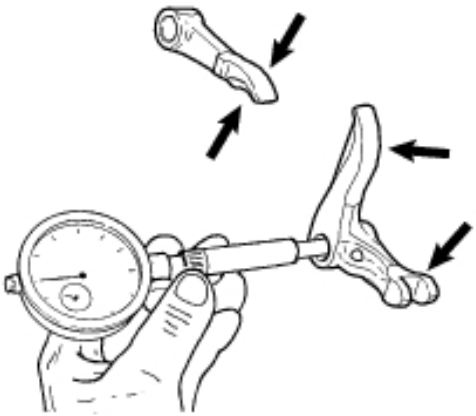
Checking the valve seal

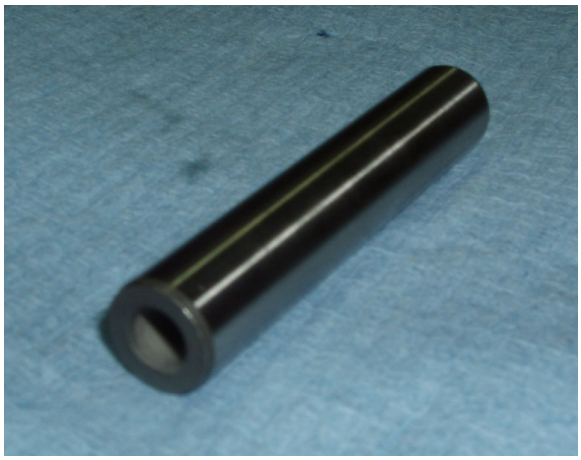
After grinding the seats it is important to check the seal between the valve face and the seat: if the seat contact area (S) on the valve is wider than the 45° band (W) this could lead to poor sealing.



Checking the rocker arms

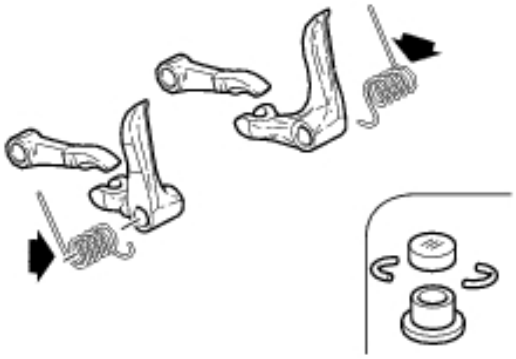
Check for signs of wear, grooves or chrome flaking off.
Check the condition of rocker arm bore and shaft.
Assembly clearance: **0.025** to **0.049** mm.
Wear limit: **0.08** mm.





Opening and closing shims - Springs

Check the condition of the contact surfaces of the valve opening and closing shims: there must be no signs of wear.
Check the condition of the closing rocker arm return springs.
Check for cracking, distortion, or loss of elasticity.



Reassembly of the cylinder head

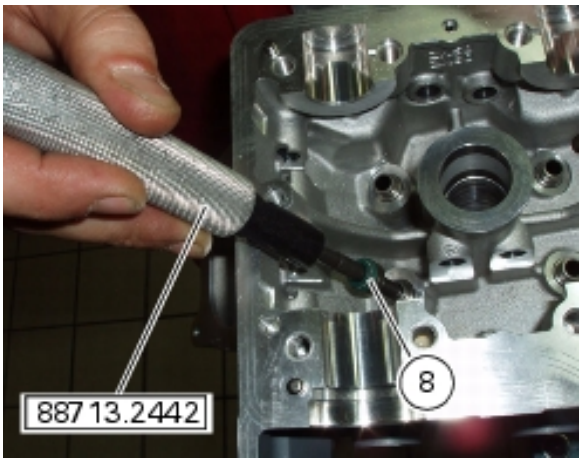
The exhaust side can be identified by the three threaded holes on the flange.

The intake side can be identified by the presence of four threaded holes on the flange.

All the photos in this chapter refer to a vertical cylinder head.

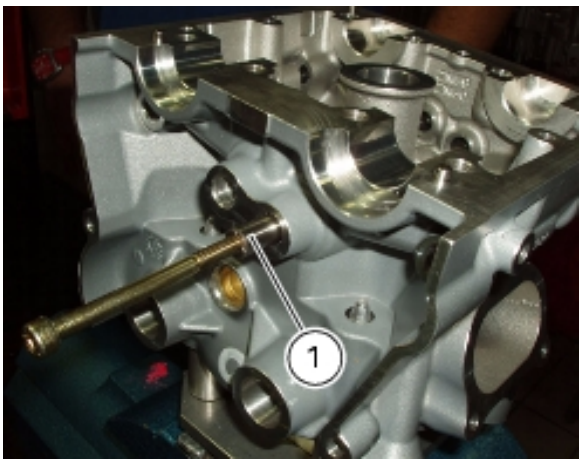
Valve guide seals

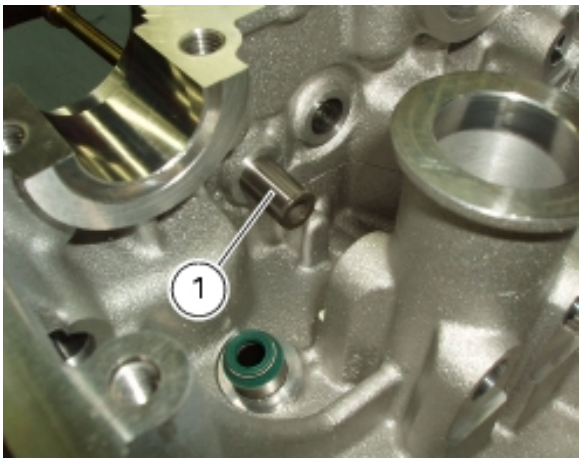
Position the cylinder head on the service stand **88713.2103**.
Use alcohol to lubricate the valve guide seals (8) and insert them from the spring side onto tool **88713.2442**.
Fit the end of the tool into the valve guide and use a mallet to tap the seals (8) home into the valve guides.



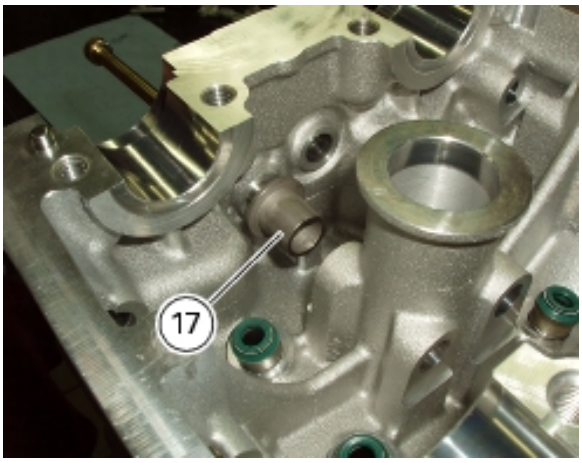
Reassembly of the closing rocker arms

Check that the rocker arms are not scored or show signs of breakage in the area of contact with the camshaft and shim.
The closing rocker arm shafts are 10 mm in diameter, whereas the opeining rocker arm shafts are 9 mm in diameter.
Using an M6 bolt, position the closing rocker shaft (1) towards the exhaust side of the cylinder head.

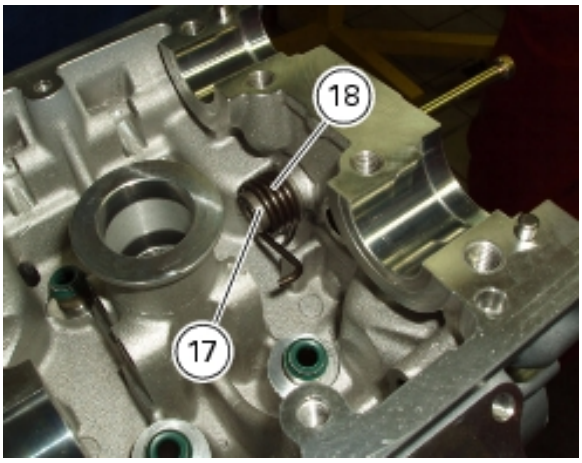




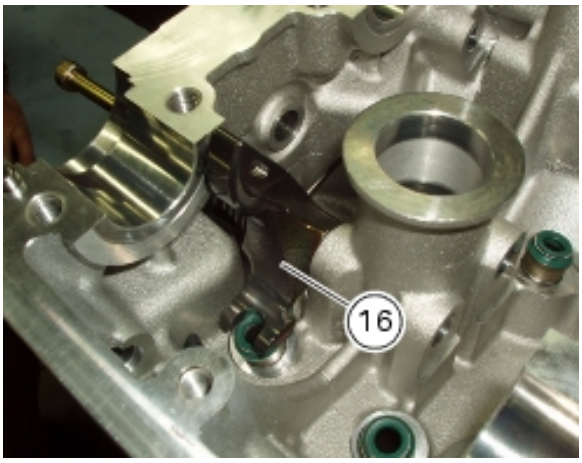
Locate the spacer (17) on the shaft.



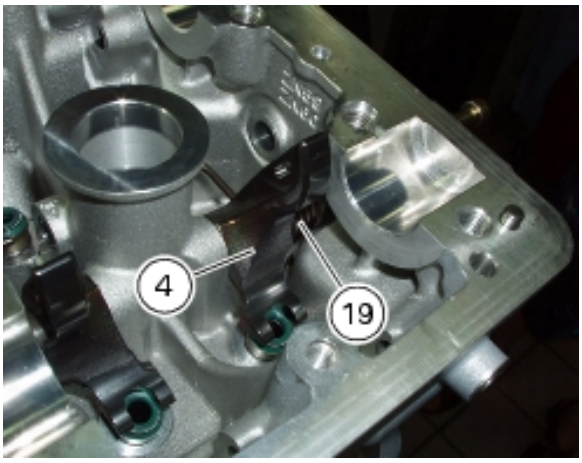
Locate the spring (18) on the spacer (17).



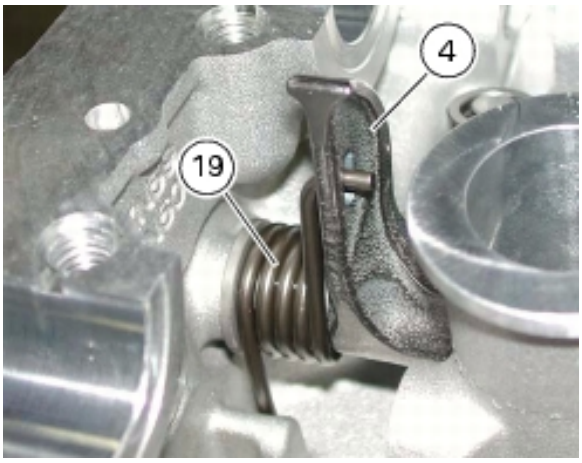
Locate the closing rocker arm (16) and drive the shaft home.

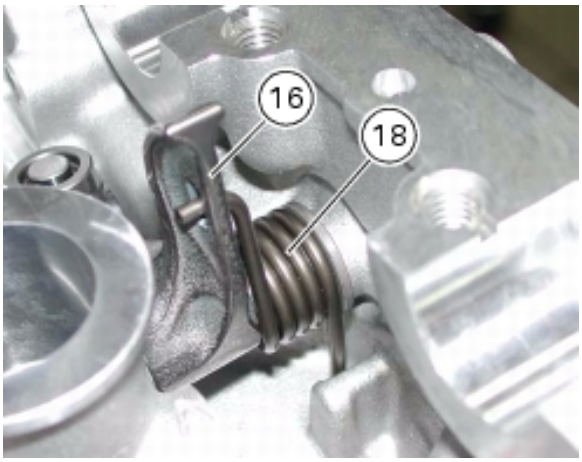


Proceed in a similar manner to install the closing rocker arm (4) with the spring (19) from the exhaust side.



Load the springs (18) and (19) on the closing rocker arms (16) and (4) respectively using service tool no **88713.2069**.





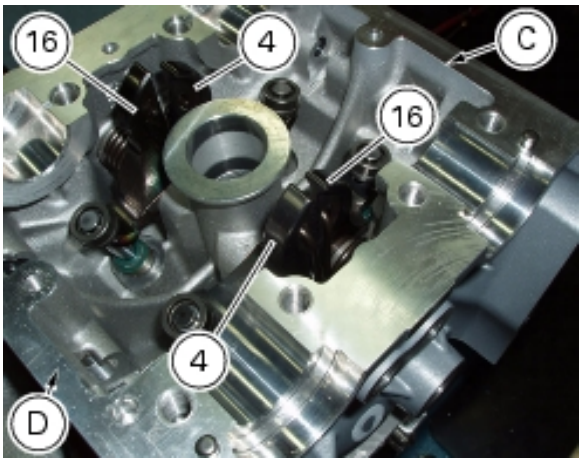
Proceed to install the closing rocker arms (4) and (16), the relative springs and shafts on the intake side (C) in the same manner as described for the exhaust side (D).

Notes

Always install the closing rocker arms on the exhaust side before those on the intake side.

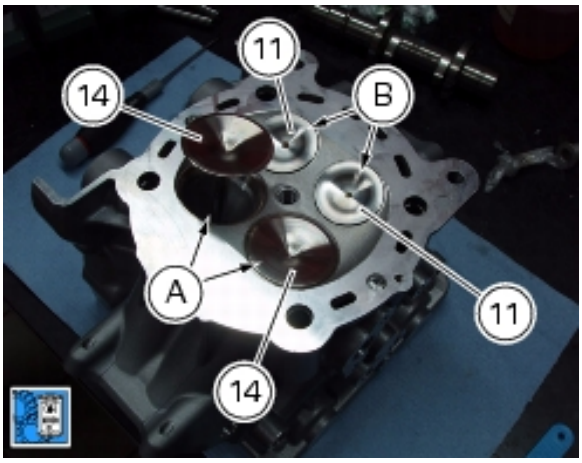
Warning

Take care not to damage the shoe of the closing rocker arm with the intake spring during assembly.

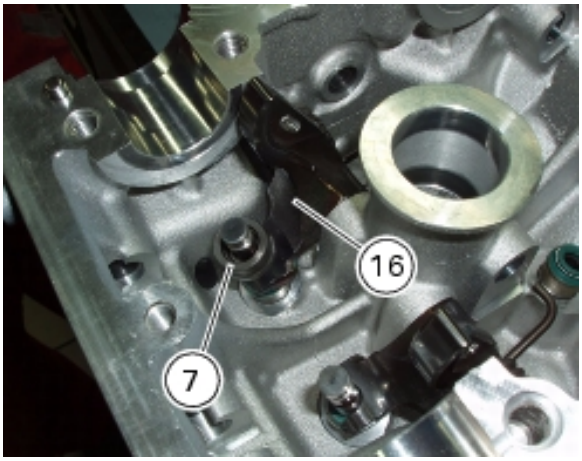


Refitting the valves, closing shims and half rings

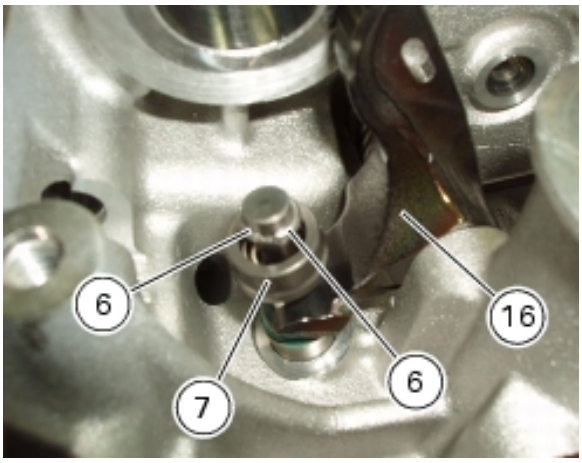
Carefully clean the two intake valve seats (A) and the two exhaust valve seats (B).
Lubricate the stems of the two intake valves (14) and the two exhaust valves (11) with engine oil.
Install the valves in respective seats in the cylinde head.



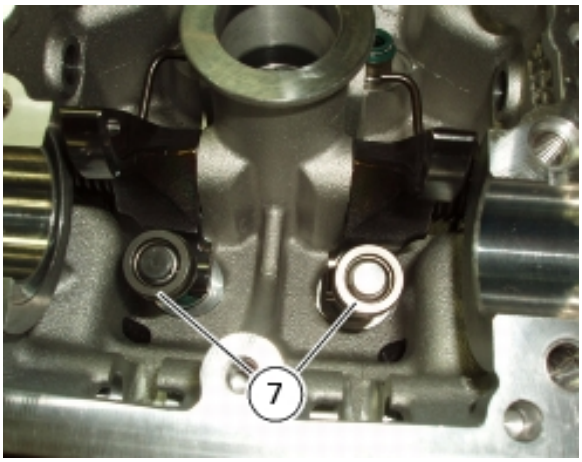
Hold the closing rocker arm (16) pushed downwards and fit the closing shim (7) on the valve stem. If using the old cylinder head, start by fitting the original shim.



Insert the new half rings (6) and release the rocker arm to ensure that they seat inside the shim (7). To ensure the half-rings are seated in the shim, tap the end of the rocker arm (16) with a rubber mallet.



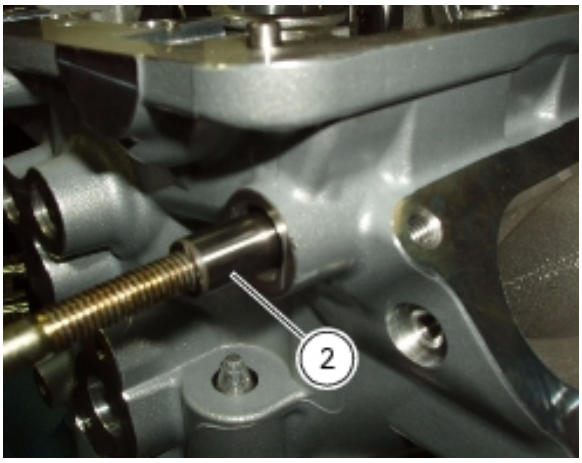
Repeat the procedure with the opposite valve and check that the top of the valve stem is aligned with the surface of the shim (7); if it is not, repeat the half-ring installation procedure.



Install the closing shims on the intake valves (14) using the method described above for the exhaust valves.
Refit the camshafts (Sect. N 4.4, Refitting the camshafts) to check the valve closing clearances (Sect. N 4.1, Checking and adjusting the valve clearances).

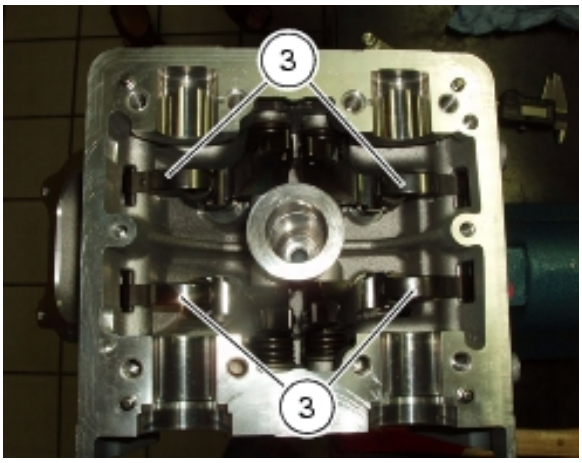
Refitting the opening shims and opening rocker arms

Using an M6 bolt, position the opening rocker arm shaft (2) (diameter 9 mm).

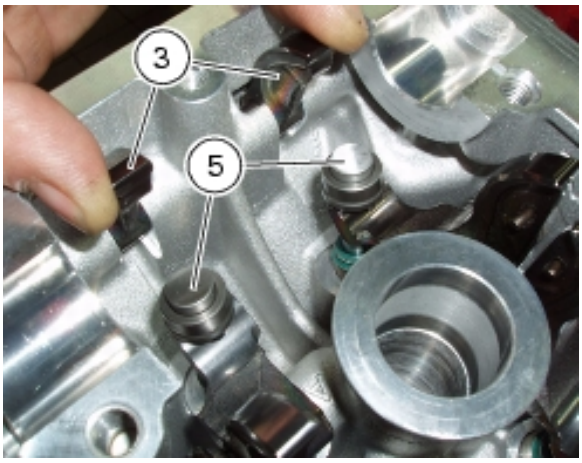


Locate the opening rocker arm (3) and drive the shaft home.

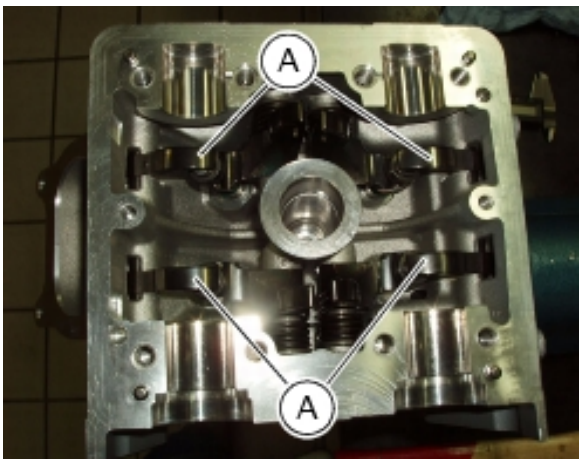
Install the four rocker arms (3) in the manner described above.



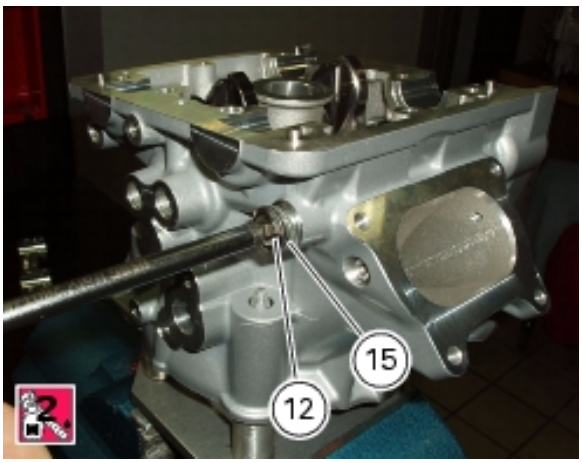
Raise the opening rocker arm (3) and install the opening shim (5) so it seats against the valve stem.



Release the rocker arm so that it rests against the shim.
Ensure the shim is correctly seated by lightly tapping the rocker arm shoe (A) with plastic mallet.
Refit the camshafts (Sect. N 4.4, Refitting the camshafts) to check the valve opening clearances (Sect. N 4.1, Checking and adjusting the valve clearances).



Apply the recommended threadlocker to the plugs (12).
Fit the eight plugs (12) with their seals (15): position the seals so that the square edges face the cylinder head.
Tighten the plugs to the specified torque (Sect. C 3, Engine torque settings).



Operation	Section reference
Refit the camshaft supports	N 4.4, Refitting the camshafts
Refit the timing belt pulleys	N 4.2, Refitting the camshaft pulleys/ idler pulleys

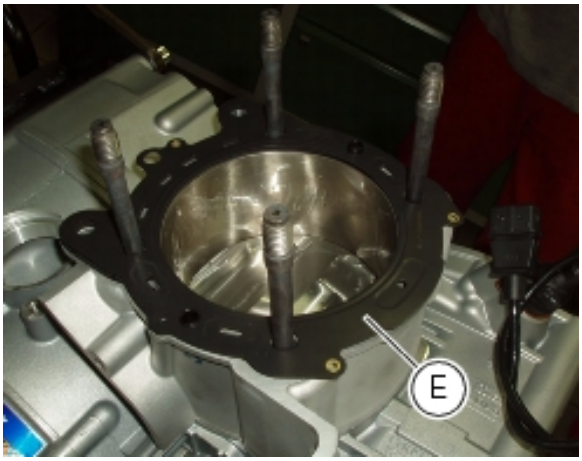
Refit the cylinder head covers	N 4.4, Refitting the camshafts
Refit the cylinder head assembly	N 4.5, Refitting the cylinder head assemblies

Refitting the cylinder head assemblies

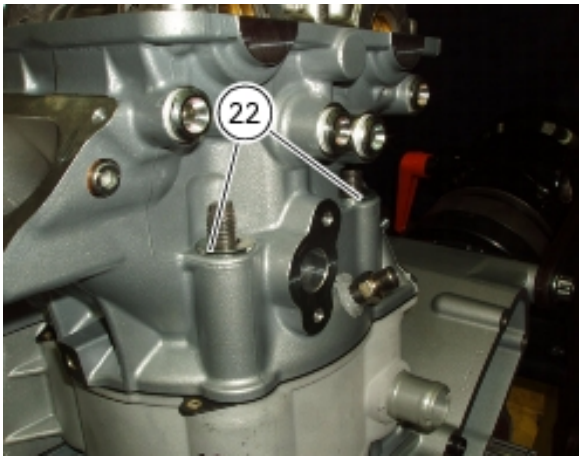
Before fitting the head, check that gasket is installed on the mating surface between head and cylinder (Sect. N 5, Refitting the cylinder/piston assembly).

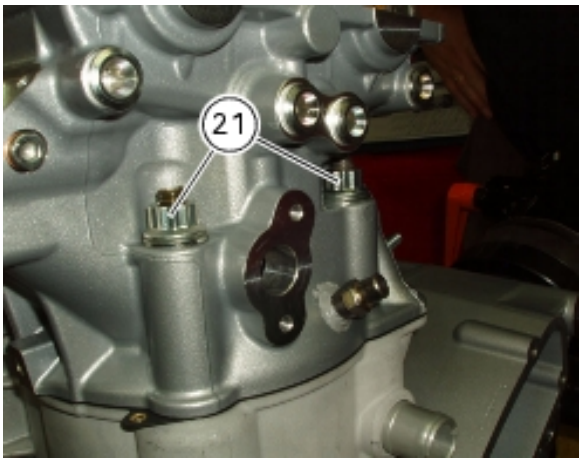
Notes

When fitting the gasket, side (E) with the stamped code must be in contact with the cylinder head.

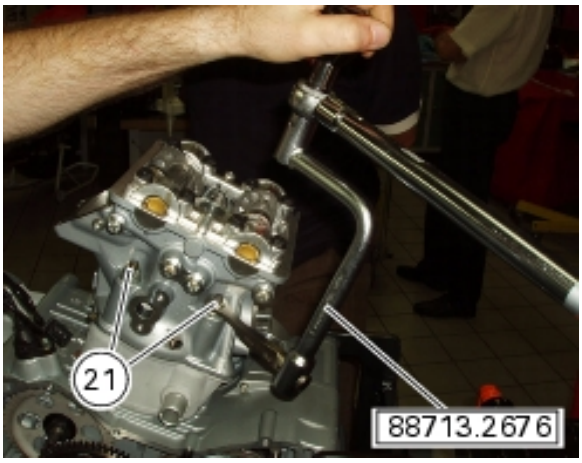


Lower the cylinder head carefully over the studs. Take care not to damage the threads.
Fit the special washers (22) and nuts (21) onto the cylinder head studs.



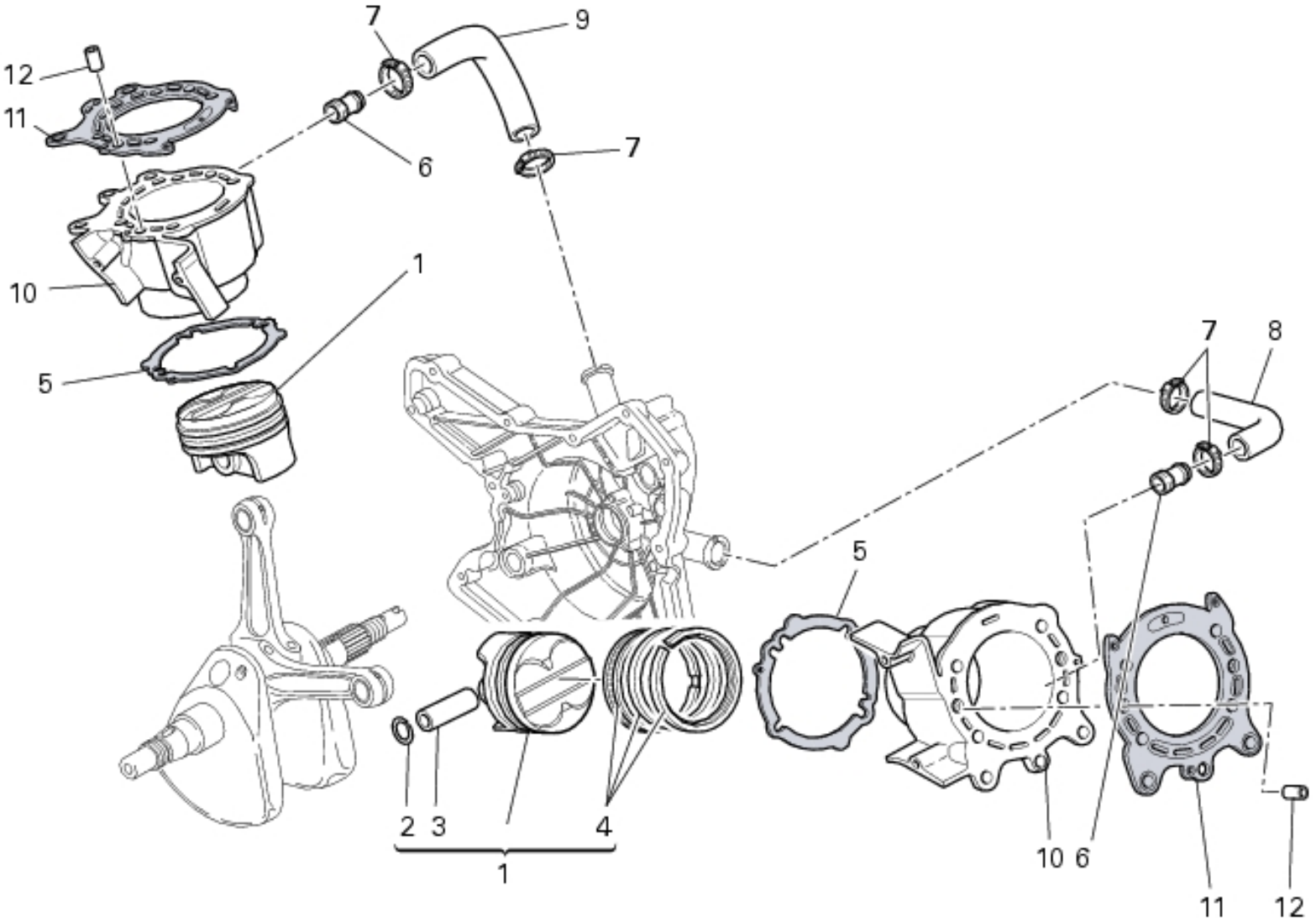


Tighten the nuts (21) on the studs evenly and gradually in a criss-cross sequence using service tool **88713.2676** in conjunction with a torque wrench.
Pre-tighten and tighten the cylinder head nuts (21) to the specified torque (Sect. C 3, Engine torque settings).



Operation	Section reference
Refit the coolant hoses	N 3.2, Refitting the cooling system hoses and unions
Refit the timing belts and covers	N 4.2, Refitting the camshaft pulleys/ idler pulleys
Refit the engine to the frame	N 1, Refitting the engine

5 - Cylinder/piston assemblies



1 Piston
2 Gudgeon pin circlip
3 Gudgeon pin
4 Set of piston rings
5 Cylinder-crankcase gasket
6 Water pump outlet union
7 Hose clip
8 Horizontal cylinder coolant inlet hose
9 Vertical cylinder coolant inlet hose
10 Cylinder barrel
11 Cylinder head gasket
12 Locating bush

Parts catalogue

Cylinders - Pistons

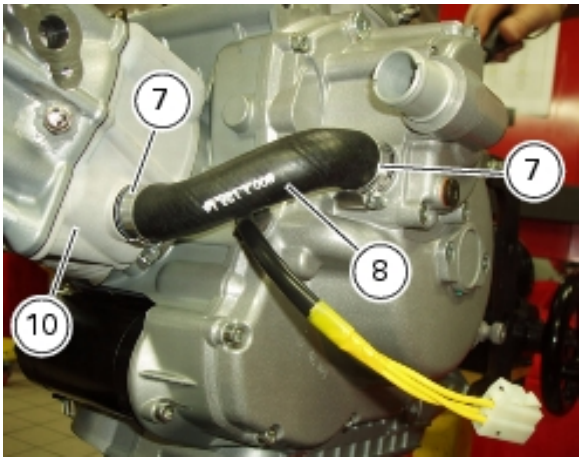
duc.nu>>

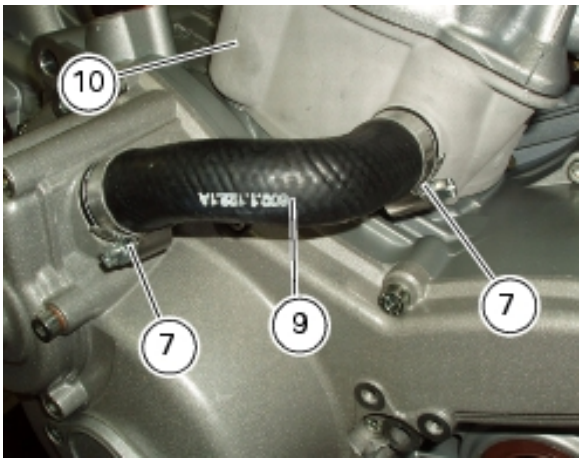
Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

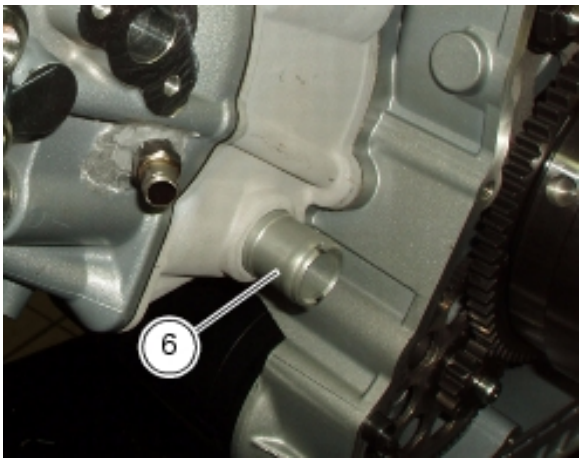
Removal of the cylinder/piston assembly

Loosen the clamps (7) and remove the hoses (8) and (9) from the cylinder barrels (10) and from the alternator-side crankcase cover.





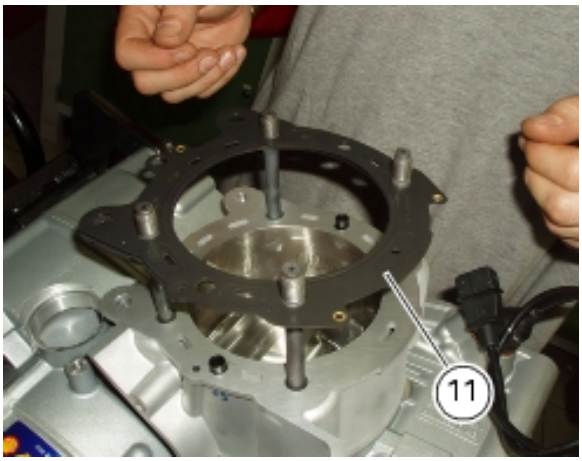
If damaged, unscrew the unions (6).



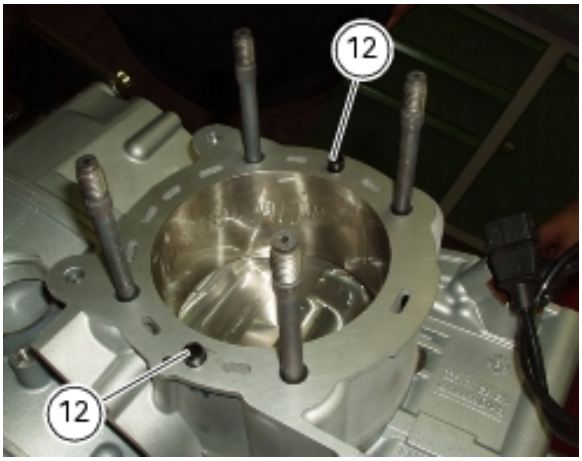
Notes

The following procedure is described with the engine removed from the frame and the cylinder head removed from the engine (Sect. N 4.5, Removal of the cylinder heads).

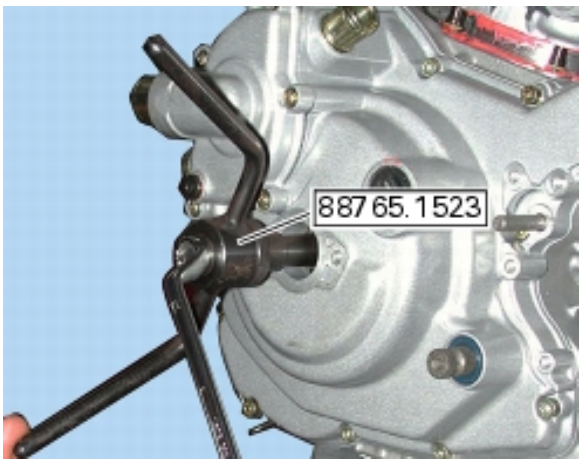
Remove the cylinder head gasket (11) from the cylinder barrel.



Remove the bushes (12).



Use service tool no. **88765.1523** to bring the piston of the horizontal cylinder to TDC.

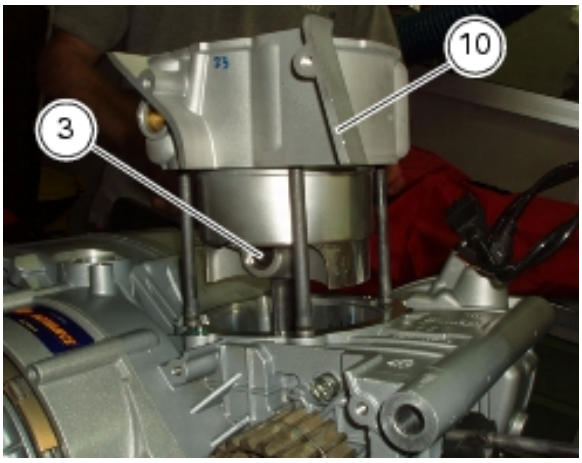


Carefully lift the cylinder barrel (10) off the crankcase, keeping it vertical.
If necessary, rock the cylinder slightly using both hands or tap its base gently with a rubber mallet. Continue to lift the cylinder until you can access the gudgeon pin (3).

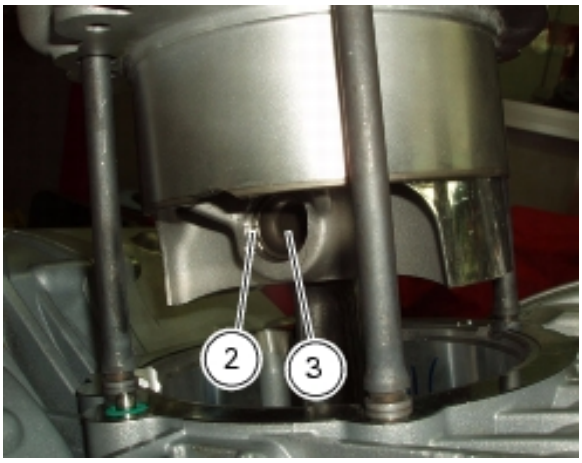
Notes

For better sealing, the piston ring gaps should be positioned at 180° intervals.

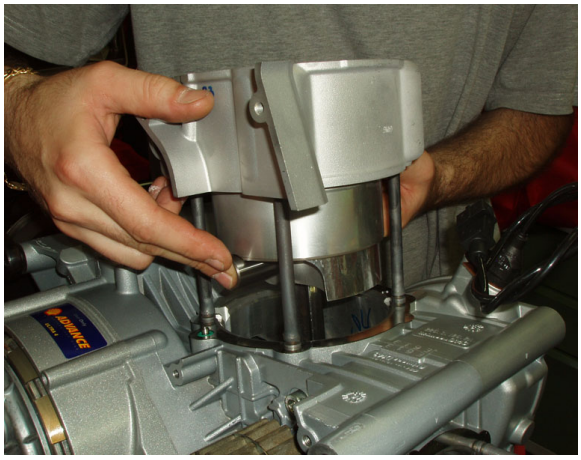
Since insertion of piston in the barrel is a difficult operation to perform at the time of reassembly, remove the piston together with the barrel as described below.
Stuff the crankcase opening with a rag or soft paper to prevent foreign material from falling in.



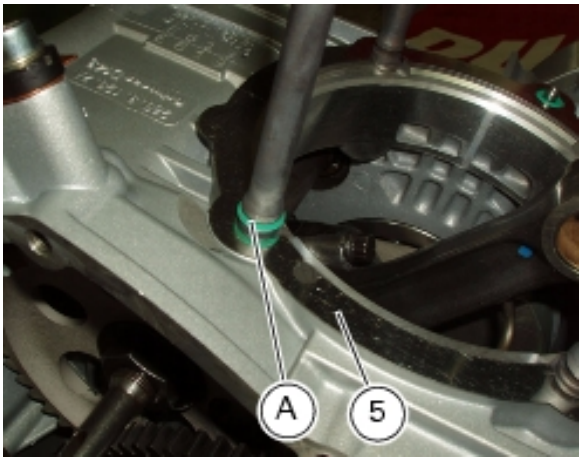
Remove the circlip (2) from the gudgeon pin (3) on the clutch side.



Working from the opposite side, drive out the gudgeon pin sufficiently to release the connecting rod.
Lift the barrel/piston assembly clear of the crankcase studs. If work is to be carried out on the piston, carefully withdraw it from the cylinder.



Remove the four O-rings (A) located on the crankcase studs between the barrel and the base gasket (5).



To remove the vertical barrel-piston assembly, bring the vertical piston to TDC and proceed as for removal of the horizontal cylinder barrel.

Important

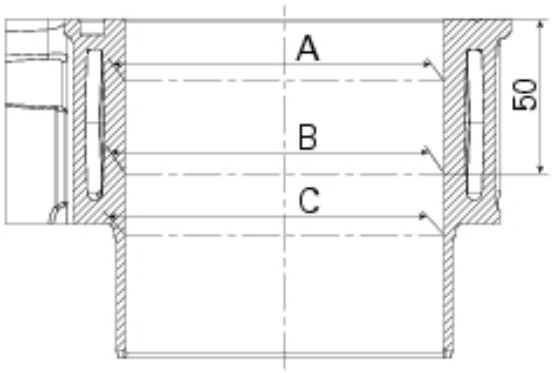
Mark the pistons to show from which cylinder they were removed:
V= Vertical - H= Horizontal

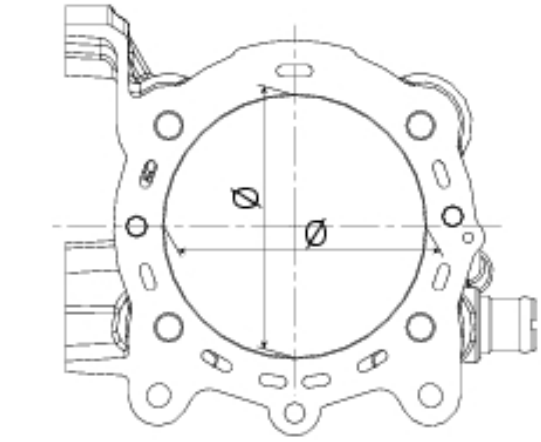
Overhaul of the cylinder barrel/piston components

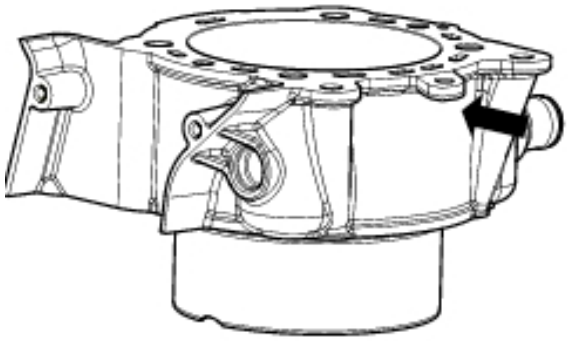
Overhauling the cylinder

Check that the walls of the cylinder bore are perfectly smooth. Measure the cylinder bore diameter at 50 mm from the top face and determine the size class to which it belongs in accordance with the values specified in Sect. C 1.1, Cylinder/Piston. Measure the bore diameter again at three different heights A, B and C and at positions offset by 90°; check that the measurements of taper and ovality in the bore fall within the range specified in Sect. C 1.1, Cylinder/Piston.

In the event of damage or excessive wear the barrel must be renewed as it has a silicon carbide coating (which provides the cylinder walls with excellent anti-friction and anti-wear properties) and therefore cannot be rebored.
The cylinder barrels are marked with letters (stamped between two oil return ways) indicating their size class.
Always match cylinders with pistons from the same size class.

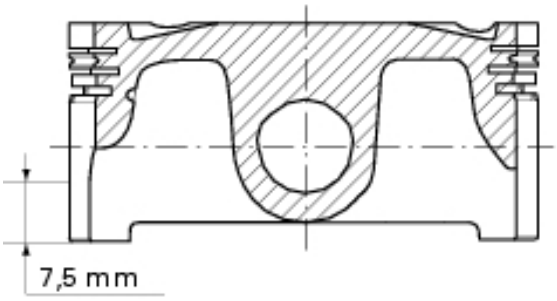






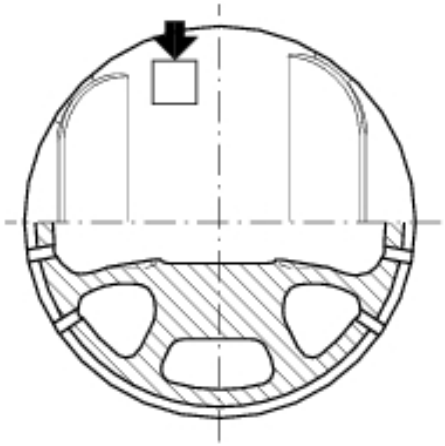
Overhauling the piston

Clean the piston crown and piston ring grooves, removing any carbon deposits.
Inspect the piston and check its dimensions carefully: there must be no signs of scuffing, scoring, cracks, or other damage.
The piston diameter must be measured at **7.5** mm up from the bottom of the skirt at a 90° angle to the gudgeon pin.
The pistons must always be renewed as a pair.



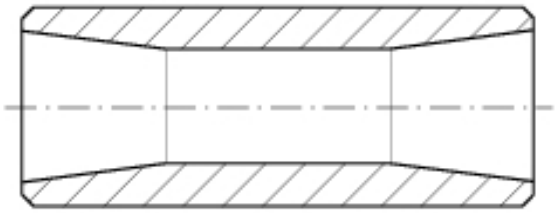
Checking the piston-cylinder clearance

The pistons are marked with a letter (punched into the piston crown) that indicates the size class to which they belong.
Always match cylinders with pistons from the same size class.
For the values, refer to Sect. C 1.1, Cylinder/Piston.



Overhauling the gudgeon pins

Gudgeon pins must be perfectly smooth without signs of scoring, steps, or blueing due to overheating. The well-lubricated gudgeon pin must slide smoothly inside the piston without stiffness.
The assembly clearance with the piston at the time of installation must be **0.002** to **0.008** mm.
The maximum permissible wear limit is **0.035** mm.
If a new gudgeon pin is fitted, you must also change the connecting rod small end bush.

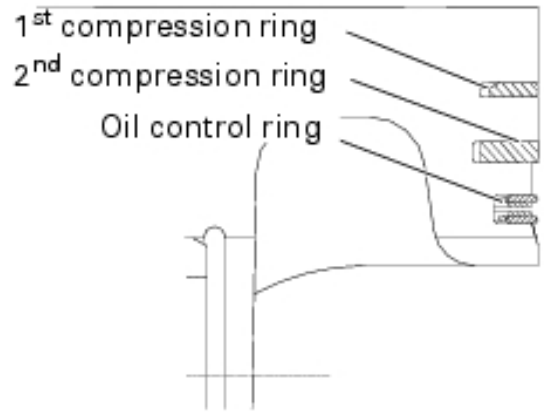


Overhauling the piston rings

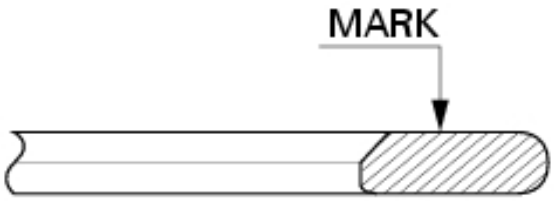
The piston rings must not show any signs of scuffing or scoring. Replacement pistons are supplied complete with piston rings and gudgeon pin.

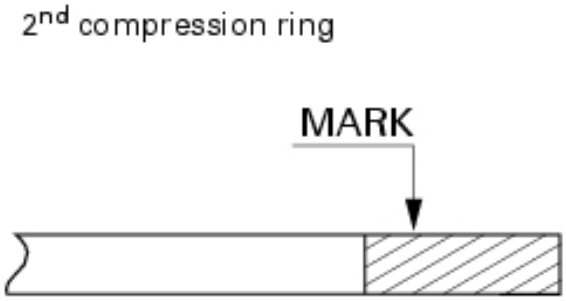
Checking the piston ring-grooves clearance

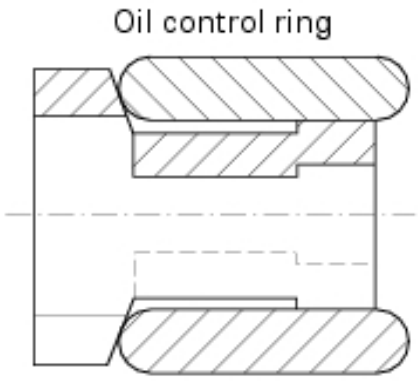
The maximum permissible wear limit is **0.15** mm for the top compression ring (1st) and **0.10** mm for the others (2nd and oil control ring).
The piston rings must always be installed with markings facing upwards.



1st compression ring



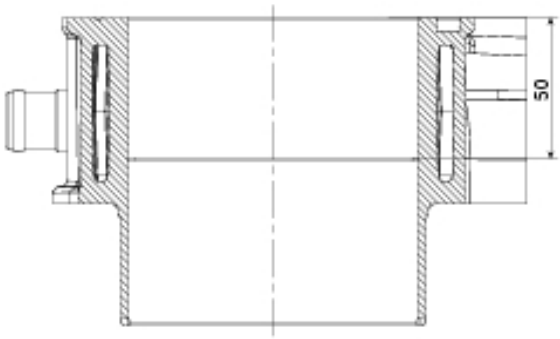


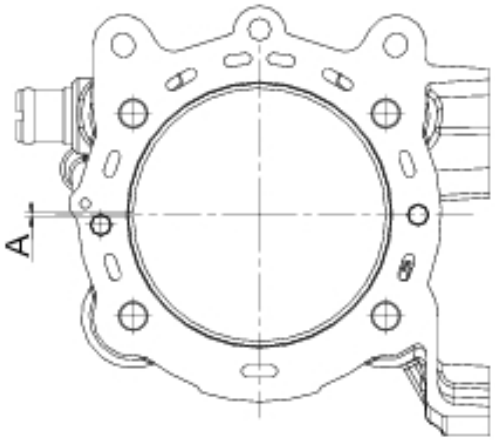


Checking the piston ring/cylinder clearance

Insert the ring in the cylinder bore so that it is positioned 50 mm from the top face of the cylinder barrel; make sure that the ring is positioned perfectly square to the cylinder walls by checking with a gauge at several points around the ring that the top surface of the ring is exactly 50 mm from the top face of the cylinder barrel.
Measure the piston ring gap (A):

	Distance (A) mm	Wear limit
Top compression ring	0.2 to 0.4	0.8
Second compression ring	0.3 to 0.5	0.8
Oil control ring	0.2 to 0.7	1.0





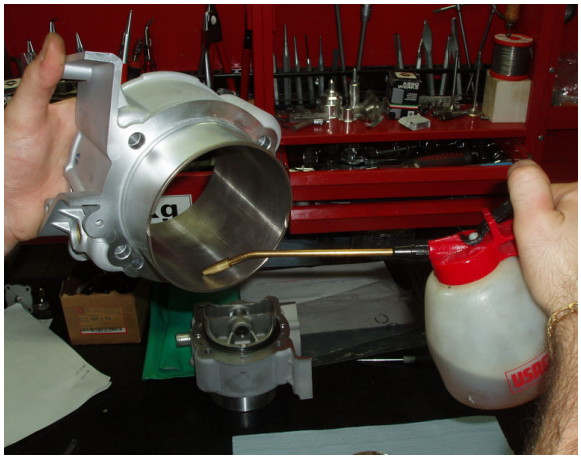
Refitting the cylinder/piston assembly

If you are using new cylinders and pistons, combine cylinders and pistons belonging to the same class (see "Overhaul of the cylinder barrel/piston components" in this section).
If the pistons have been separated from their cylinders, before reassembling these components, position the piston ring gaps at 120° from one another (the markings must always face the piston crown).

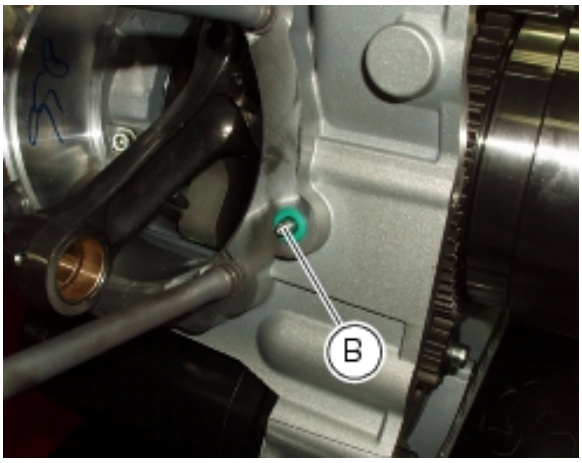
Notes

For better sealing the piston ring gaps should be positioned at 180° intervals.

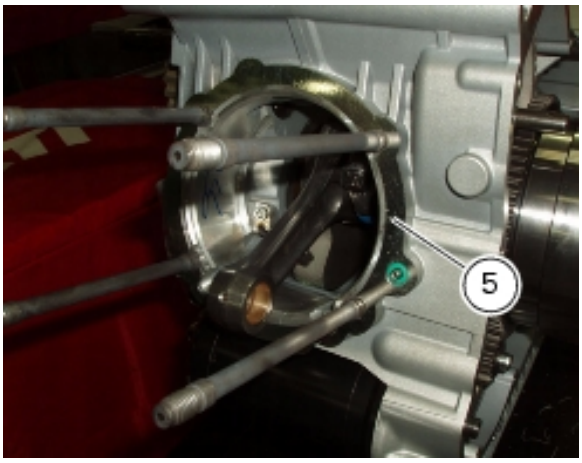
Use a universal tool to carefully insert the piston into the cylinder (first lubricate the inside of the cylinder with engine oil). Position the cylinder with the smallest valve recess is on the side of the exhaust port.



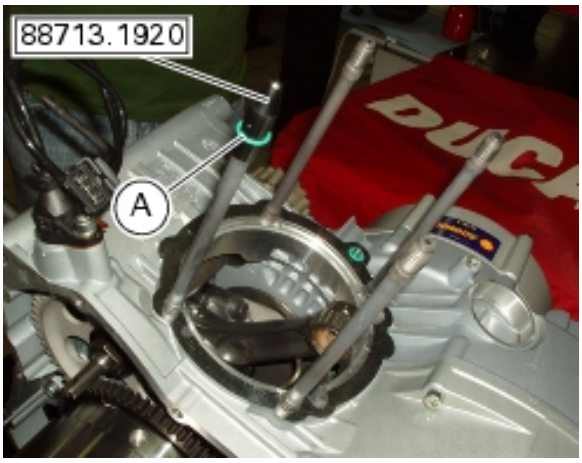
Remove any deposits and degrease the contact surfaces of the crankcase and the cylinders.
Check that the cylinder barrel locating bushes (B) are fitted on the crankcase.



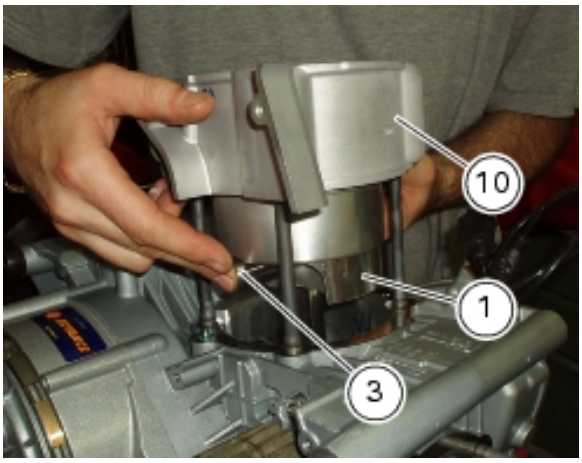
Apply sealant to the gasket (5) then locate the gasket on the crankcase.



Using the cap **88713.1920**, fit the O-rings (A) on each stud and guide them into their seats in the crankcase.

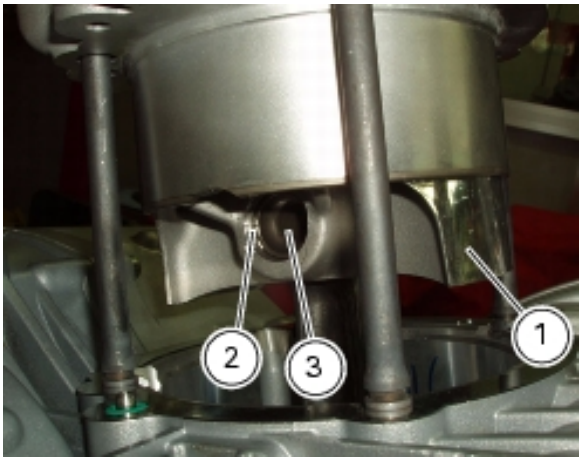


Bring the connecting rod small end close to TDC and slide the barrel-piston assembly (1-10) onto the crankcase studs. Push the connecting rod small end into the piston close to the gudgeon pin (3) bore. Lubricate and insert the gudgeon pin.

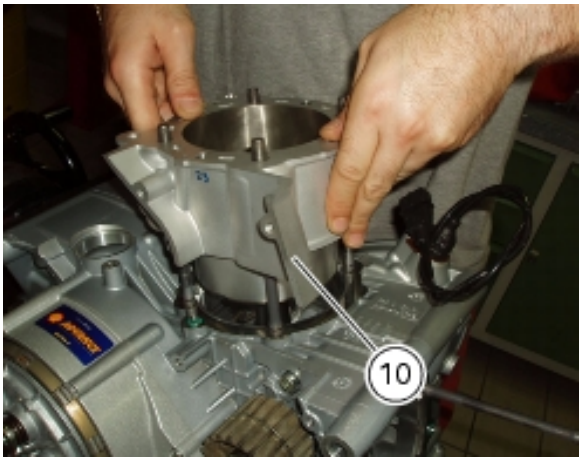


The gudgeon pin (3) must slide smoothly in the connecting rod small end bush and in the piston (1).
Stuff the crankcase opening with a cloth to prevent foreign objects from falling inside and then fit circlip (2).

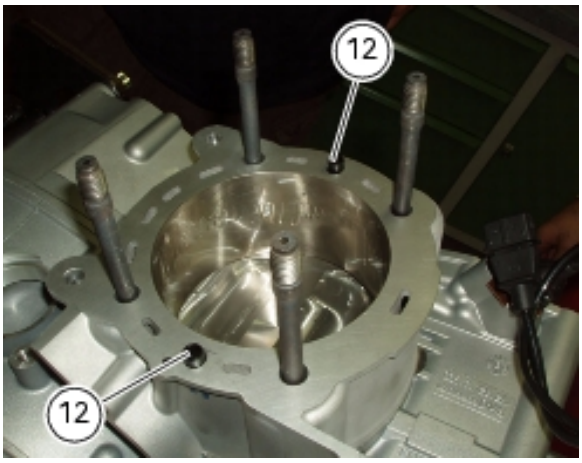
Important
Always use new circlips (2) on reassembly.



Push the cylinder barrel (10) down until it seats against the crankcase.



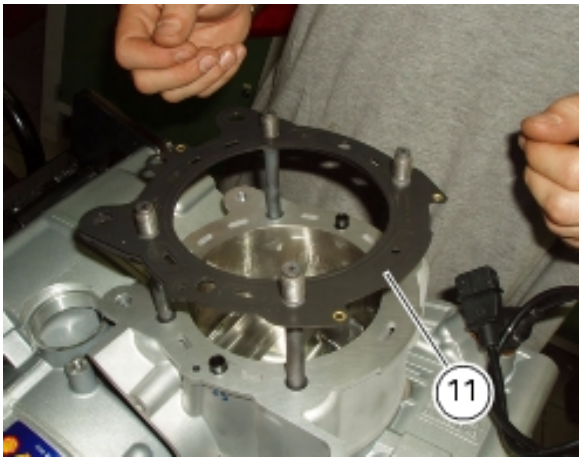
Refit the bushes (12).



Fit the cylinder head gasket (11) over the studs. The side marked with the part number must be facing the cylinder head.

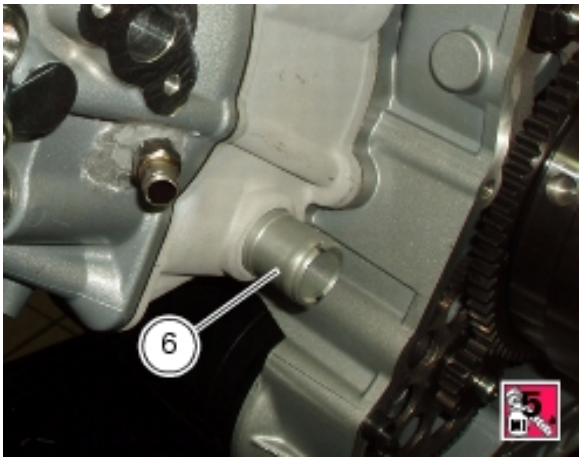
Notes

The shape of the gasket prevents incorrect fitting, provided that the coolant flow holes are aligned with those on the cylinder.

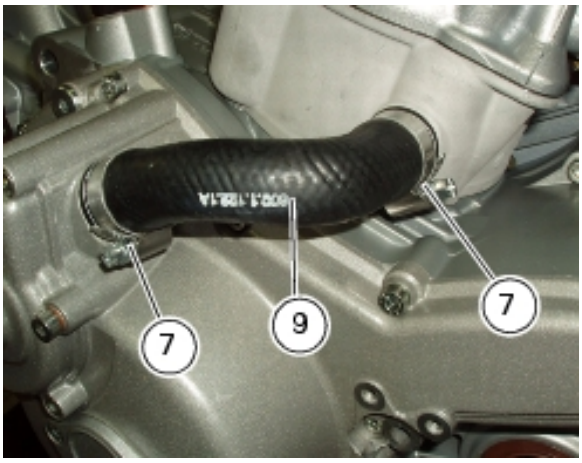


Repeat the procedure for the other cylinder barrel and refit the cylinder heads (Sect. N 4.5, Refitting the cylinder head assemblies).

If removed, apply the recommended threadlocker to the unions (6) and tighten them to the specified torque (Sect. C 3, Engine torque settings).



Fit the hoses (8) and (9) and tighten the hose clamps (7) to the specified torque (Sect. C 3, Engine torque settings).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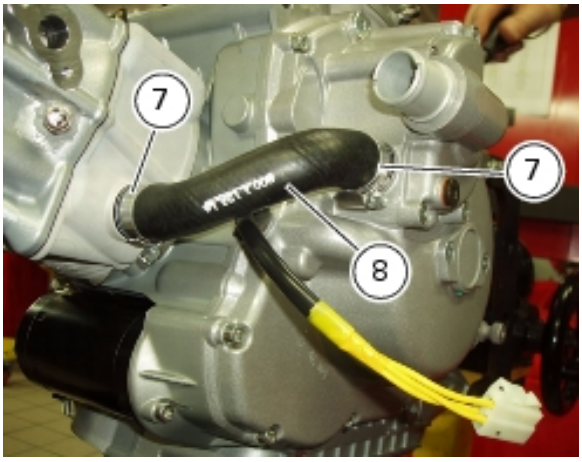
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7
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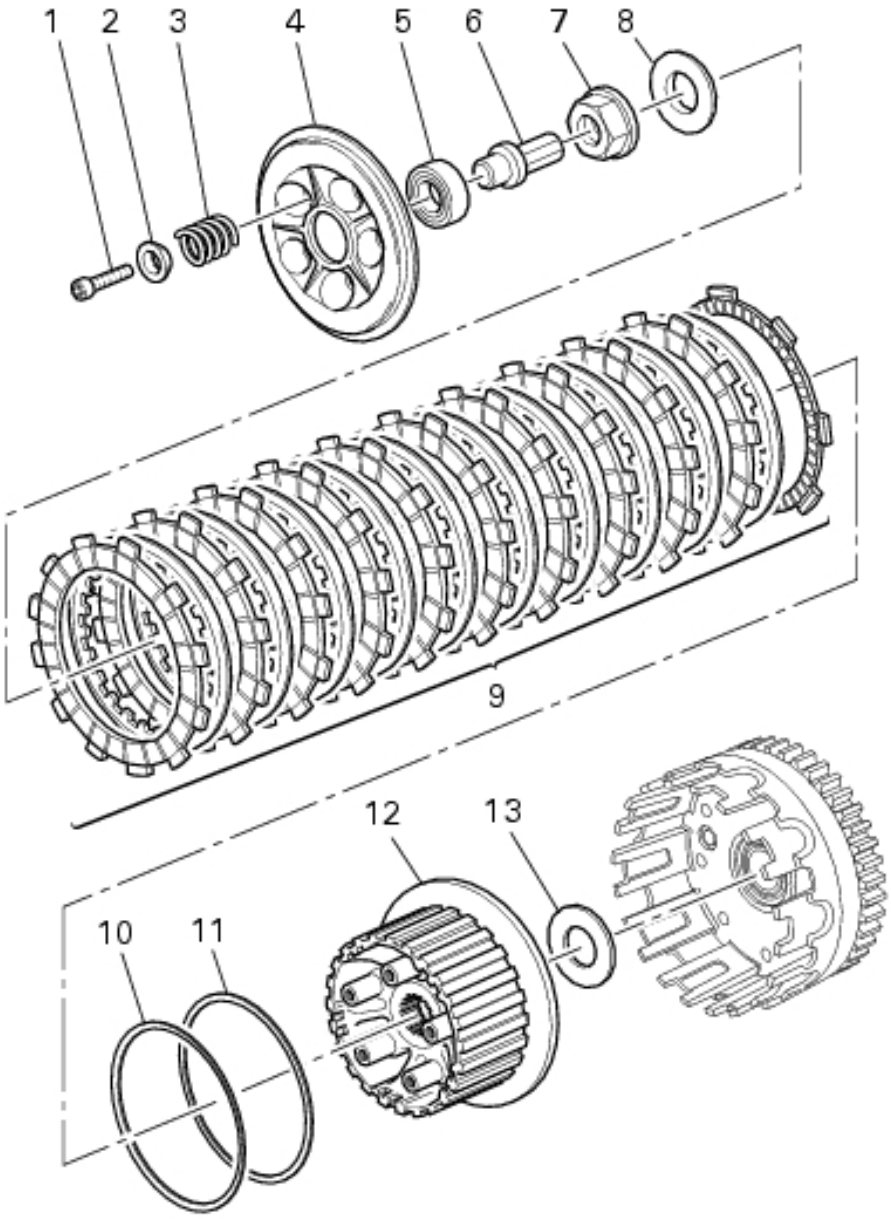
6.1 - Clutch assembly: clutch



1 Bolt
2 Collar
3 Clutch spring
4 Pressure plate
5 Bearing
6 Clutch lifter
7 Nut
8 Belleville washer
9 Clutch plates
10 "FCC" Belleville washer
11 Flat ring
12 Clutch centre
13 Spacer

Parts catalogue

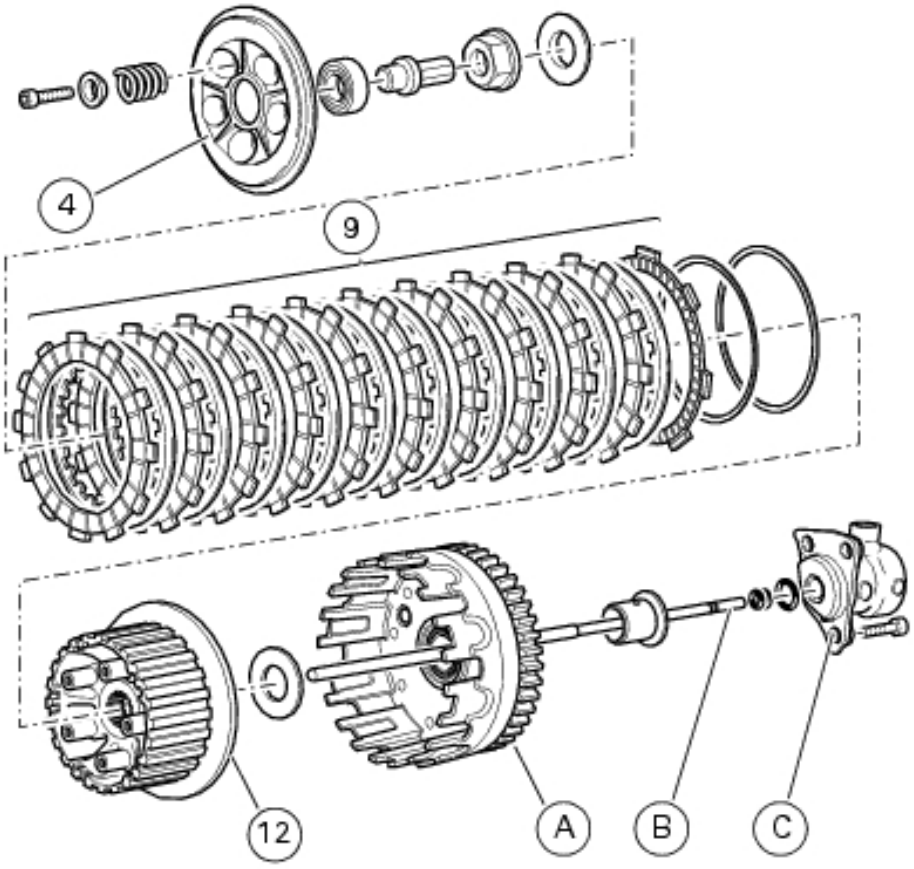
Clutch

Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Description of the clutch assembly

The clutch is disengaged by a slave cylinder consisting of a piston (C) housed inside a cylinder mounted to the left-hand side crankcase cover. This piston (C) pushes a pushrod (B), which runs through gearbox primary shaft and operates the pressure plate (4) located on top of the clutch plate pack (9).
Drive is transmitted from the crankshaft to the gearbox primary shaft by a gear integrated with the clutch housing/primary drive gear pair (A).
The latter contains the clutch plate pack (9) made up of driving and driven discs; the latter move a drum (12) keyed onto the gearbox primary shaft.
Before working on the internal clutch parts, check that the clutch operates correctly. Then deal with the problem in a systematic manner.



The following is a list of possible causes of clutch malfunctions.

A clutch which does not disengage may be caused by:
- excessive play of the control lever;
- distorted clutch plates;
- incorrect spring tension;
- faulty clutch release mechanism;
- excessive wear of the hub or clutch drum.

A clutch which slips may be caused by:
- insufficient play of the control lever;
- worn clutch plates;
- weakened springs;
- faulty clutch release mechanism;
- excessive wear of the hub or clutch drum.

A noisy clutch may be caused by:
- excessive backlash between the primary drive gears;
- damaged primary drive gear teeth;
- excessive play between driving plate tabs and clutch drum;
- worn gear/clutch drum bearings;
- the presence of metal particles (filings) on the gear teeth.

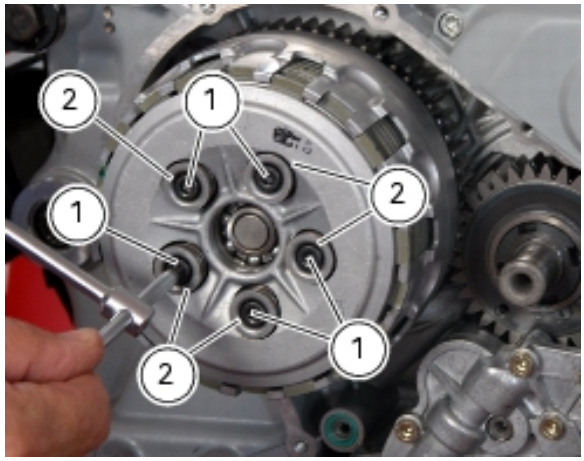
Removal of the clutch

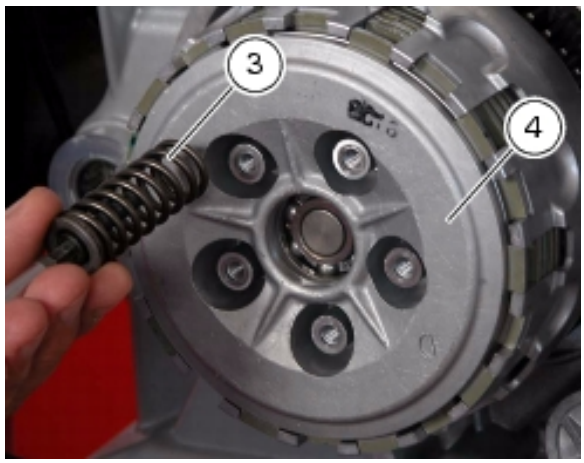
Operation	Section reference
Drain the engine oil	D 4, Changing the engine oil and filter cartridge
Remove the clutch-side crankcase cover	N 6.2, Removal of the clutch-side crankcase cover

Notes

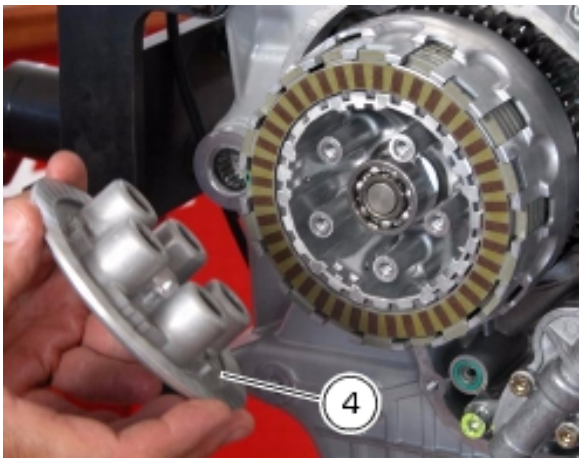
For clarity, the figures show the engine removed from the frame.

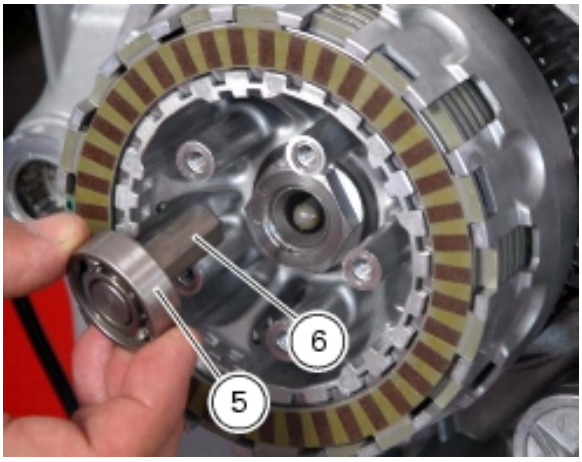
Unscrew the retaining bolts (1) and remove the collars (2) and the clutch springs (3) from the pressure plate (4).



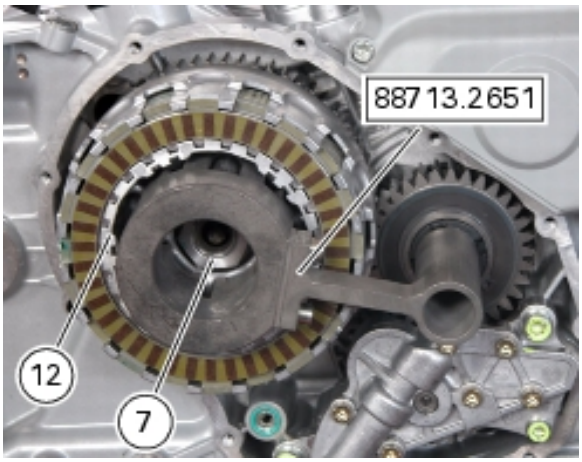


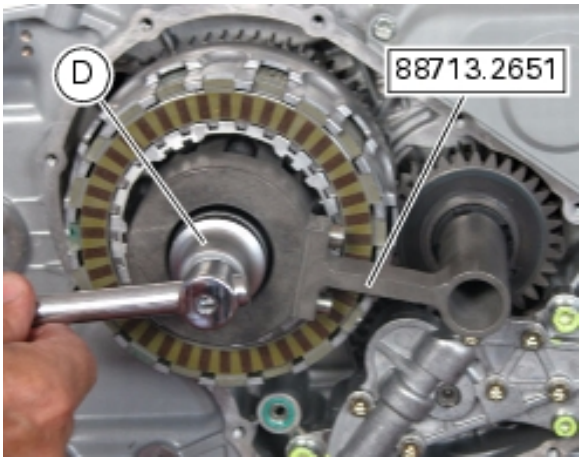
Remove the pressure plate (4). Remove the clutch lifter (6). If necessary, remove the bearing (5) using a drift of suitable diameter.



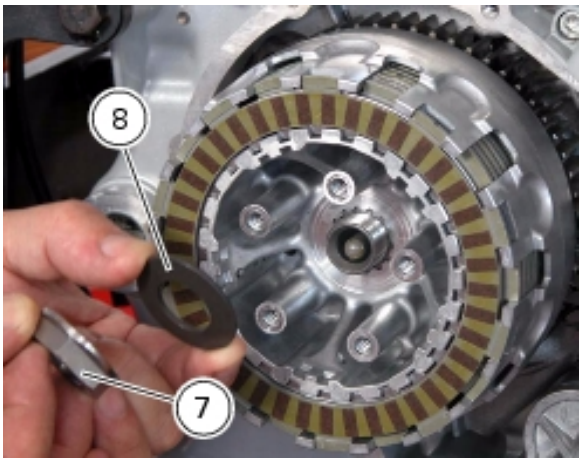


Restrain the clutch centre (12) using service tool no. **88713.2651**, insert the socket (D) inside the tool and unscrew the locking nut (7).

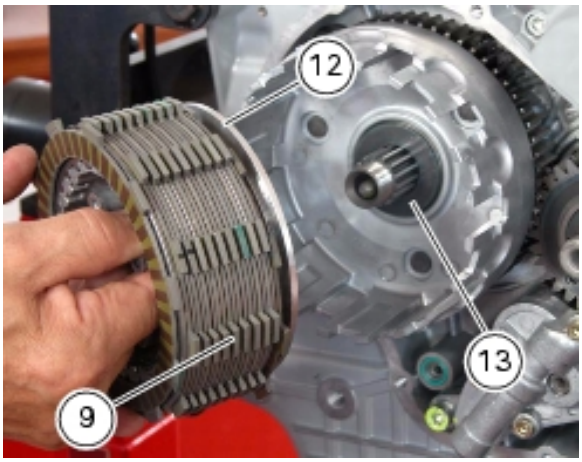




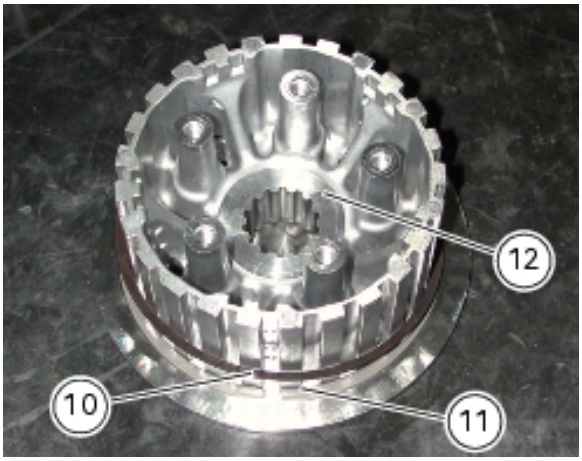
Remove the nut (7) and the Belleville spring (8), withdraw the clutch centre (12) and the plates (9) from the clutch drum.



Slide the clutch plates (9) off the clutch centre (12). When removing the plates, keep them paired in the assembly order and set them aside tied together, if necessary.
Remove the spacer (13) from the gearbox input shaft.



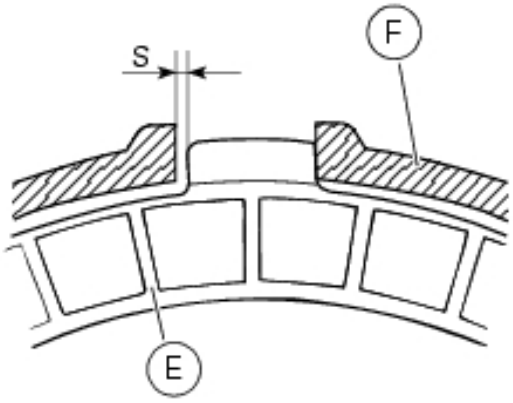
Withdraw the Belleville washer (10) and flat ring (11) from the clutch centre (12).



Checking and overhauling the components

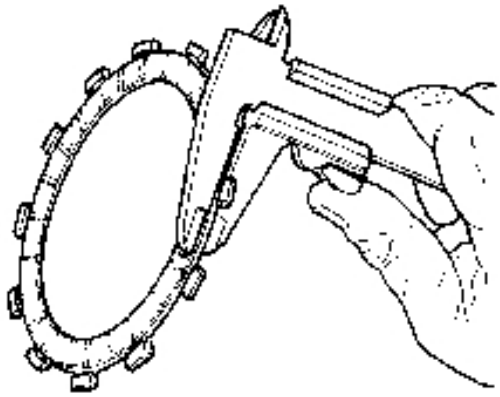
Clearance between the clutch drum and friction plates

Insert a friction plate (E) in the clutch drum (F) and measure the clearance (S) with a feeler gauge.
The clearance "S" must not exceed **0.6** mm.
If it does, renew the plates and, if necessary, the clutch drum.



Overhaul of the clutch plates

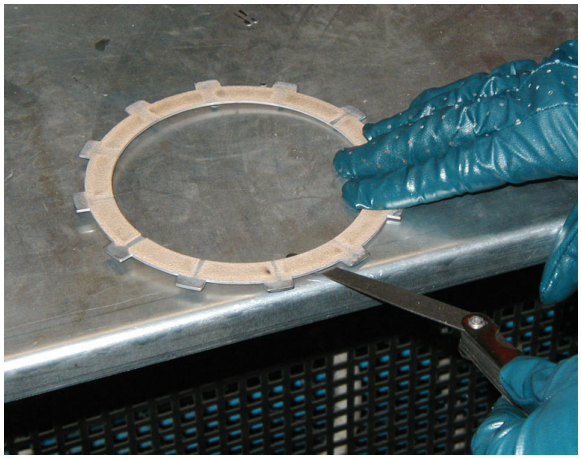
The clutch plates must not show any signs of blackening, grooves or deformation.
Measure the thickness of the friction plates. It should not be less than **2.6** mm.



Important

The total thickness of the clutch plate pack must not be less than **46.1** mm.

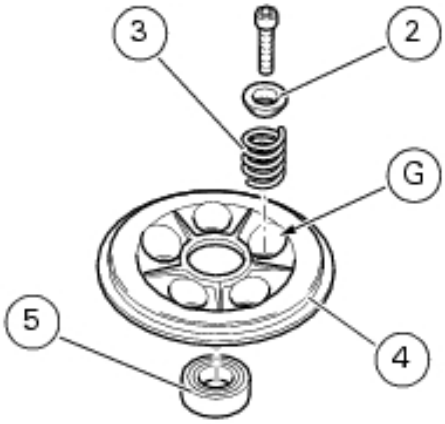
Place the plate on a flat surface and check the amount of deformation with a feeler gauge.
Max flatness error: **0.2** mm.



Overhaul of the pressure plate

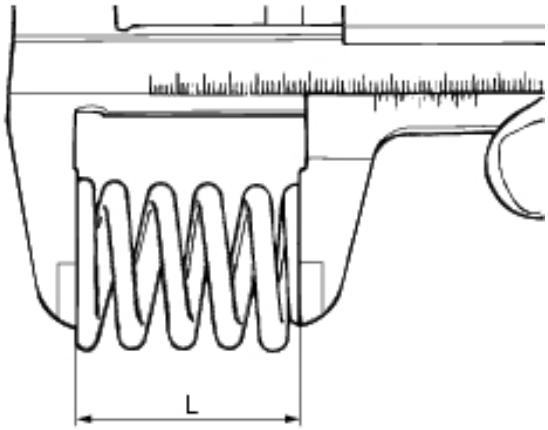
Check the condition of bearing (5): renew the bearing if the play is excessive.
Check the contact surface of last plain steel plate. If extremely scored, polish it in the same manner as described previously for the cylinder head surface (Sect. N 4.5, Overhaul of cylinder head components).

Check the condition of spring guide cups (G) and of thepressure plate (4); at each overhaul always renew spring retainer collars (2).



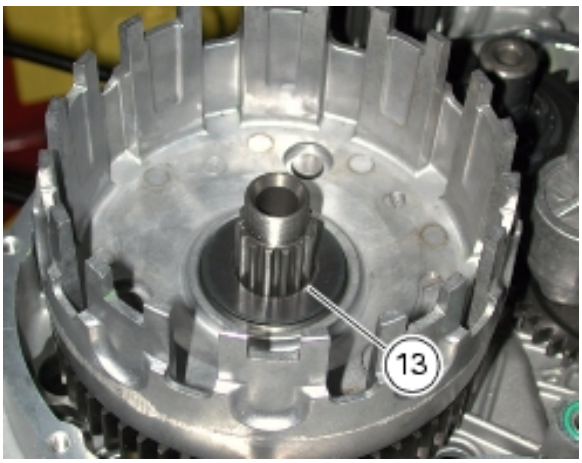
Overhauling the pressure plate springs

Measure the length "L" of each spring (3):
minimum length: **41** mm.
Renew any springs that are shorter than the above limit value.

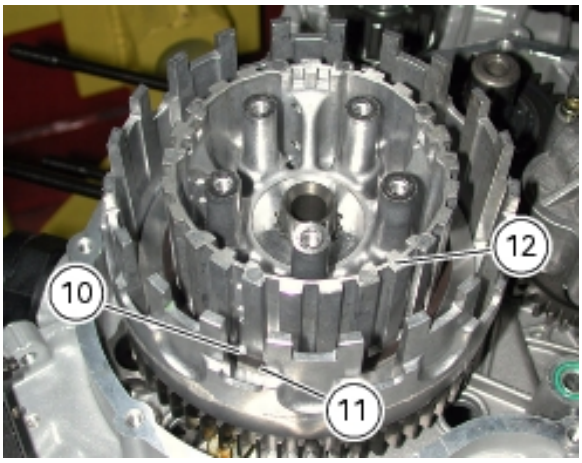


Reassembly of the clutch

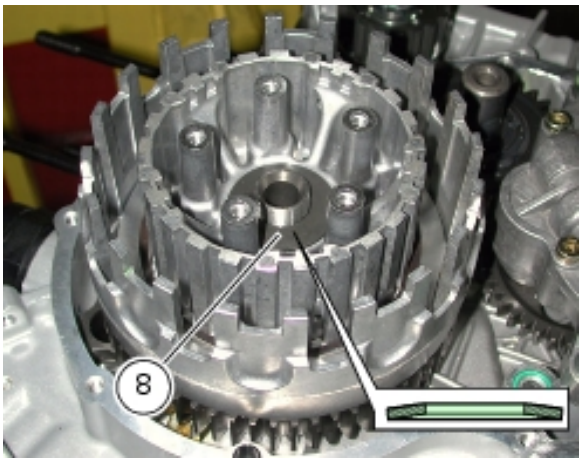
Fit the spacer (13) on the gearbox input shaft: the spacer (13) must be centred relative to the axis of the gearbox input shaft.



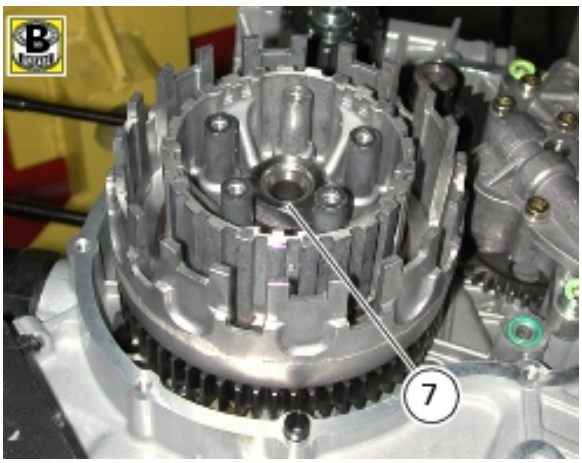
Fit the clutch centre (12) and onto the latter fit the flat ring (11) and the Belleville washer (10), so that the convex side faces the clutch centre.



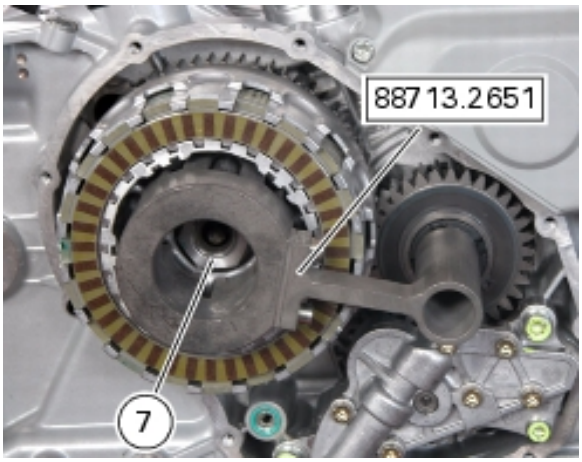
Locate the Belleville washer (8).

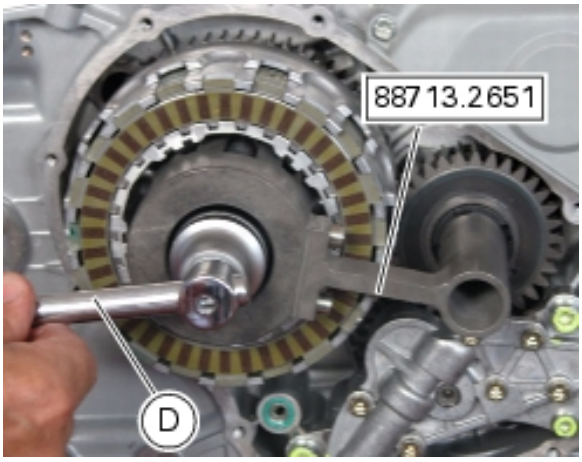


Apply the prescribed grease to the thread of the gearbox input shaft and the mating surface of nut (7), and fit it over Belleville washer (8).

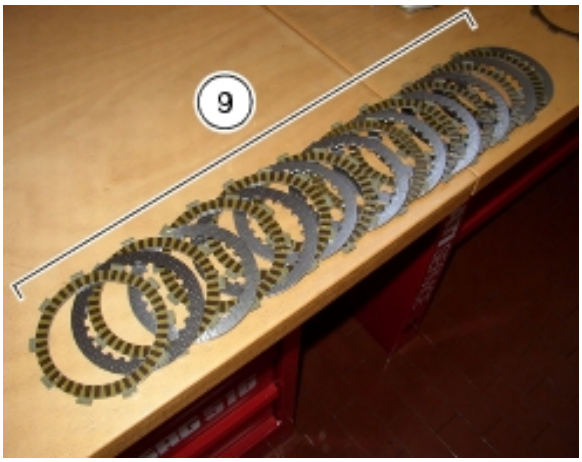


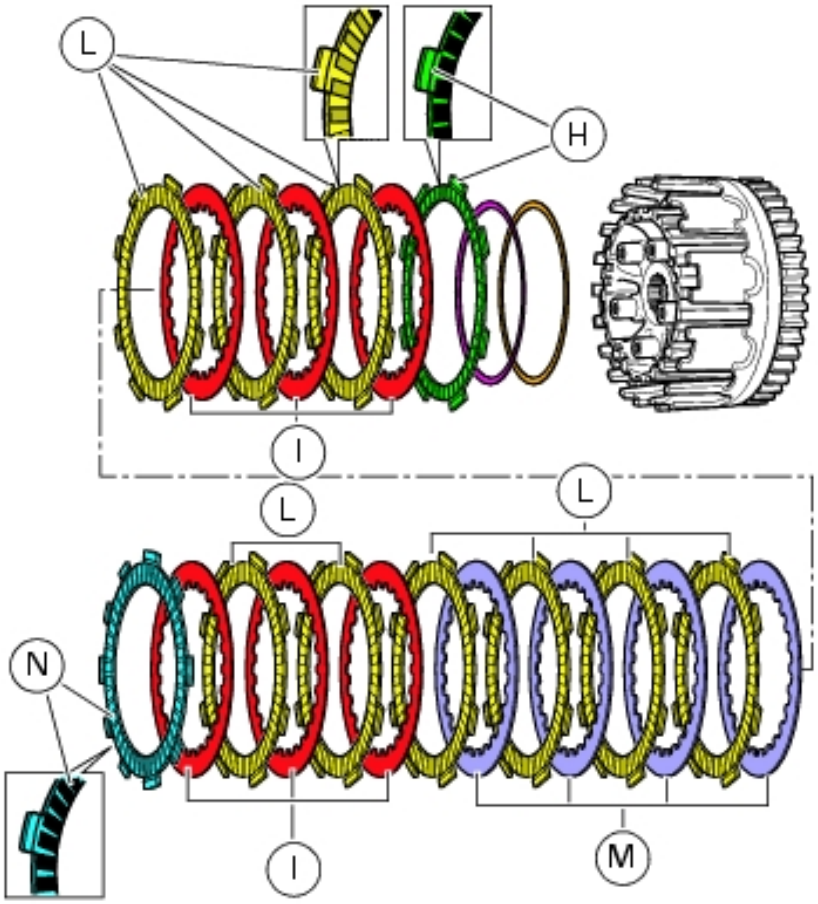
Restrain the clutch centre using service tool no. **88713.2651**, insert the socket (D) in the tool and tighten the locking nut (7) to the specified torque (Sect. C.3, Engine torque settings).





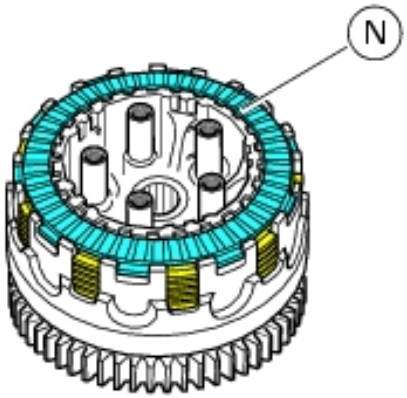
Install the clutch plates (9) in the following order:
- one friction plate (H) with 48 square tangs;
- a series of three plain plates (I) thickness **1.6** mm, alternated with three friction plates (L) with 40 rectangular tangs;
- a series of four plain plates (M) thickness **2** mm, alternated with four friction plates (L) with 40 rectangular tangs;
- a series of two plain plates (I) thickness **1.6** mm, alternated with two friction plates (L) with 40 rectangular tangs;
- one plain plate (I), **1.6** mm thick;
- one friction plate (N) with 48 rectangular tangs.



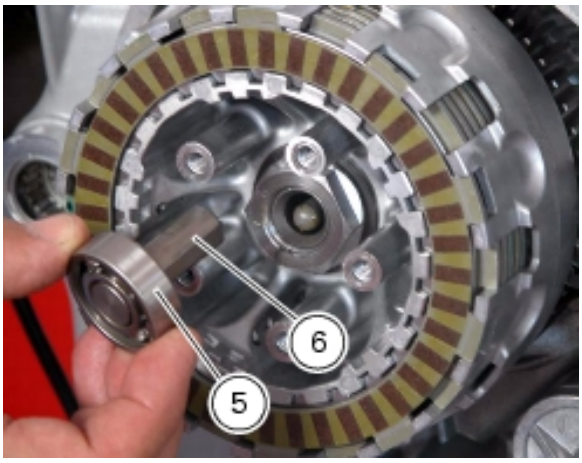


Notes

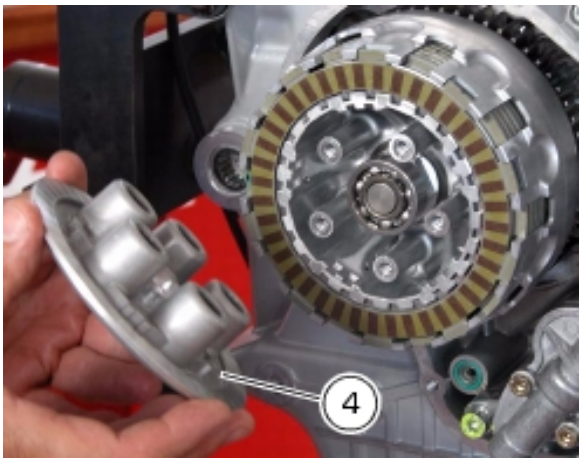
The last plate must be fitted the opposite way round to the previous plates, as shown in the figure.



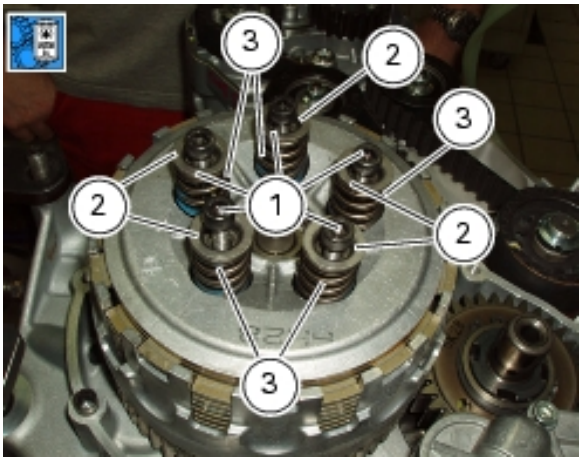
Lubricate the hole in the gearbox input shaft with engine oil.
Fit the clutch lifter (6) in the bearing (5) in the gearbox input shaft.



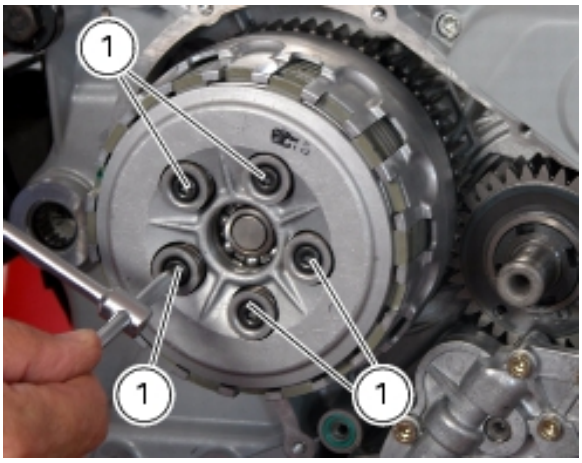
Fit the pressure plate (4).



In each cavity, fit a spring (3) and a collar (2).
Lubricate the threads of the bolts (1) with oil.

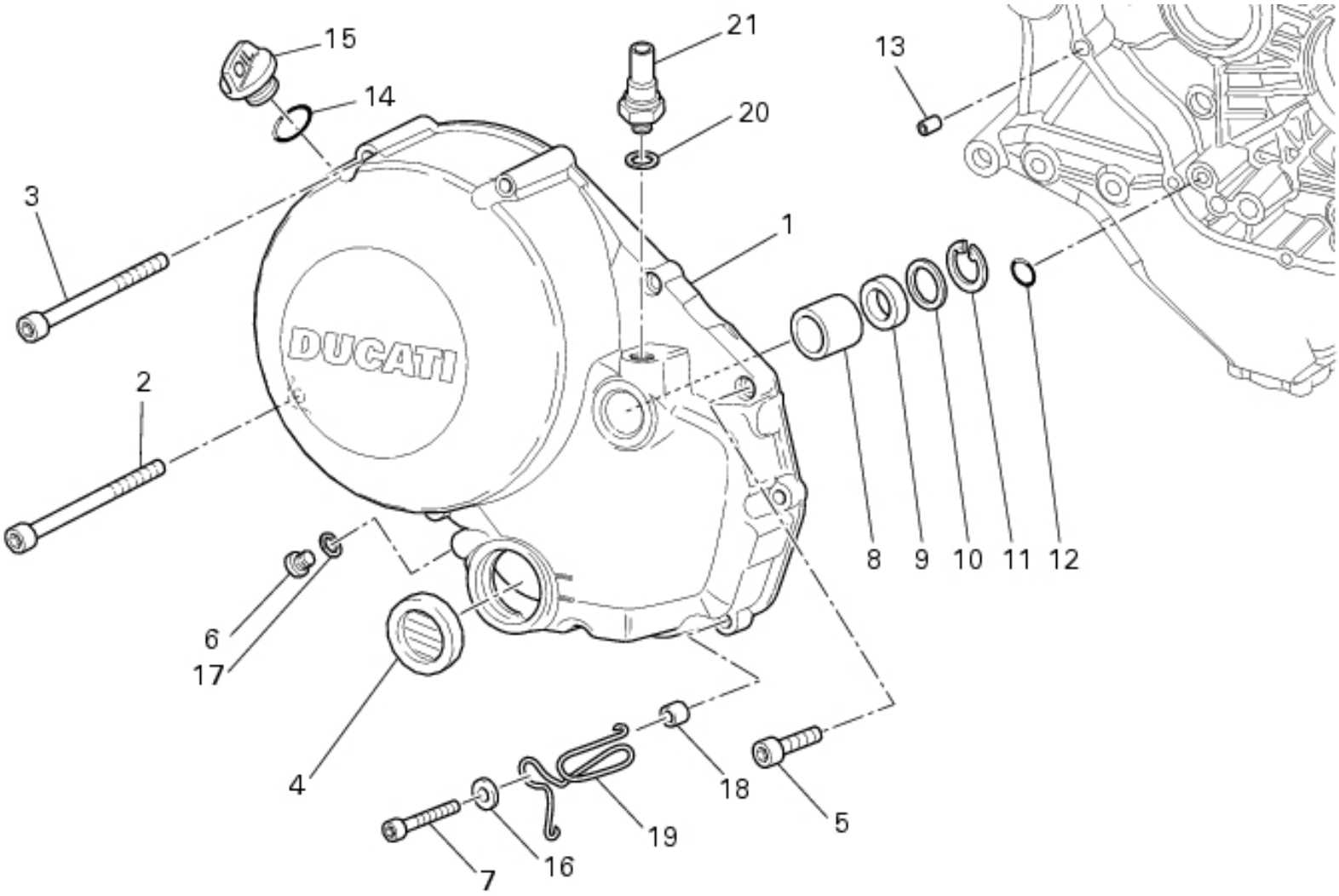


Tighten the bolts (1) to the specified torque (Sect. C 3, Engine torque settings), working in a crosswise pattern.



Operation	Section reference
Refit the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
Top up the engine oil	D 4, Changing the engine oil and filter cartridge

6.2 - Clutch assembly: clutch-side crankcase cover



1 Clutch-side crankcase cover
2 Bolt
3 Bolt
4 Oil level sight glass
5 Bolt
6 Plug
7 Bolt
8 Bush
9 Oil seal
10 Shim
11 Circlip
12 O-ring
13 Locating bush
14 O-ring
15 Plug
16 Washer
17 Seal
18 Spacer

19 Support
20 Sealing washer, thickness 2
21 Pressure switch

Parts catalogue

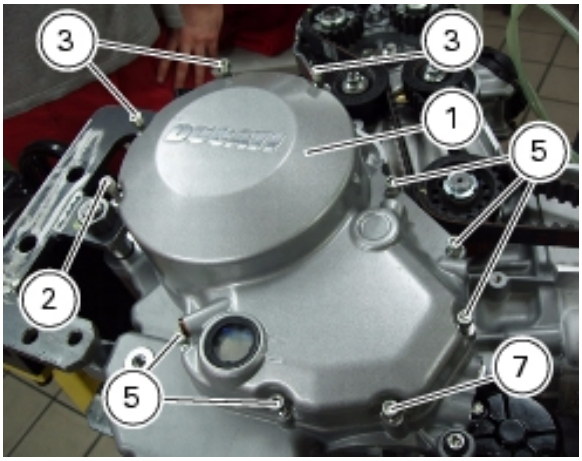
Clutch-side crankcase cover

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

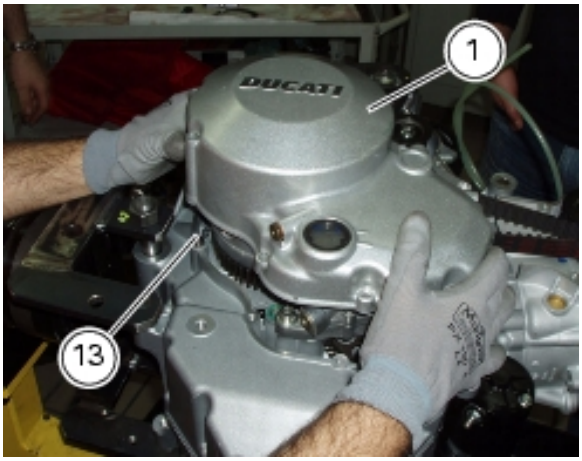
Removal of the clutch-side crankcase cover

Operation	Section reference
Drain the engine oil	D 4, Changing the engine oil and filter cartridge
Disconnect the oil pressure sensor	P 5, Checking the front and rear brake light switches, neutral light switch, oil pressure switch and clutch switch

Unscrew the bolt (7) from the bottom of the clutch-side crankcase cover.
Remove the bolt (7), washer (**16**), cable guide (**19**) and spacer (**18**).
Unscrew the bolts (2), (3) and (5) securing the clutch-side crankcase cover (1).

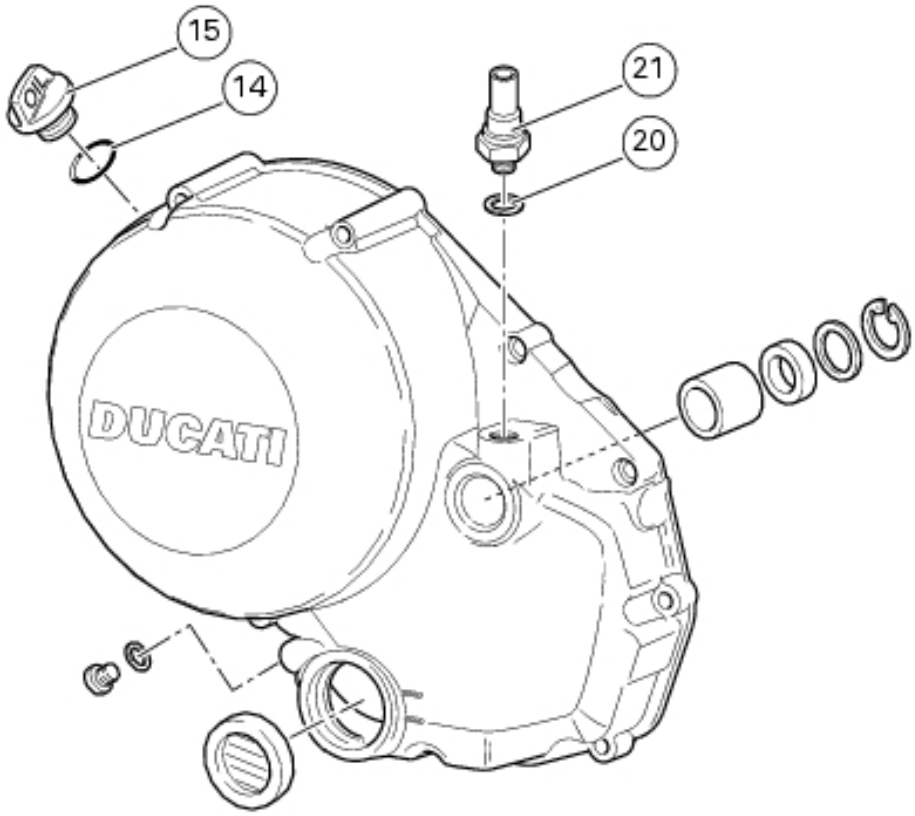


Tap around the edge of the cover with a plastic mallet to detach it from the crankcase.
Remove the crankcase cover (1) taking care not to damage the locating bush (13).
Check the condition of the locating bush (13) and replace if deformed.

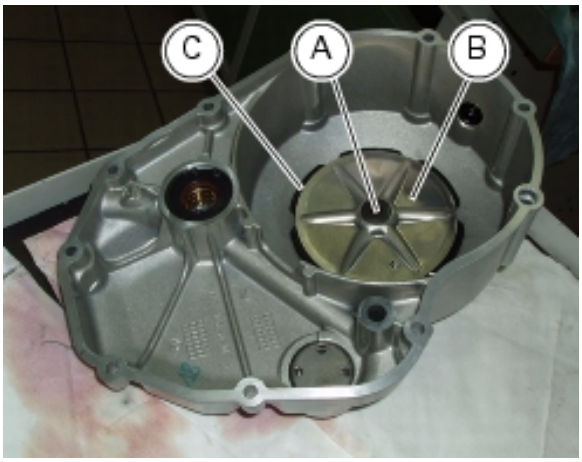


Disassembly of the clutch-side crankcase cover

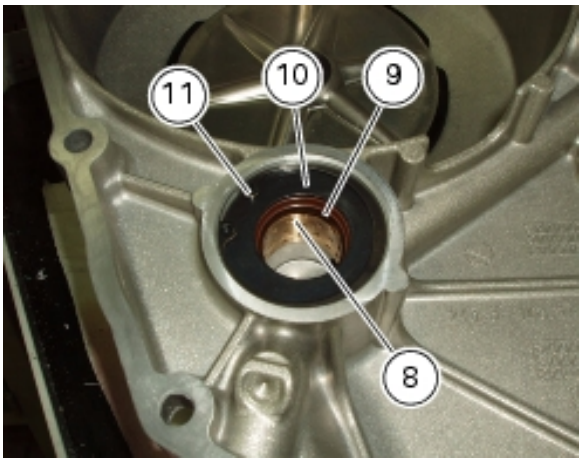
Remove the plug (15) from the cover and the relative O-ring (14), the engine oil pressure switch (21) and its seal (20).



Unscrew the bolt (A) securing the inner cover (B).
Remove the inner cover (B) and sound-proofing panel (C).



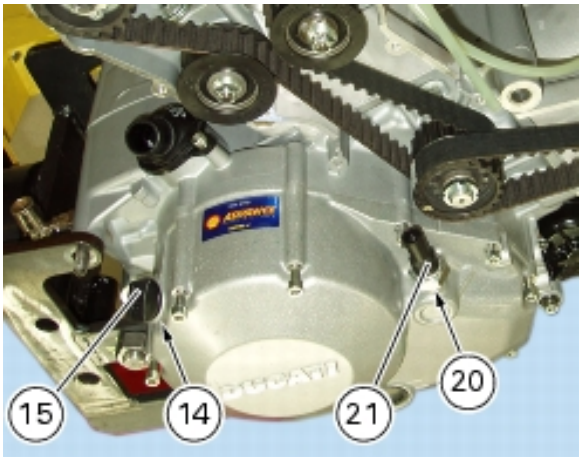
Remove the circlip (11) and slide off the shim (10) and the oil seal (9).
The drilled bush (8) is mounted to the cover by a forced interference fit. Remove it using a suitable puller.



Inspect the oil seal (9) and renew it if necessary.

Reassembly of the clutch-side crankcase cover

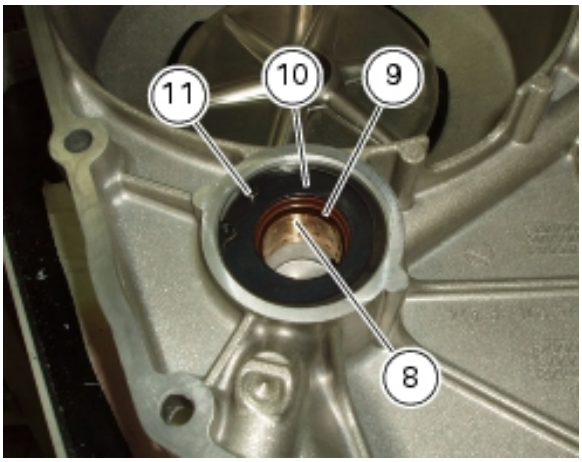
Fit the plug (15) and the seal (14). Install the pressure switch (21) with its seal (20).



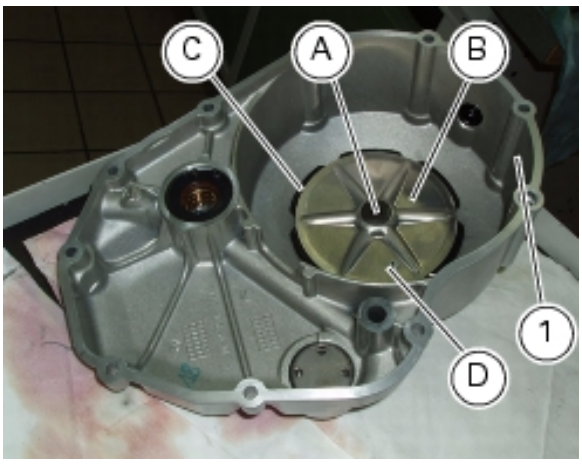
If the bush has been replaced, fully seat the new bush (8) in the slot in the cover using a suitable drift and a press.
If the oil seal (9) needs to be renewed, fit the new seal into the crankcase cover, positioning it so the side without a spring is facing the circlip (11).
Before fitting, check that the edges of the circlip groove show no sign of burrs which might otherwise damage the oil seal.
Then fit the shim (10) and the circlip (11).

Important

In order for the oil seal (9) to function correctly, it must have an assembly clearance that allows the circlip (13) to rotate.

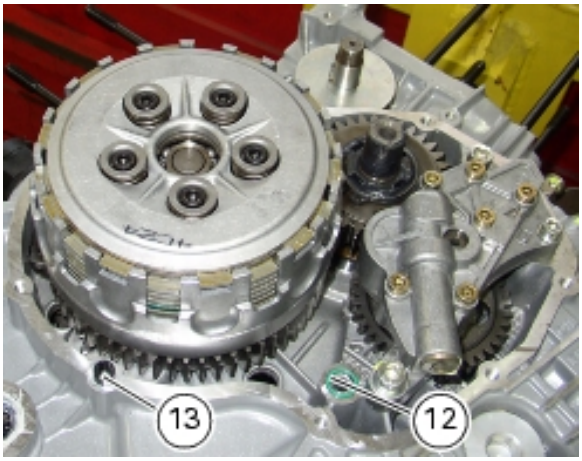


Position the sound-proofing panel (C) inside the clutch-side crankcase cover (1), aligning it with the pin (D) as shown in the figure.
Position the inner cover (B) on the panel (C), aligning it with the pin (D).
Install the six bolts (A) and tighten them to the specified torque (Sect. C 3, Engine torque settings).

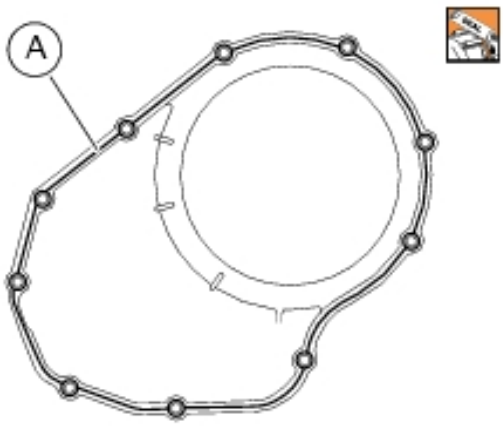


Refitting the clutch-side crankcase cover

Clean and degrease mating surfaces on the clutch-side crankcase cover and crankcase and ensure that locating bush (13) and the O-ring (12), located in correspondence with the oil way, are installed in the crankcase.



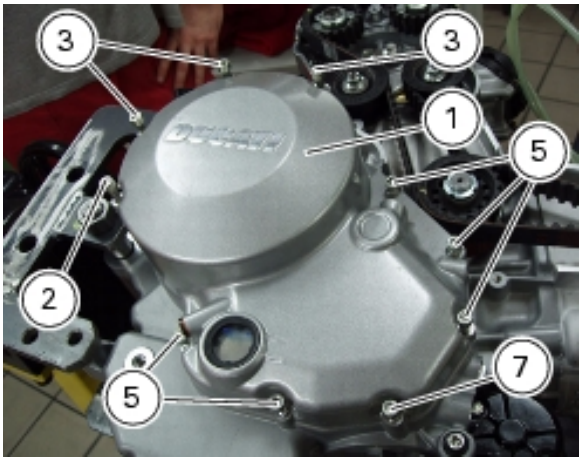
Apply a uniform continuous bead of DUCATI liquid gasket (A) onto crankcase mating surfaces, working around all the holes.



Fit the cover assembly (1) to the crankcase half and insert the retaining bolts. Tighten the bolts (2), (3), (5) and (7) to the specified torque (Sect. C 3, Engine torque settings) in a crosswise pattern.

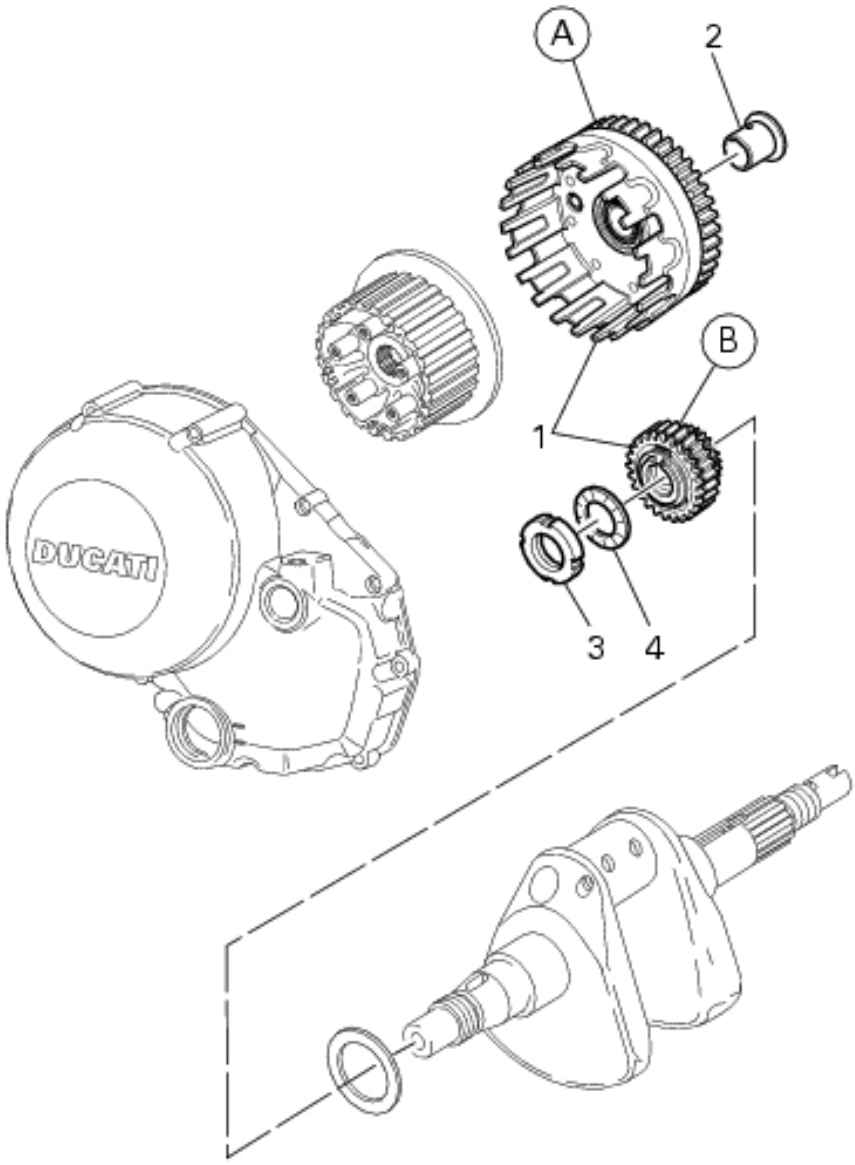
Notes

Refit the cable guide (**19**), the bush (**18**) and the washer (**16**).



Operation	Section reference
Connect the oil pressure sensor	P 5, Checking the front and rear brake light switches, neutral light switch, oil pressure switch and clutch switch
Top up the engine oil	D 4, Changing the engine oil and filter cartridge

6.3 - Clutch assembly: primary drive gears



1 Clutch drum/Primary drive gears
2 Spacer
3 Threaded ringnut
4 Lock washer

Parts catalogue

Clutch
Clutch-side crankcase cover
Connecting rods

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

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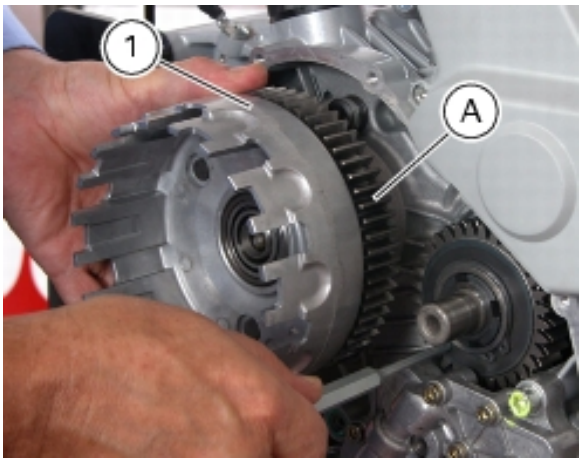
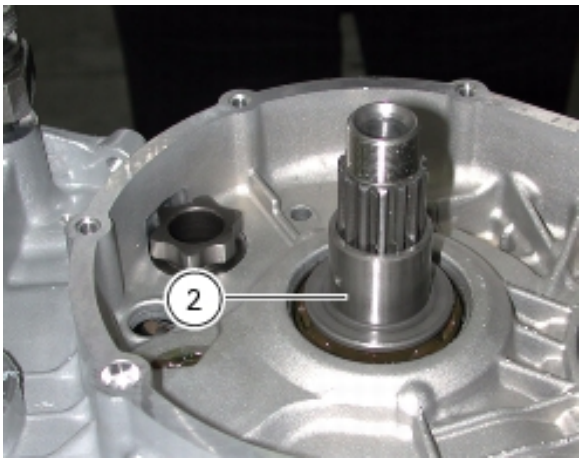
Removal of the primary drive gears

Operation	Section reference
Drain the engine oil	D 4, Changing the engine oil and filter cartridge
Remove the clutch-side crankcase cover	N 6.2, Removal of the clutch-side crankcase cover
Remove the clutch assembly	N 6.1, Removal of the clutch

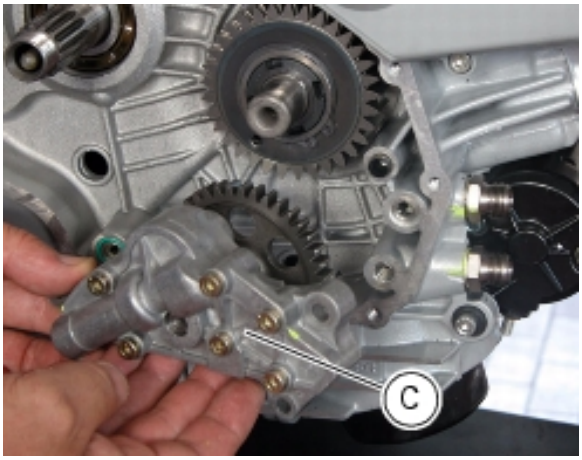
Withdraw the clutch drum (1) complete with driven gear of the primary pair (A).



Remove the inner spacer (2).

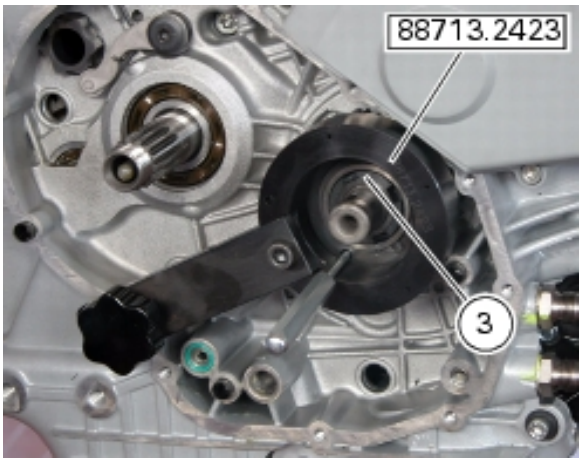


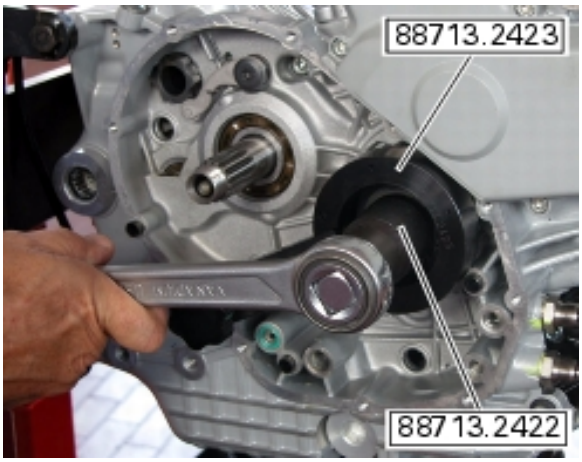
Remove the oil pump (C) (Sect. N 2.1, Removal of the oil pump).



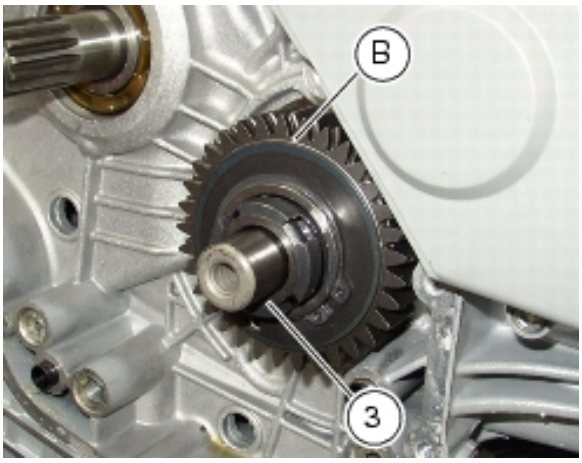
Restrain the primary drive gear (B) with the holding tool no. **88713.2423** and unscrew the ringnut (3) using socket

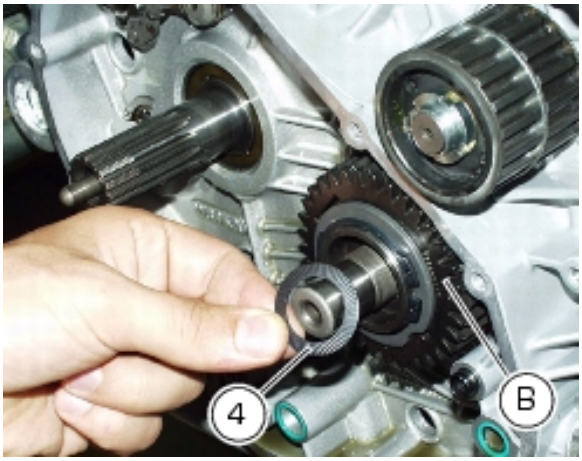
wrench part no. **88713.2422**.



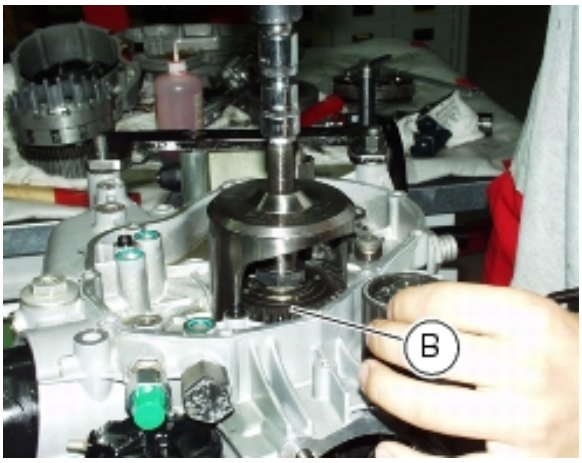


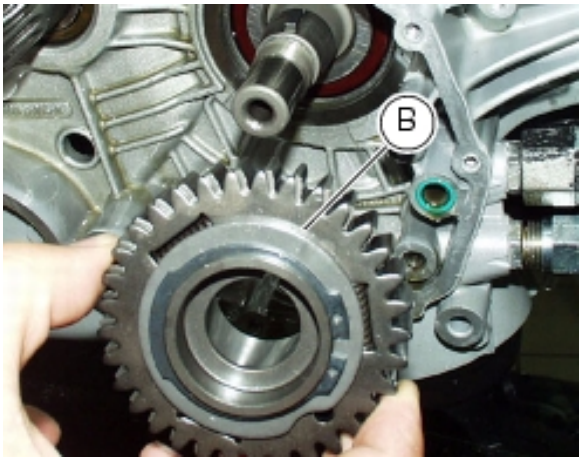
Remove the nut (3) and lockwasher (4).



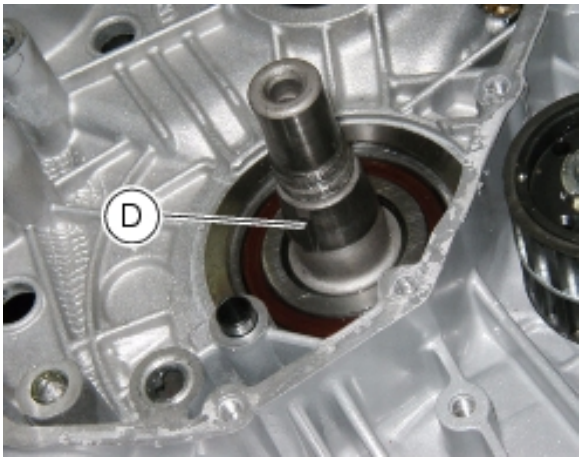


Remove the complete primary drive gear (B) using a commercial puller and placing a brass or aluminium pad between the end of the crankshaft and the puller screw.



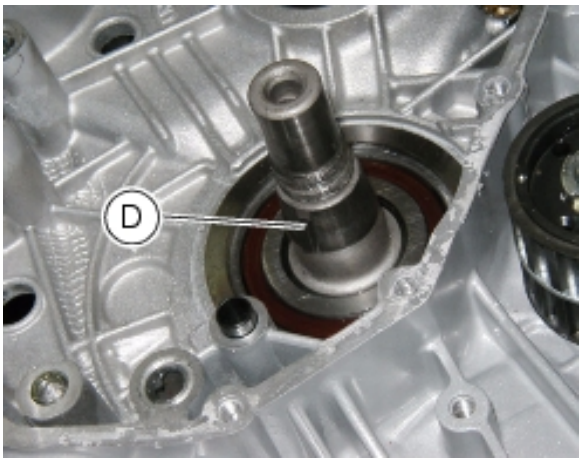


Do not damage the Woodruff key (D) located on the crankshaft.

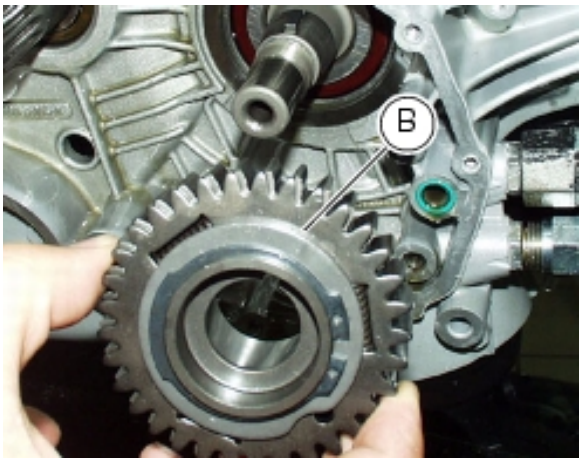


Refitting the primary drive gears and checking backlash

Fully degrease the crankshaft splined end and the corresponding spline on the primary drive gear.
Check that the Woodruff key (D) is positioned on the crankshaft.



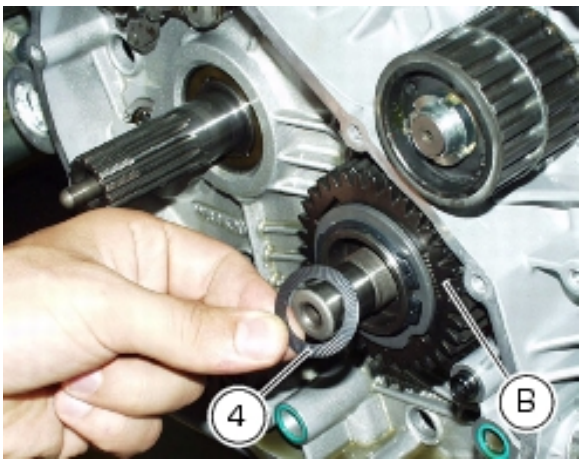
Fit the driving gear (B) onto the crankshaft with the oil pump drive sprocket facing the crankcase.

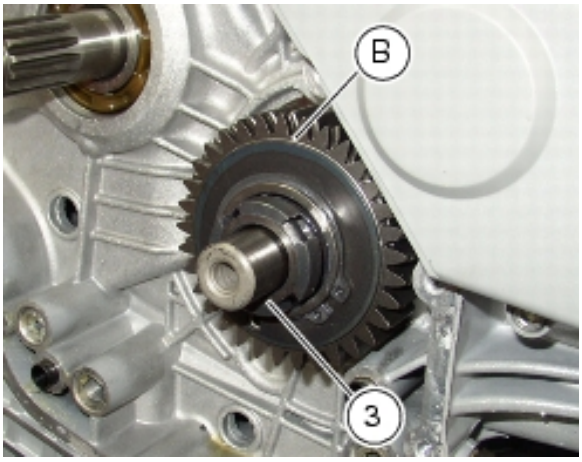


Temporarily secure the gear with the washer (4) and nut (3).

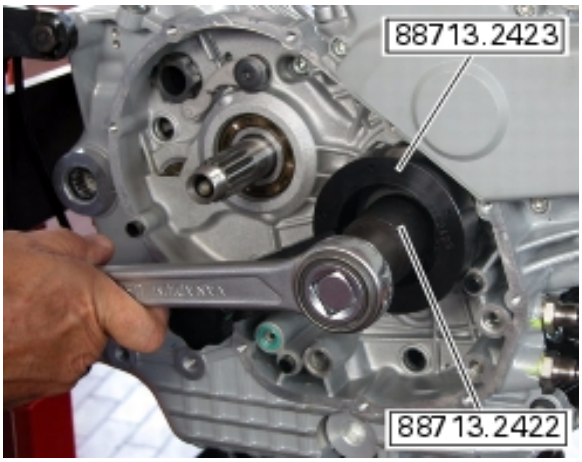
Important

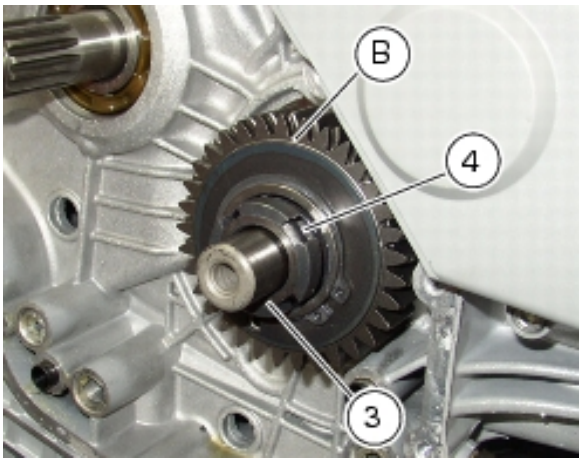
If fitting a new primary driving gear (B), check the backlash.



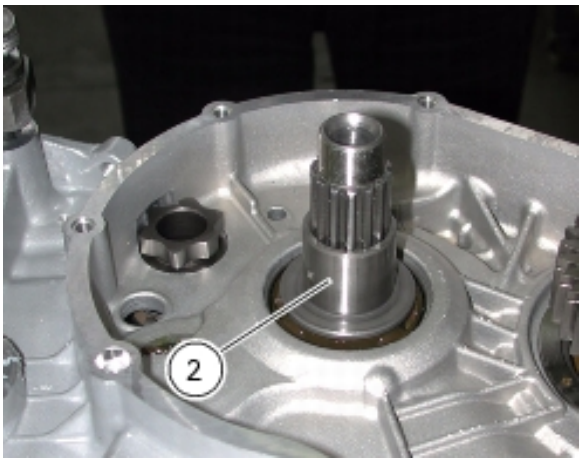


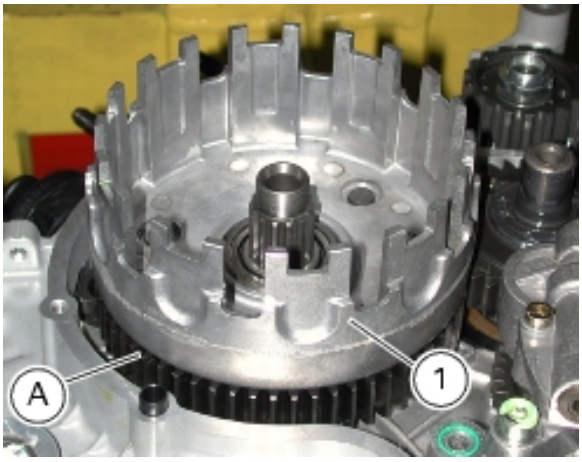
To check the backlash, temporarily fit the clutch drum (**1**) complete with the primary driven gear (**A**) on the gearbox input shaft. Fix a dial gauge to the engine crankcase, positioning the stylus against a gear tooth.
Turn the driven gear (**A**) to mesh the teeth and check with the dial gauge that backlash ranges between **0.05** and **0.07** mm.
Repeat the check at 16 different points of the driven gear.
If the measured values are outside the permissible tolerance limits, try changing the position of driven gear (**A**) on the input shaft, leaving the drive gear (B) on the crankshaft. If the backlash is still outside the tolerance limits, renew the primary drive gear pair (**1**).
After checking backlash, fit the socket part no. **88713.2422** to a torque wrench, restrain the pinion (B) with the holding wrench part no. **88713.2423** and tighten the nut (3) to the specified torque (Sect. C 3, Engine torque settings).
Stake the washer (4) onto the drive gear (B) in a milled location and onto nut (3) at a diametrically opposed position.





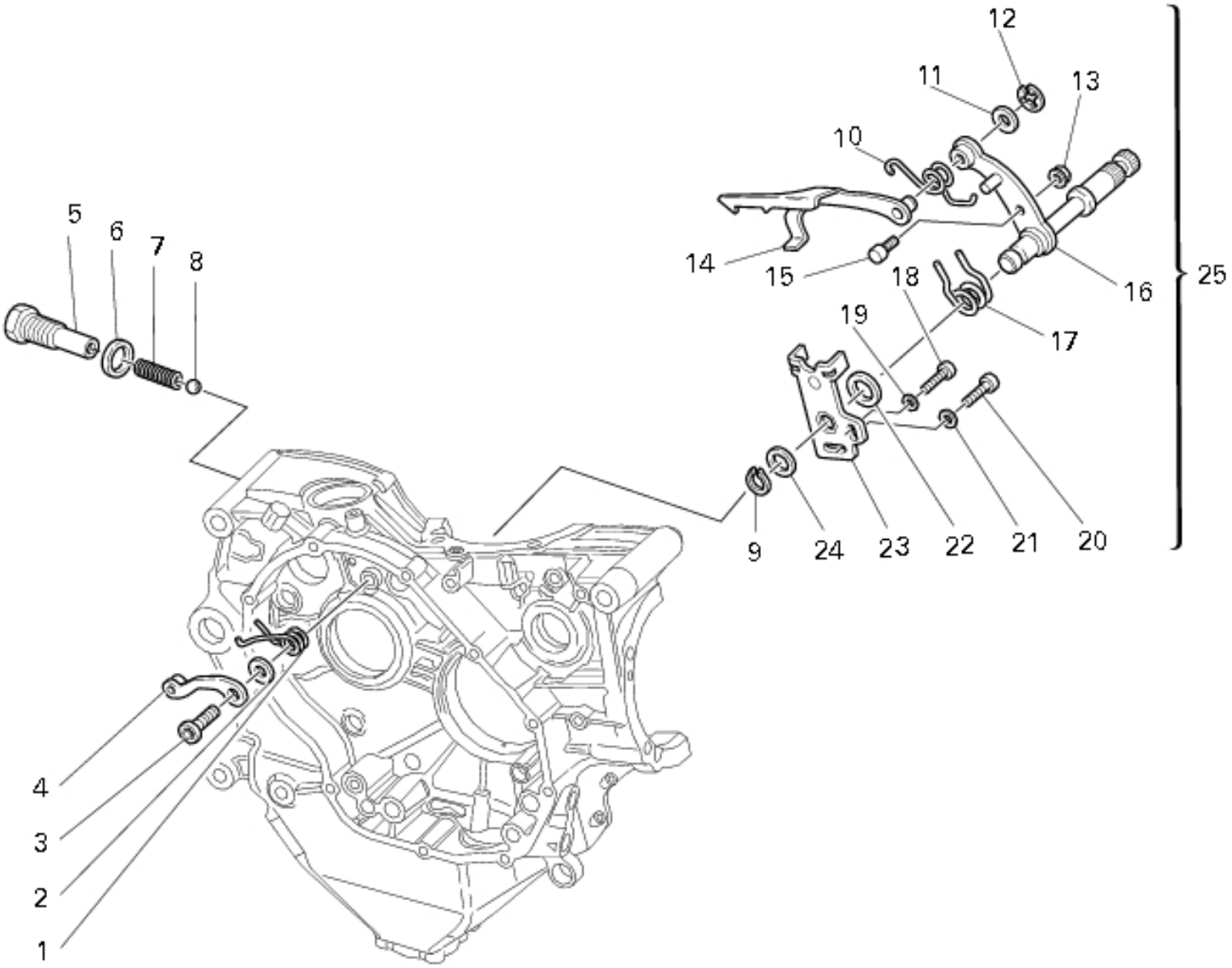
Refit the oil pump and check the backlash between the oil pump gear and primary drive gear on the crankshaft (Sect. N 2.1, Refitting the oil pump).
Thoroughly degrease the mating surfaces of the clutch drum (1).
Fit the spacer (2) onto the input shaft. Fit the clutch drum (1) along with the driven gear (A).





Operation	Section reference
Refit the complete clutch assembly	N 6.1, Reassembly of the clutch
Refit the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
Refill the engine with oil	D 4, Changing the engine oil and filter cartridge

7.1 - Gearbox assembly: gearchange mechanism



1 Return spring
2 Washer
3 Special bolt
4 Gear pawl assembly
5 Interlock plunger holder
6 Seal
7 Detent ball spring
8 Ball
9 Circlip
10 Selector claw return spring
11 Shim, thickness 0.5
11 Shim, thickness 0.2
12 Ring
13 Nut
14 Selector drum control fork
15 Gearchange lever pin
16 Shaft with gearchange lever arm
17 Gearchange lever arm return spring

18 Bolt
19 Washer
20 Bolt
21 Washer
22 Locating ring
23 Stop plate
24 Shim, thickness 0.2
24 Shim, thickness 0.5
25 Gearchange mechanism

Parts catalogue

Gearchange CONTROL

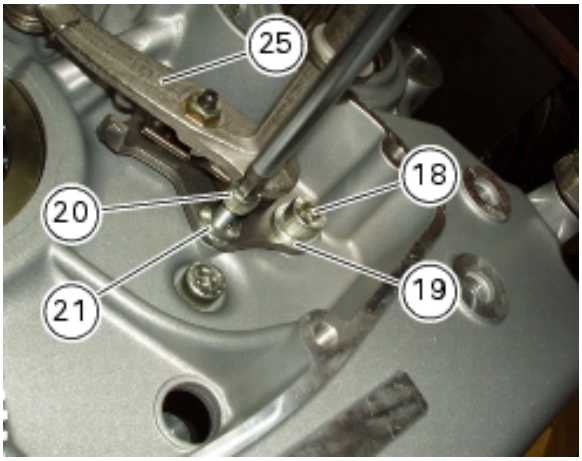
Important

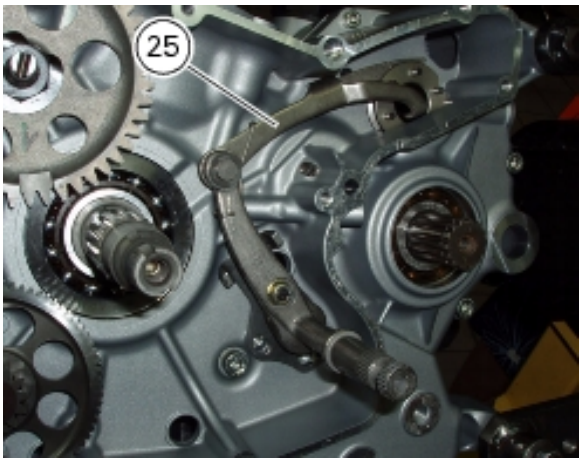
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the gearchange mechanism

Operation	Section reference
Remove the alternator-side crankcase cover and flywheel/ alternator assembly	N 8, Removal of the alternator-side crankcase cover
Remove the clutch-side crankcase cover complete with the clutch drum and primary drive gear	N 6.2, Removal of the clutch-side crankcase cover

Unscrew and remove the bolts (18) and (20) securing the gearchange mechanism (25) and recover the washers (19) and (21).
Remove the gearchange mechanism complete with the shaft, spring, and stop plate.

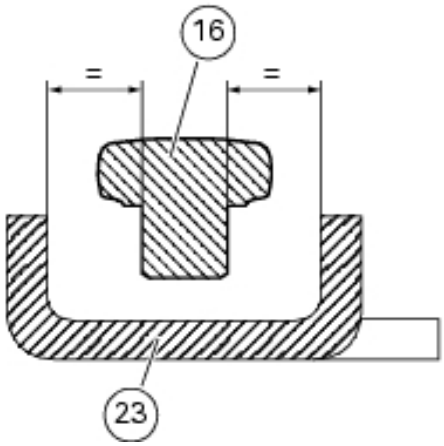




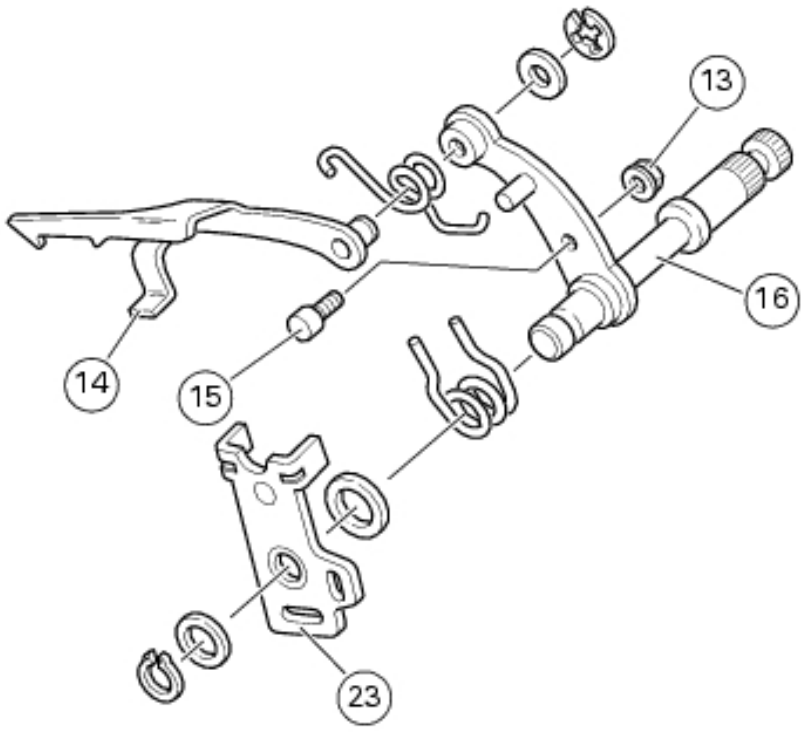
Important

Visually inspect the gear selector claw (14) for wear, particularly around the area where it contacts the selector drum.

If it proves necessary to change components, disassemble the gear selector lever as shown in the exploded view. Reassemble the gearchange mechanism, orienting the eccentric pin (15) in such a way that the lever arm (16) is positioned centrally with respect to the shoulders of the stop plate (23).

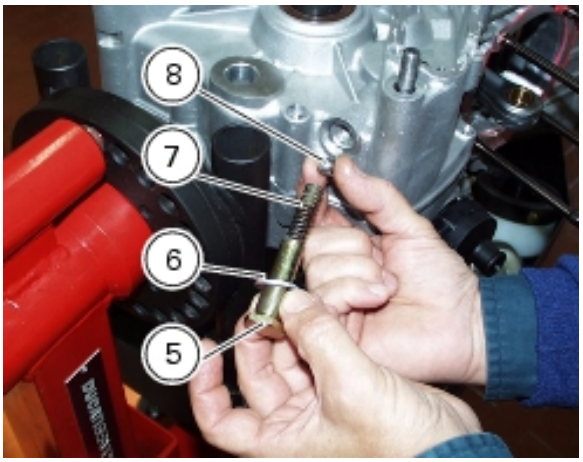


Now tighten the nut (13) to the specified torque (Sect. C 3, Engine torque settings).

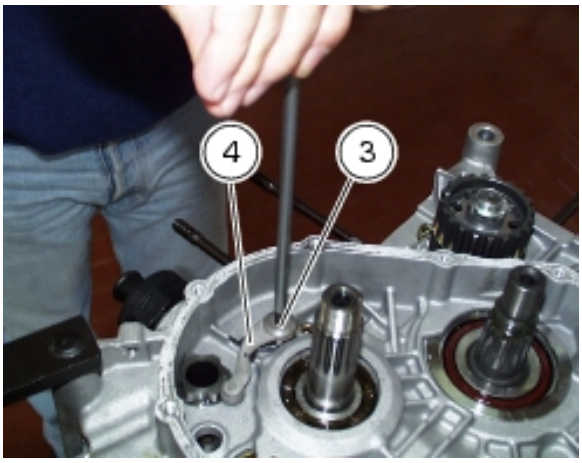


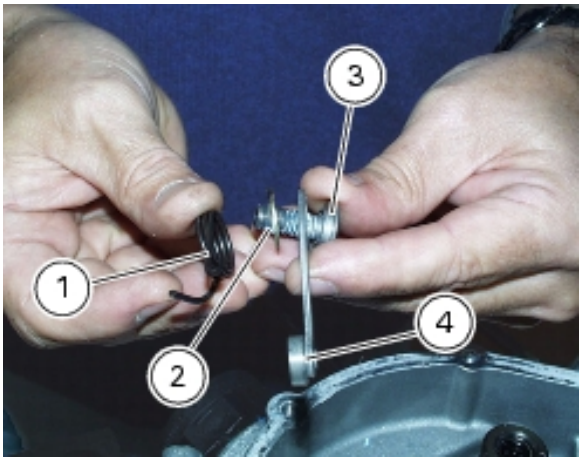
Disassembly of gear interlock plunger and pawl assembly

Unscrew the interlock plunger screw (5) and remove the seal (6), spring (7) and the detent ball (8).



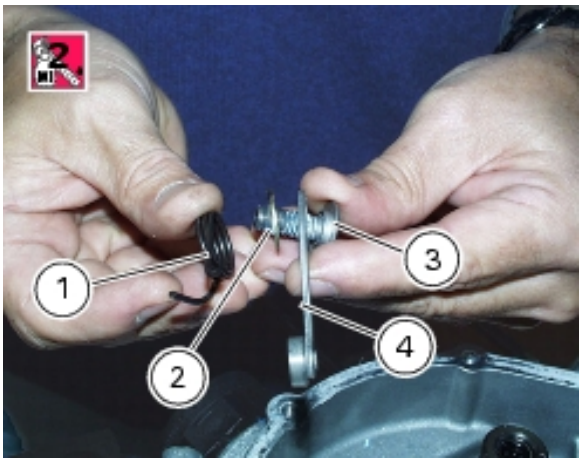
Unscrew the clutch-side crankcase half bolt (3) and remove the pawl (4), washer (2) and spring (1).

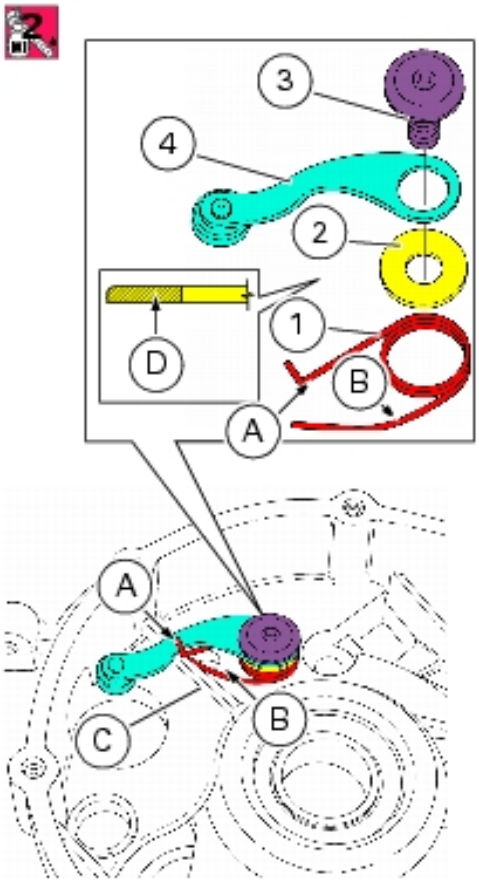




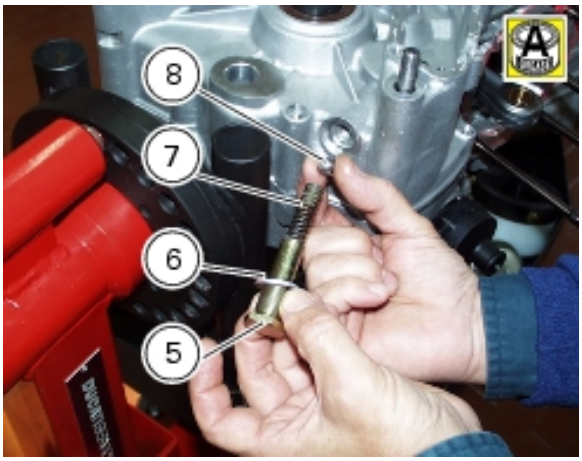
Refitting the gear interlock plunger and pawl assembly

On the special bolt (3), fit the gear pawl lever (4), orienting it as shown in the figure, the washer (2) with the square edge side (D) facing the clutch-side crankcase, and the spring (1), positioning it so that the hook end (A) is facing the gear pawl lever. Locate the hook end (A) of the spring on the gear pawl lever as shown in the figure.
Apply threadlocker to the bolt thread. Start the bolt in the crankcase half. Position end (B) of the spring so that it rests against rib (C) of the crankcase half, as shown in the figure. Tighten the bolt (3) to the specified torque (Sect. C 3, Engine torque settings). Check that the spring functions correctly by manually moving the gear pawl lever.



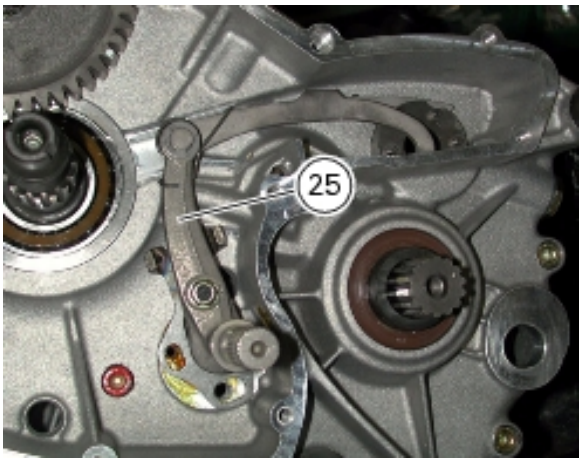


Grease and then fit the ball (8), spring (7), and seal (6) to the gear interlock plunger (5).
Tighten the gear interlock plunger to the specified torque (Sect. C 3, Engine torque settings).

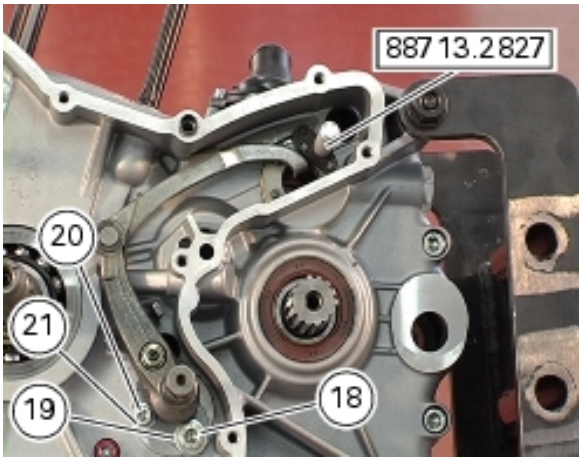


Refitting the gearchange mechanism

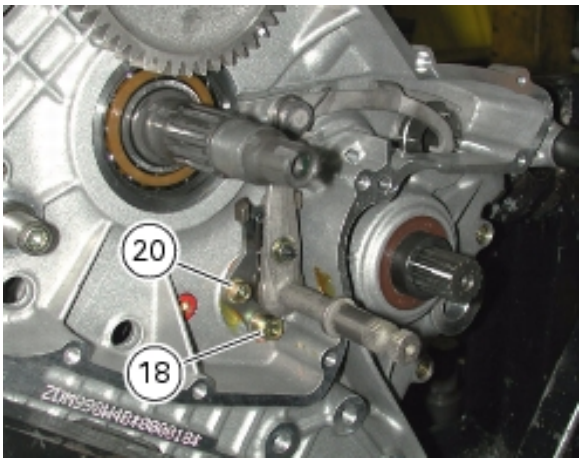
Locate the gearchange mechanism (25) with the shaft, spring, and stop plate, on the chain-side crankcase half.



Fit the bolts (18) and (20) with the washers (19) and (21).
Locate the gearbox drum selector claw in the centre of the drum rollers.
Temporarily fit the gearchange lever (or a service lever) and the engine sprocket, and shift to second gear.
Fit the plate **88713.2827** in the claw shaft pins (see figure).
Fit the selector shaft claw on the pin of the service plate.

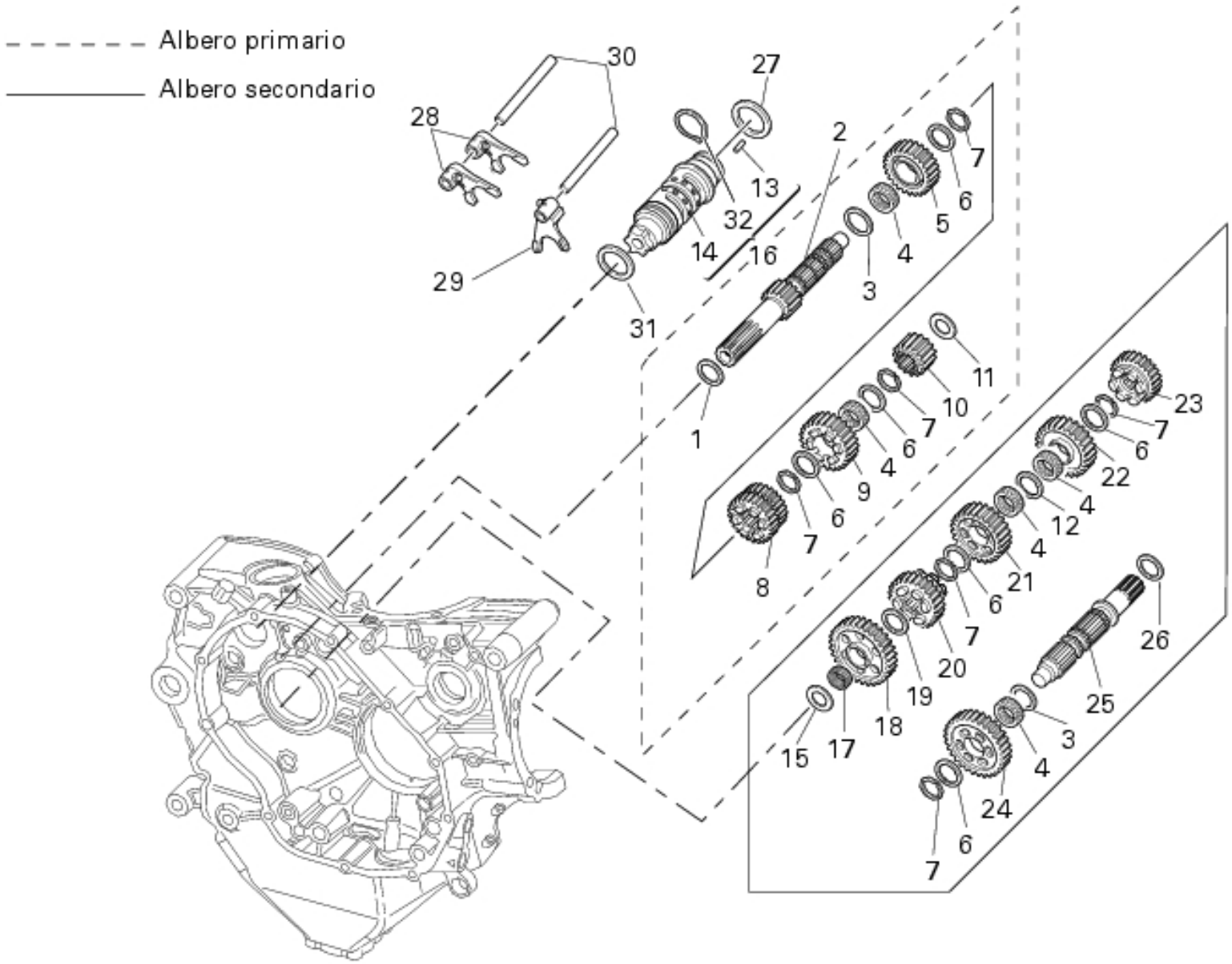


Then tighten the gearchange mechanism retaining bolts (18) and (20) to the specified torque (Sect. C 3, Engine torque settings).
Remove sercvice tool no.
With the gearbox in neutral, check that the lever travel is the same when shifting up and down. The same should apply when a gear is engaged.
Operate the gearchange lever and turn the front sprocket at the same time to check that all the gears engage when shifting up and down.
Remove the previously installed lever and sprocket.



Operation	Section reference
Refit the primary gear, the clutch drum and the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
Refit the flywheel/alternator assembly and alternator-side crankcase cover	N 8, Refitting the flywheel/alternator assembly

7.2 - Gearbox assembly: gearbox shafts



1 Shim, thickness 1.2
2 Gearbox input shaft
3 Shim, thickness 0.5
4 Needle roller bearing
5 5th speed driving gear
6 Splined washer, thickness 0.5
7 Circlip
8 3rd- 4th speed driving gear
9 6th speed driving gear
10 2nd speed driving gear
11 Shim, thickness 1.6
12 Splined washer
13 Special roller
14 Selector drum
15 Shim, thickness 3.15
16 Selector drum assembly
17 Needle roller bearing

18 1st speed driven gear
19 Shim, thickness 1
20 5th speed driven gear
21 4th speed driven gear
22 3rd speed driven gear
23 6th speed driven gear
24 2nd speed driven gear
25 Gearbox output shaft
26 Shim, thickness 0.8
27 Shim, thickness 0.9
28 1st, 4th- 2nd, 3rd speed selector fork
29 5th, 6th speed selector fork
30 Selector fork shaft
31 Shim, thickness 1
32 Needle roller retaining circlip (square cross-section)

Parts catalogue

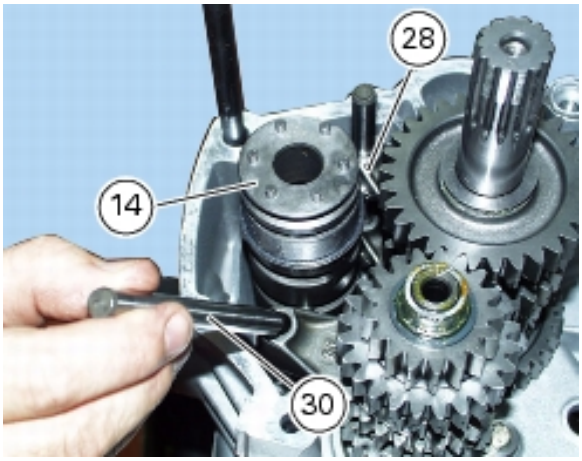
Gearchange CONTROL
Gearbox

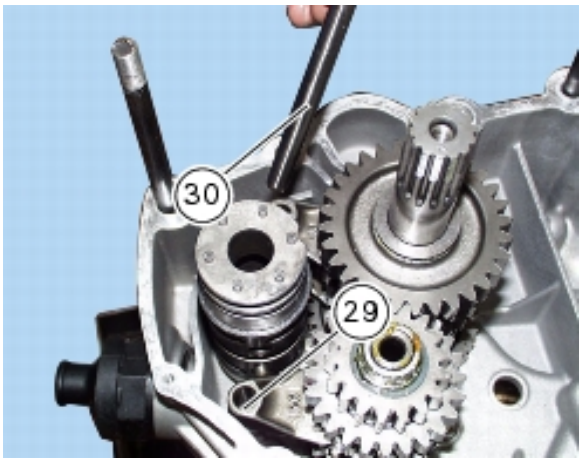
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the gearbox assembly

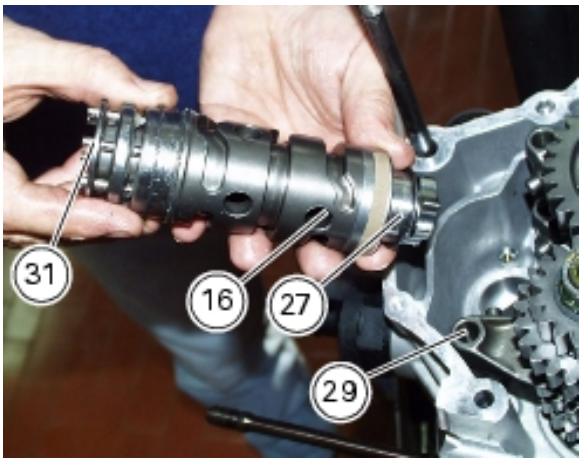
Operation	Section reference
Remove the engine from the frame	N 1, Removal of the engine
Separate the crankcase halves	N 9.2, Separation of the crankcase halves

Withdraw the selector fork shafts (30).
Move the forks (28) and (29) to disengage them from the slots in the selector drum (14).

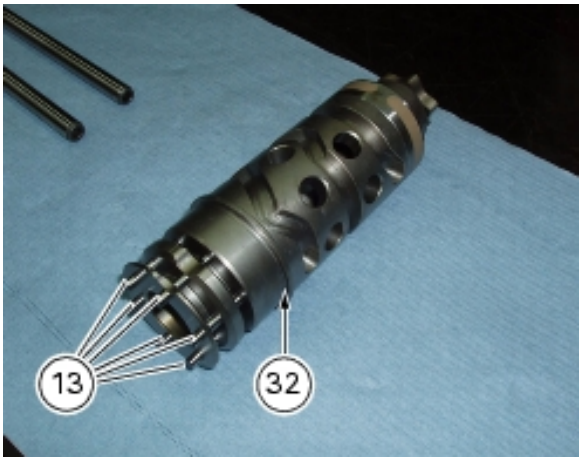




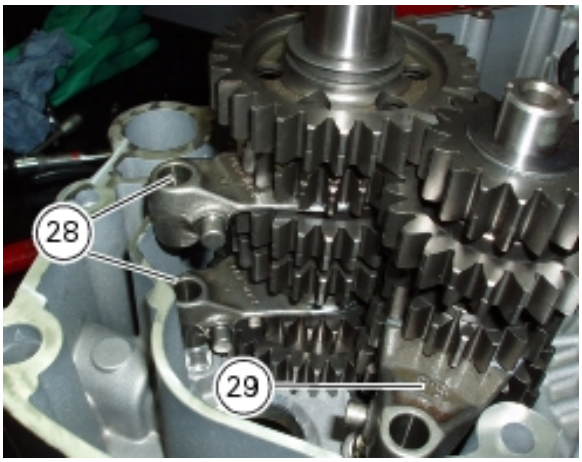
Withdraw the selector drum (16) taking care not to lose shims (31) and (27) mounted on the shaft. Note that the positions of the shims must not be inverted.

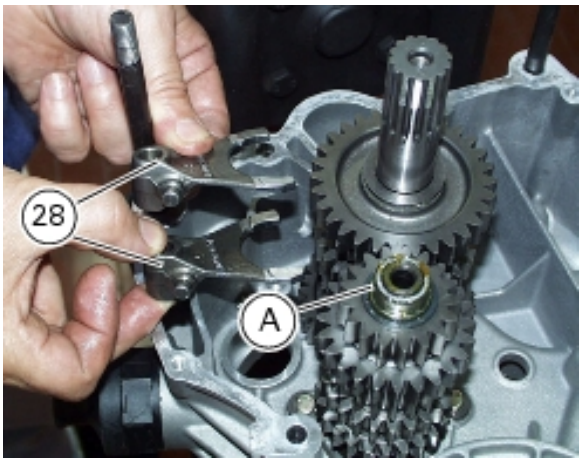


Now you can renew the needle roller retaining ring (32) and the special needle rollers (13).



Remove gear selector forks (29) and (28).
Remove the gearbox input (2) and output (25) shafts complete with gears, taking care to recover the spacers on the ends of the shafts.
If the bearing inner races (A) are left on the shafts, slide them off the ends of the gearbox input (2) and output (25) shafts (Sect. N 9.2, Separation of the crankcase halves).





Disassembly of the gearbox shafts

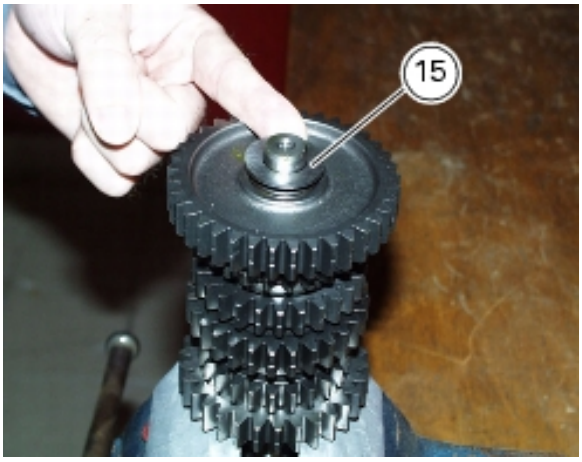
Place the shaft in a vice in such a way as to facilitate the disassembly operations.

Important

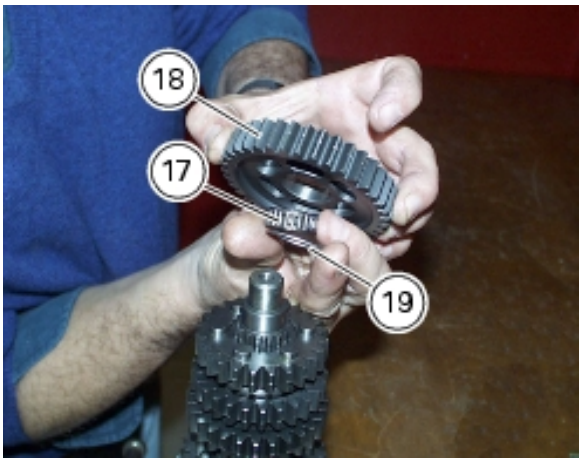
Take care not to invert the positions of the shims on reassembly:
this would potentially lead to jamming when using the gear selector control, making it necessary to reopen the engine crankcase.

Disassembly of the gearbox output shaft

Remove the chain-side shim (**26**) and clutch-side shim (15) from the output shaft.

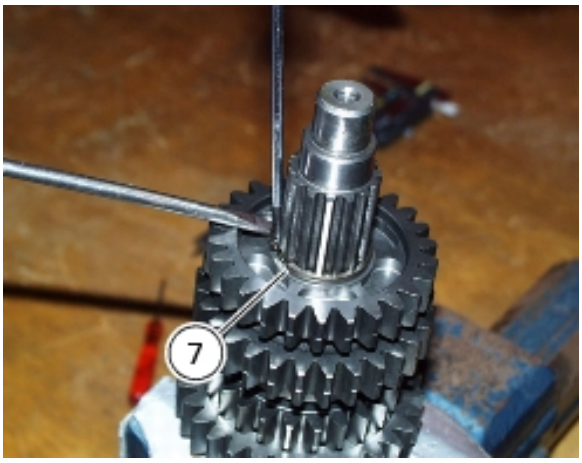


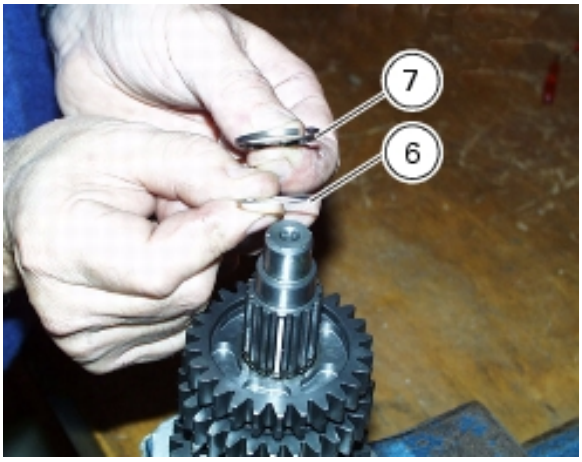
Withdraw the first speed driven gear (18) with the roller cage (17) and the shim (19).



Remove the fifth speed driven gear (20).

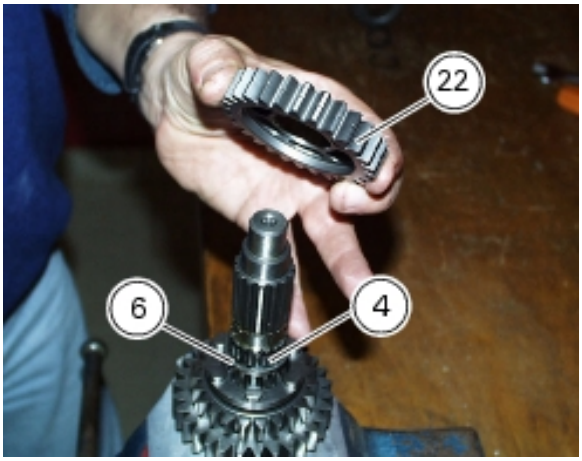
Use two flat blade screwdrivers to remove the circlip (7) taking care not to damage the shaft surface.
Remove the circlip (7) and the splined washer (6).



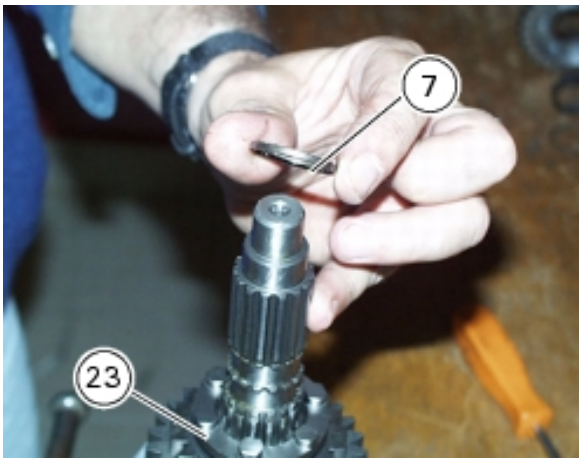


Withdraw the fourth speed driven gear (21) with the roller cage (4) and splined washer (12).

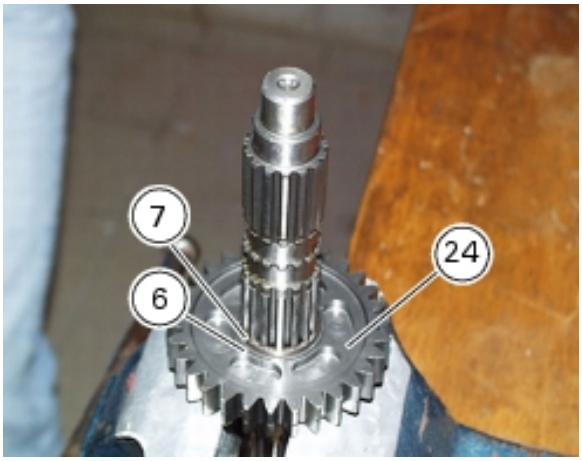
Remove the third speed driven gear (22) with the roller cage (4) and the splined washer (6).



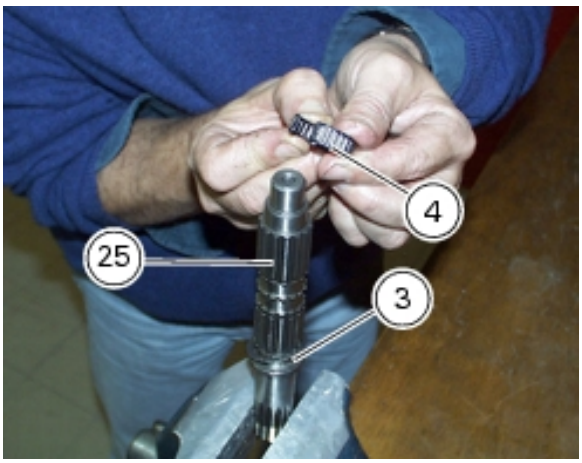
Remove the circlip (7) and remove the sixth speed driven gear (23).



Remove the circlip (7) and withdraw the splined washer (6) and the second speed driven gear (24).



Withdraw the roller cage (4) and the shim (3). All the components have thus been removed from gearbox output shaft (25).



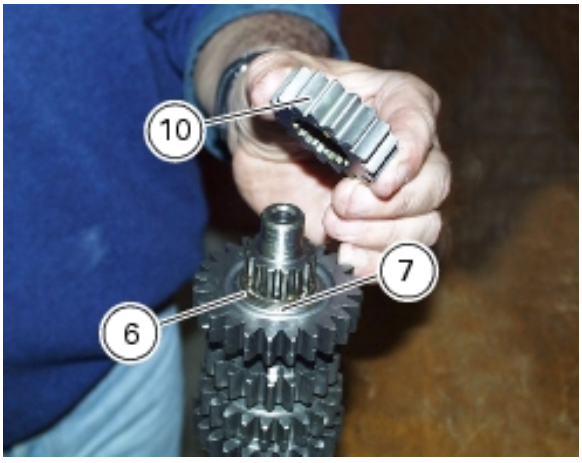
Disassembly of the gearbox input shaft

Remove the chain-side shim (11) and the clutch-side shim (**1**) from the input shaft.

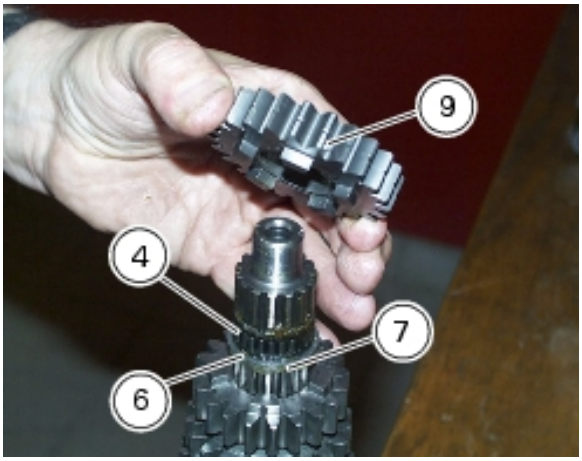
Remove the second speed driving gear (10). Use two screwdrivers to prise out the circlip (7) and the splined washer (6).

Important

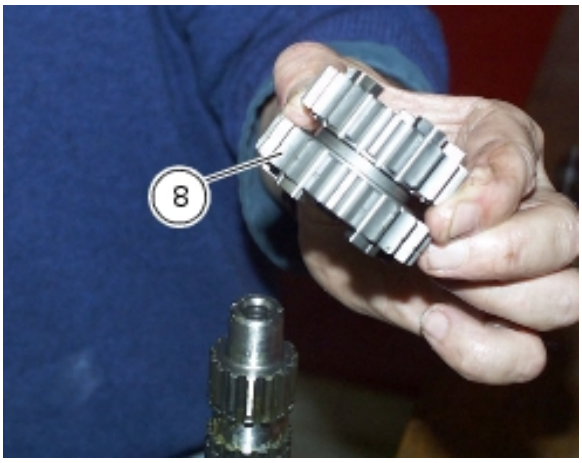
Take care to avoid damaging the surface of the shaft while removing circlip (7).



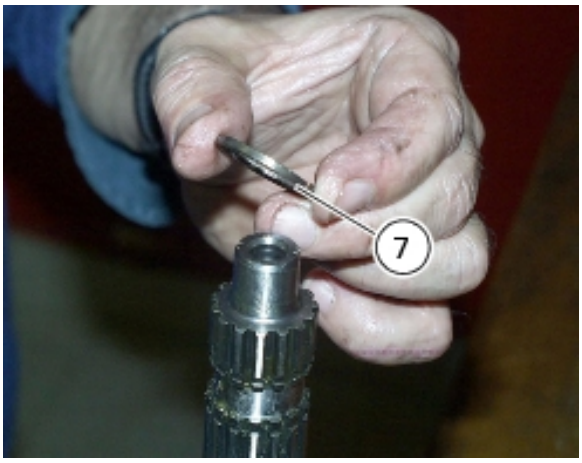
Remove the sixth speed driving gear (9) with its roller cage (4). Remove the splined washer (6) and the circlip (7).

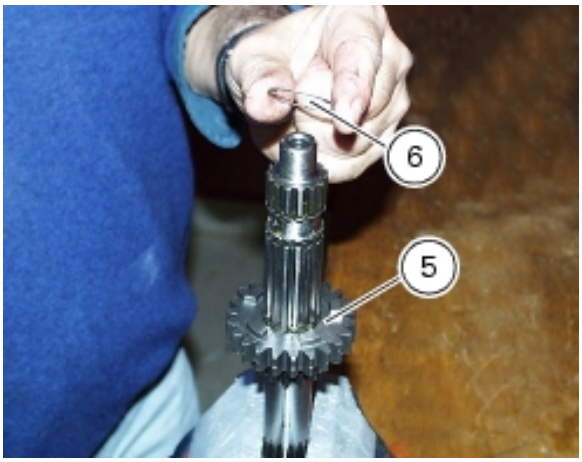


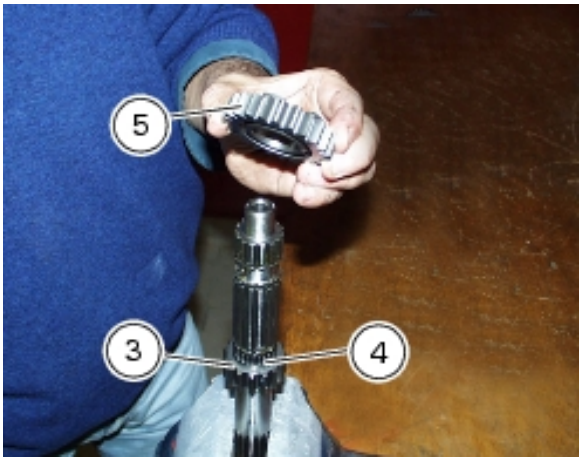
Withdraw the third and fourth speed driving gear (8).



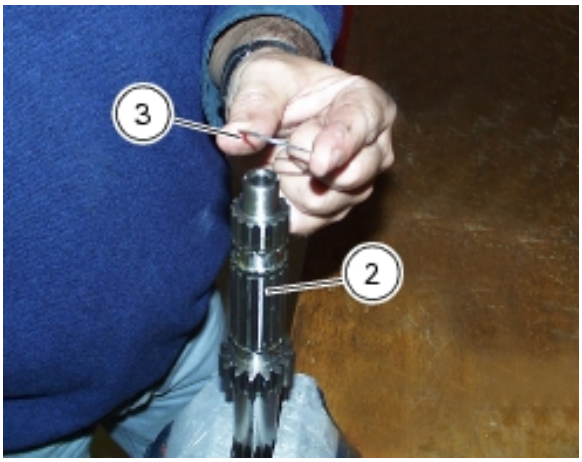
Remove the circlip (7) and the splined washer (6).
Remove the fifth speed driving gear (5) with the roller cage (4).





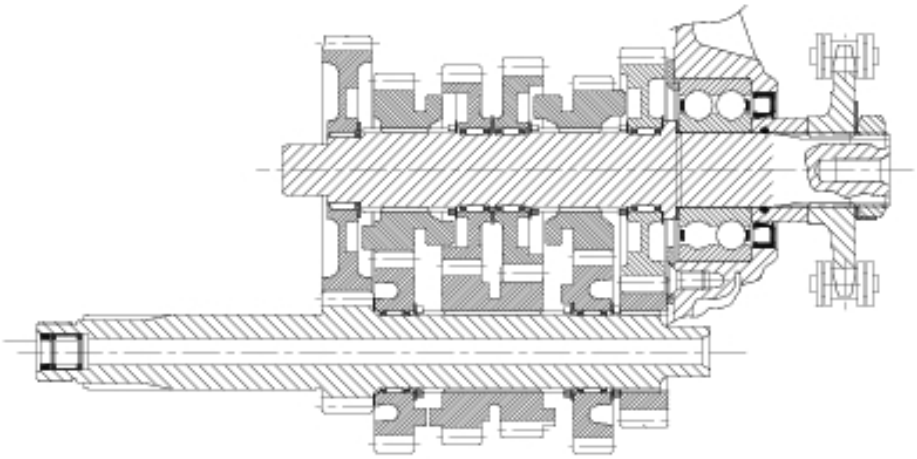


Slide the shim (3) off the input shaft (2).



Overhaul of the gearbox

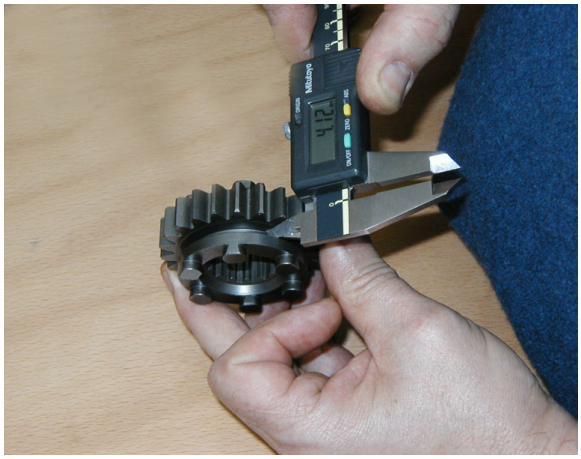
Check the condition of the front coupling dogs of the gears. They must be in perfect condition and with no sign of wear on the edges of the teeth.
The idler gears must rotate freely on their shafts.
When refitting, make sure the circlips are correctly positioned.
Check the needle roller bearings for wear.
The threads and splines of the shafts must be in perfect condition.
Also check that the component parts of the gear selector mechanism are in good condition.



Engage the gears and check that the gearchange mechanism does not stick (selector fork - gear groove, and fork pin - desmodromic drum groove) due to incorrect end float. Restore the correct endfloat by shimming the gearbox shafts and the selector drum with suitable shims.
For the total gearbox shaft and selector drum end float values, refer to Sect. C 1.1, Gearbox.

Inspection of the gear selector forks

Visually inspect the gear selector forks. Bent forks must be renewed as they may lead to difficulties in gear changing or may suddenly disengage when under load.
Use a feeler gauge to check the clearance of each fork in its gear groove.
If the service limit has been exceeded, check whether or not it is necessary to renew the gear or the fork by referring to the limits specified for each part (Sect. C 1.1, Gearbox).



Inspection of the gear selector drum

Use a gauge to measure the clearance between fork pin and the slot on the selector drum.
If the service limit is exceeded, determine which part must be renewed by comparing these dimensions with those of new components (Sect. C 1.1, Gearbox).
Also check the wear on the drum support pins; these must not show any signs of scoring, burrs, or deformation.
Turn the drum in the crankcase to establish the extent of radial play. If play is excessive, change whichever part is most worn.

Reassembly of the gearbox shafts

Figure 1 shows all the parts to be reassembled on the gearbox input shaft (2), with the calculated end shims (1) and (11) (Sect. N 9.2, Reassembly of the crankcase halves).

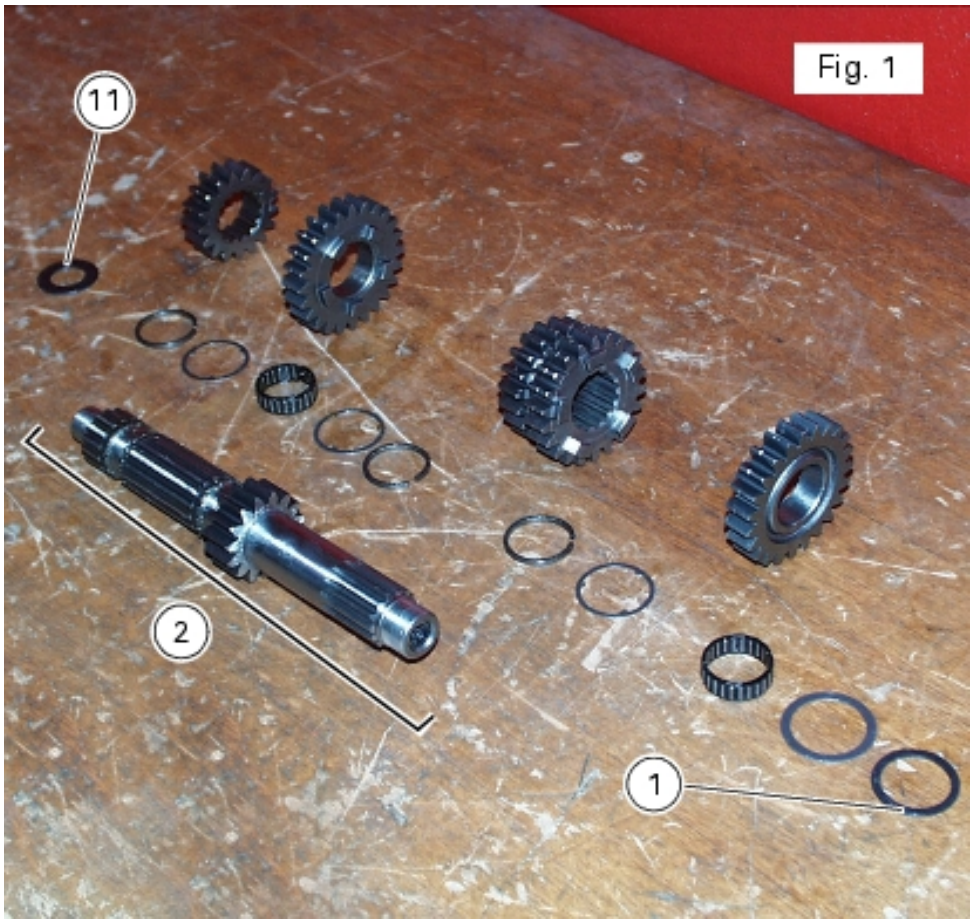
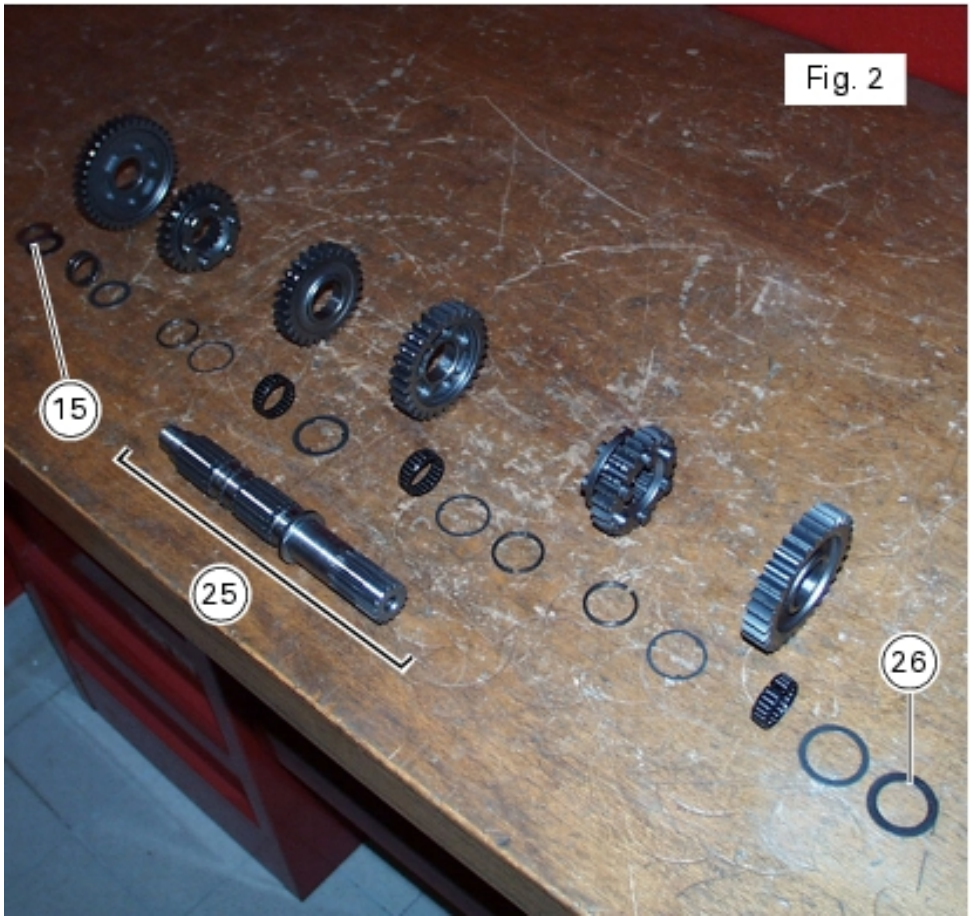


Figure 2 shows all the parts to be reassembled on the gearbox output shaft (25), with calculated end shims (15) and (26) (Sect. N 9.2, Reassembly of the crankcase halves).

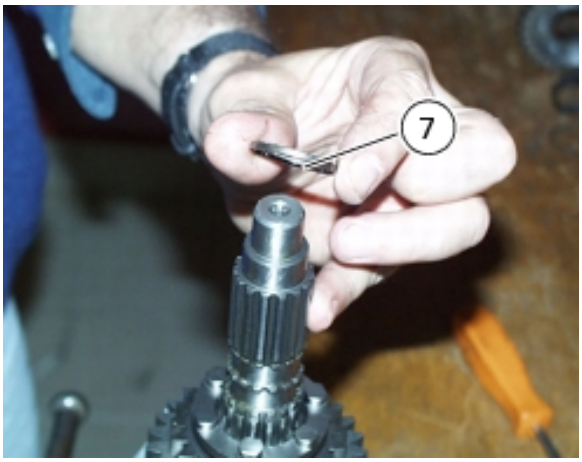


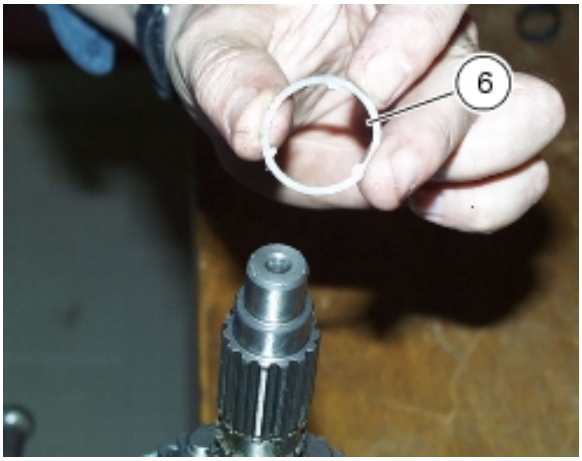
Reassemble the gears on the gearbox shafts by reversing the disassembly procedure.

Take particular care when installing the idler gears. The assembly of the 3rd and 4th speed gears and the relative fixing components on the output shaft is given as an example.

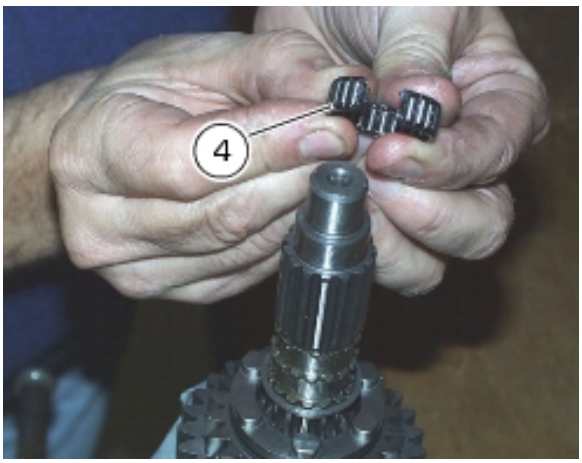
Fit the circlip (7), checking that it is fully inserted into its groove on the shaft. Push the circlip into position with a suitable size tubular drift.

Slide the washer with three internal points (6) over the shaft until it locates against the circlip you have just fitted.



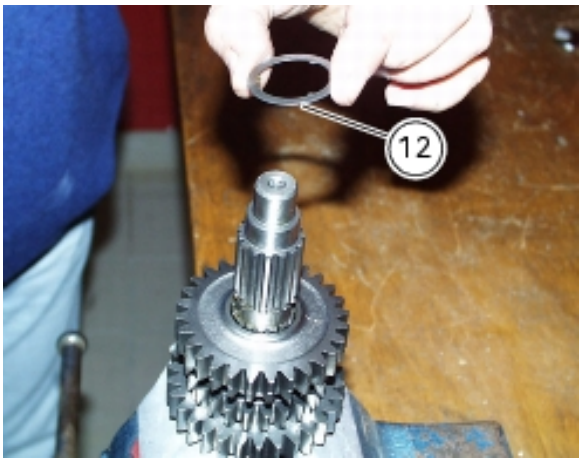


To fit the needle roller cage (4) onto the shaft, first lubricate it with plenty of grease (of recommended type) and then open it slightly to make it easier to slide on to the shaft.



Fit the 3rd speed gear (22).

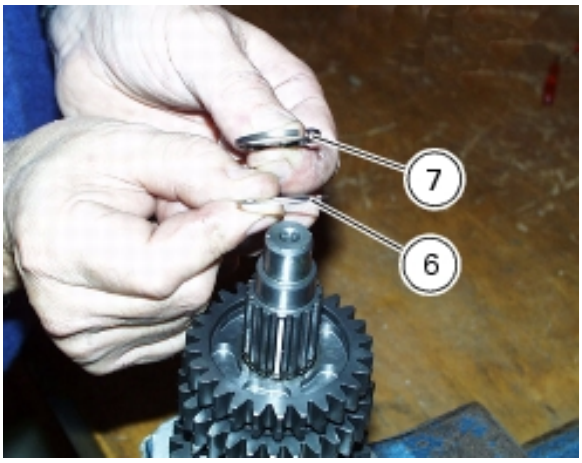
Fit the three-pointed washer (12), which can be distinguished from its counterpart (**6**) by its bigger outside diameter.



Fit another needle roller cage (4) using the method already described.

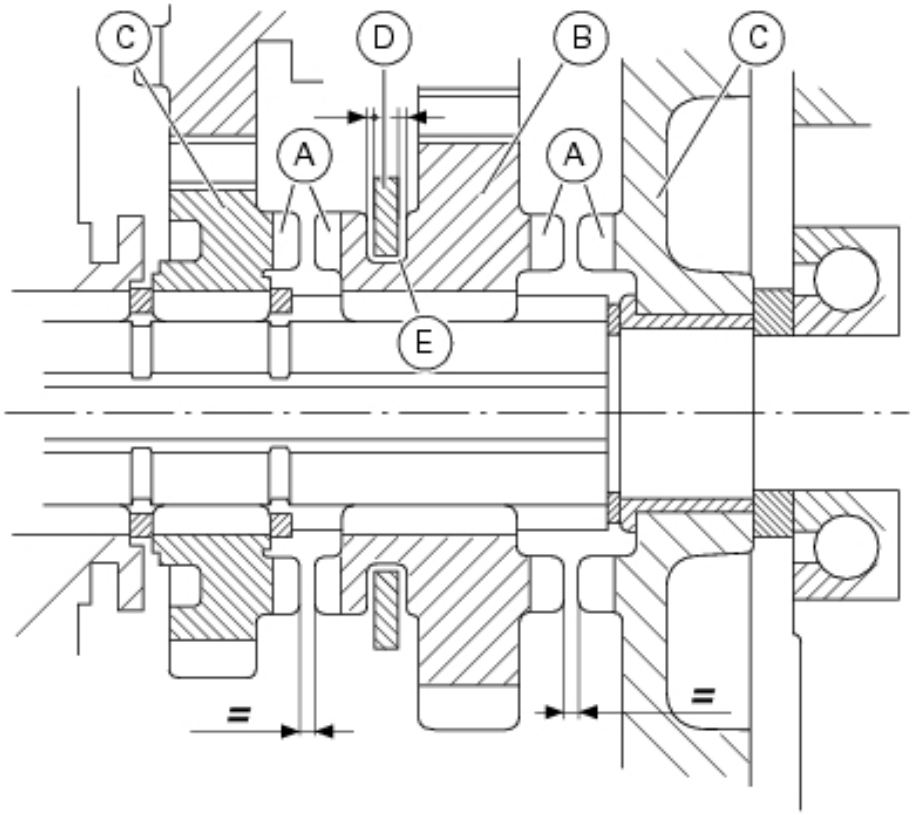
Fit the 4th speed gear (21).

Fit another 3-pointed washer (6) and another circlip (7) onto the shaft. Seat the circlip using the drift used previously.



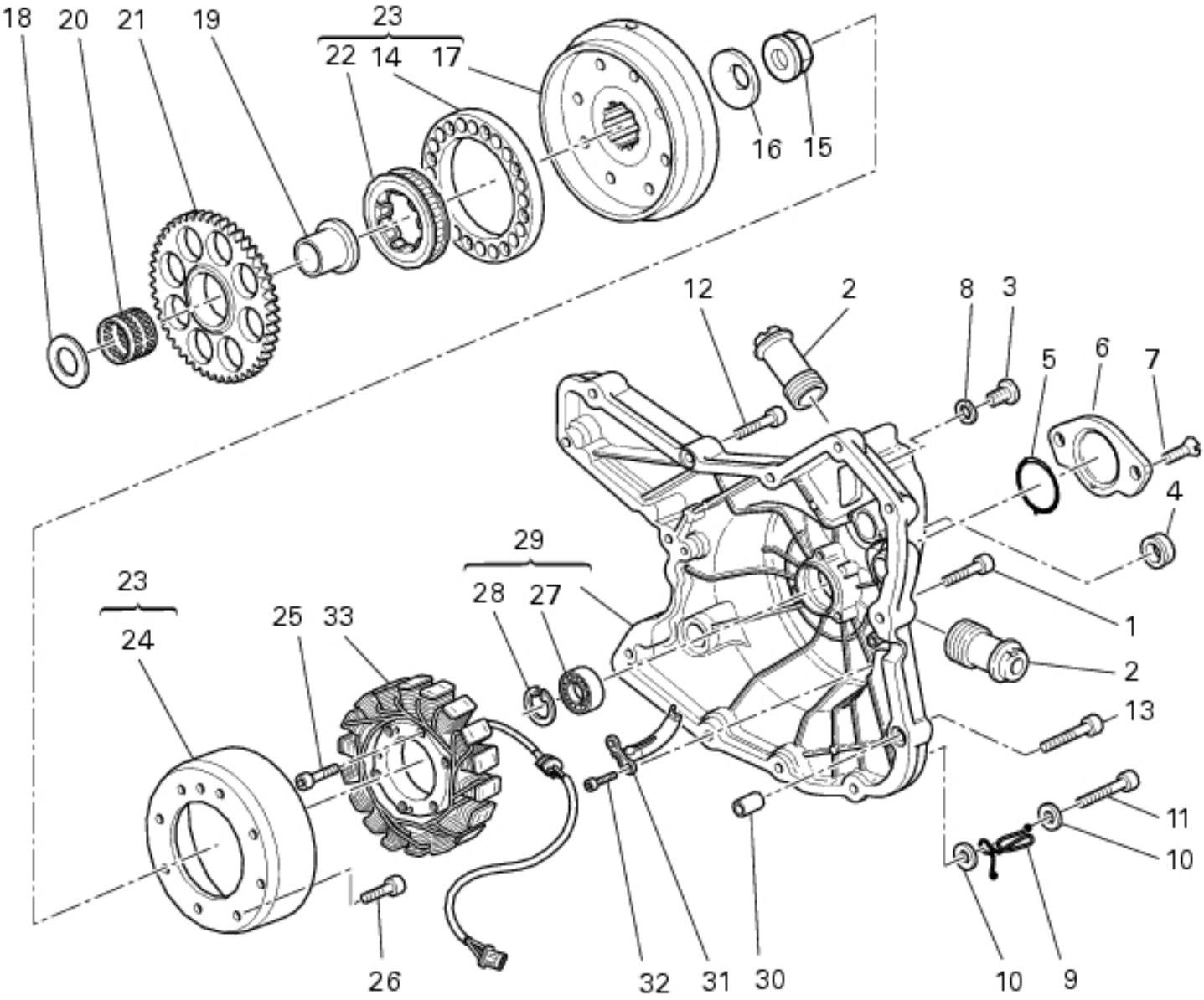
Reassembly of the gearbox

To reassemble gearbox components follow the procedure under Sect. N 9.2, Reassembly of the crankcase halves relating to reassembly of the crankcase halves.
As a final practical test, ensure that with the gearbox in neutral the front coupling dogs (A) of sliding gears (B) are equidistant on both sides with respect to the corresponding coupling dogs on the fixed gears (C).
Check also that there is always a small amount of clearance between fork (D) and relative groove (E) on sliding gear (B) when engaging the gears.



Operation	Section reference
Reassemble the engine crankcase halves	N 9.2, Reassembly of the crankcase halves
Refit the engine to the frame	N 1, Refitting the engine

8 - Flywheel-alternator



1 Bolt
2 Cylinder coolant inlet union
3 Ignition inspection plug
4 Oil seal
5 O-ring
6 Cover
7 Bolt
8 Aluminium gasket
9 Cable guide
10 Washer
11 Bolt
12 Bolt
13 Bolt
14 Flange
15 Flanged nut
16 Belleville washer
17 Flywheel
18 Washer

19 Inner ring
20 Needle roller bearing
21 Electric starter driven gear
22 Starter clutch
23 Flywheel-starter clutch assembly
24 Alternator rotor
25 Bolt
26 Bolt
27 Bearing
28 Circlip
29 Alternator-side crankcase cover
30 Locating bush
31 Bracket
32 Bolt
33 Alternator stator

Parts catalogue

WATER PUMP-ALTR-SIDE CRANKCASE COVER
Electric starting and ignition
connecting rods

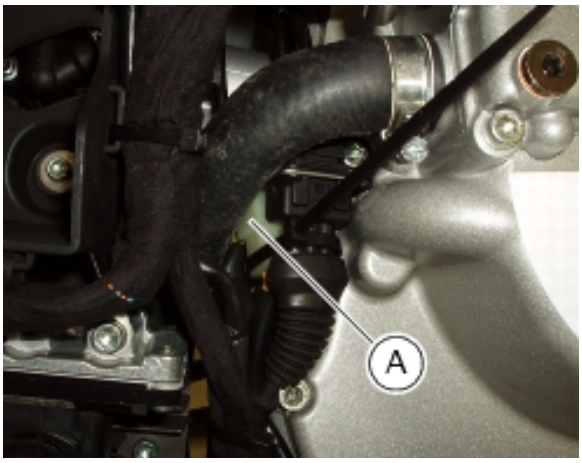
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the alternator-side crankcase cover

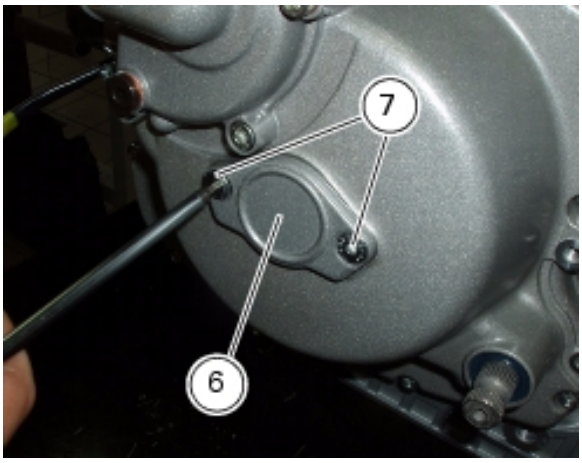
Operation	Section reference
Remove the front sprocket cover	G 8, Removal of the front sprocket
Drain the engine oil	D 4, Changing the engine oil and filter cartridge
Remove the clutch pushrod	F 2, Removal of the clutch slave cylinder
Remove the pump-cylinder hoses	N 5, Removal of the cylinder/piston assembly
Remove the water pump-radiator hose	N 3.3, Removal of the water pump

Notes
This operation is described for an engine removed from the frame since all reassembly procedures are easier with the engine on the bench.

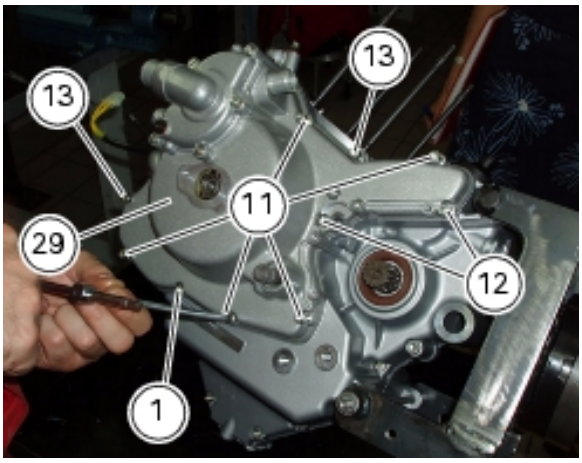
Disconnect the alternator wiring connector from the main wiring loom (A).

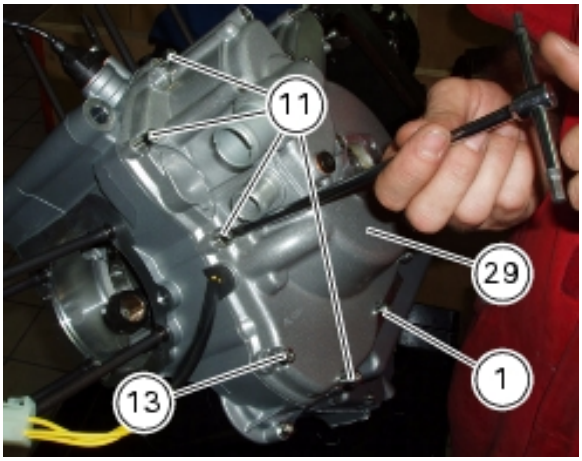


Unscrew the two retaining bolts (7) of the centre cap (6) over the end of the crankshaft.



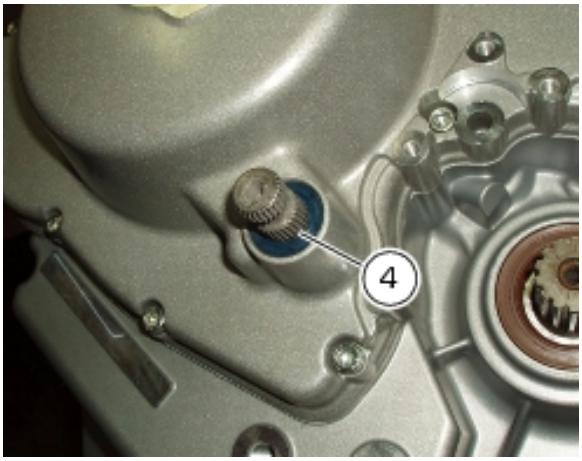
Unscrew the bolts (1), (11), (12) and (13) securing the alternator-side crankcase cover (29).





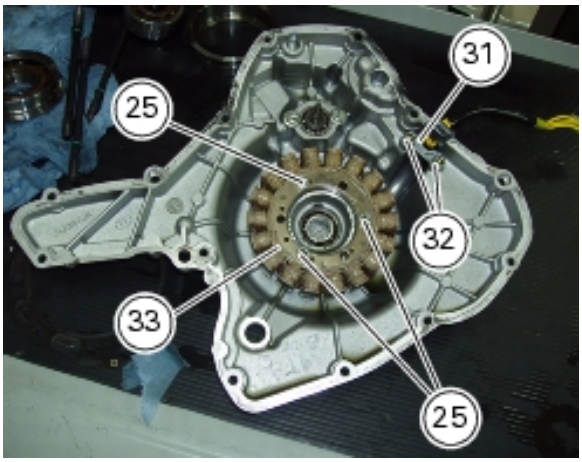
Fix service tool no. **88713.1749** to the holes of the two bolts (7) you have just removed.
Turn the tool shaft slowly to separate the cover (29) from the LH crankcase half.

There is an oil seal (4) on the cover in correspondence with the gearchange shaft that may be damaged when removing the crankcase cover.
Always check the condition of this oil seal and renew it if damaged.



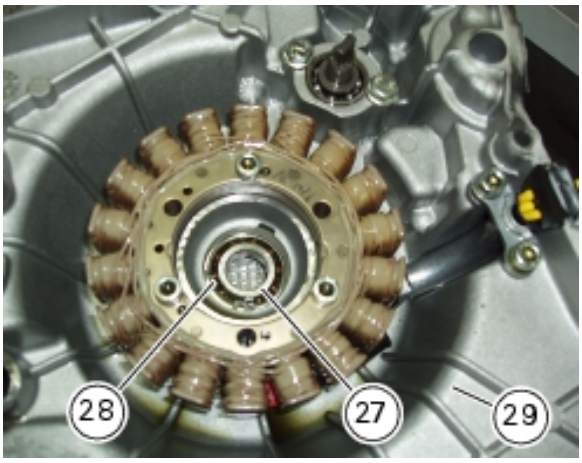
Disassembly of the alternator-side crankcase cover

Undo the three stator retaining bolts (25) and the retaining bolts (32) of the two cable guide brackets (31) from inside the crankcase cover.
Remove the stator (33) and the cable guide (31).



The alternator-side crankcase cover is fitted with a bearing (27), held in place by circlip (28), which locates on the end of the crankshaft.
Remove the circlip (28) with circlip pliers.
Remove the bearing (27) using a universal puller.
Be careful when fitting the new bearing (27) to ensure it is positioned with the shielded side facing away from the

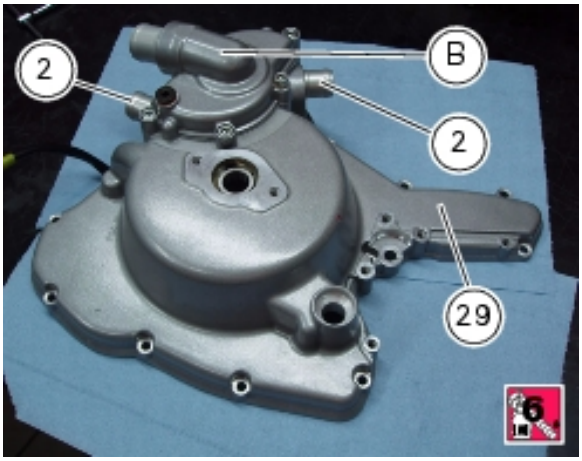
cover.
Secure the bearing with the circlip (28), ensuring that it is correctly fitted in its seat in the crankcase cover (29).



Unscrew the horizontal and vertical cylinder coolant inlet unions (2).
When fitting new components, apply the recommended threadlocker and tighten to the specified torque. (Sect. C 3, Engine torque settings).

Important
The unions (2) may also be removed without removing the alternator-side crankcase cover (29) from the engine.

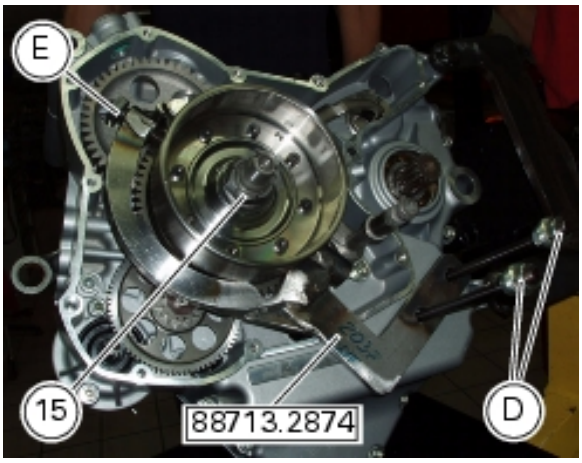
Disassemble the components of the water pump (B) as described in Sect. N 3.3, Removal of the water pump.



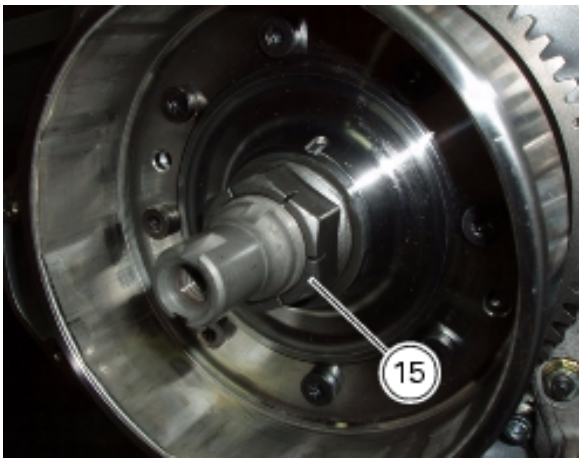
Removal of the flywheel/alternator assembly

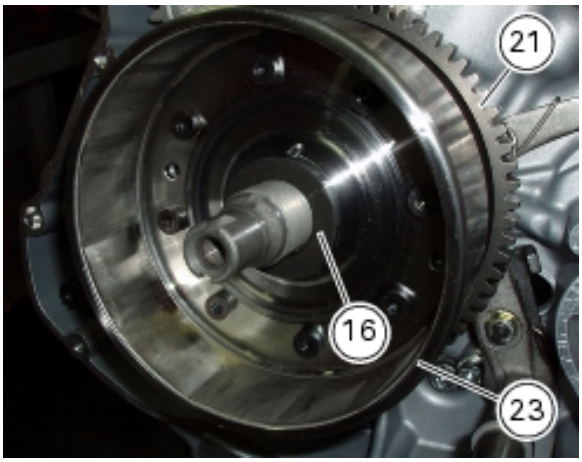
Use service tool no. **88713.2874** fixed to the M10 sidestand fixing holes (D).
Lock the tool to the flywheel with the bolt (E).
Unscrew the alternator/flywheel retaining nut (15).

Warning
While unscrewing the nut, apply axial pressure to the socket to avoid damage or injury in the event of the wrench suddenly slipping off the nut.



Remove the nut (15), the Belleville washer (16) and the flywheel assembly (23) with the driven gear (21) from the crankshaft.

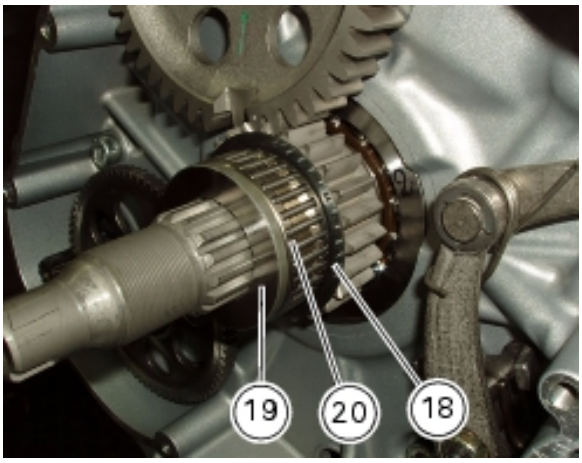




Remove the inner ring (19), the needle roller bearing (20) and the washer (18).

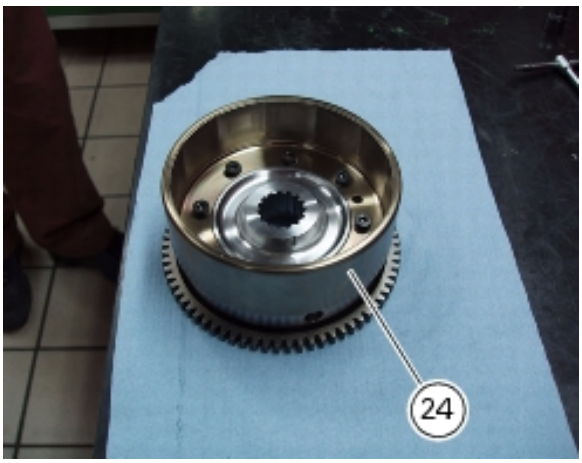
Important

Check the ring (19), the needle roller bearing (20) and the inner washer (18) for wear. Renew if worn.



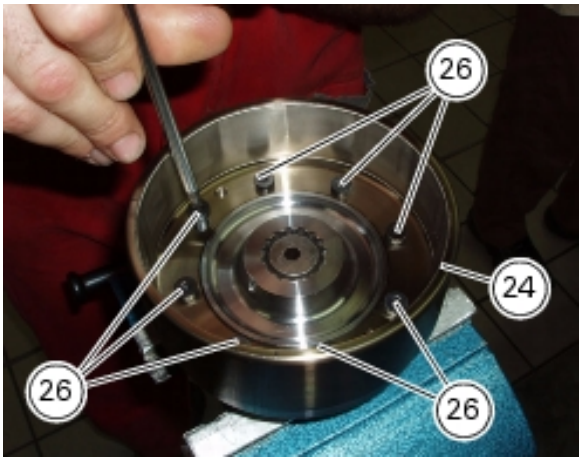
Overhaul of the flywheel/alternator assembly

Check that the inner part of alternator rotor (24) shows no signs of damage.
Check that the starter clutch is working properly and that the needle races do not show signs of wear or damage of any kind.
If there is any malfunction, remove the whole assembly.

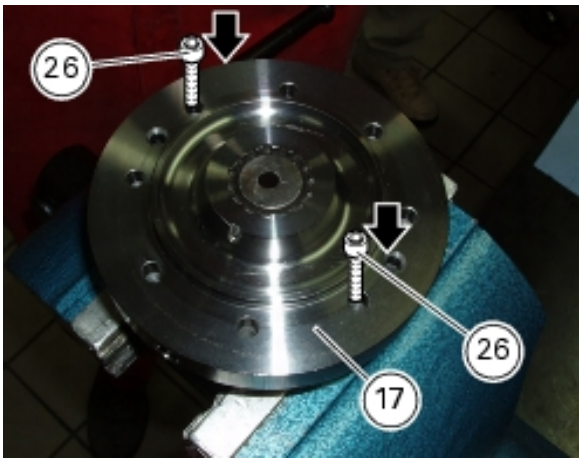


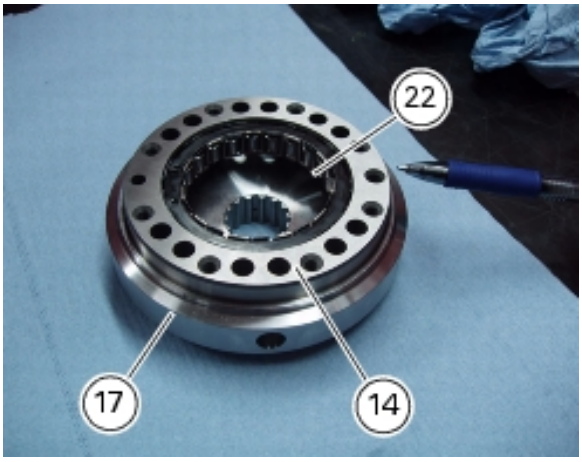
Disassembly of the flywheel/alternator

Undo the eight bolts (26) and remove the rotor (24) from the flywheel.



Insert two of the bolts (26) just removed from the flywheel rotor-side in their holes in order to remove the flange (14) and the starter clutch (22) from the flywheel (17).
The starter clutch is a slight interference fit on the flange. To remove it, use a suitable drift.



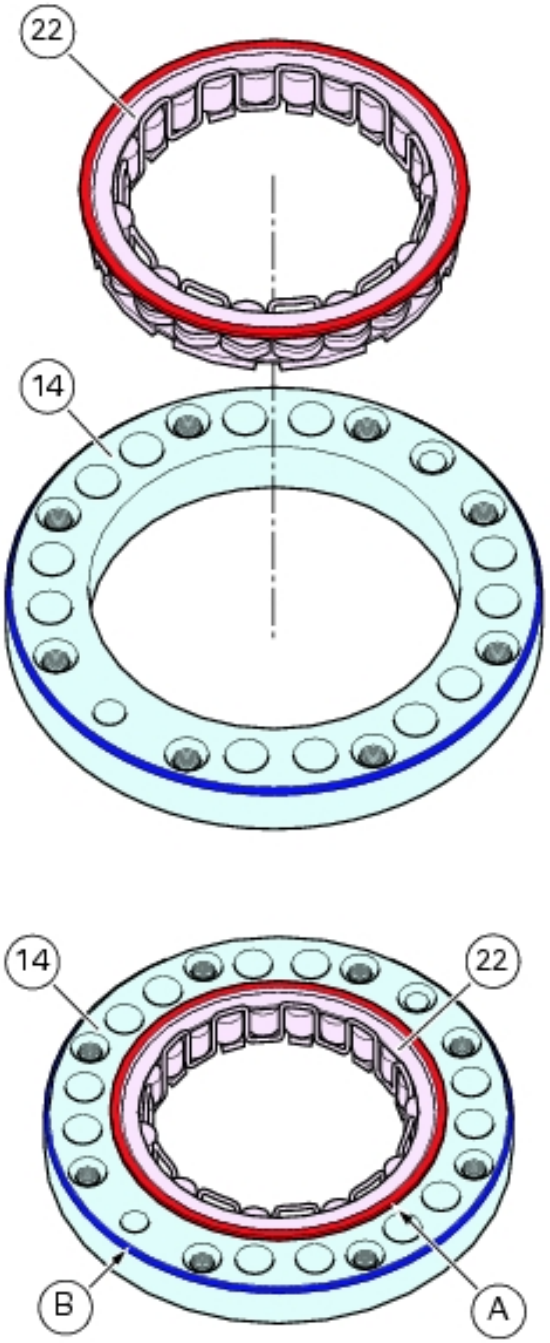


Reassembly of the flywheel-alternator assembly

Install the starter clutch (22) in the flange (14) to bring the edge (A) of the clutch up against the flange.

Important

Assemble the components (starter clutch and flange) so that the edge (A) of the starter clutch is positioned on side of the flange with the bevelled edge (B).

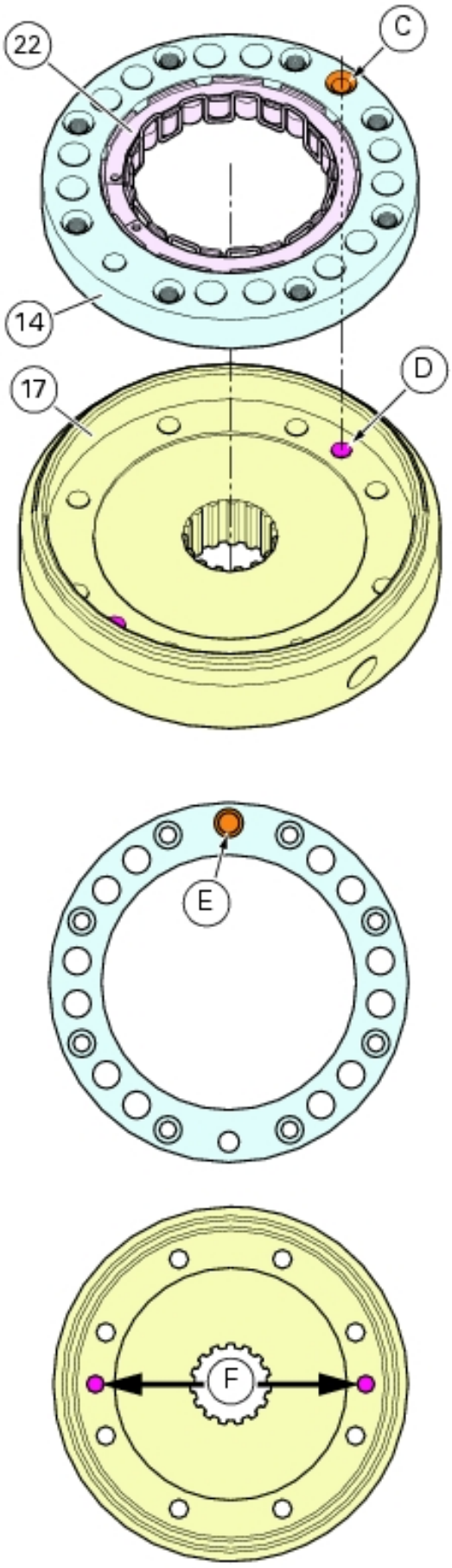


Seat the flange (14) with the starter clutch (22) in the flywheel (17), aligning the flange locating hole (C) with the flywheel locating hole (D).

Notes
The flange locating hole (C) is the hole with the countersunk lead-in (E).

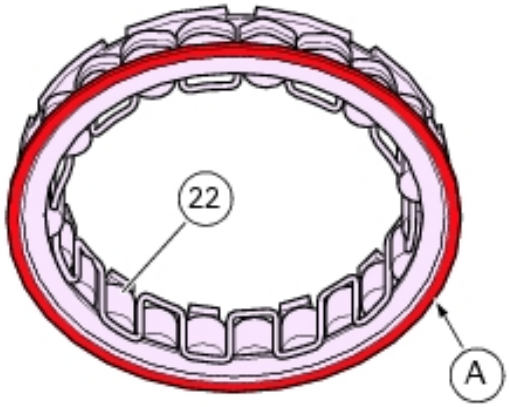
Notes
The locating hole (D) of the flywheel can be either one of the two holes (F).

Notes
Use suitable tools to align the locating holes.


22
C
14
17
D
E
F

Important

Assemble the components (flange and flywheel) so that edge (A) of the starter clutch (22) is enclosed between the flange and flywheel.



Install the rotor (24) on the flywheel (17), aligning one of the the flywheel locating holes (D) with the rotor locating hole (G).

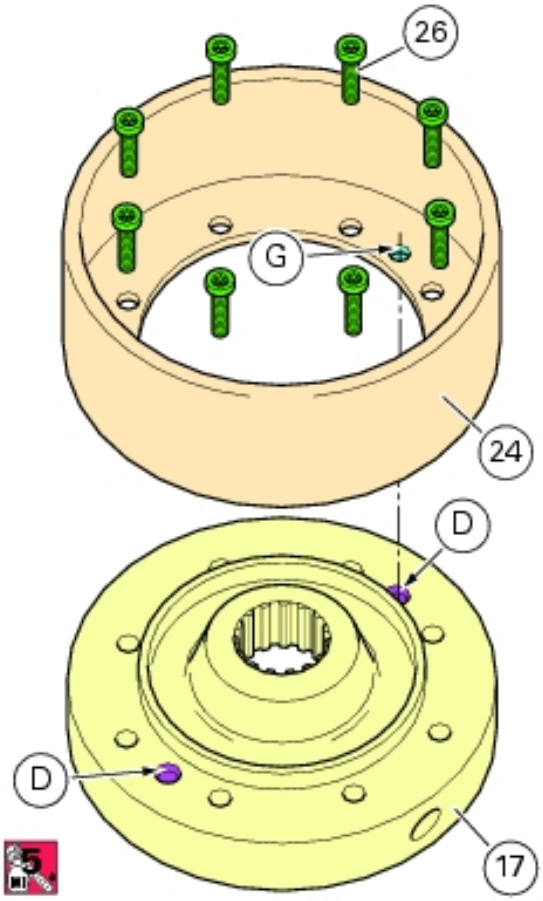
Notes

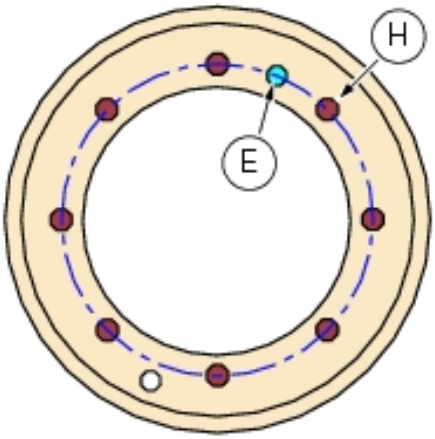
The rotor locating hole (G) is the hole positioned on the same diameter as the fixing holes (H).

Notes

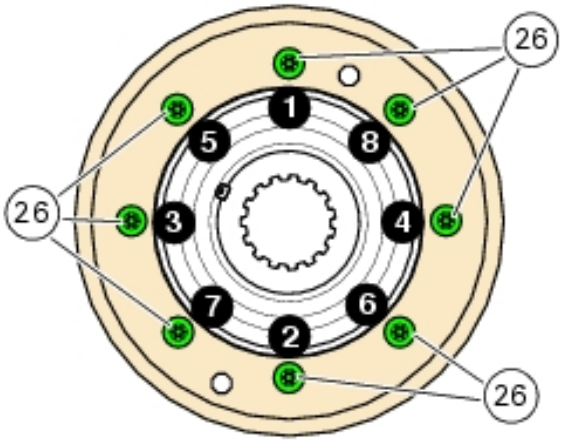
Use suitable tools to align the locating holes.

Apply threadlocker to the rotor/flywheel fixing bolts (26) and start them in their threads.





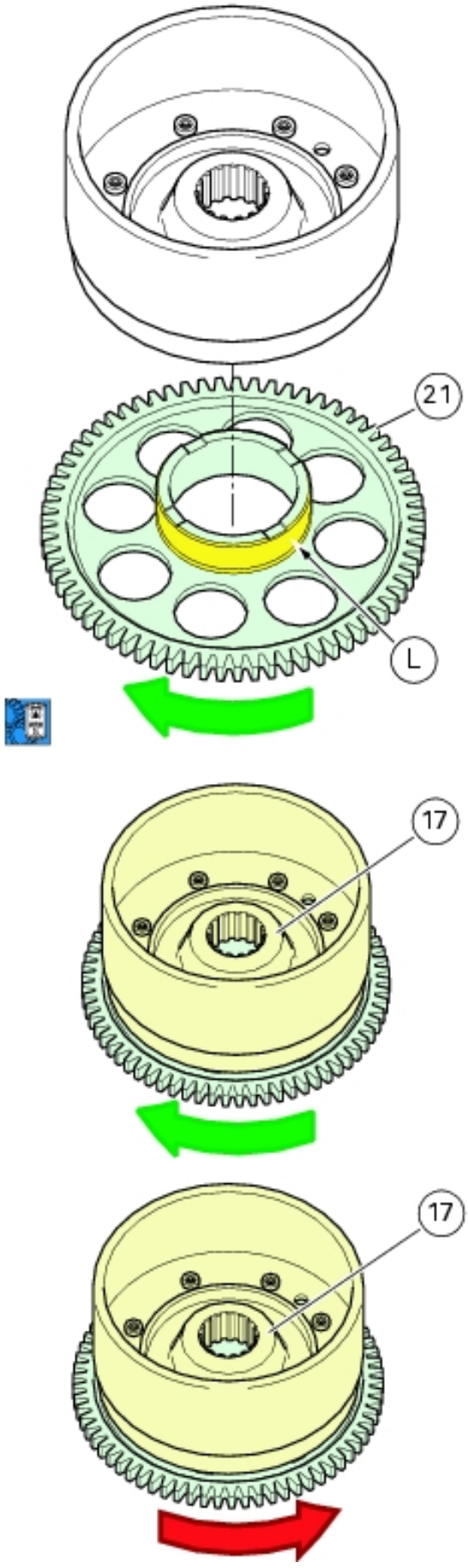
Tighten the bolts (26) to the specified torque (Sect. C 3, Engine torque settings), in the indicated sequence.



Lubricate the surface (L) of the driven gear (21) with engine oil.
Install the driven gear on the starter clutch, ensuring it is properly seated.

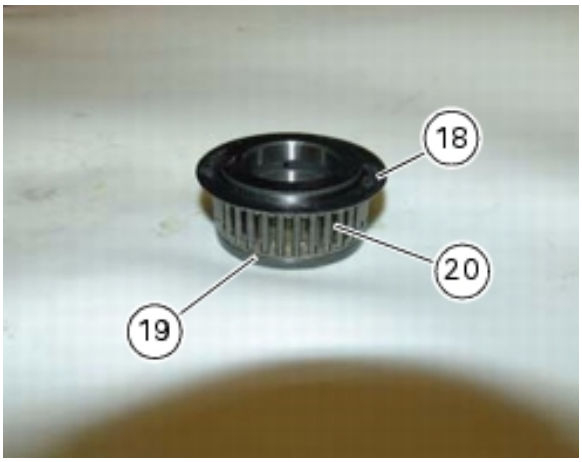
Notes
To facilitate installation, rotate the driven gear in the direction of the green arrow.

Hold the flywheel (17) with one hand and check that the driven gear can rotate freely in the direction of the green arrow but not in the direction of the red arrow.
If either of these two conditions is not met, this means that the starter clutch has not been installed correctly.

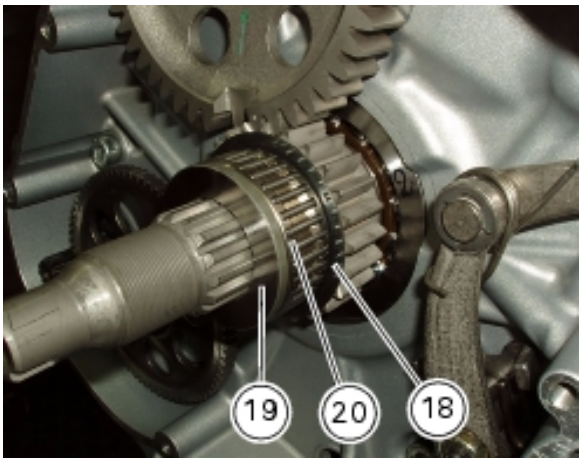


Refitting the flywheel/alternator assembly

Install the roller cage assembly (20) with the washer (18) and inner ring (19).



Install the roller cage assembly (20) with the washer (18) and inner ring (19).

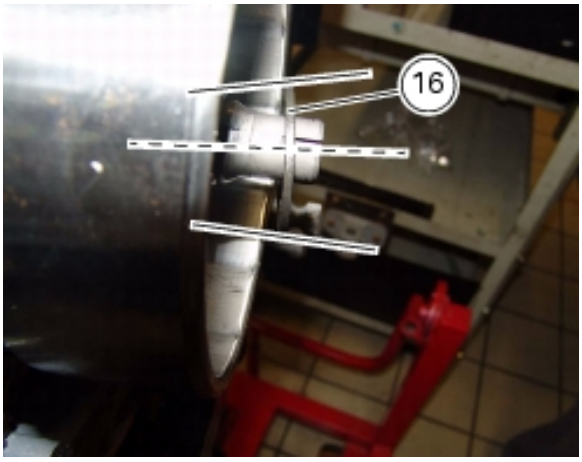


Install the flywheel assembly (23) with the gear (21), aligning the notches as shown in the photo.

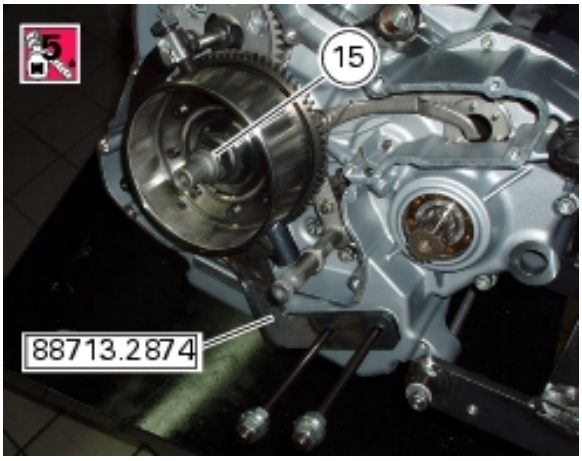
Fit the Belleville washer (16) on the end of the crankshaft.

Warning

The Belleville washer is tapered: position it as shown in the photo.

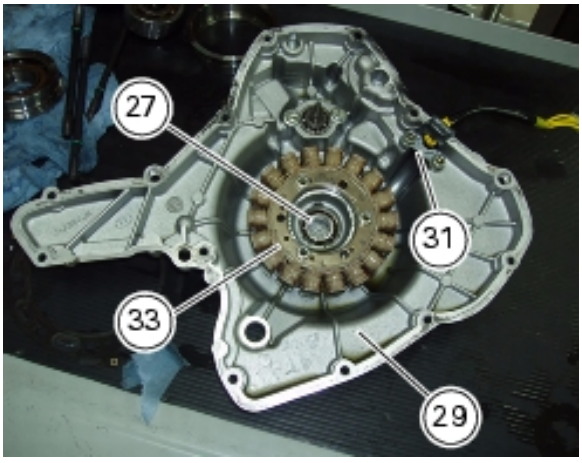


Apply the recommended threadlocker to the thread on the end of the crankshaft and the nut (15).
Start the nut (15) on the crankshaft.
Hold the flywheel with the service tool **88713.2874** to prevent rotation, and tighten the nut (15) to the specified torque (Sect. C 3, Engine torque settings).

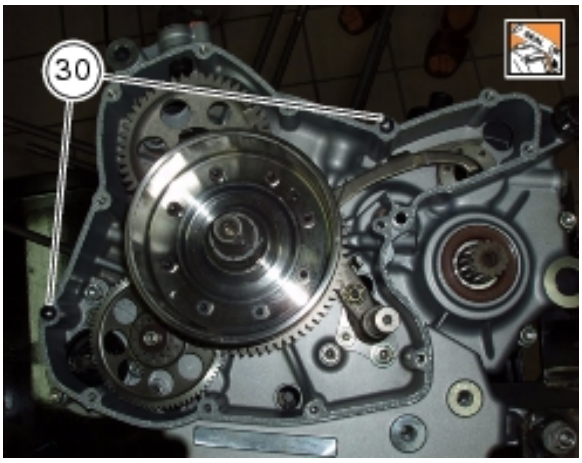


Refitting the alternator-side crankcase cover

Make sure that the following parts are installed in the alternator-side crankcase cover (29) before refitting it:
crankshaft end bearing (27) with its circlip;
the alternator stator (33) with the cable clamp (31).
Install the water pump (Sect. N 3.3, Refitting the water pump).



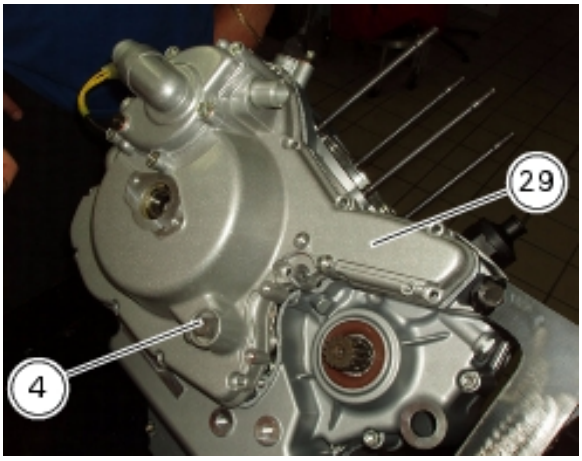
Remove any scale and grease from the mating surfaces of the left-hand crankcase half and the crankcase cover.
Fit the two locating bushes (30).
Spread a continuous uniform bead of DUCATI liquid gasket on the cover mating surface, ensuring continuity around the holes for the retaining bolts and bushes.



Grease the end of the crankshaft and the gearchange shaft to facilitate installation of the cover and to prevent the oil seal (4) from being damaged, if already installed in the cover.
While positioning the cover (29) on the crankcase, slightly turn the timing belt drive shaft pulleys to facilitate insertion of the pump control shaft.
Tap the cover at different positions with a rubber mallet to facilitate its location on the shafts and locating bushes.

Notes

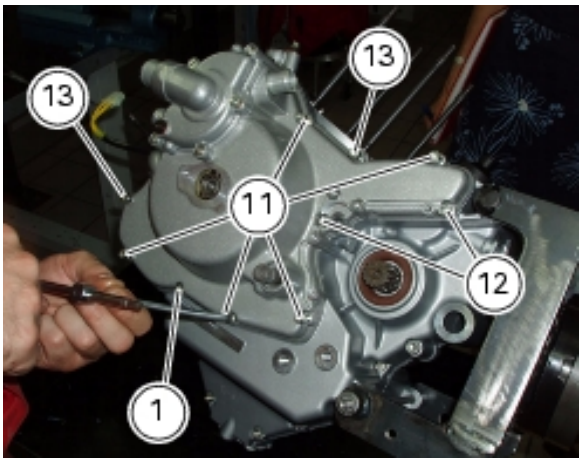
Should it be necessary to remove the cover again, fit the puller **88713.1749** to the threaded holes located in correspondence with the crankshaft.

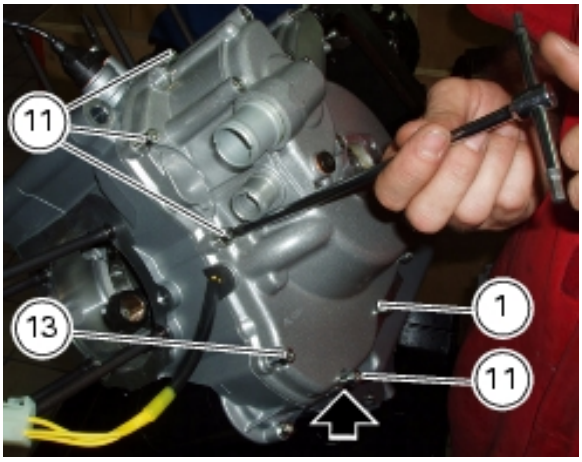


Insert the retaining bolts in their holes following the indications given in the table.

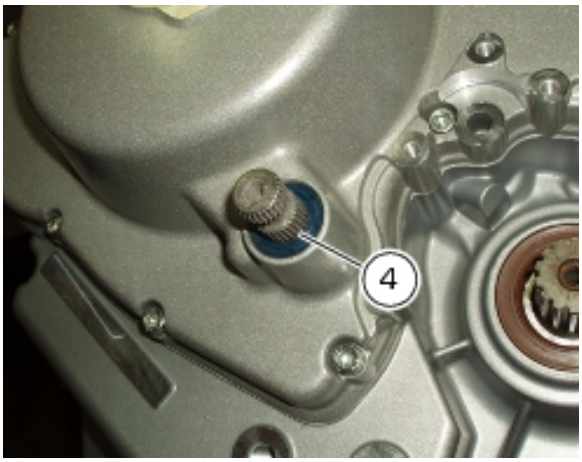
Ref.	Qty.	Description
11	8	M6x25 mm bolts
12	2	M6x20 mm bolts
13	2	M6x30 mm bolts
1	1	M6x25 mm drive-lock bolt

Under the bolt (11), located in correspondence with the starter motor, fit the washers (**10**) and hose/wiring clip (**9**).
Tighten the retaining bolts to the specified torque (Sect. C 3, Engine torque settings).

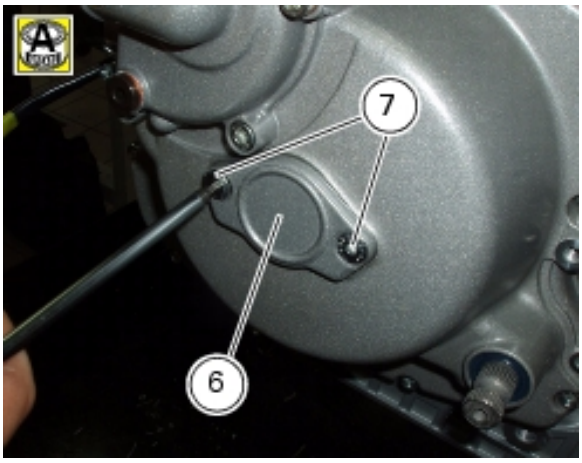




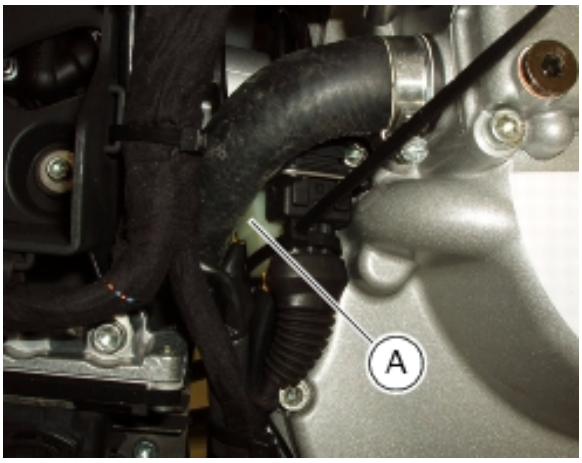
Moisten the oil seal (4) with alcohol and install it in the alternator-side crankcase cover, in correspondence with the gearchange shaft.



Make sure that the O-ring (**5**) is installed in the cover (6).
Apply threadlocker to the bolts (7).
Tighten the two retaining bolts (7) of the inspection cover (6) over the end of the crankshaft to the specified torque (Sect. C 3, Engine torque settings).

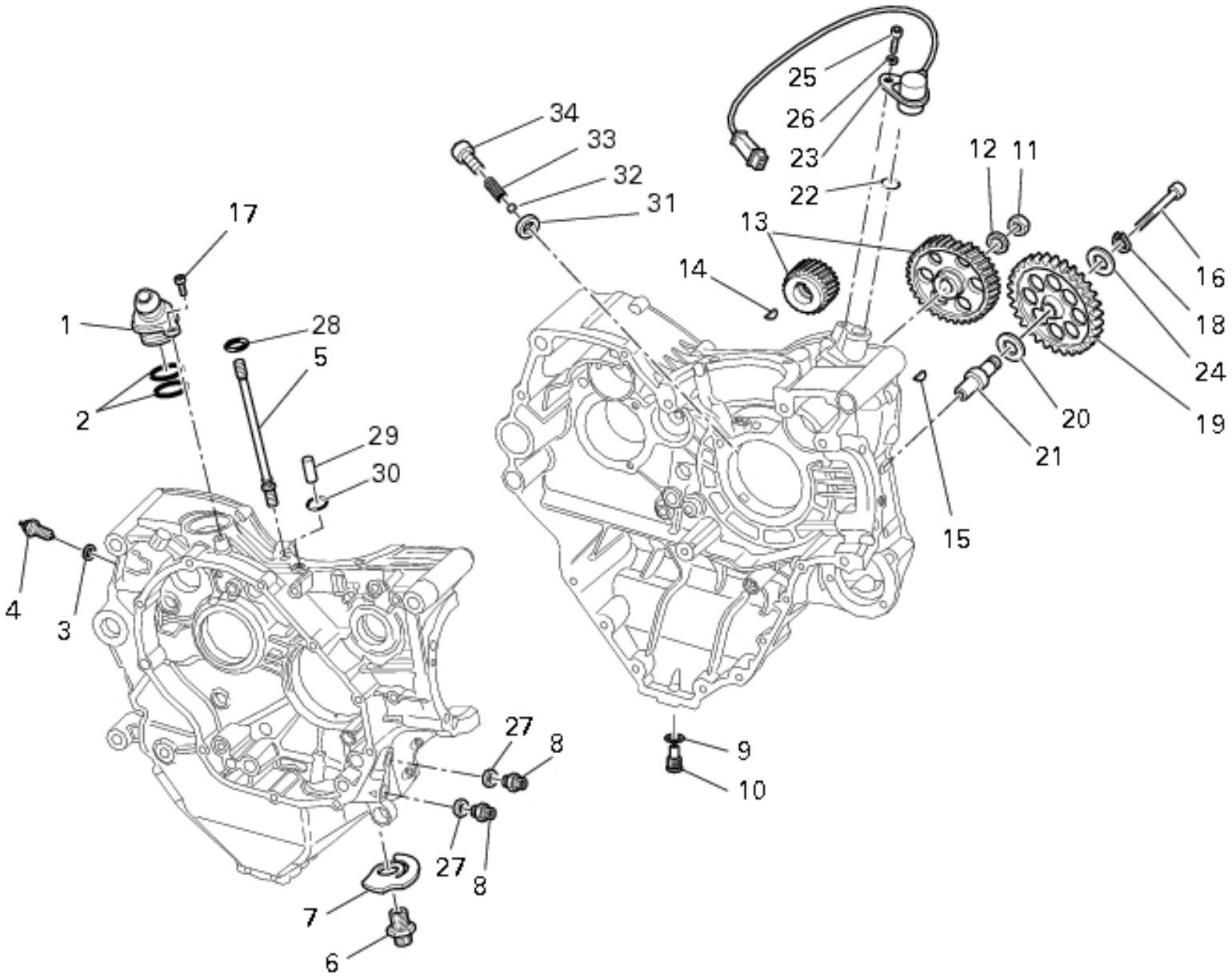


Reconnect the alternator wiring to the main wiring loom (A).



Operation	Section reference
Refit the water pump-radiator hose	N 3.3, Refitting the water pump
Refit the pump-cylinder hoses	N 5, Refitting the cylinder/piston assembly
Fit the clutch pushrod	F 2, Refitting the clutch slave cylinder
Refit the sprocket cover	G 8, Refitting the front sprocket
Top up the engine oil	D 4, Changing the engine oil and filter cartridge

9.1 - Crankcase assembly: external components



1 Oil breather valve
2 O-ring
3 Seal
4 Neutral switch
5 Cylinder barrel/head stud
6 Nipple
7 By-pass spring
8 Nipple
9 Aluminium gasket
10 Plug
11 Nut
12 Lock washer
13 Timing gear pair
14 Key
15 Key
16 Bolt
17 Bolt
18 Circlip
19 Starter idler gear

20 Washer
21 Gear shaft
22 O-ring
23 Engine sensor
24 Washer
25 Bolt
26 Washer
27 Aluminium gasket
28 O-ring
29 Drilled locating dowel
30 O-ring
31 Seal
32 Ball
33 Spring
34 Special bolt

Parts catalogue

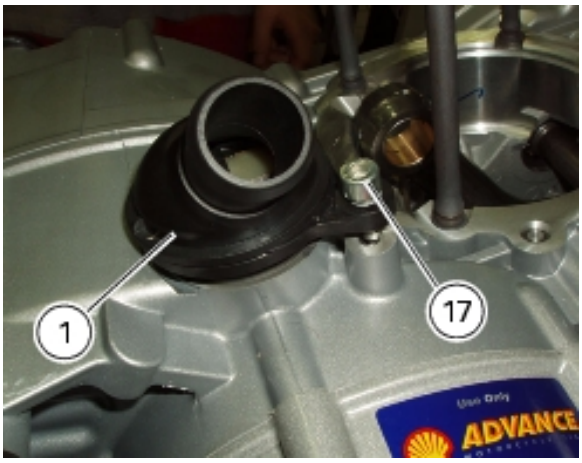
GEARCHANGE CONTROL
Timing system
Crankcase halves
Crankcase halves
Electric starting and ignition

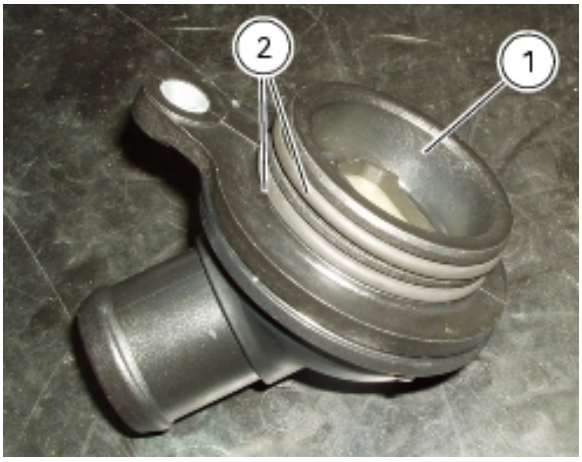
Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of external components

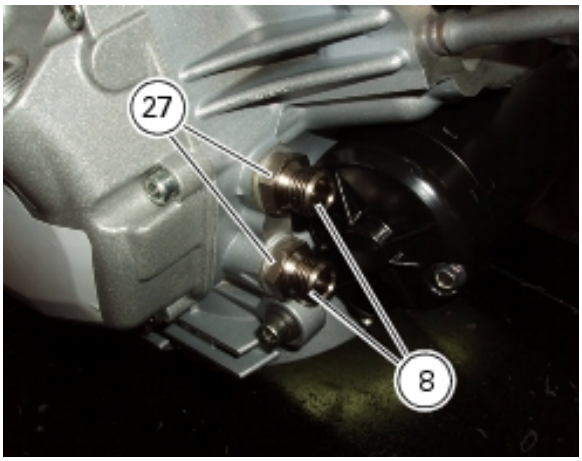
Operation	Section reference
Remove the engine from the frame	N 1, Removal of the engine
Drain off the engine oil and remove the the oil filter cartridge	D 4, Changing the engine oil and filter cartridge
Remove the cylinder head assemblies and the timing parts	N 4.2, Removal of the timing belt covers
Remove the cylinder barrel/piston assemblies	N 5, Removal of the cylinder/piston assembly

Unscrew the bolt (17) and remove the oil breather valve (1) with the O-rings (2). Check the condition of O-rings (2) and renew them if necessary.

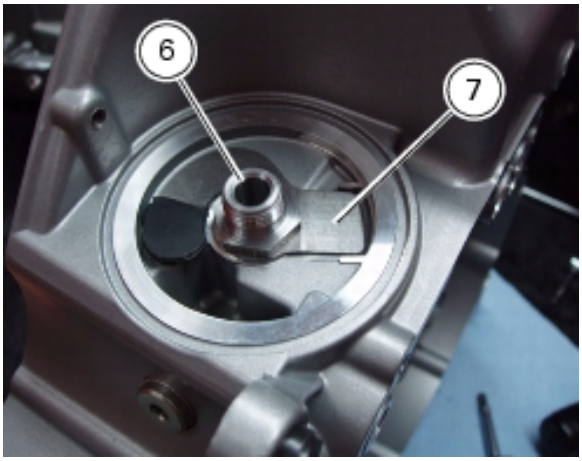




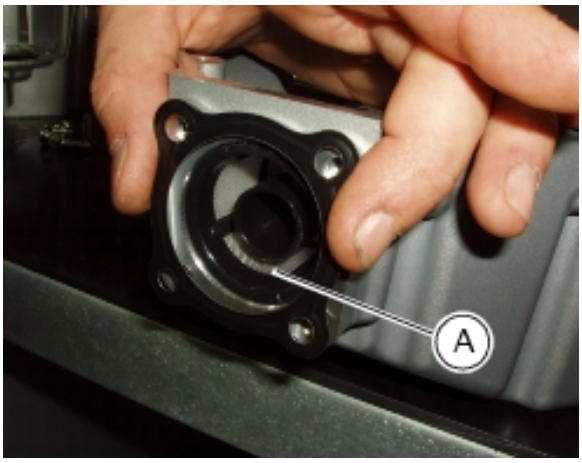
Unscrew and remove the oil inlet and outlet nipples (8) from the clutch-side crankcase half and recover the seals (27).



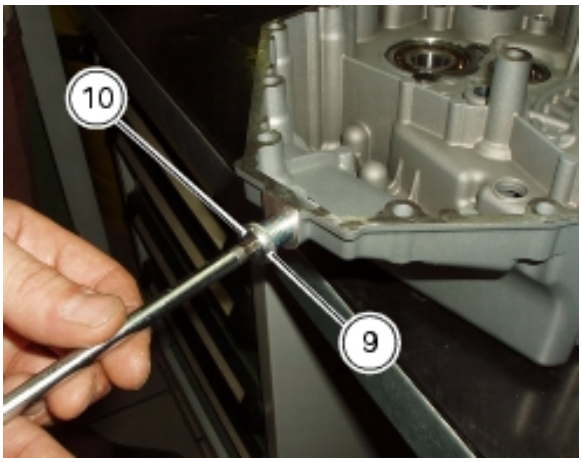
Unscrew and remove the oil filter support nipple (6) and remove also by-pass spring (7).



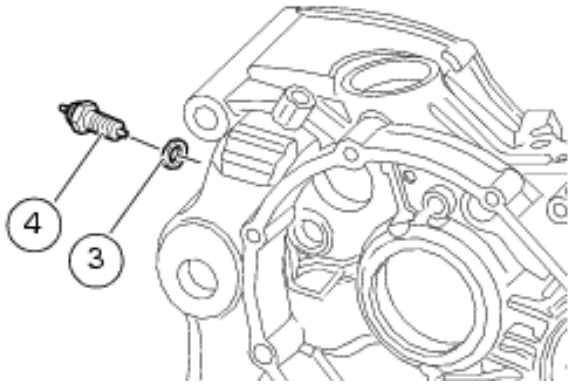
Remove the gauze filter (A) with its seal from the alternator-side crankcase half (Sect. D 4, Changing the engine oil and filter cartridge).



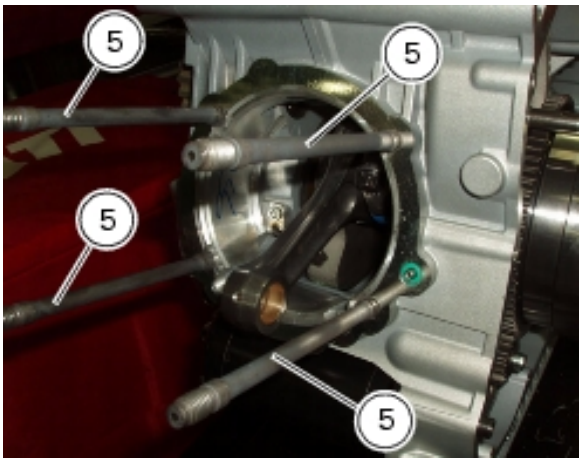
Remove the drain plug (10) with its seal (9).

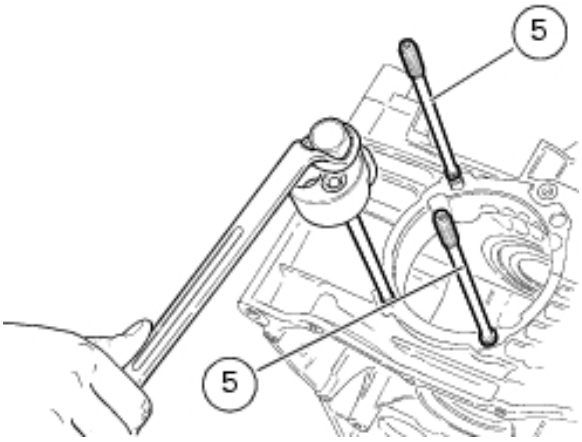


Remove the neutral switch (4) with seal (3).

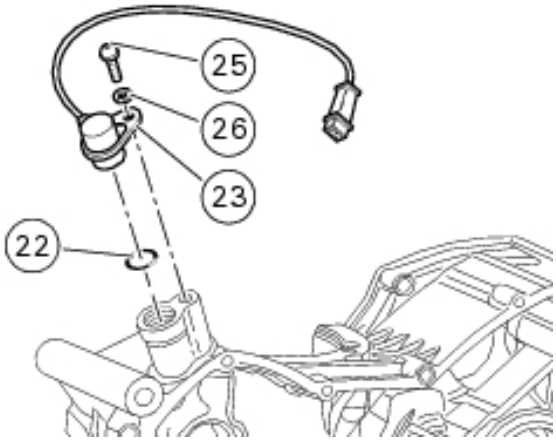


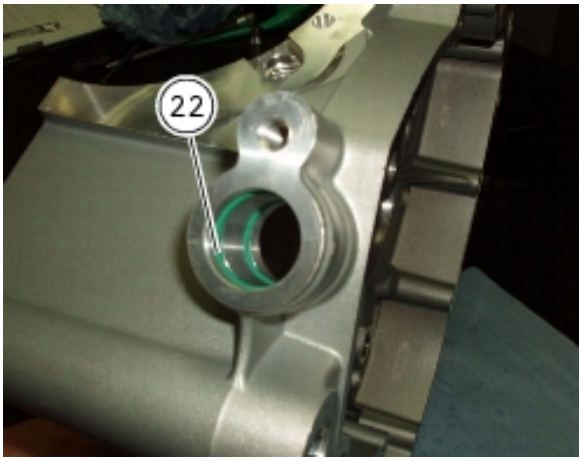
Remove the cylinder head studs (5) with the aid of the appropriate tool.





To remove the engine sensor (23), unscrew the bolt (25) and recover the shim (24) and the washer (26). Check the condition of O-ring (22) and renew it if necessary.



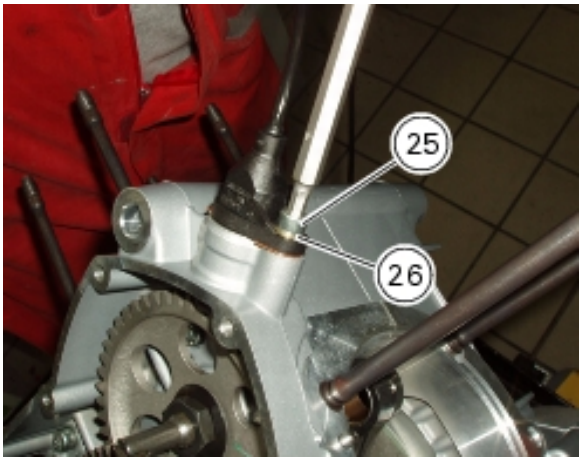


Refitting the external components

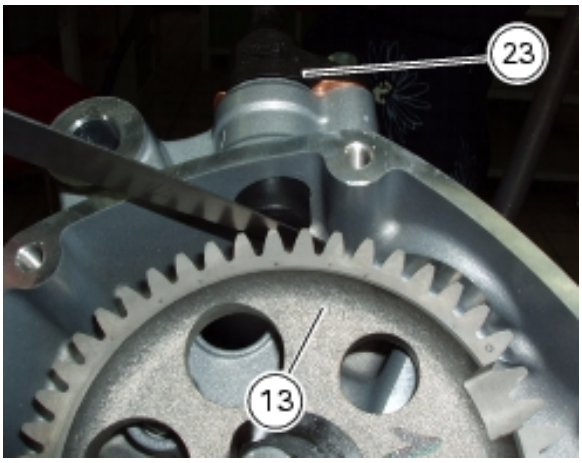
Grease the engine sensor (23) in the part indicated.

Fit the engine sensor (23) in its seat in the crankcase.

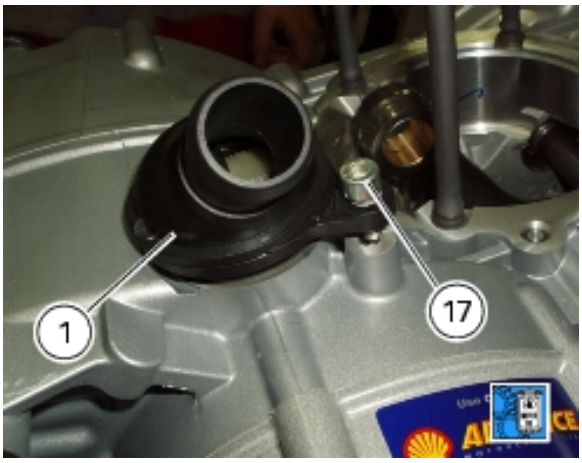
Insert the bolt (25) with the washer (26) and tighten to the specified torque (Sect. C 3, Engine torque settings).



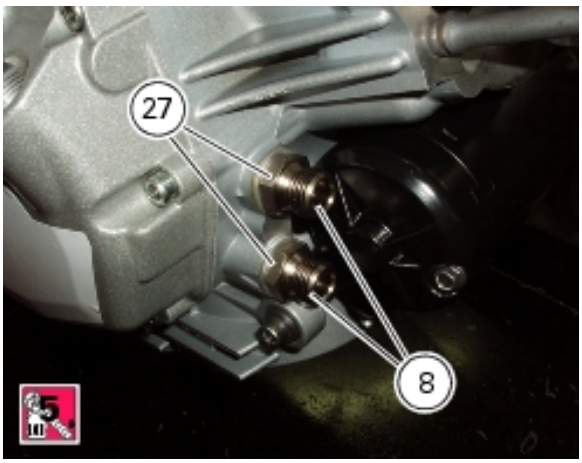
Use a feeler gauge to check the clearance between the engine sensor (23) and the timing gear (13). The value must be between **0.6** and **0.8** mm.



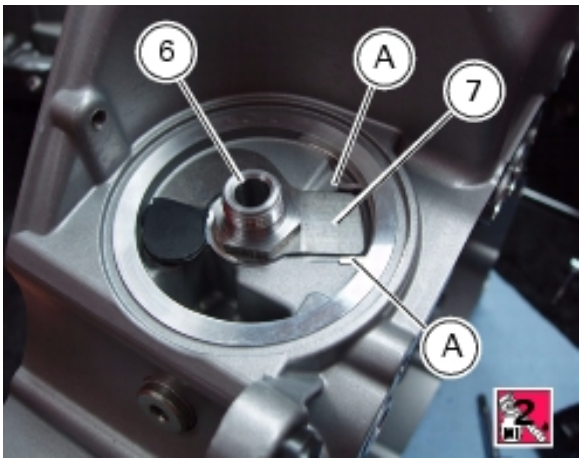
Install the oil vapour breather valve (1) in the crankcase along with O-rings (**2**), previously lubricated.
Tighten the bolt (17) to the specified torque (Sect. C 3, Engine torque settings).



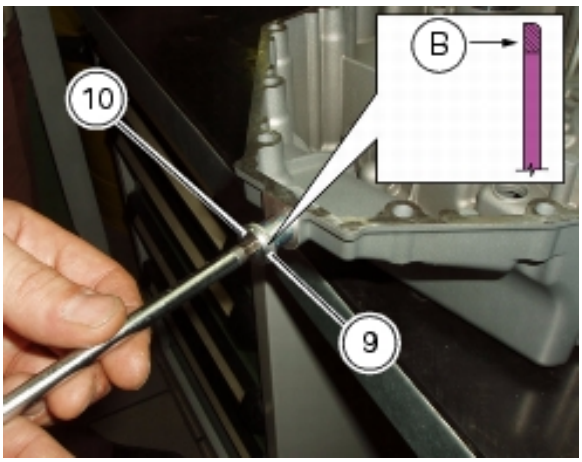
Tighten the two oil hose connection nipples (8) with the seals (27) to the specified torque (Sect. C 3, Engine torque settings).



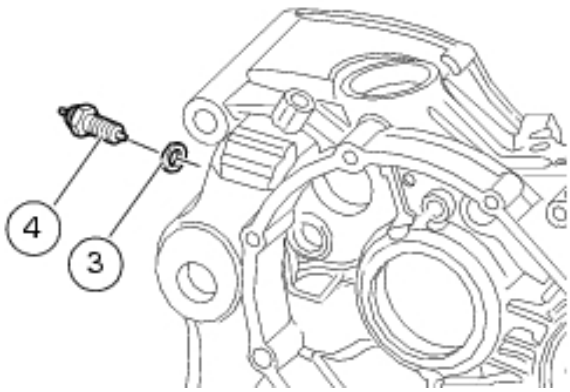
Position the by-pass spring (7) on the nipple (6) and apply the recommended threadlocker to the end of the nipple to be screwed in.
Screw oil filter cartridge fitting (6) fully into the crankcase, positioning the spring in the seat between the two notches (A).
Tighten the fitting to the specified torque (Sect. C 3, Engine torque settings).



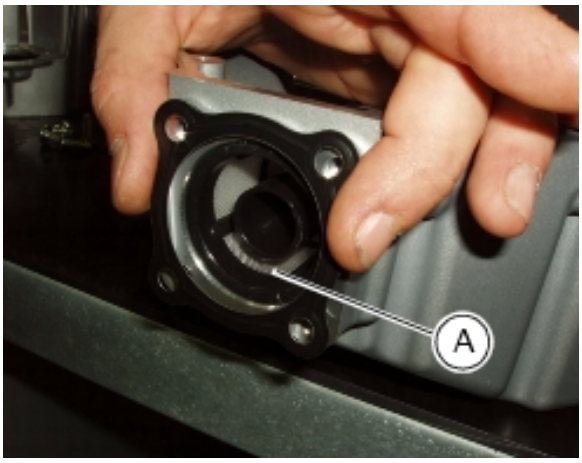
Fit the seal (9) on the oil drain plug (10). Position the seal that the side with the square edge (B) is facing the chain side crankcase half.
Clean the threasds of the plug; apply THREE BOND TB1215 to the threads.
Tighten drain plug (10) and seal (9) to the specified torque (Sect. C 3, Engine torque settings) applying the specified threadlocker.



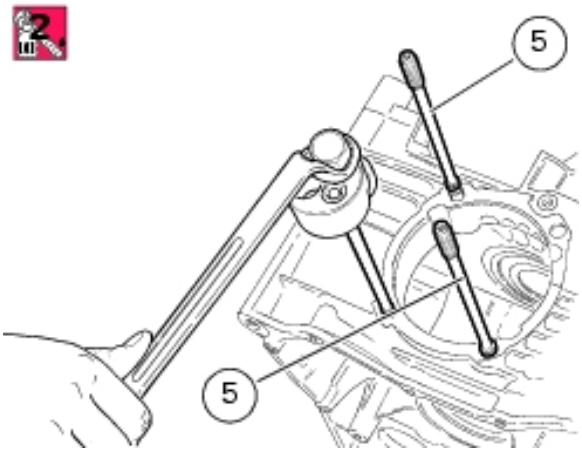
Refit the neutral switch (4) with its seal (3).



Refit the gauze filter (A) as described in Sect. D 4, Changing the engine oil and filter cartridge.



Check the condition of O-rings (**28**) on the studs (5) and renew them if necessary.
Now fit the studs (5) in the crankcase halves, applying threadlocker and tightening to the specified torque value (Sect. C 3, Engine torque settings). Use the appropriate commercial tool for this operation.

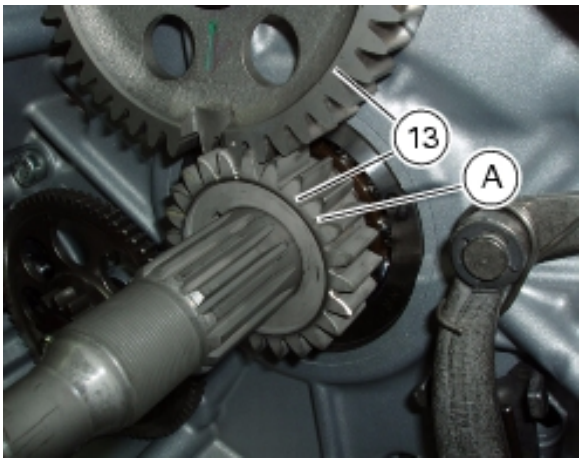


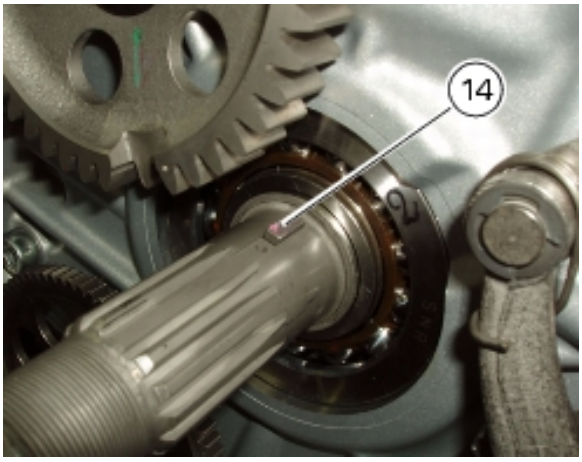
Operation	Section reference
Refit the cylinder barrel/piston assemblies	N 5, Refitting the cylinder/piston assembly
Refit the cylinder head assemblies and the timing parts	N 4.2, Refitting the timing belt driveshaft pulley
Refit the oil filter cartridge and replenish the engine oil	D 4, Changing the engine oil and filter cartridge
Refit the engine to the frame	N 1, Refitting the engine

Removal of the timing gears

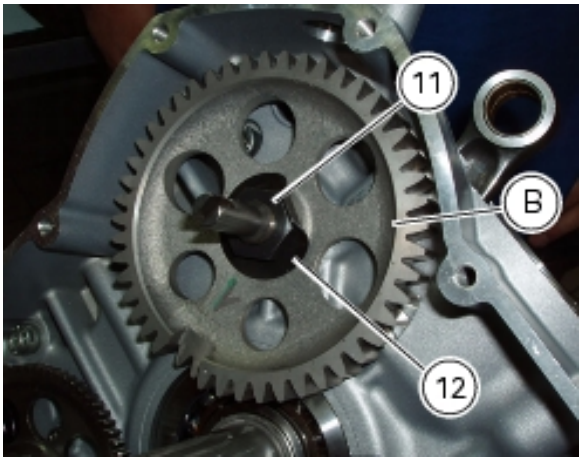
Operation	Section reference
Remove the alternator-side crankcase cover and the alternator assembly	N 8, Removal of the alternator-side crankcase cover

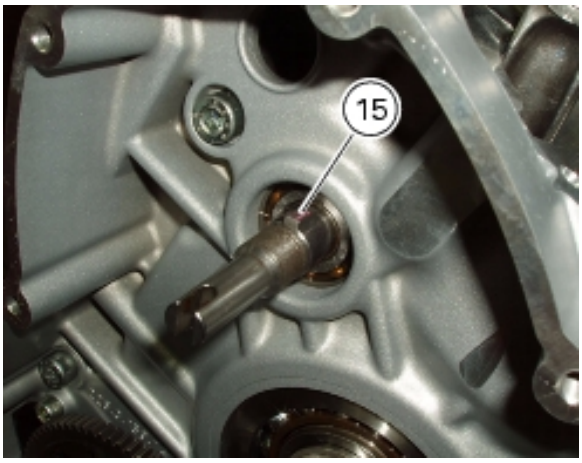
Slide out driving gear (A) of timing gear pair (13) and remove the Woodruff key (14).





Relieve the staking on the lock washer (12) of the nut (11).
Restrain the driven timing gear by inserting a pin in one of the holes, and unscrew the nut (11).
Remove the nut (11), washer (12), driven timing gear (B) and Woodruff key (15) from the timing belt driveshaft shaft.





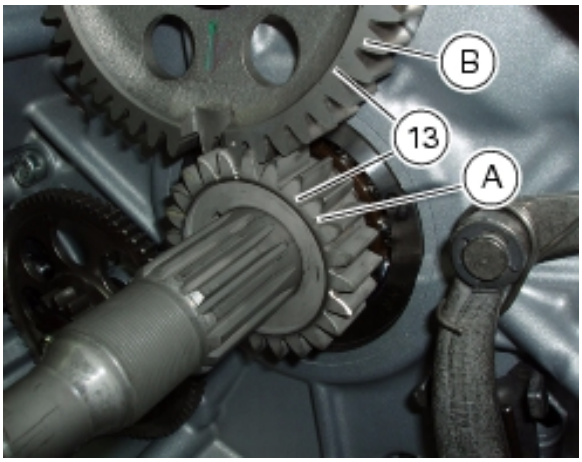
Refitting the timing gears

Before refitting, check the wear on the timing gear pair (13) and renew if necessary.

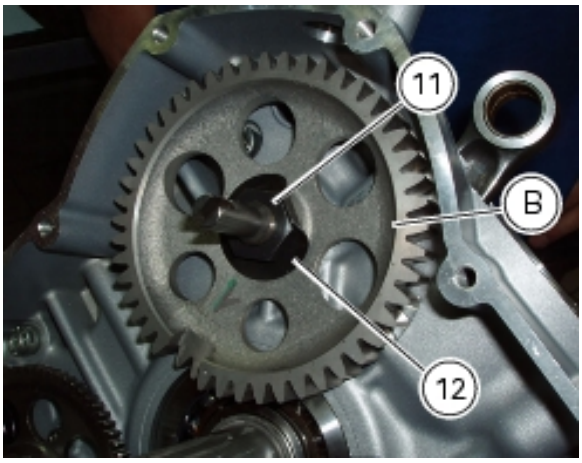
Important
The timing gears (13) must always be renewed as a pair.

Refitting is the reverse of removal.

Warning
When installing the driven gear (B), align the timing mark with that on the driving gear (A).



Important
On completion of the refitting operations, check that tab washer (12) is staked against nut (11) in such a way as to prevent the nut from working loose.

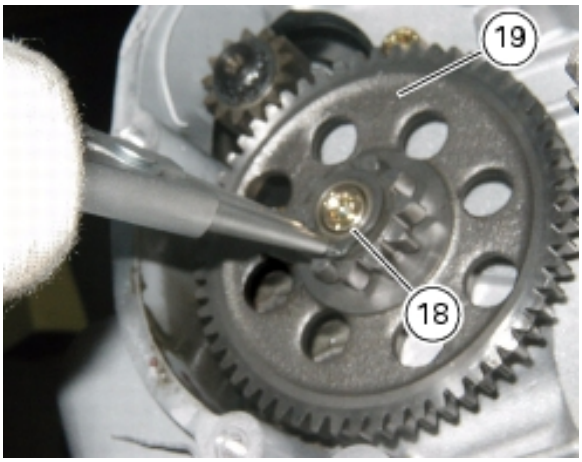


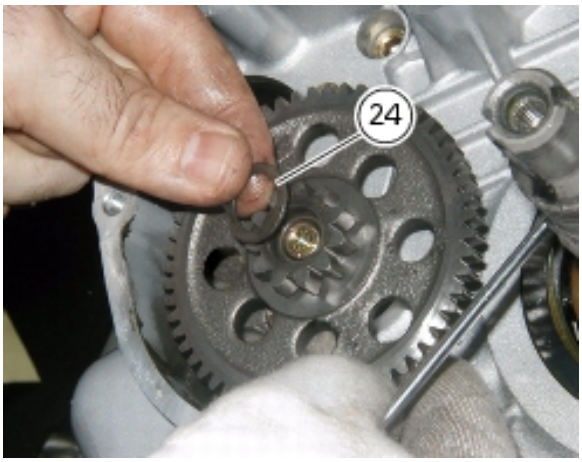
Operation	Section reference
Refit the alternator-side crankcase cover and alternator assembly	N 8, Refitting the flywheel/alternator assembly

Removal of the starter motor idler gear

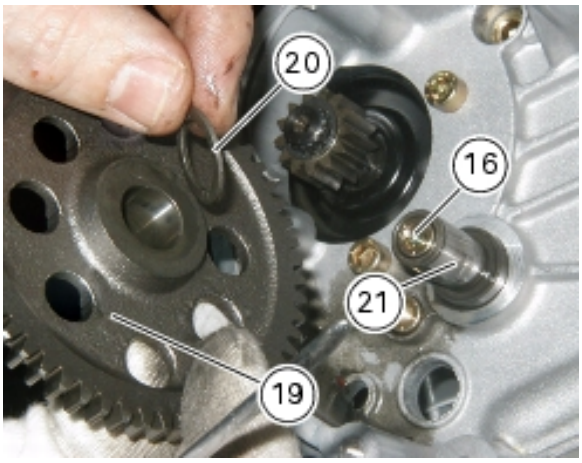
Operation	Section reference
Remove the flywheel/alternator assembly	N 8, Flywheel-alternator

Remove the circlip (18) and the washer (24).
Remove the starter motor idler gear (19) and shim (20).





Undo the bolt (16) securing the idler gear shaft (21) and remove the shaft.



Refitting the starter motor idler gear

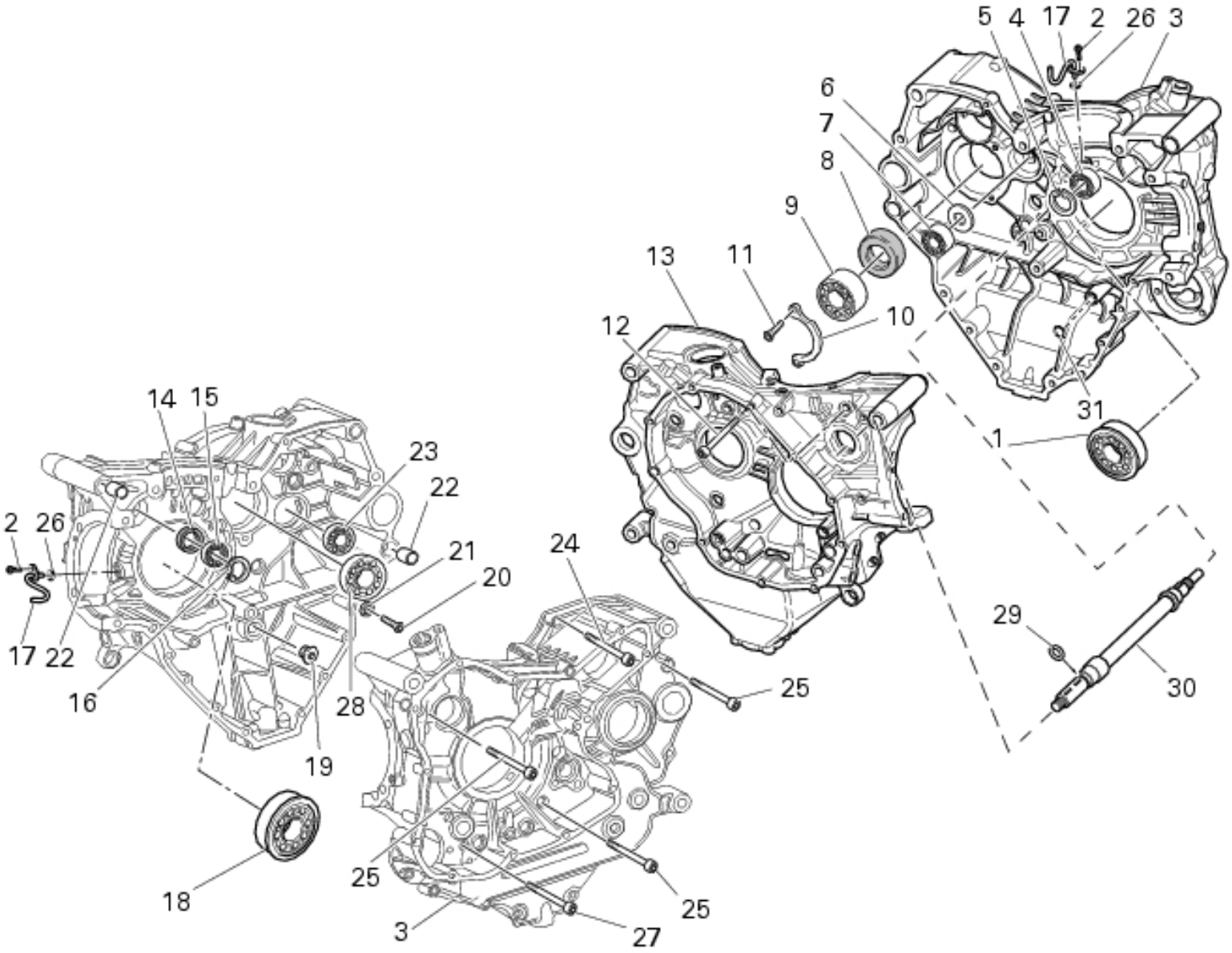
Refitting is the reverse of removal.

Notes

Apply the prescribed threadlocker to the bolt (16) and tighten to the prescribed torque (Sect. C 3, Engine torque settings).

Operation	Section reference
Refit the flywheel/alternator assembly	N 8, Flywheel-alternator

9.2 - Crankcase assembly: crankcase halves



1 Bearing
2 Bolt
3 Alternator-side crankcase half
4 Bearing
5 Circlip
6 Washer
7 Bearing
8 Oil seal
9 Bearing
10 Retaining plate
11 Bolt
12 Bolt (M8x90)
13 Clutch-side crankcase half
14 Oil seal
15 Bearing
16 Circlip
17 Hose
18 Bearing

19 Plug
20 Bolt
21 Spacer
22 Bush
23 Bearing
24 Bolt (M6x35)
25 Bolt (M8x75)
26 O-ring
27 Bolt (M6x75)
28 Bearing
29 Circlip
30 Timing belt driveshaft
31 O-ring

Parts catalogue

Timing system
Crankcase halves
Crankcase halves

Important
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

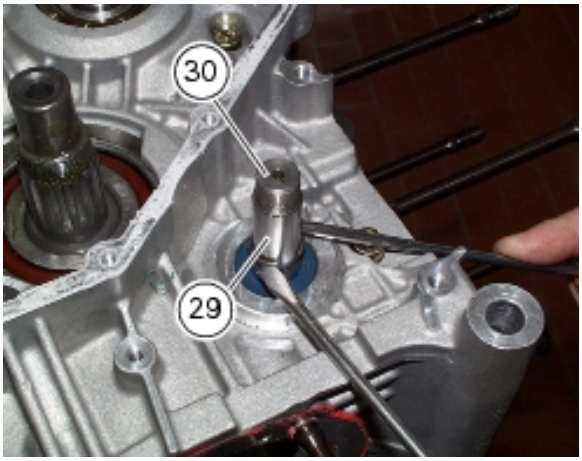
Separation of the crankcase halves

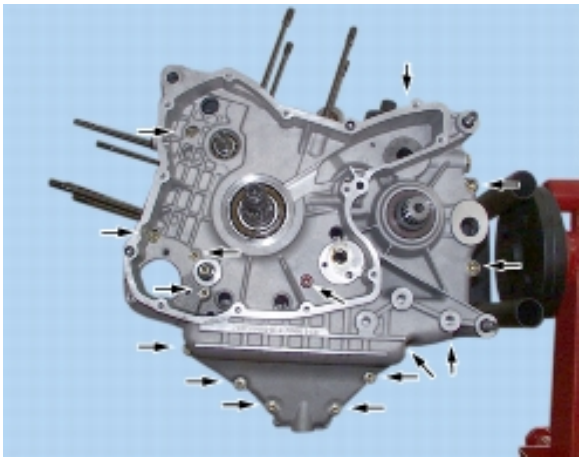
Operation	Section reference
Remove the engine from the frame	N 1, Removal of the engine
Remove the cooling system	N 3.2, Removal of the radiator
Remove the cylinder head assemblies and the timing parts	N 4.2, Removal of the timing belt covers
Remove the cylinder barrel/piston assemblies	N 5, Removal of the cylinder/piston assembly
Remove the alternator-side crankcase cover and the alternator assembly	N 8, Removal of the alternator-side crankcase cover
Remove the lubrication system	N 2.1, Removal of the oil pump
Remove the engine starting system	P 3, Starter motor
Remove the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
Remove the clutch assembly	N 6.1, Removal of the clutch
Remove the gauze pickup filter	D 4, Changing the engine oil and filter cartridge

Use two screwdrivers to remove the circlip (29) from the timing belt driveshaft shaft (30) on the clutch-side crankcase half.

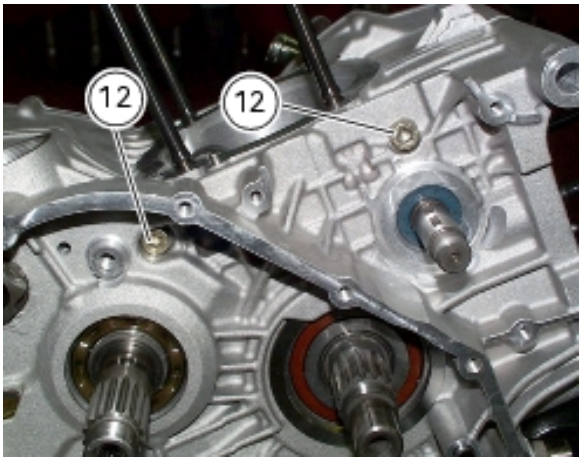
Notes
Take care to avoid scoring the surface of the shaft while removing the circlip.

Unscrew the crankcase bolts on the chain side.





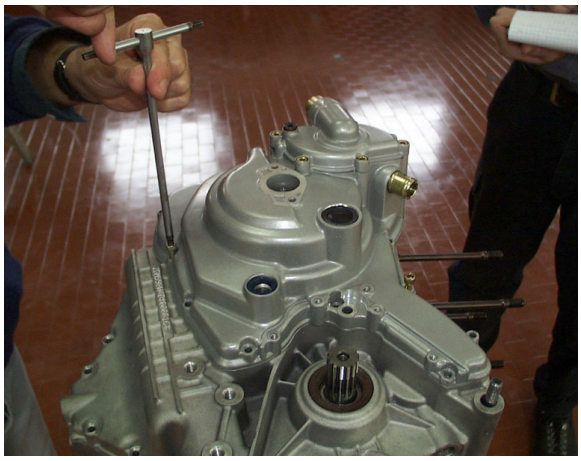
Unscrew the two bolts (12) on the clutch side near the vertical cylinder.



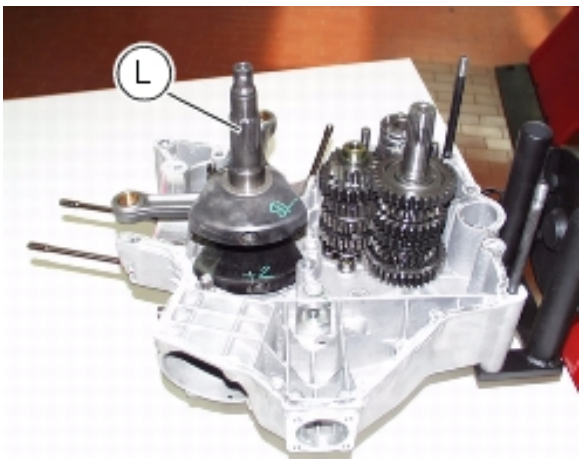
Re-use the alternator-side crankcase cover or a service cover with puller **88713.1749**. Secure it to the crankcase half using some of the original bolts and begin separating the crankcase halves by turning the central pin of the tool. Tap the end of the gearbox output shaft with a plastic mallet to separate the crankcase halves.

Notes

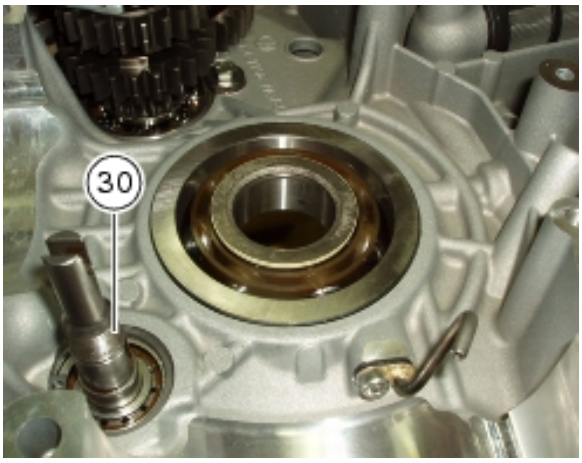
Take care not to lose the shims on the shafts and on the selector drum.



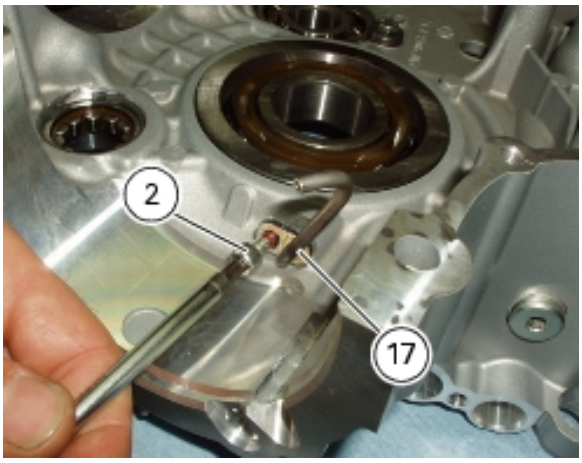
Remove the gearbox shafts and gear selector drum from the crankcase halves as described in Sect. N 7.2, Removal of the gearbox assembly.
Drive out the crankshaft (L) using a plastic mallet, taking care not to lose the shims.



Remove the timing belt driveshaft (30).

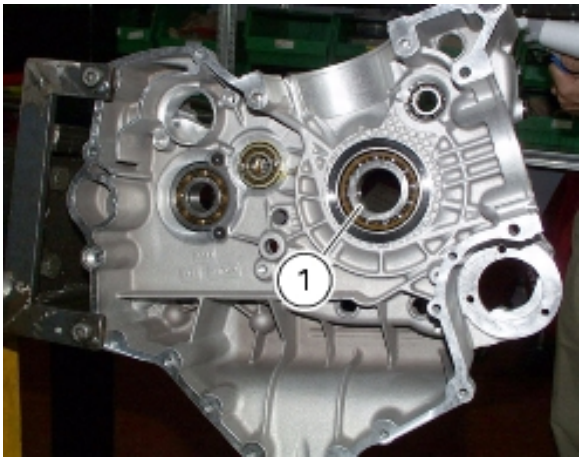


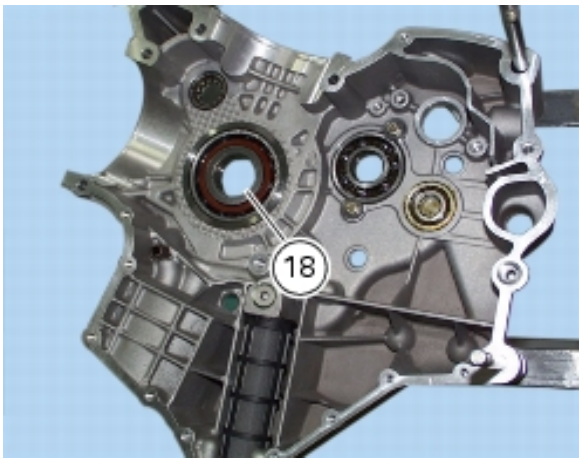
Remove the bolts (2), remove the hoses (17) and recover the O-rings (**26**).



Overhaul of the crankcase halves

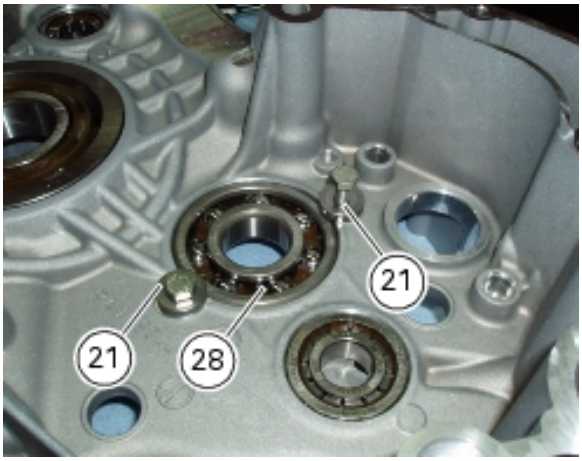
Carefully examine the engine crankcase halves.
Check that the surfaces of the crankcases are perfectly flat using a reference surface.
Check that the bearings (1) and (18) are in good condition. Note that the main bearings must always be changed in pairs (refer to the procedure below in "Main bearings").

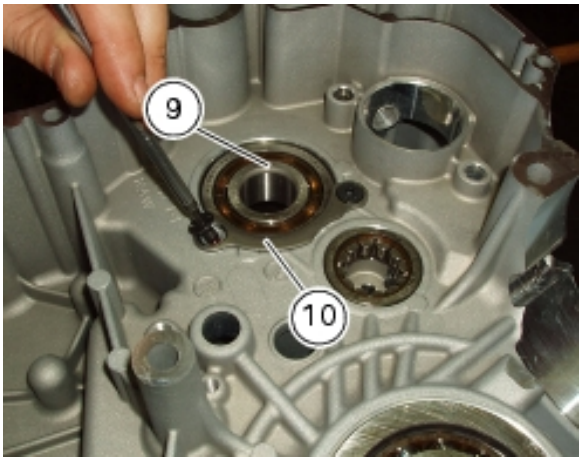




Notes

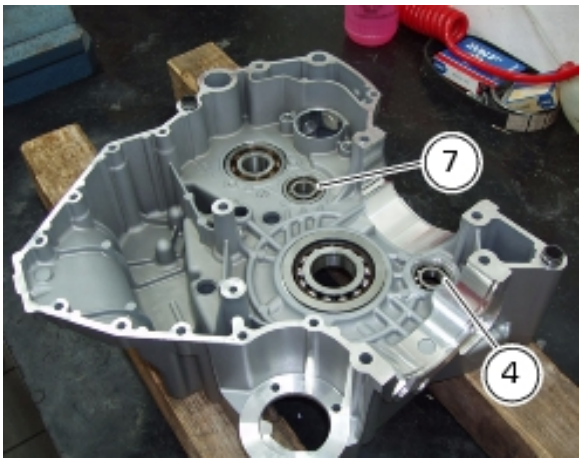
When overhauling an engine it is good practice to renew all the crankcase bearings.
After having renewed the gearbox shaft bearings (28) and (9), secure them in the crankcase with the spacers (21) and the retaining plate (10).

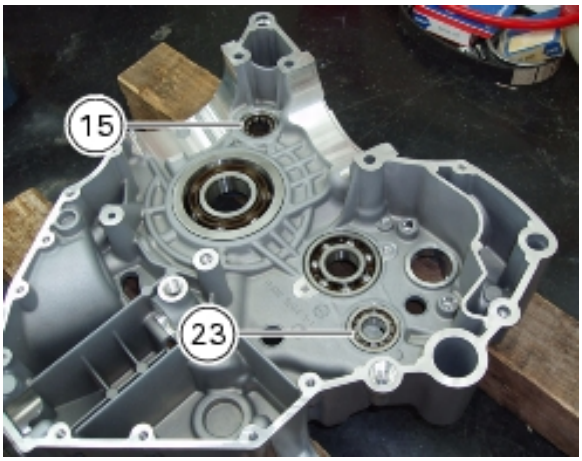




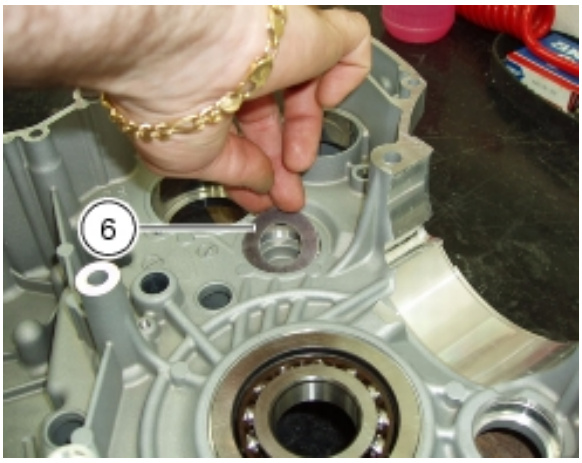
At each overhaul it is recommended to renew also the oil seal (8) on the outside of bearing (9).

Renew the bearings (7) and (23) on the ends of the gearbox shafts and timing belt driveshaft bearings (4) and (15).

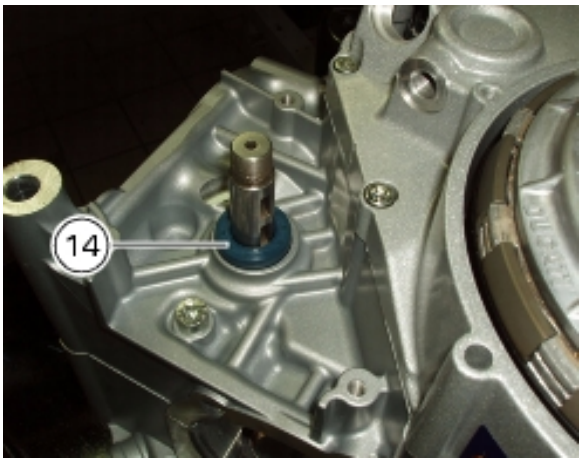




Take care not to lose the shim (6) interposed between the bearing (7) on the end of the gearbox input shaft and the chain side crankcase half.

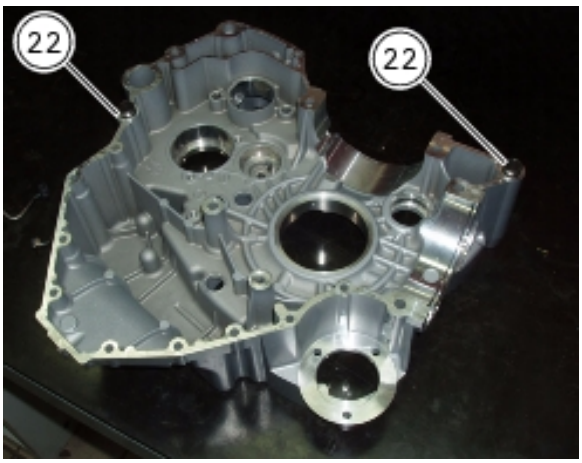


The oil seal (14) on the external side of the roller bearing (15) must be renewed at each engine overhaul.

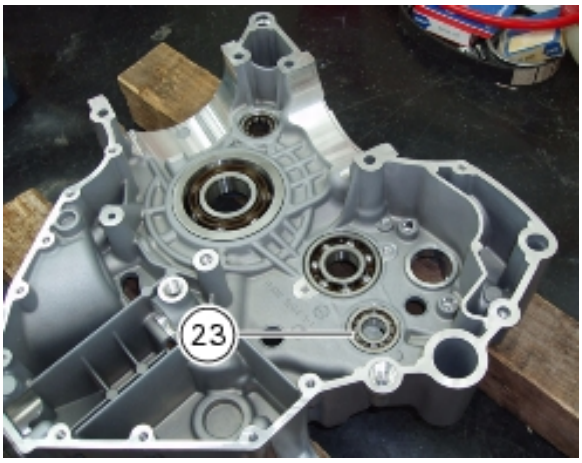


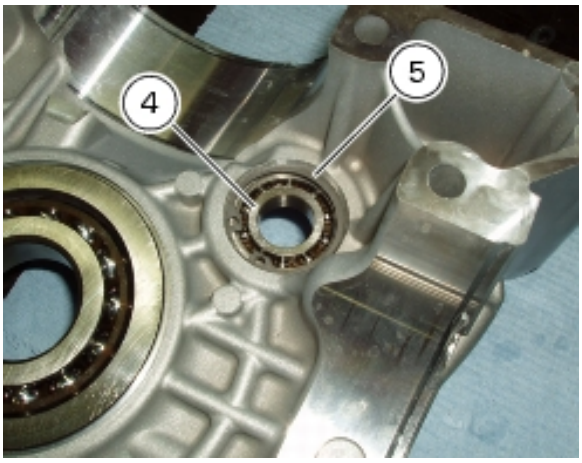
Check that the oilways are free of restrictions or clogging.
Check the condition of locating bushes (22). In the event of signs of distortion or excessive assembly clearance with the corresponding seats, remove the locating bushes using appropriate tools.
If it proves difficult to remove the bushes (22) from the crankcase, use a tap with a left-hand thread to force them out.

Important
The bushes (22) must always be renewed when they have been removed using the above procedure.



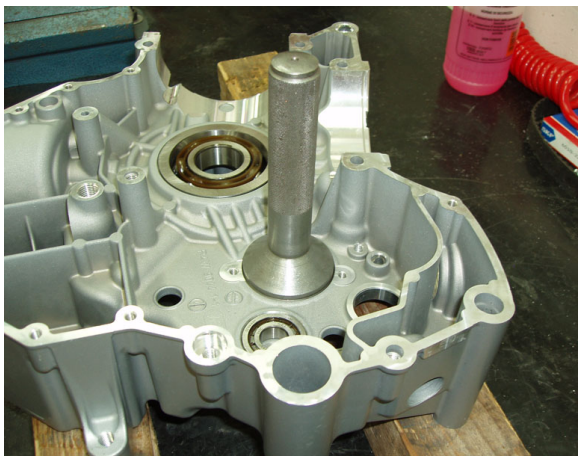
Remove the bearing (23), the circlip (5) and the roller bearing (4).





Main bearings

The main bearings have are of the angular contact type with offset inner races so that the balls transmit loads from one groove to the other along straight lines at an angle to the axis of the bearing. Angular contact thrust bearings are designed to withstand combined loads (radial and axial loads).
Bearings of this type can bear thrust loads in one direction only. In fact, under the action of a radial load inside the bearing, an axial force is created that must be counterbalanced by an axial force acting in the opposite direction; that is why these bearings are generally fitted back to back in pairs.
To renew the bearings proceed as follows:
- heat the crankcase half in an oven to **100** °C;
- remove the bearing using a drift and hammer;
- install the new bearing (while the crankcase is still hot) keeping it perfectly square in its seat using a tubular drift that only bears on the outer ring of the bearing;
- allow the parts to cool and check that the bearing is securely seated in the crankcase.



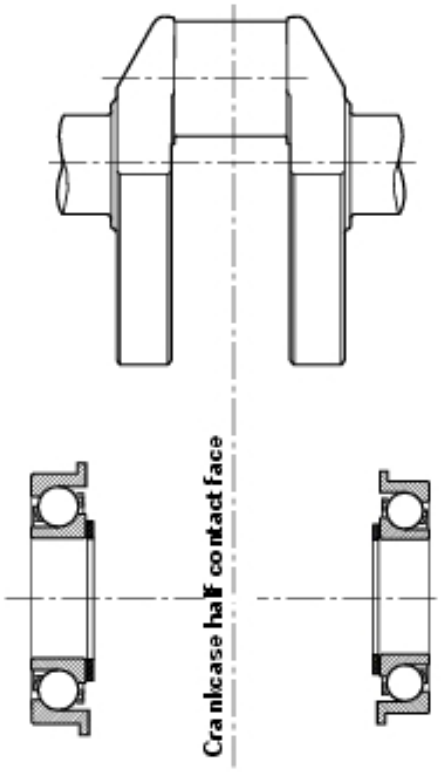
Important

On worn engines, the bearing may no longer be a tight fit in the crankcase half.

After having removed the bearing, check that the interference fit between the crankcase and the bearing is no less than **0.03** mm, otherwise the crankcase halves must be renewed.

Notes

For shimming the main bearings, see the chapter at the end of this section.

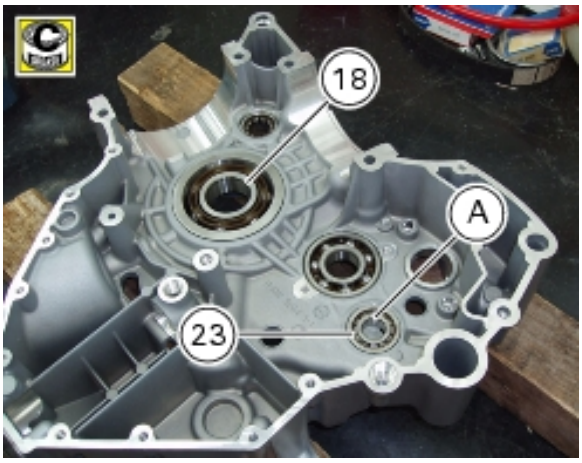


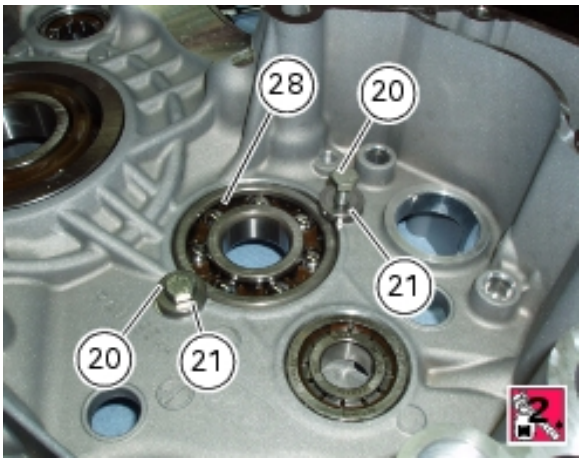
Reassembly of the crankcase halves

The crankcase halves must be in good condition and perfectly clean. The mating surfaces must be perfectly flat and free from burrs.

Overhauling the alternator-side crankcase half

The following parts must be present on the internal side of the crankcase half:
the output shaft end bearing (23); apply grease to the bearing rollers. Fit the inner race (A) removed previously from the bearing. Apply grease to the inner race.
The input shaft bearing (28), secured with bolts (20) and retaining spacer (21): apply the recommended threadlocker to the bolts (20) and tighten them to the specified torque (Sect. C 3, Engine torque settings).
The main bearing (18).

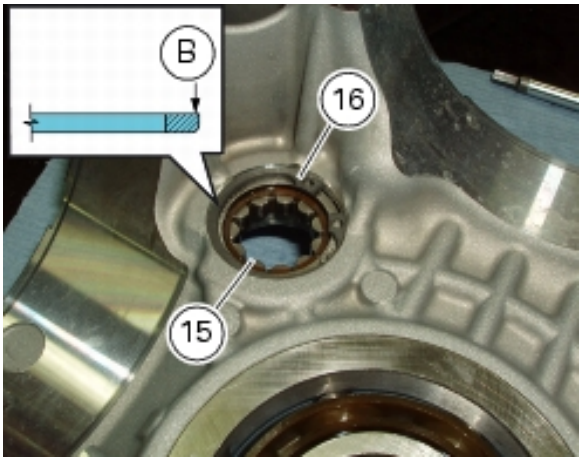




the roller bearing (15) with retaining circlip (16) installed in correspondence with the end of the timing belt driveshaft.

Notes

Position the circlip so that the side with the square edge (B) is facing upwards (opposite side of the bearing).



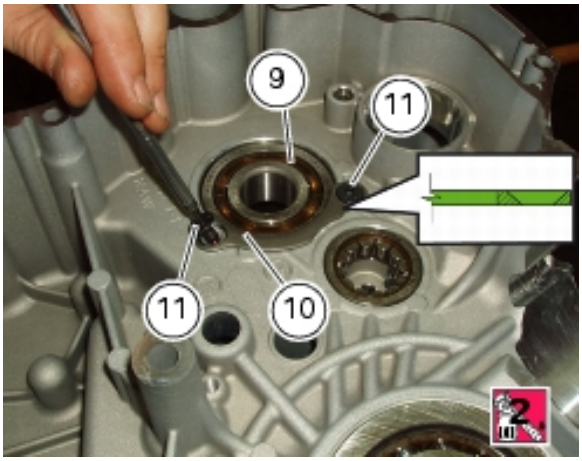
Refitting the alternator-side crankcase half

The following parts must be present on the internal side of the crankcase half:
The double race ball bearing (9) supporting the selector fork shaft. Apply threadlocker to the bolts (11). Fit the retaining plate (10) to the gearbox output shaft bearing (9) screwing the bolts fully into the chain-side crankcase half (11).

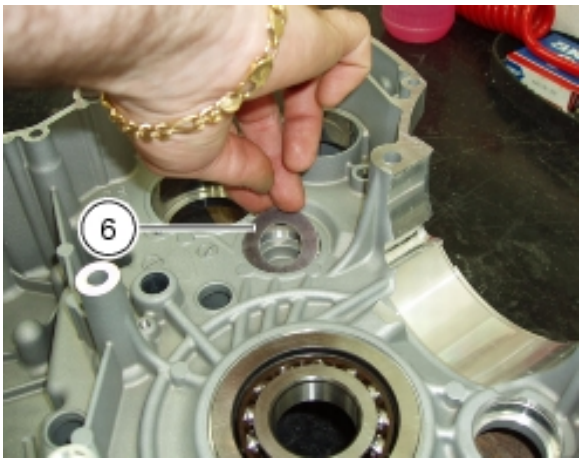
Notes

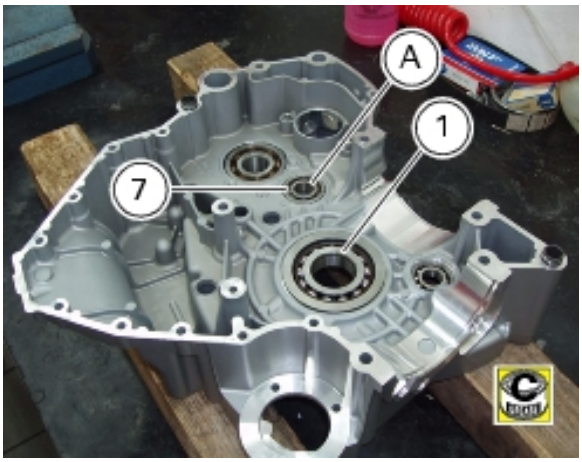
The bearing retaining plate must be positioned so that the countersunk side is facing upwards.

Tighten the bolts (11) to the specified torque (Sect. C 3, Engine torque settings).



The gearbox input shaft end bearing (7) with the inner spacer (6): apply grease to the bearing rollers. Fit the inner race (A) removed previously from the bearing. Apply grease to the inner race.
The main bearing (1) complete with bush (2).

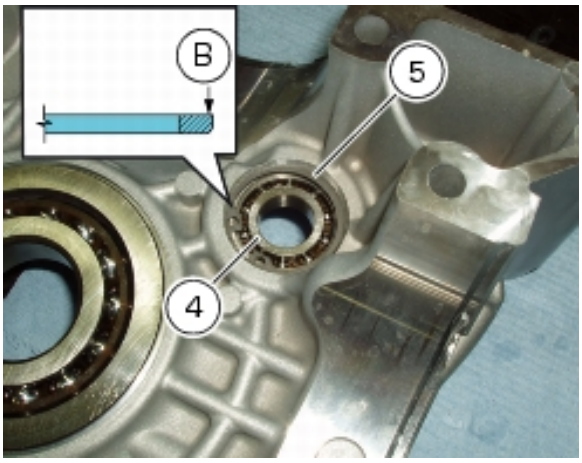




The bearing (4) with the retaining circlip (5) installed in correspondence with the timing belt driveshaft.

Notes

Position the circlip so that the side with the square edge (B) is facing upwards (opposite side of the bearing).



Notes

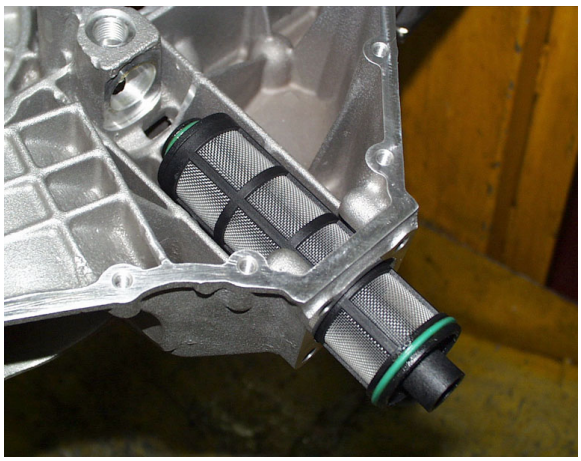
None of the bearings except the main bearings have an obligatory assembly direction. it is good practice to install the bearings so that side bearing the writing is facing upwards.

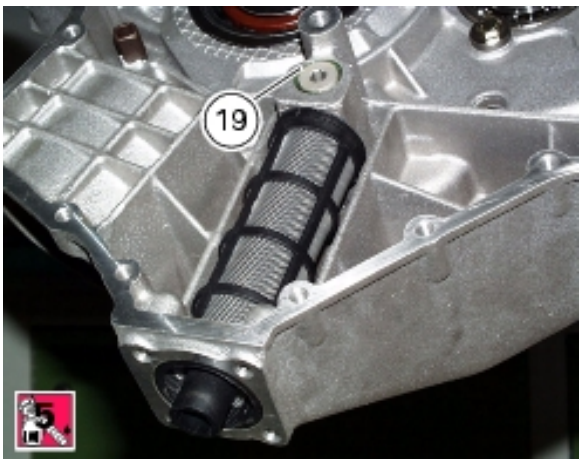
Refit the gauze pickup filter as described in Sect. D 4, Changing the engine oil and filter cartridge.

Important

To avoid damaging the filter, insert it by hand only. Do not use hammers or other metal tools.

Above the gauze filter seat there is a plug (19) which closes off the lubrication oilway. If it is to be renewed, apply the prescribed threadlocker to its threads.
Tighten the bolts and the plug to the specified torque (Sect. C 3, Engine torque settings).



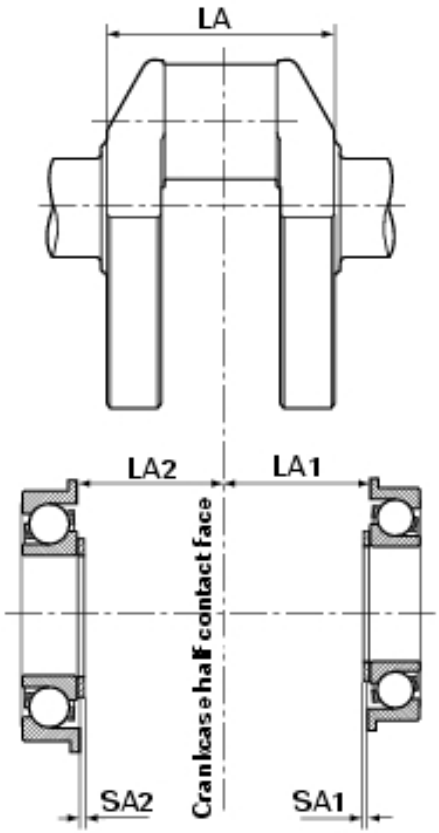


Shimming the shafts

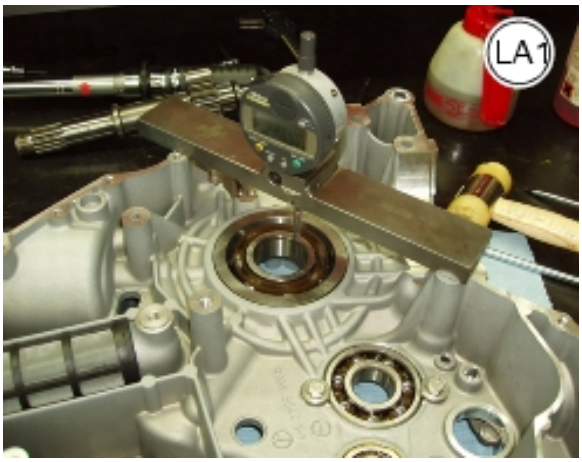
Before assembling the crankcase halves, calculate the shims required to obtain the correct end float of the crankshaft and gearbox shafts.
To determine the correct shim thicknesses proceed as follows.

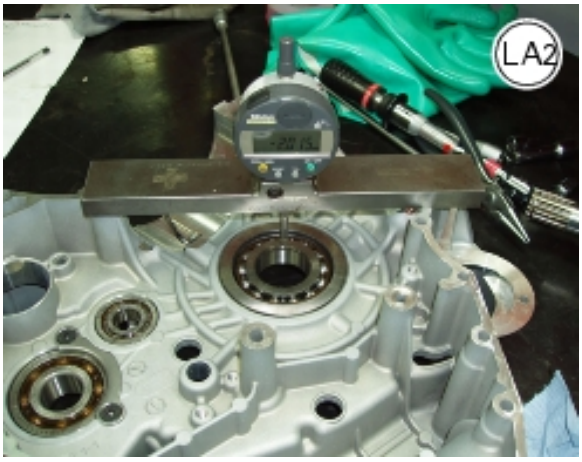
Shimming the crankshaft

After fitting the new main bearings, proceed as follows to determine the total shim thickness "SA":
Measure the distance "LA" between the bearing contact surfaces on the crankshaft;
Measure the depths "LA1" and "LA2" corresponding to the distance between contact surface of the crankcase half and the contact surface of the inner race of the bearings.

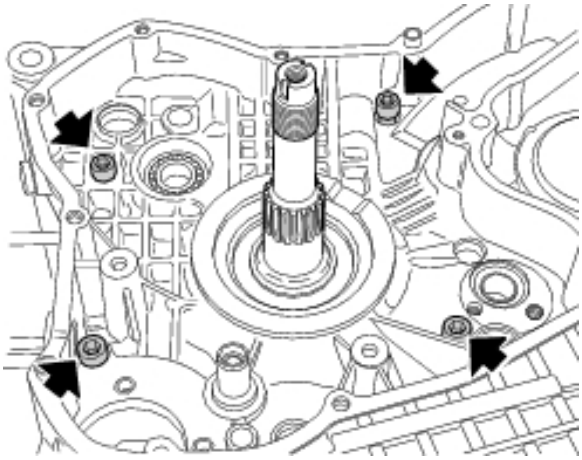


Add a pre-load of **0.30** mm to prevent excessive crankshaft end float when the crankcase halves are at their normal operating temperature.
This gives:
SA=LA1+LA2+0.30-LA.
To calculate the thickness of each shim note that:
SA=SA1+SA2
where "SA1" and "SA2" represent the shims for the clutch-side crankcase half 1 and the alternator-side crankcase half 2.
Considering the alignment of the shaft, this gives:
SA1=LA1+0.15-LA/2;
and finally, the second shim thickness: SA2=SA-SA1.

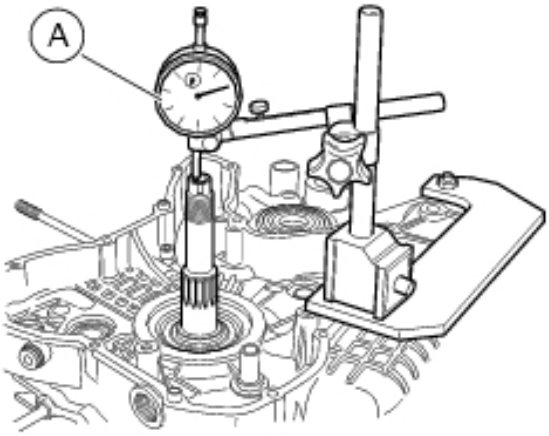




In addition to the above procedure, the following is a practical shimming method, providing a guide on how to calculate the crankshaft shim thicknesses accurately.
Install a shim of minimum thickness (**1.90** mm) on each side of the crankshaft to prevent contact between the crankshaft web and the engine block.
Install the crankshaft and assemble the two crankcase halves.
Fit four M8 bolts into the holes shown in the figure and tighten to the specified torque (Sect. C 3, Engine torque settings).



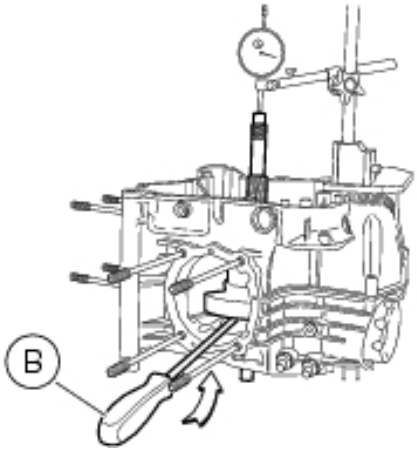
Place a dial gauge (A) with a magnetic base on a support plate fixed to the crankcase.
Bring the stylus into contact with the end of the crankshaft and set the dial gauge to zero in this position.



Insert a lever (B) between the crankcase and the crank web and force the crankshaft towards the dial gauge.
Note the dial gauge reading. This is the crankshaft endfloat. Add a preload of (**0.30** mm) plus the thickness of the shims used (**1.90x2=3.8** mm).
Divide the resulting value by two to obtain the thickness of the shim packs to be installed at either end of the crankshaft.

Notes

After assembling the crankcase, the crankshaft should turn with some interference in the new bearings.



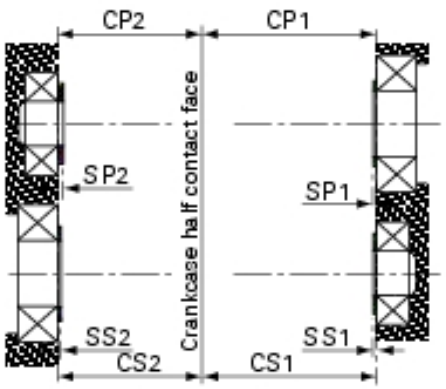
Shimming the gearbox shafts

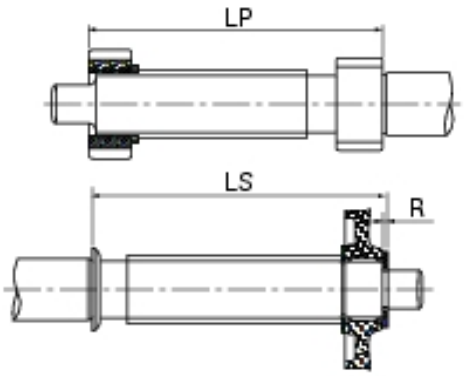
To establish the total shim thicknesses to be installed on the input shaft "SP" and the output shaft "SS", proceed as follows:
Measure the dimensions "LP" and "LS" on the input and output shafts (for the output shaft add shim thickness "R" of **2.3** mm;
Measure the depth corresponding to the distance between the contact surface of the crankcase half and the contact surface of the inner race of the bearing for the input shaft ("CP1" and "CP2") and for the output shaft ("CS1" and "CS2");
Given that end float should be in the range **0** to **0.15** mm, we will take the optimal value of **0.15** mm, which gives:
SP=CP1+CP2-LP-0.15 and
SS=CS1+CS2-LS-0.15.
To determine the thickness of each single shim pack, note that:
SP=SP1+SP2 and
SS=SS1+SS2

Where "SP1" and "SP2" are the clutch and chain side input shaft shimming values respectively and "SS1" and "SS2" the corresponding values for the output shaft. This gives:
SP1=CP1-64-0.075 and
SS1=CS1-64-0.075, so that
SP2=SP-SP1 and SS2=SS-SS1.

Notes

The method described for the crankshaft can also be used to calculate the shim thicknesses for the gear shafts.





Shimming the gearbox selector drum

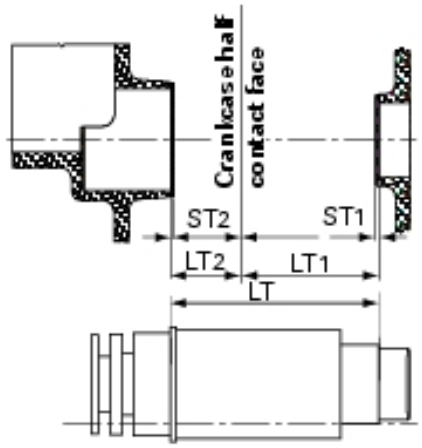
To determine the total thickness "ST" of the gearbox selector drum shims, proceed as described below.

Given that:
LT1 = clutch-side crankcase half depth
LT2 = chain-side crankcase half depth
LT = gearbox selector drum shoulder.

Given that the end float should be **0 10** to **0.40** mm
and taking the mean optimal value of **0.25** mm,
This gives: ST=LT1+LT2-LT-0.25.
Given that ST=ST1+ST2
we obtain ST1=LT1-59-0.125, so that ST2=ST-ST1.

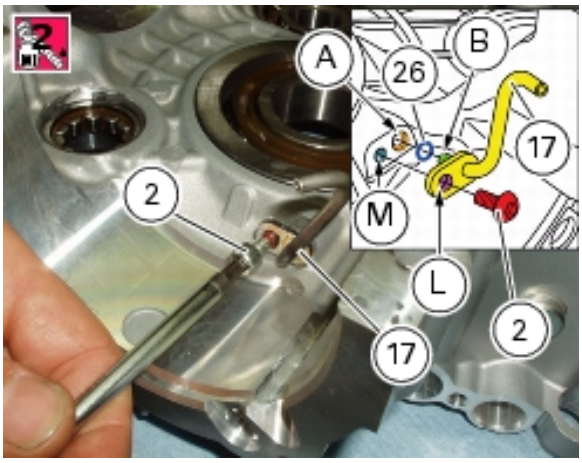
Notes

The method described for the crankshaft can also be used to calculate the shim thicknesses for the gear shafts.

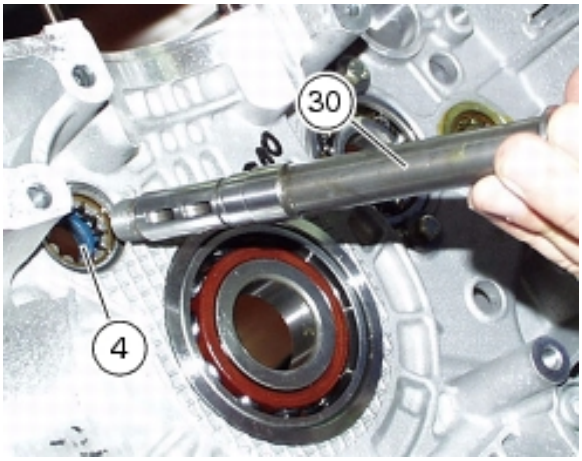


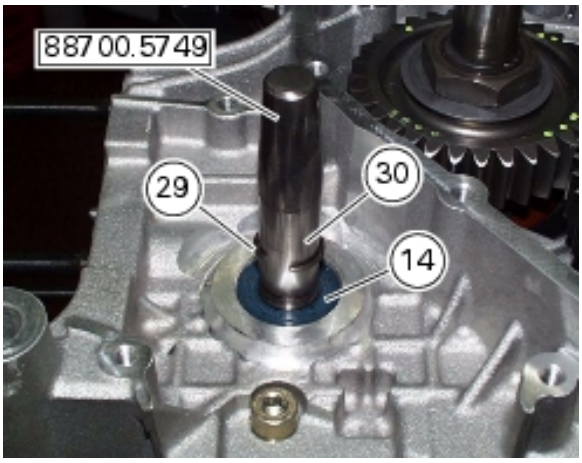
Reassembly of the crankcase halves

Install the O-ring (26) on its seat (A) in the crankcase half. Fit the pipe (17) in the crankcase half, inserting the end (B) fully in the O-ring. Align the hole (L) of the pipe with the threaded hole (M) in the crankcase. Apply threadlocker to the bolt (2) and start it in the threaded hole (M). Tighten the bolt to the specified torque (Sect. C 3, Engine torque settings).



Install the timing belt driveshaft (30) in the roller bearing (4) in the clutch-side crankcase half.
To avoid damaging the oil seal (14) on the timing belt driveshaft, protect the threaded end of the shaft with the special protective cap **88700.5749**. Dampen the oil seal (14) with alcohol and fit it on the timing belt driveshaft, seating it against the roller bearing (4).
Fit the circlip (29) in the groove on the shaft and remove the protective cap.

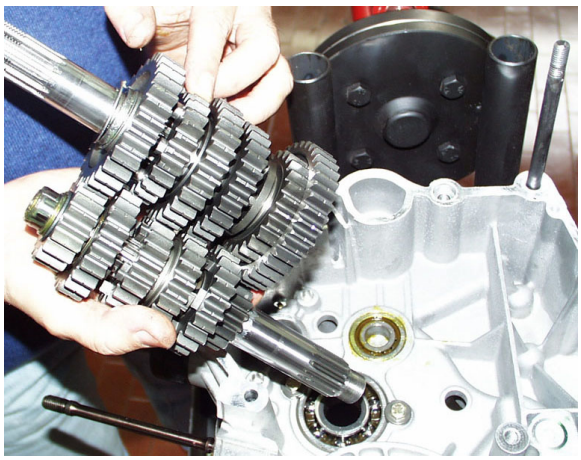




Notes

When refitting used components, make sure that the inner races (C) of the gearbox shaft bearings are fitted into the correct bearings and have not been left on the shafts.

Mesh the gearbox shafts and install them on the clutch-side crankcase half with the calculated shims.



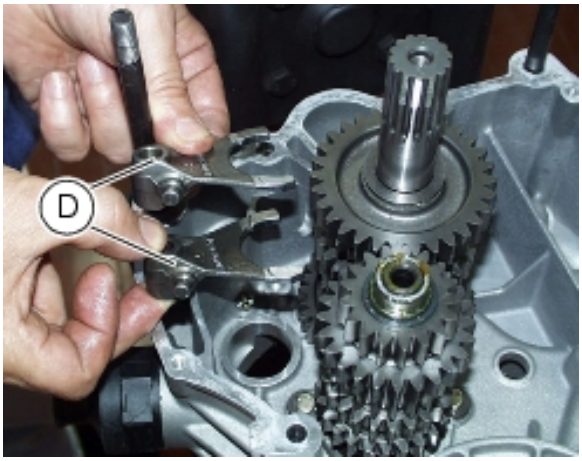
Notes

A figure and a list of the component parts of the gearbox appear in Sect. N 7.2, Reassembly of the gearbox shafts.

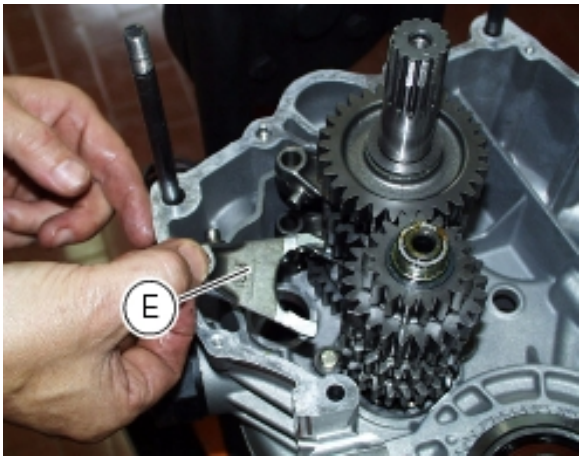
Insert the 1st-4th and 2nd-3rd speed selector forks (D) in their respective channels in the driven gears of the output shaft.

Notes

The two selector forks are identical.

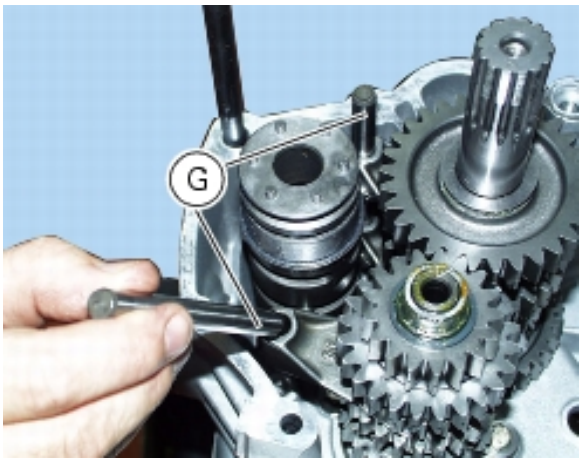


Insert the 5th-6th speed selector fork (E) in the driven gear of the input shaft.



Install the selector drum (F) in the crankcase with calculated shim thickness.

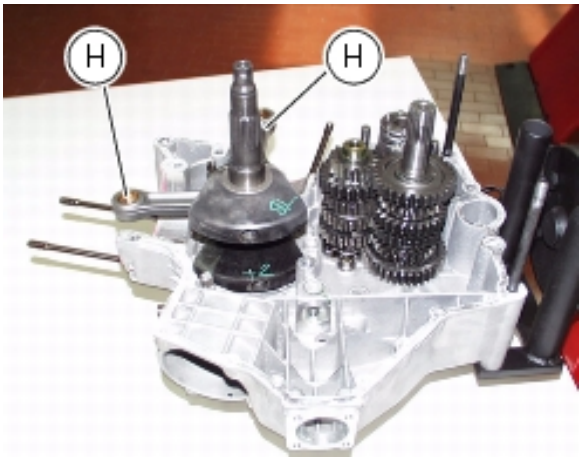
Fit the pins (G) in the previously installed selector forks.



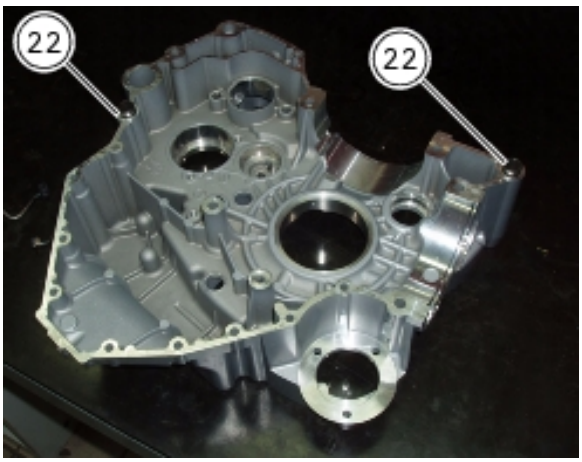
Fit the shimmed crankshaft into the clutch-side crankcase half, positioning the connecting rods (H) in correspondence with the relative cylinder barrel seats.

Important

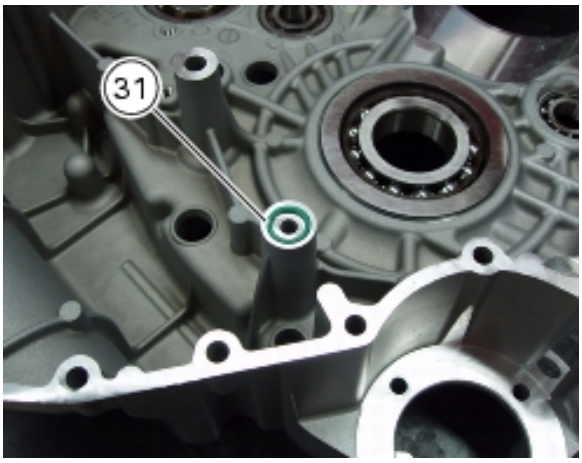
Make sure that the connecting rods (H) are correctly positioned in the respective cylinder seats. Incorrect positioning of the connecting rods at this stage will inevitably lead to the need to re-open the crankcase.



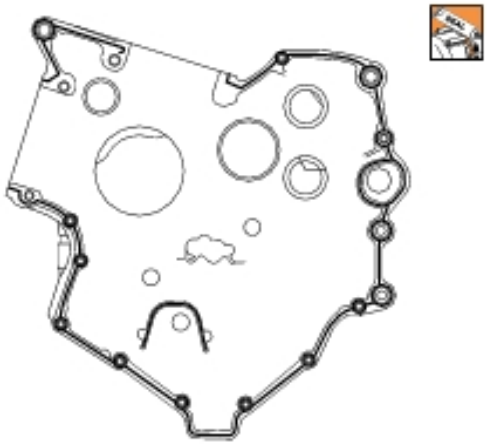
Check that the two locating bushes (22) are correctly installed.



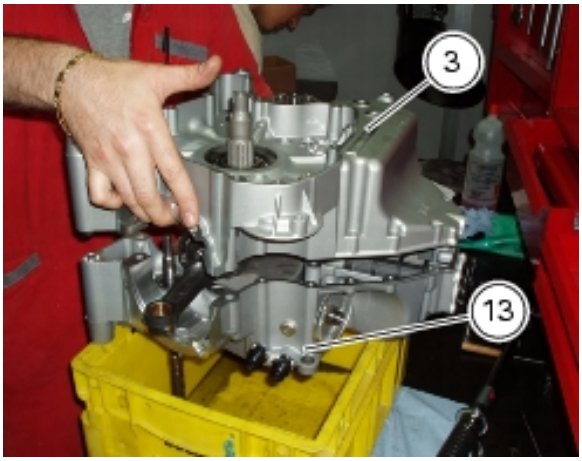
Grease the O-ring (31) to hold it in position and install it.



Apply a uniform and continuous bead of DUCATI liquid gasket to the mating surfaces of the crankcase halves, going around all the holes as shown in the figure.



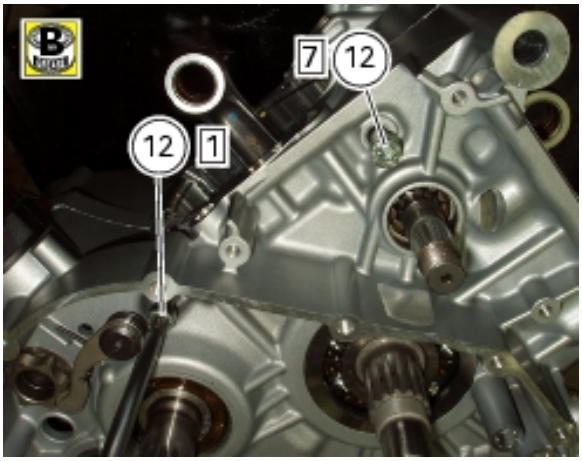
Bring the crankcase halves (3) and (13) together, tapping with a rubber mallet in the area of the shafts if necessary.

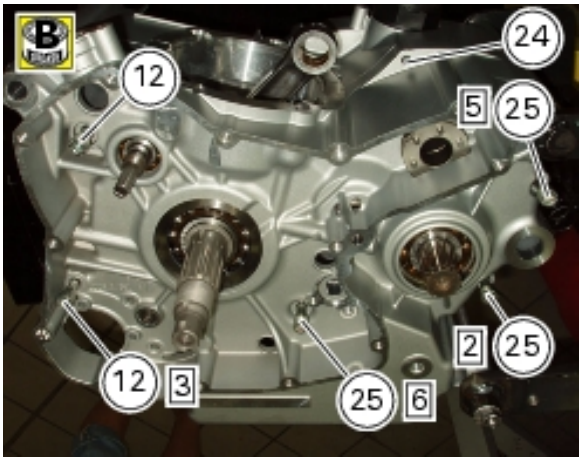


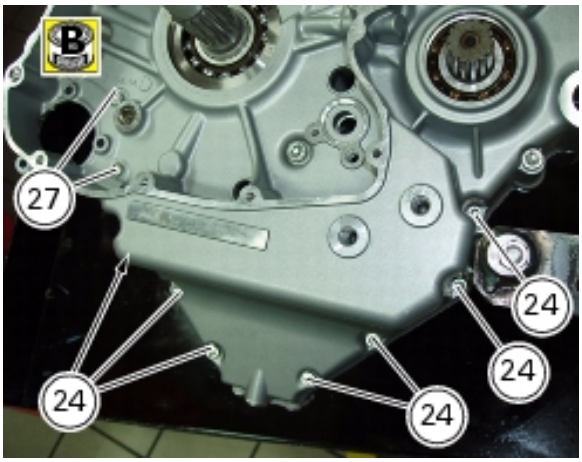
Apply the recommended grease to the bolts and insert them in their holes (note that the bolts are different lengths). Start with the larger diameter bolts (M8), and in particular, the left-hand side bolt (25) and follow the order indicated.

Ref.	Qty.	Description
12	4	M8x90 mm bolts
25	3	M8x75 mm bolts
24	8	M6x35 mm bolts
27	2	M6x75 mm bolts

Tighten all the bolts to the specified torque (Sect. C 3, Engine torque settings).







Ensure that the crankshaft can be turned with a certain amount of interference with the main bearings (the crankshaft should have a pre-load of **0.2** to **0.30** mm); check also that all the parts you have fitted are free to rotate or move correctly.

Install the gauze filter cover with its gasket as described in Sect. D 4, Changing the engine oil and filter cartridge.

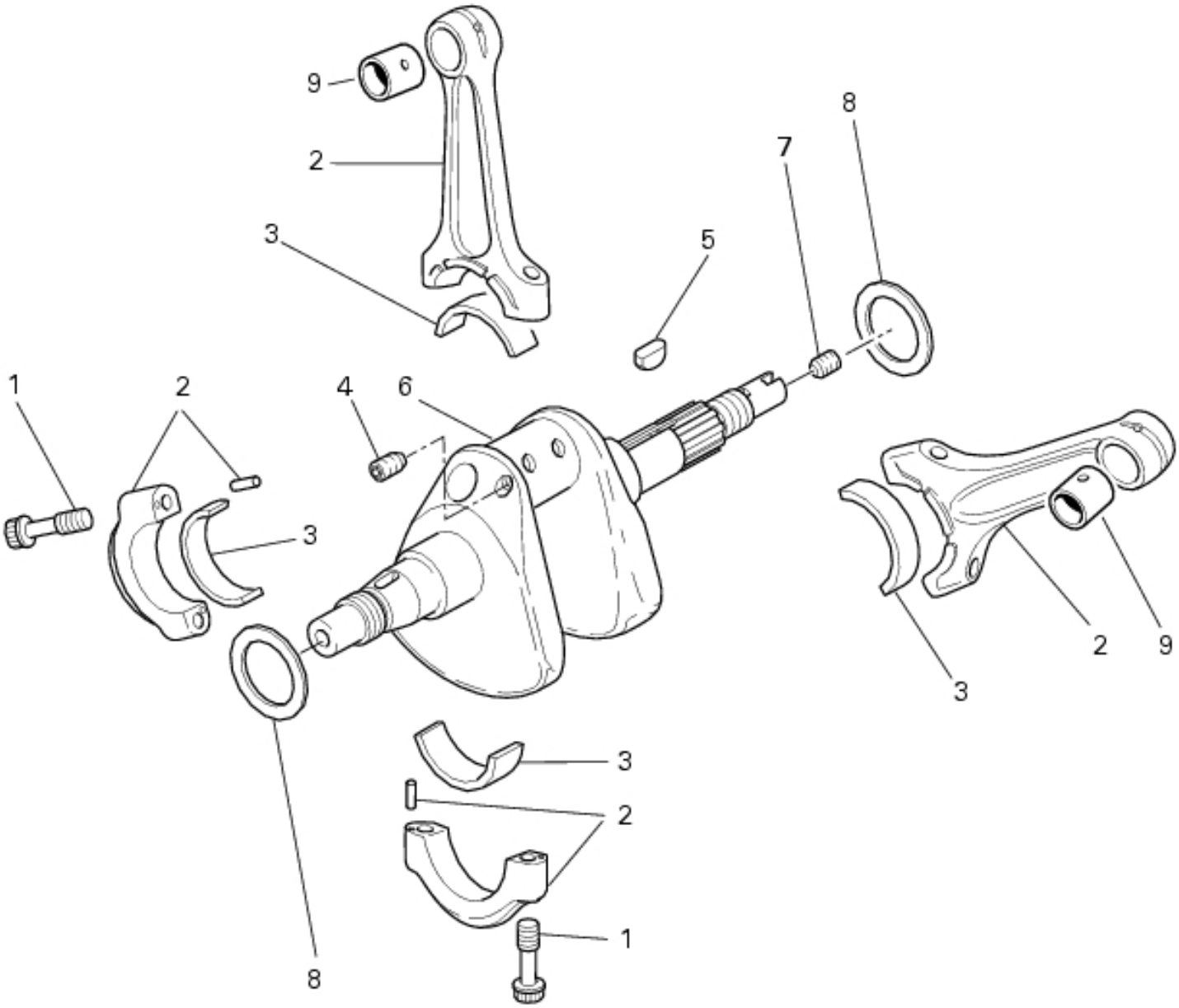
Fit the filter cartridge (Sect. D 4, Changing the engine oil and filter cartridge).

Install the oil seal (8) on the gearbox output shaft.

Install the bush of service tool no. **88713.2060** on the output shaft. Lubricate the new oil seal (8) and seat it. Using the tool's drift, drive the oil seal fully home so it seats against the crankcase bearing.

Operation	Section reference
Refit the clutch assembly	N 6.1, Reassembly of the clutch
Refit the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
Refit the engine starter system	P 3, Starter motor
Refit the lubrication system	N 2.1, Refitting the oil pump
Refit the alternator-side crankcase cover and alternator assembly	N 8, Refitting the flywheel/alternator assembly
Refit the cylinder barrel/piston assemblies	N 5, Refitting the cylinder/piston assembly
Refit the cylinder head assemblies and the timing parts	N 4.2, Refitting the timing belt driveshaft pulley
Refit the cooling system	N 3.2, Refitting the radiator
Install the engine in the frame	N 1, Refitting the engine

9.3 - Crankcase assembly: crankshaft/connecting rods assembly



1 Special bolt
2 Connecting rod assembly
3 Half bearing
4 Grub screw
5 Key
6 Crankshaft
7 Grub screw
8 Shim
9 Bushes

Parts catalogue

connecting rods

Important

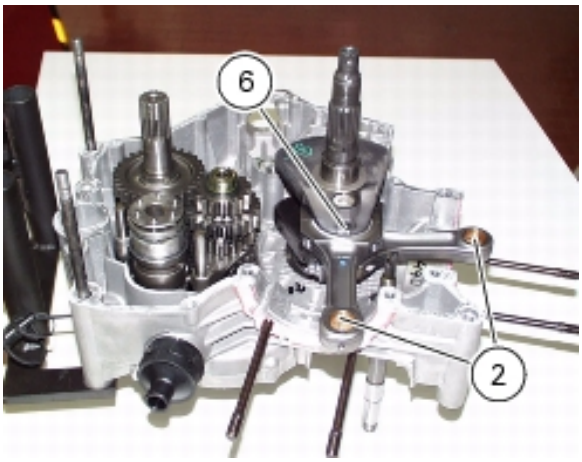
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the

exploded view diagram.

Removal of the crankshaft/connecting rods assembly

Operation	Section reference
Remove the engine from the frame	N 1, Removal of the engine
Remove the cooling system	N 3.2, Removal of the radiator
Remove the cylinder head assemblies and the timing parts	N 4.2, Removal of the timing belt covers
Remove the cylinder barrel/piston assemblies	N 5, Removal of the cylinder/piston assembly
Remove the alternator-side crankcase cover and the alternator assembly	N 8, Removal of the alternator-side crankcase cover
Remove the lubrication system	N 2.1, Removal of the oil pump
Remove the engine starting system	P 3, Starter motor
Remove the clutch-side crankcase cover	N 6.2, Removal of the clutch-side crankcase cover
Remove the clutch assembly	N 6.1, Removal of the clutch
Separate the crankcase halves	N 9.2, Separation of the crankcase halves

After separating the crankcase halves, withdraw the crankshaft (6) complete with connecting rods (2).

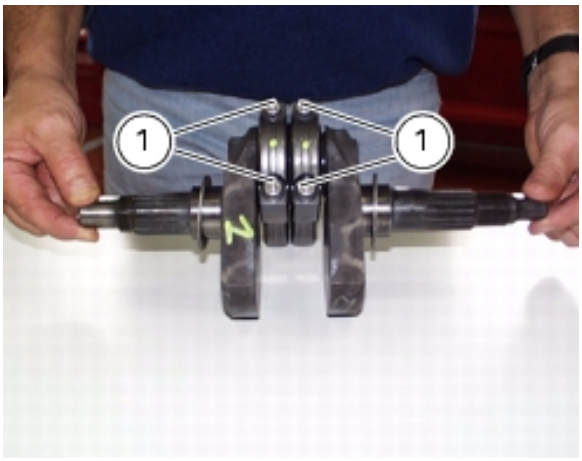


Disassembly of the crankshaft/connecting rods assembly

Unscrew the bolts (1) and separate the connecting rods from the crankshaft.

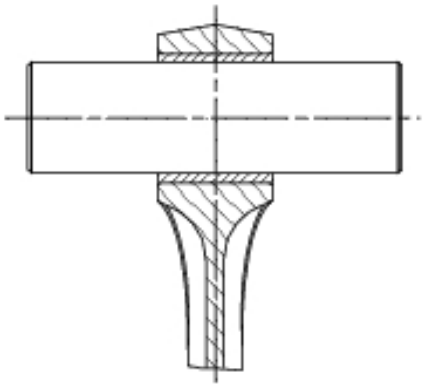
Important

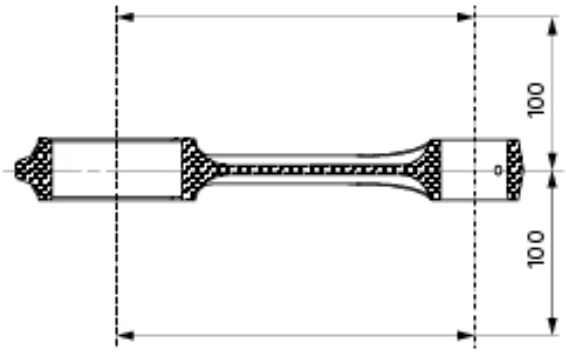
Take care not to mix up components of different connecting rods and maintain the original orientation.



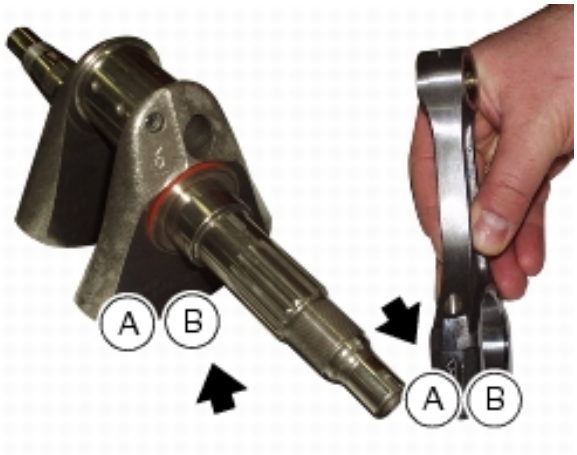
Overhaul of the connecting rods

Make the following dimensional checks on the connecting rods:
- clearance with gudgeon pin on assembly.
In the event of excessive wear (Sect. C 1.1, Crankshaft), renew the connecting rod.
The small end bushing must be in good condition and firmly driven into its seat.
Check for parallelism error measured at **100** mm from the connecting rod longitudinal axis: the value must be **H**-**h** less than **0.02** mm; otherwise, renew the connecting rod.



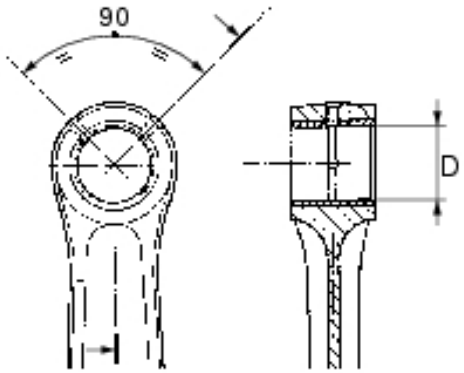


The connecting rod is supplied in two size classes **A** and **B** relative to the big end diameter (Sect. C 1.1, Crankshaft) as punch marked on the side of the cap.
It is preferable to use crankshafts and connecting rods of the same size class.



Renewal of the small end bushing

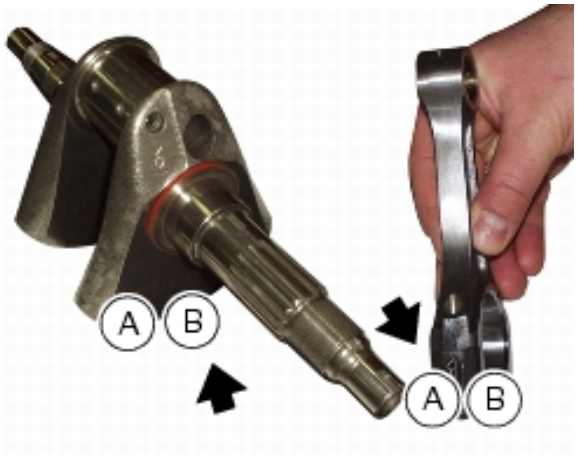
To remove the worn bushing, use a suitable drift and a press.
Drill lubrication holes into the new bushing in correspondence with the existing lubrication holes on the connecting rod small end.
Now ream out the bushing until the inside diameter (D) is **20.035** to **20.045** mm.

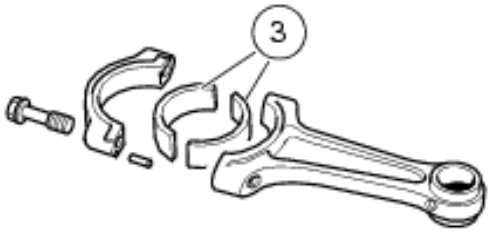


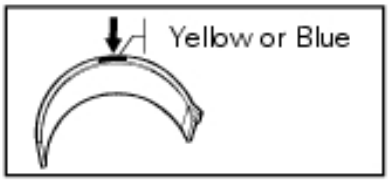
Connecting rod bearings

It is good practice to renew the bearings (3) each time the engine is overhauled.
Replacement bearings are supplied ready for assembly and they must not be reworked with scrapers or emery cloth.
The bearings may belong to two different size classes, each identified by a specific colour (YELLOW and BLUE).
The bearings are comprised of an external steel ring, the inner face of which is electro-plated with a lead-based compound.
The table shows the appropriate bearings to be fitted according to the size class of the crankshaft and connecting rod.

Crankshaft class	Connecting rod class	Bearings colour
B	B	BLUE/YELLOW
B	A	YELLOW/YELLOW
A	B	BLUE/BLUE
A	A	BLUE/YELLOW

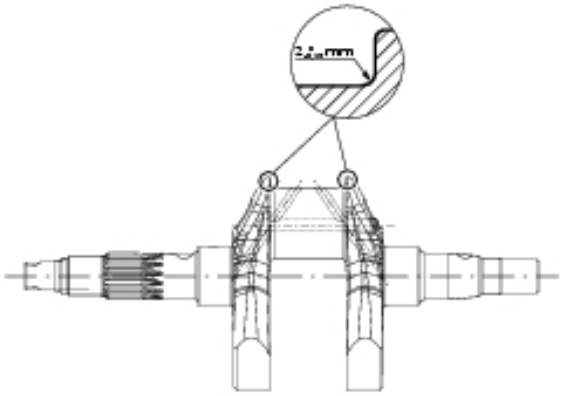




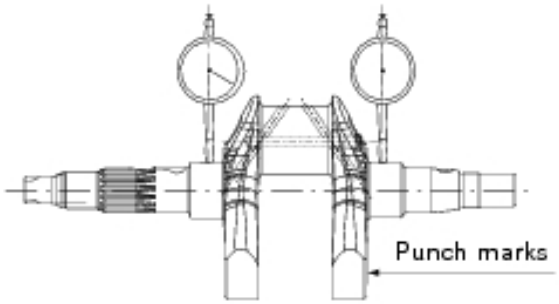


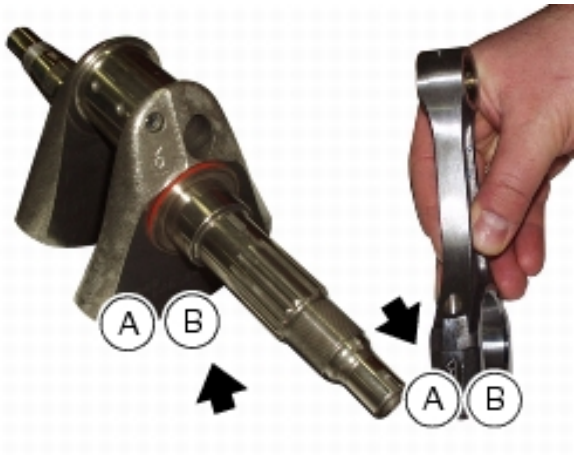
Crankshaft

The main bearing and big-end journals should not be scored or grooved;
the threads, keyways, and slots must be in good condition.
Check for fretting or burrs in the fillet between journal and shoulder.
Fillet radius: **2** mm.

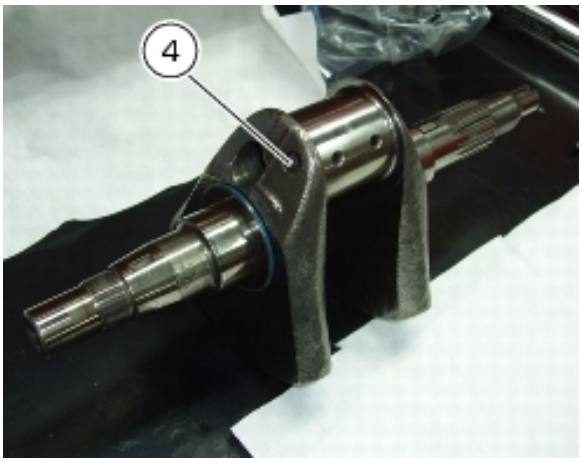


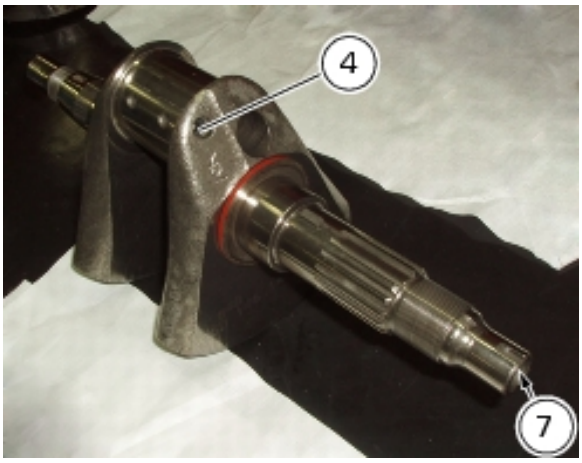
With the aid of a micrometer, measure the ovality and taper of the big-end journals, taking the measurements in various different directions.
Use a dial gauge to measure the alignment of the main journals by setting the crankshaft between two opposing centres.
At each overhaul, it is advisable to clean the crankshaft's internal oilways.
The prescribed values are given in Sect. C 1.1, Crankshaft.
The crankshaft is supplied in two size classes (journals) **A** and **B**, as punch marked on the side of the crank web on the pinion side.

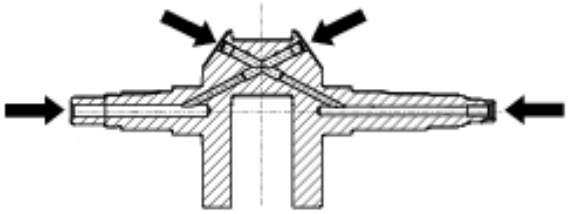




Unscrew all the plugs (4) and (7) from the crankshaft, heating the crankshaft, if necessary, to release the threadlocker applied at the time of assembly.
Clean all the oilways using suitable diameter metal brushes and then blow with compressed air to remove any residues that have accumulated and are restricting the oil flow.
Apply THREE BOND 1375B liquid gasket to the plug threads (4) and (7) and reinstall them.
Tighten all the plugs to the specified torque (Sect. C 3, Engine torque settings).

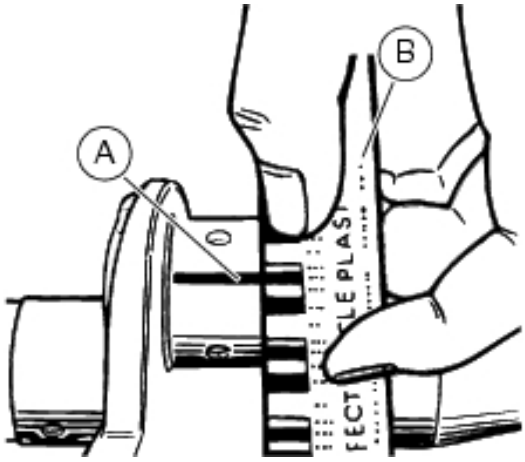






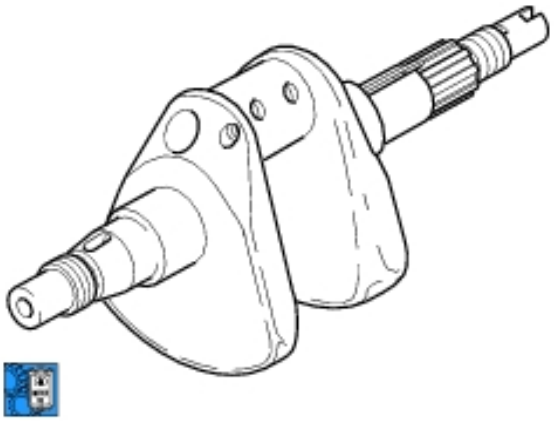
Big-end bearing shell-journal clearance

To check the assembly clearance between the bearing shells and crankshaft journals you will lay a strip (A) of GREEN "Plastigage PG-1" on the journal. Fit the connecting rod with the original bearings and tighten the bolts to a torque of **50** Nm.
Remove the connecting rod and compare the width of the Plastigage strip to the scale (B).
If the width measured corresponding to the existing clearance is not within the prescribed limit (Sect. C 1.1, Crankshaft), either the bearings or the crankshaft must be renewed.



Reassembly of the connecting rods

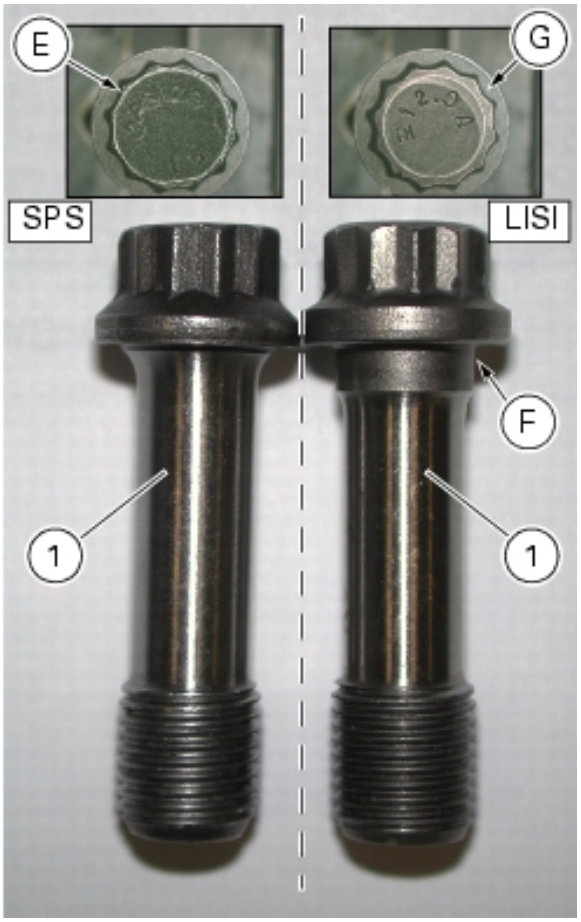
Before starting, check that the crankshaft main bearing journals and big-end journals are free of burrs or evident signs of machining: if necessary, clean the surfaces with very fine emery cloth and oil.
Check that the grooves are in perfect condition with no signs of forcing.



Check that each connecting rod (2) and cap are fitted with their locating pins (D).
Wash the pins and dry them with compressed air.
Clean and lubricate the journals and con-rod bearing shells (3) with engine oil and fit the connecting rods in their original mounting positions.

Important

There are two types of big-end cap bolts (1):
-"SPS" bolts: can be identified from the marking on the head (E) and by the absence of the collar (F);
-"LISI" bolts: can be identified from the marking on the head (G) and by the presence of the collar (F).
The two types of bolts require different tightening procedures, as described below.



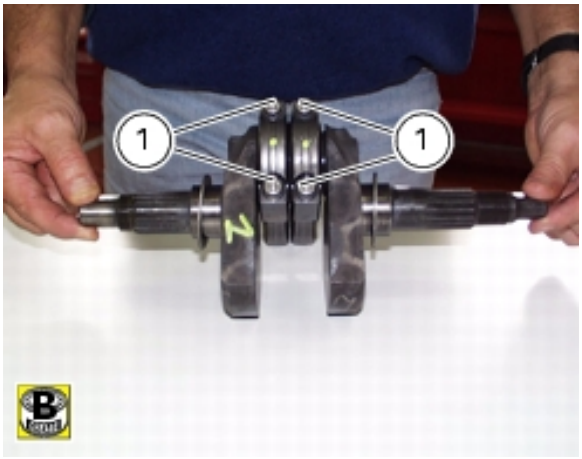
Use the recommended grease to lubricate the threads and underside of the heads of the new bolts (1) and the threaded hole in the connecting rod, packing in grease from both sides of the hole.

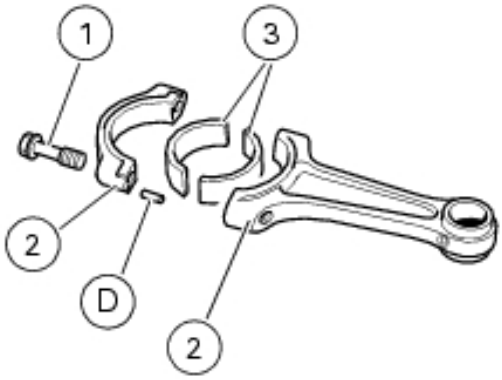
Warning

The grease utilised is an irritant in contact with the skin. Wear protective gloves.

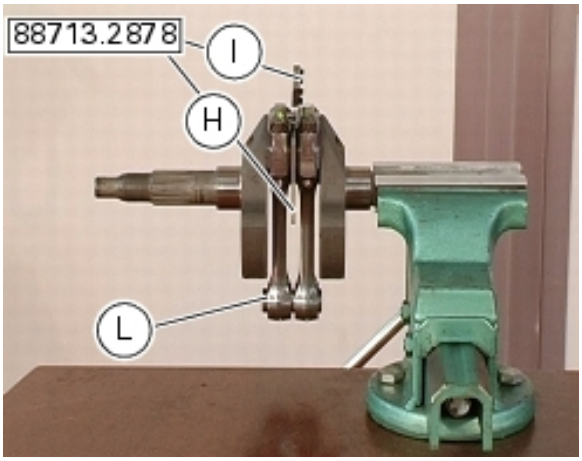
Important

Lubrication of big-end cap bolts is essential to obtain the correct coupling and to prevent breakage of the parts.
The big-end cap bolts may only be used and **tightened once**, after which they must be discarded.
Tighten the bolts (1) by hand.
If this proves difficult or if the bolts jam, undo them and lubricate them again.
Remove excess grease. Tighten the bolt by hand until the head seats against the connecting rod.





Fit the spacer (H) of the tool **88713.2878** between the connecting rods and take up residual axial play with the fork feeler gauge (I) of the tool **88713.2878** which is available in the following thicknesses:
0.1 mm - **0.2** mm - **0.3** mm.
Temporarily fit the gudgeon pin (L) to align the connecting rods, and then tighten the bolts.



Tightening procedure for “SPS” big-end cap bolts

Tighten the bolts (1) with a torque wrench and angle reading (degree wheel) in accordance with the procedure

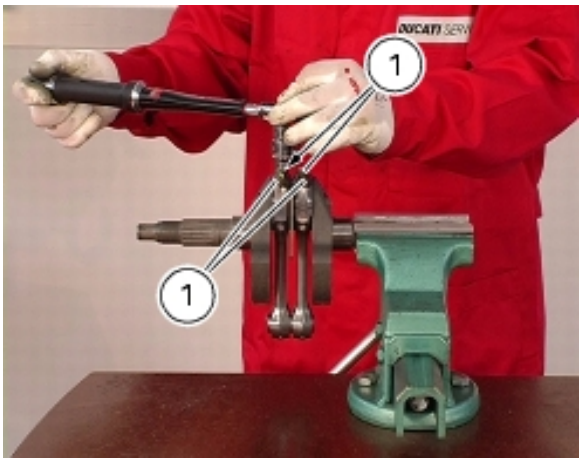
described below (observe the same tightening sequence at each step as that of the previous step):
1 first torque each bolt to a value of **20** Nm;
2 now carry out a second tightening stage applying a torque of **35** Nm on each bolt;
3 now tighten each bolt, reading the angle of rotation, to **85** Nm, checking that the final angle is between **55°** and **90°**.

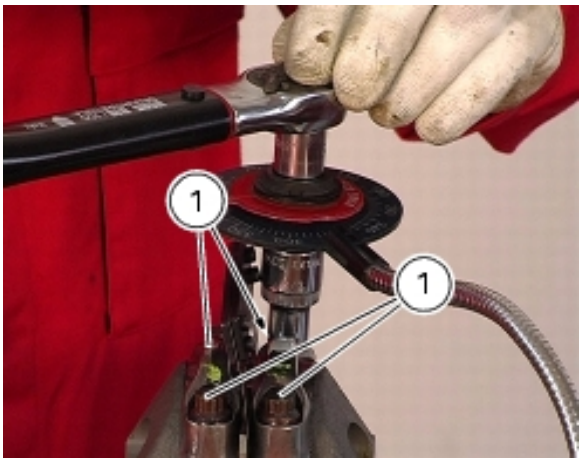
Important
If the final angle is less than **55°** or greater than **90°**, repeat the tightening procedure using two new bolts.

Tightening procedure for “LISI” big-end cap bolts

Tighten the bolts (1) with a torque wrench and angle reading (degree wheel) in accordance with the procedure described below (observe the same tightening sequence at each step as that of the previous step):
1 first torque each bolt to a value of **20** Nm;
2 now carry out a second tightening stage applying a torque of **35** Nm on each bolt;
3 now tighten each bolt, reading the angle of rotation, to **70** Nm, checking that the final angle is between **55°** and **75°**.

Important
If the final angle is less than **55°** or greater than **75°**, repeat the procedure using two new bolts.



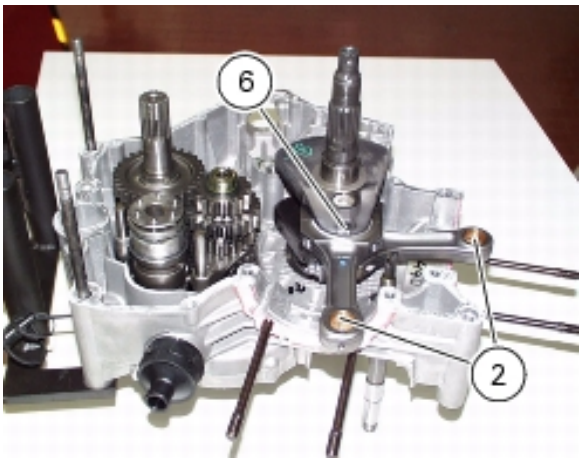


Refitting the crankshaft/connecting rod assembly

Install the crankshaft/connecting rod assembly (6) and (2) in the crankcase, carry out the shimming and crankcase reassembly procedure as described in Sect. N 9.2, Reassembly of the crankcase halves.

Important
Make sure that the connecting rods (2) are correctly positioned in the respective cylinder seats. Incorrect positioning

of the connecting rods at this stage will inevitably lead to the need to re-open the crankcase.



Operation	Section reference
Refit the clutch assembly	N 6.1, Reassembly of the clutch
Refit the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
Refit the engine starter system	P 3, Starter motor
Refit the lubrication system	N 2.1, Refitting the oil pump
Refit the alternator-side crankcase cover and alternator assembly	N 8, Refitting the flywheel/alternator assembly
Refit the cylinder barrel/piston assemblies	N 5, Refitting the cylinder/piston assembly
Refit the cylinder head assemblies and the timing parts	N 4.2, Refitting the timing belt driveshaft pulley
Refit the cooling system	N 3.2, Refitting the radiator
Install the engine in the frame	N 1, Refitting the engine

0P - Electrical system

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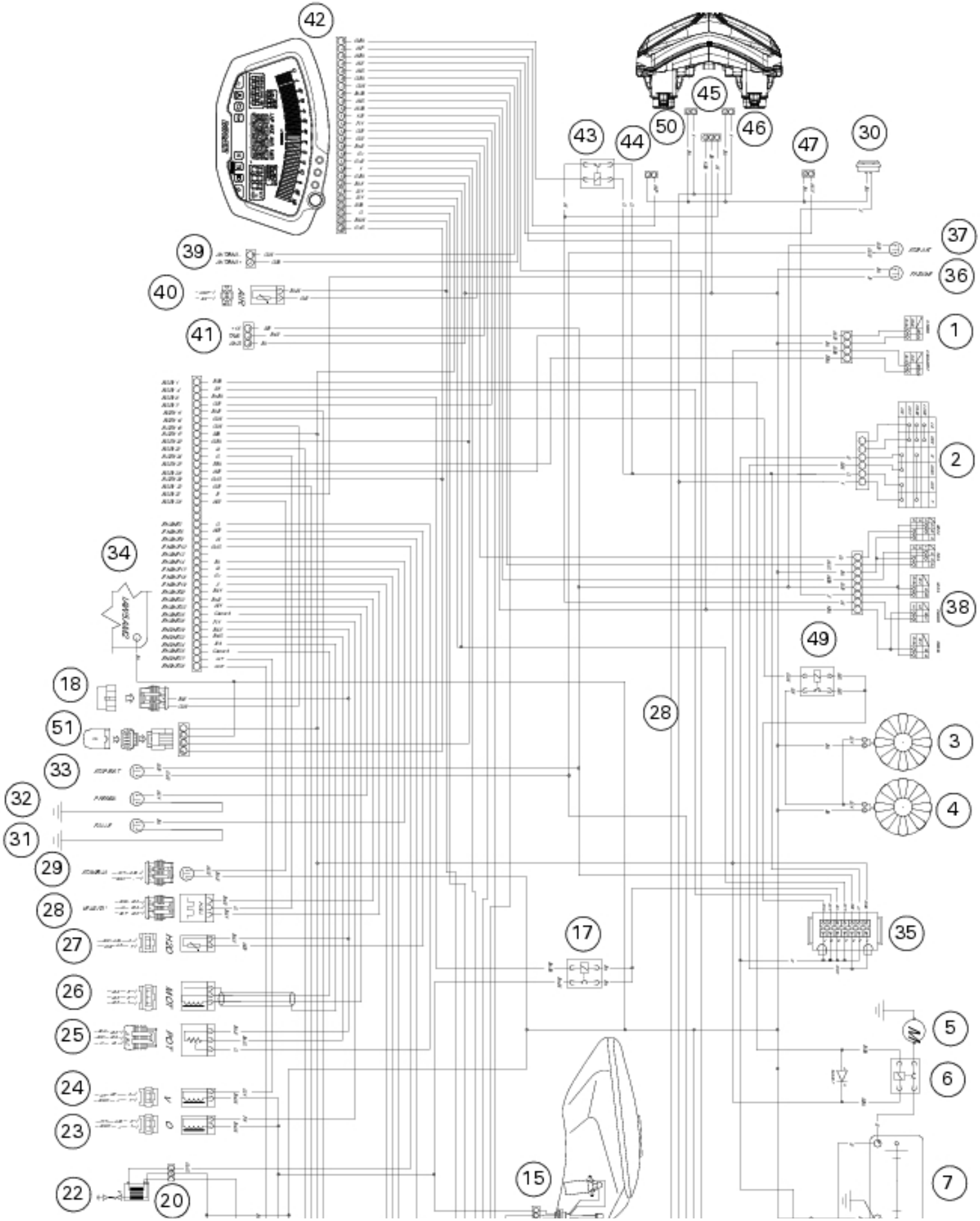
1 - Wiring diagram



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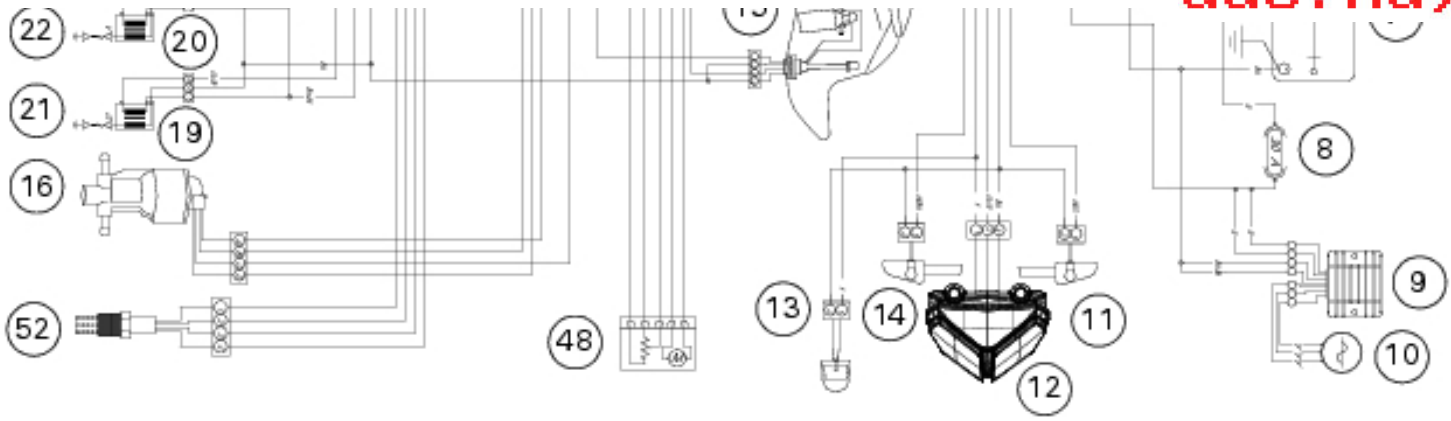

Key to wiring diagram

1 Right-hand handlebar switch
2 Key switch
3 Left cooling fan
4 Right cooling fan
5 Starter motor
6 Starter contactor
7 Battery
8 Regulator fuse
9 Regulator
10 Alternator
11 Rear right turn signal
12 Tail light
13 Number plate light
14 Rear left turn signal
15 Fuel tank
16 Stepper motor
17 Injection relay
18 Self-diagnosis
19 Horizontal cylinder coil
20 Vertical cylinder coil
21 Horizontal cylinder spark plug
22 Vertical cylinder spark plug
23 Horizontal cylinder injector
24 Vertical cylinder injector
25 Throttle position sensor
26 Rpm/timing sensor
27 Coolant temperature sensor
28 Speed sensor
29 Sidestand
30 Horn
31 Neutral switch
32 Oil pressure switch
33 Rear brake light switch
34 ECU
35 Fuses
36 Clutch switch
37 Front brake light switch
38 Left-hand handlebar switch
39 Transponder antenna
40 Air temperature sensor
41 Finish line sensor
42 Instrument panel
43 Lights relay
44 Front left turn signal
45 Headlight
46 Right sidelight

47 Front right turn signal
48 EX-UP motor
49 Fan relay
50 Front left sidelight
51 Data Acquisition
52 Lambda sensor

Wiring colour codes

B Blue
Bk Black
Bn Brown
G Green
Gr Grey
Lb Light blue
O Orange
P Pink
R Red
V Violet
W White
Y Yellow

Key to fusebox

Pos.	Item	Val.
1	Key-on	10 A
2	Lights	15 A
3	Device	15 A
4	Instrument panel	5 A
5	Injection	20 A
6	Engine Electronic Control Unit	5 A
7	Fans	7.5 A

Routing of wiring on frame

The routing of the wiring has been optimised to ensure the minimum obstruction.
Each section is designed to prevent interference with parts that might damage wires or cause operating failures when riding. The plates on the following pages show the origins (“0” points) for correct re-routing of wiring and the locations of cable ties.
Each figure includes references to the plates showing the wiring routing or the item to which it must be connected.

Position		Description
1	Plate 8	Air temperature sensor wiring
2	Plate 8	Lights relay wire
3	Plate 9	Instrument panel wiring
4	Plate 9	Right front indicator wiring branch
5	Plate 9	Left front indicator wiring branch
6	Plate 10	Headlight wiring
7	Plate 10	Right sidelight wiring
8	Plate 10	Left sidelight wiring
9	Plate 11	Finish line sensor wiring
10	Plate 12	Coolant temperature sensor wiring
11	Plate 13	Vertical cylinder coil wire
12	Plate 13	Main wiring rear branch
13	Plate 14	Horizontal cylinder coil connector
14	Plate 14	Main wiring branch
15	Plate 14	Fusebox
16	Plate 15	Right-hand handlebar switch wire
17	Plate 15	Front brake switch wire
18	Plate 16	Immobilizer antenna wiring
19	Plate 17	Right cooling fan wiring
20	Plate 18	Keyswitch wire
21	Plate 18	Left-hand handlebar switch connector
22	Plate 18	Keyswitch connector
23	Plate 18	Clutch switch connector
24	Plate 18	Left-hand handlebar switch wire
25	Plate 18	Clutch switch wire
26	Plate 19	Left cooling fan connector
27	Plate 20	Horizontal injector
28	Plate 21/Plate 22	Pick-up connector
29	Plate 21/Plate 22	Alternator connector
30	Plate 21/Plate 22	Engine earth cable
31	Plate 23	Horn wiring
32	Plate 24	Rear brake light switch wiring
33	Plate 25	Neutral sensor wiring
34	Plate 26	Oil pressure sensor wiring
35	Plate 27	Speed sensor wiring
36	Plate 28	Lambda sensor wiring
37	Plate 29	Stepper motor wiring branch

38	Plate 29	TPS wiring branch
39	Plate 30	Fuel tank flange wiring
40	Plate 31	Sidestand wiring
41	Plate 32	Vertical cylinder injector wiring
42	Plate 33	Exhaust valve motor wiring
43	Plate 34/Plate 35	Data acquisition connector
44	Plate 34/Plate 35	Rear wiring harness connector
45	Plate 35/Plate 36/Plate 37/ Plate 38/Plate 39/Plate 40/ Plate 41	Battery support wiring branch
46	Plate 35/Plate 36	Fuse
47	Plate 36	Contactor/battery positive terminal cable
48	Plate 37	Contactor connector
49	Plate 38	ECU earth
50	Plate 38	ECU connector (body)
51	Plate 38/Plate 41	ECU connector (engine)
52	Plate 39	Relay (injection and fans)
53	Plate 40	Wiring branch for sidestand switch connector
54	Plate 40	Regulator/main wiring harness connector
55	Plate 41	Battery negative
56	Plate 41	Pick-up connector
57	Plate 41	Earth connections union
58	Plate 41	Engine earth
59	Plate 42/Plate 43	Starter motor/contactor cable

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Plate 1

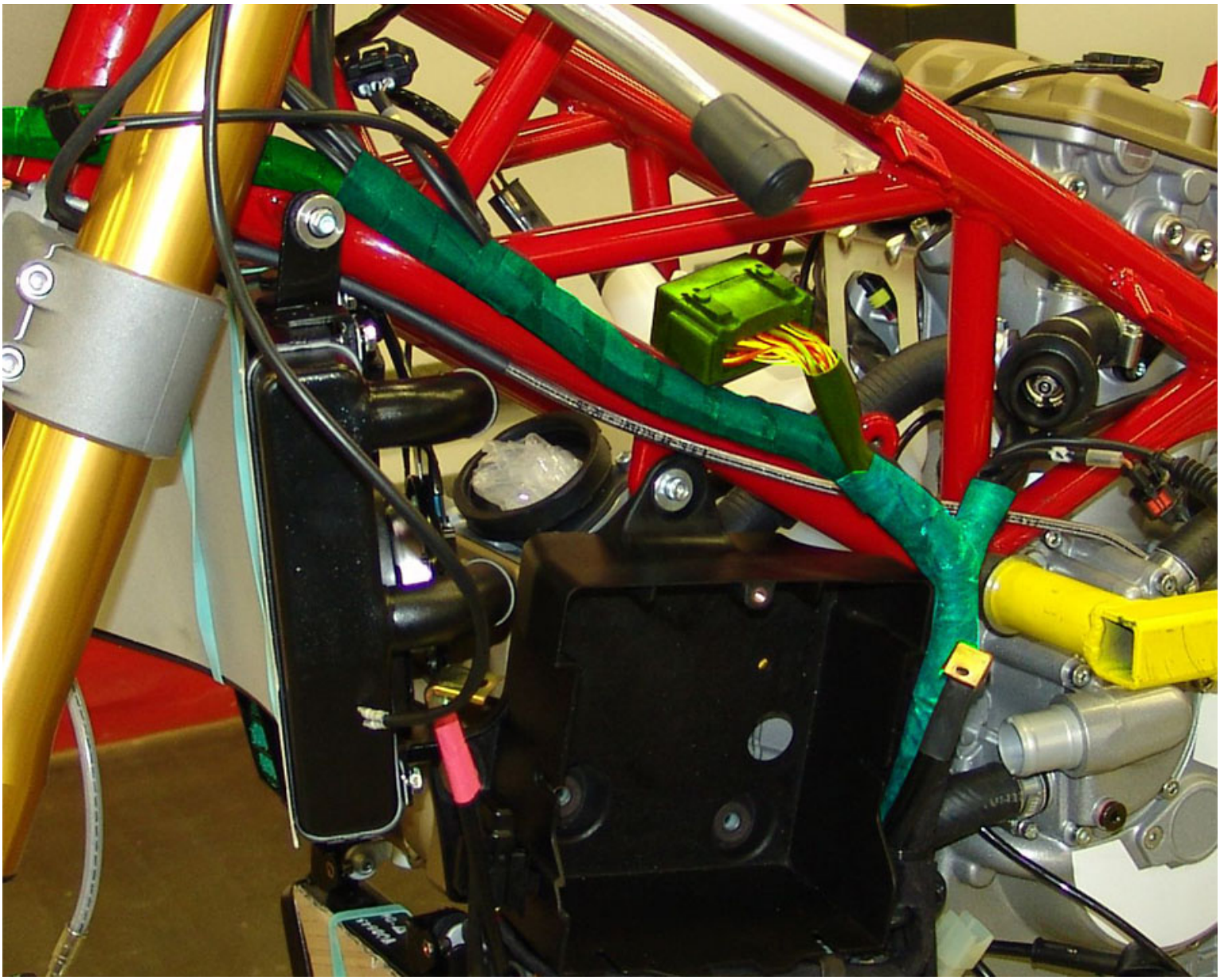

Plate 2

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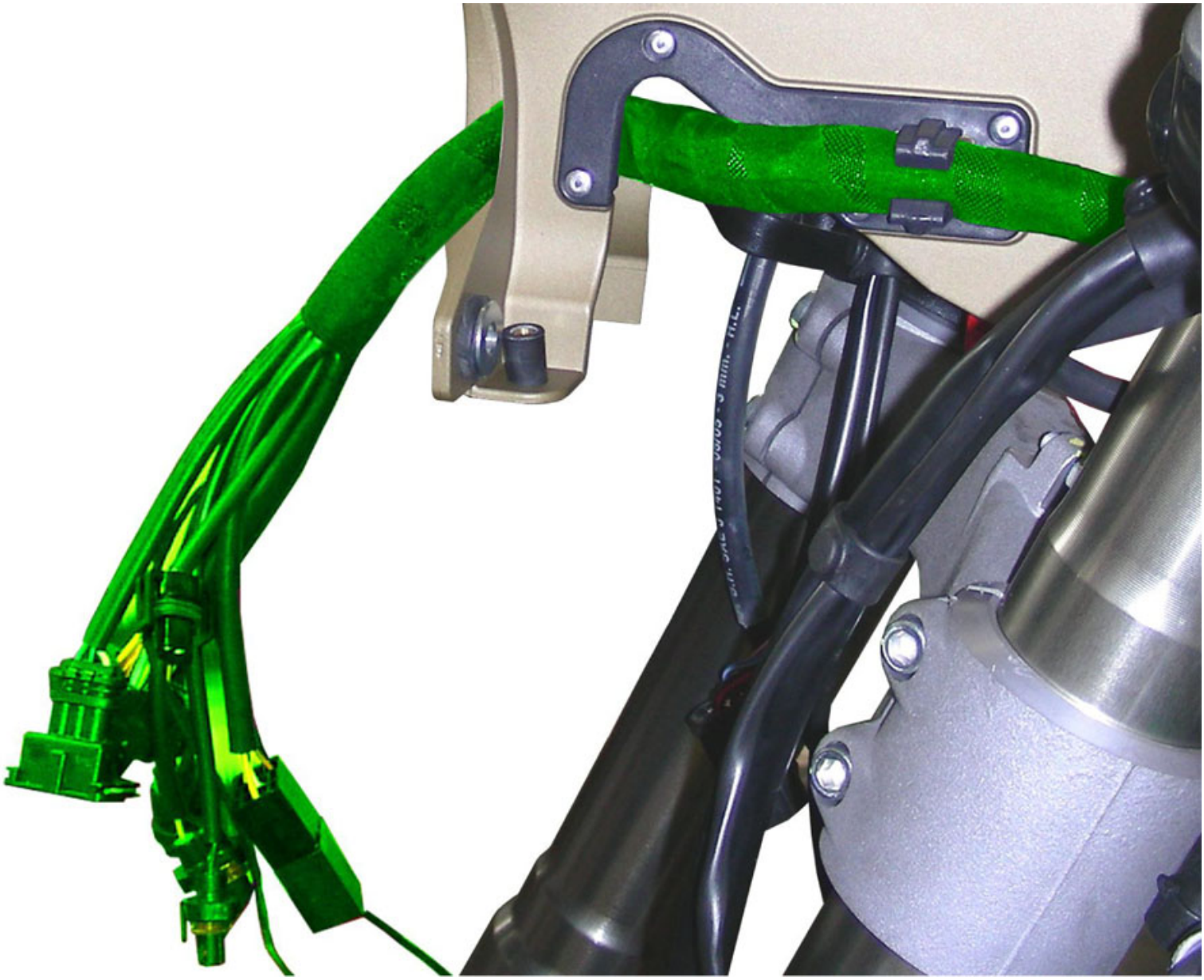

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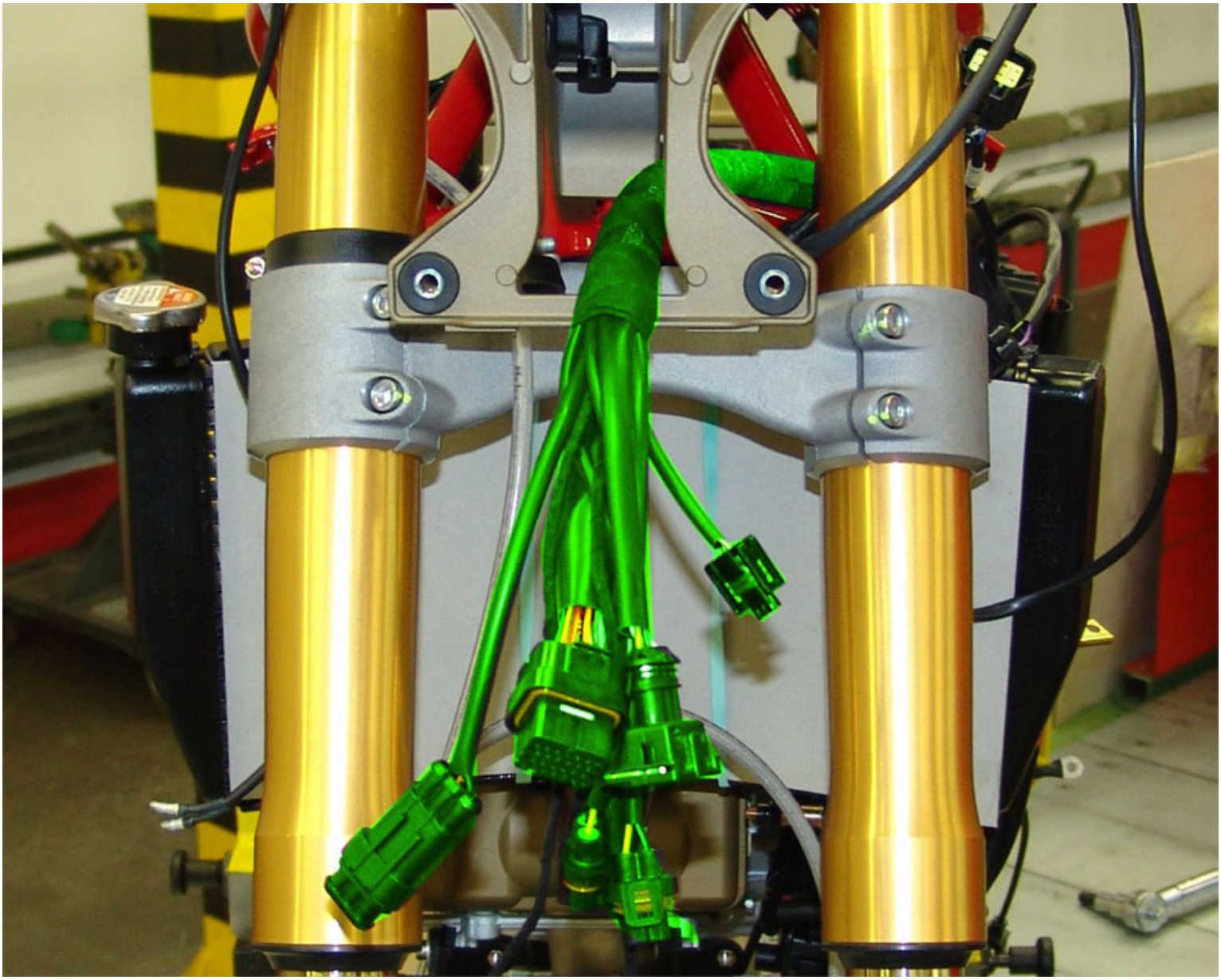

Plate 4

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Plate 5

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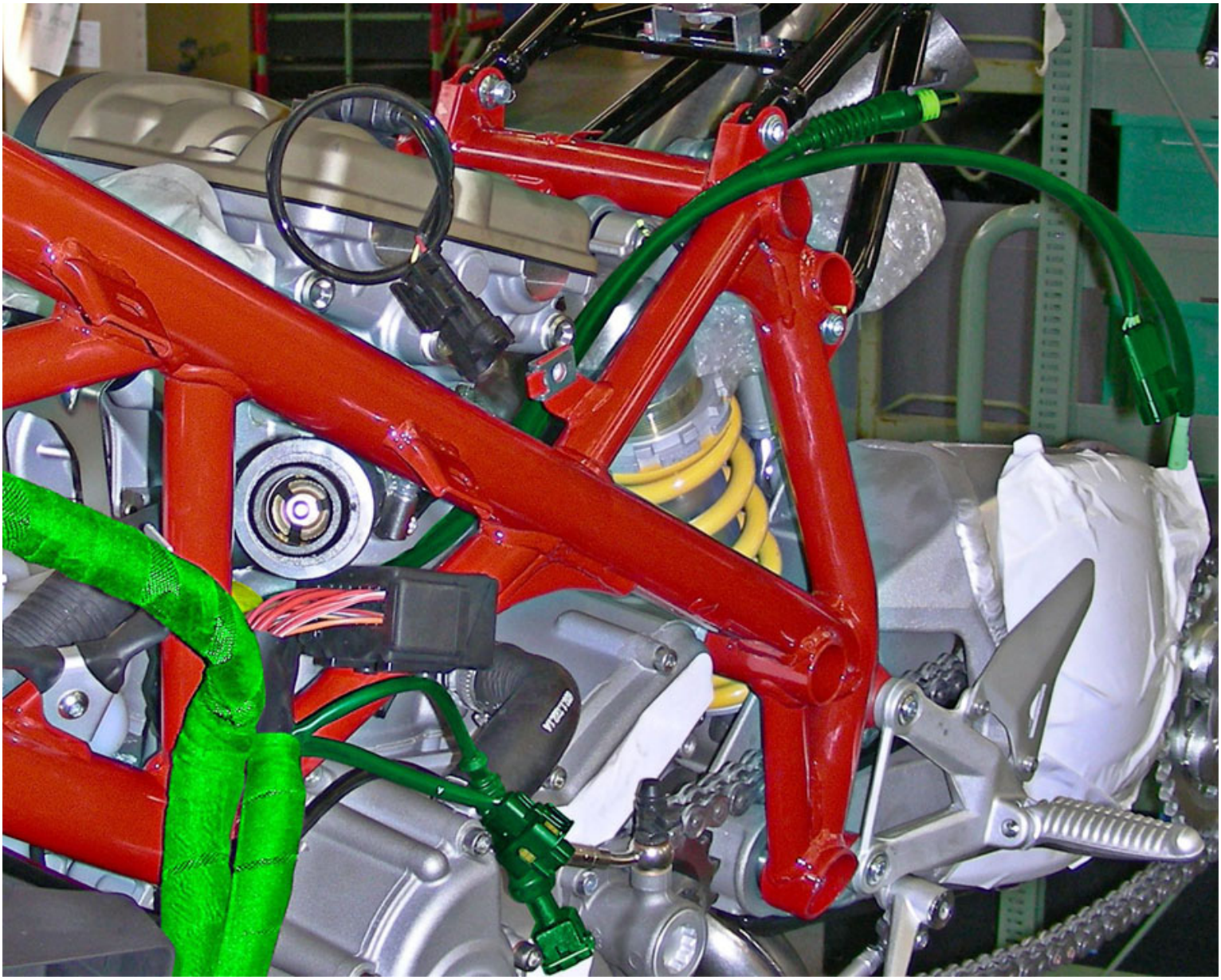
Plate 6

Plate 7



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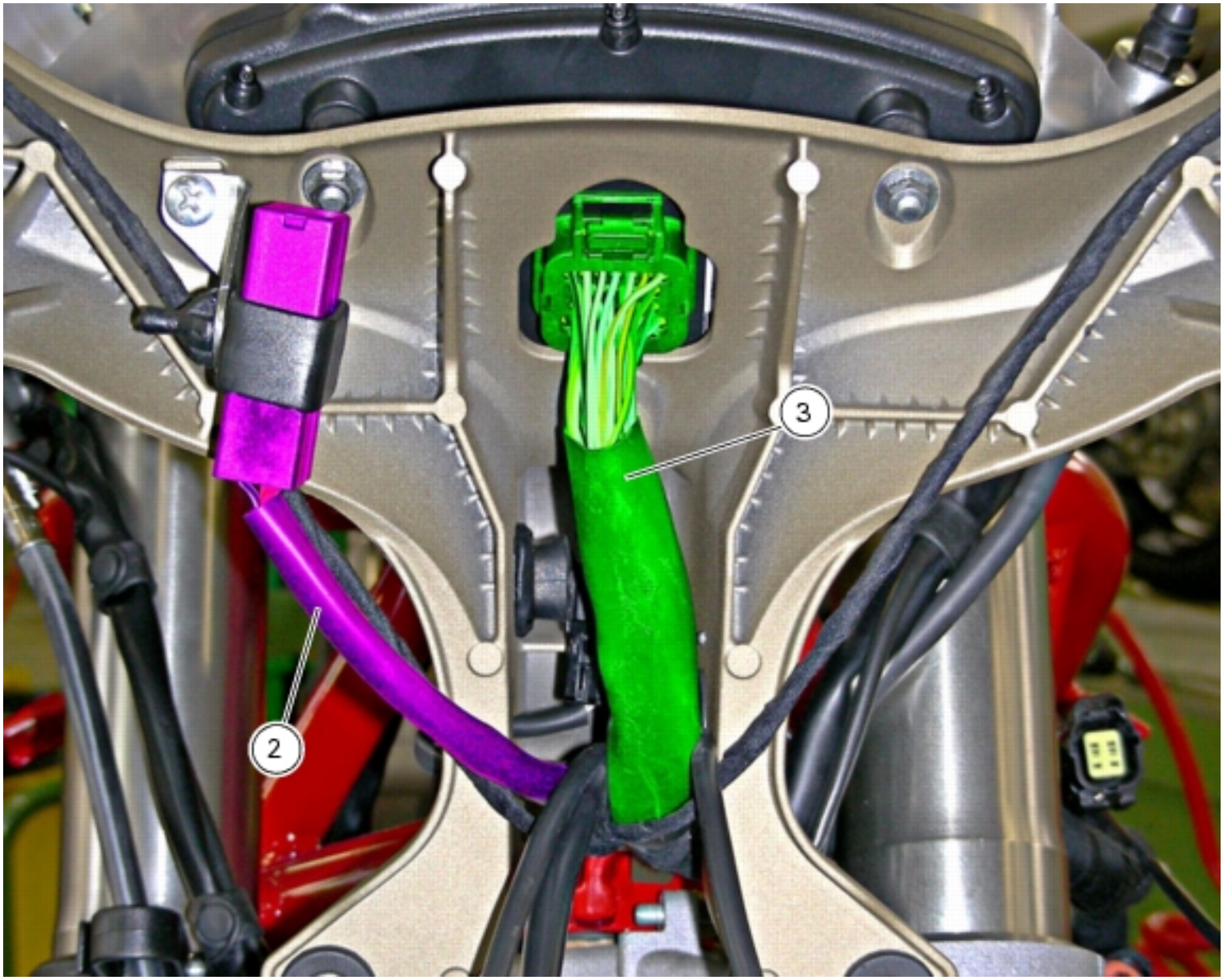

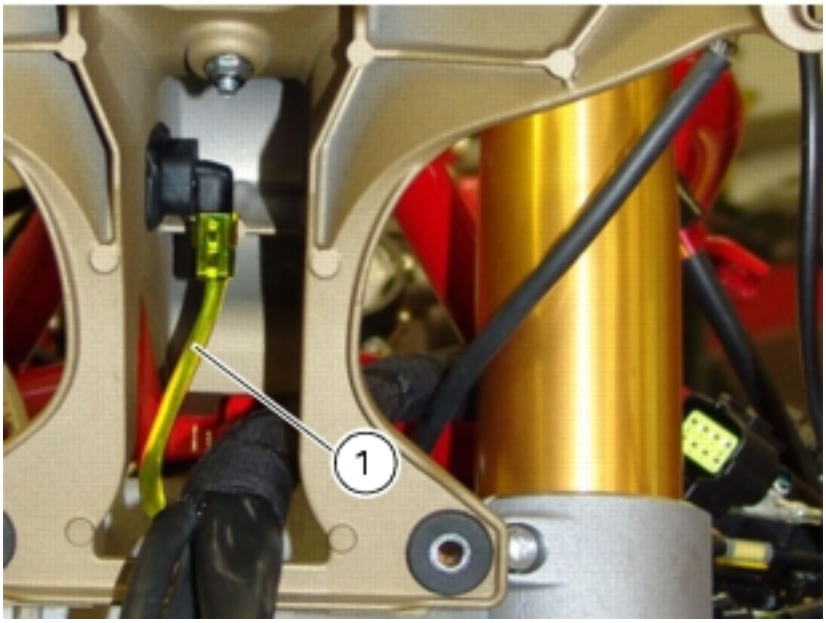

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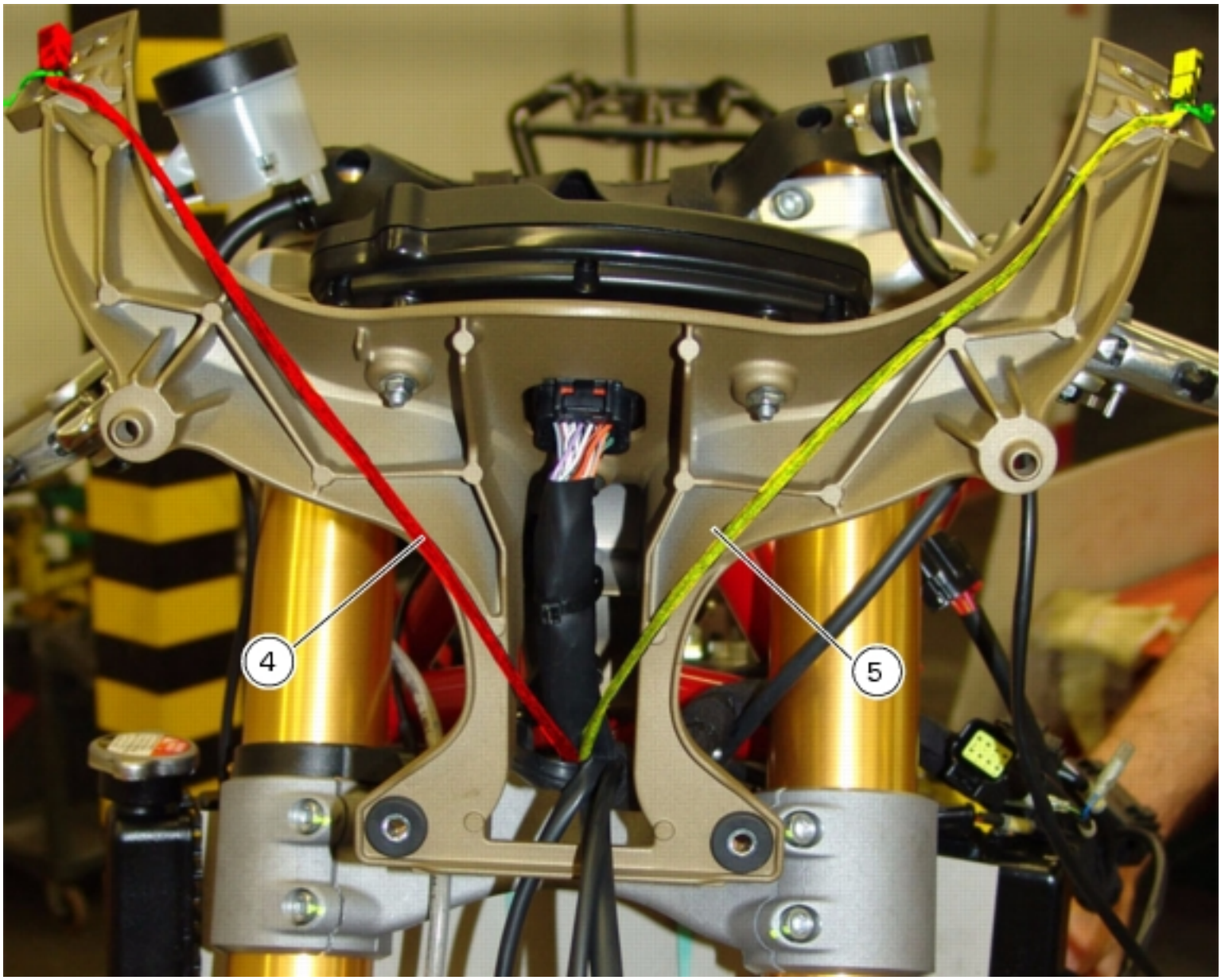

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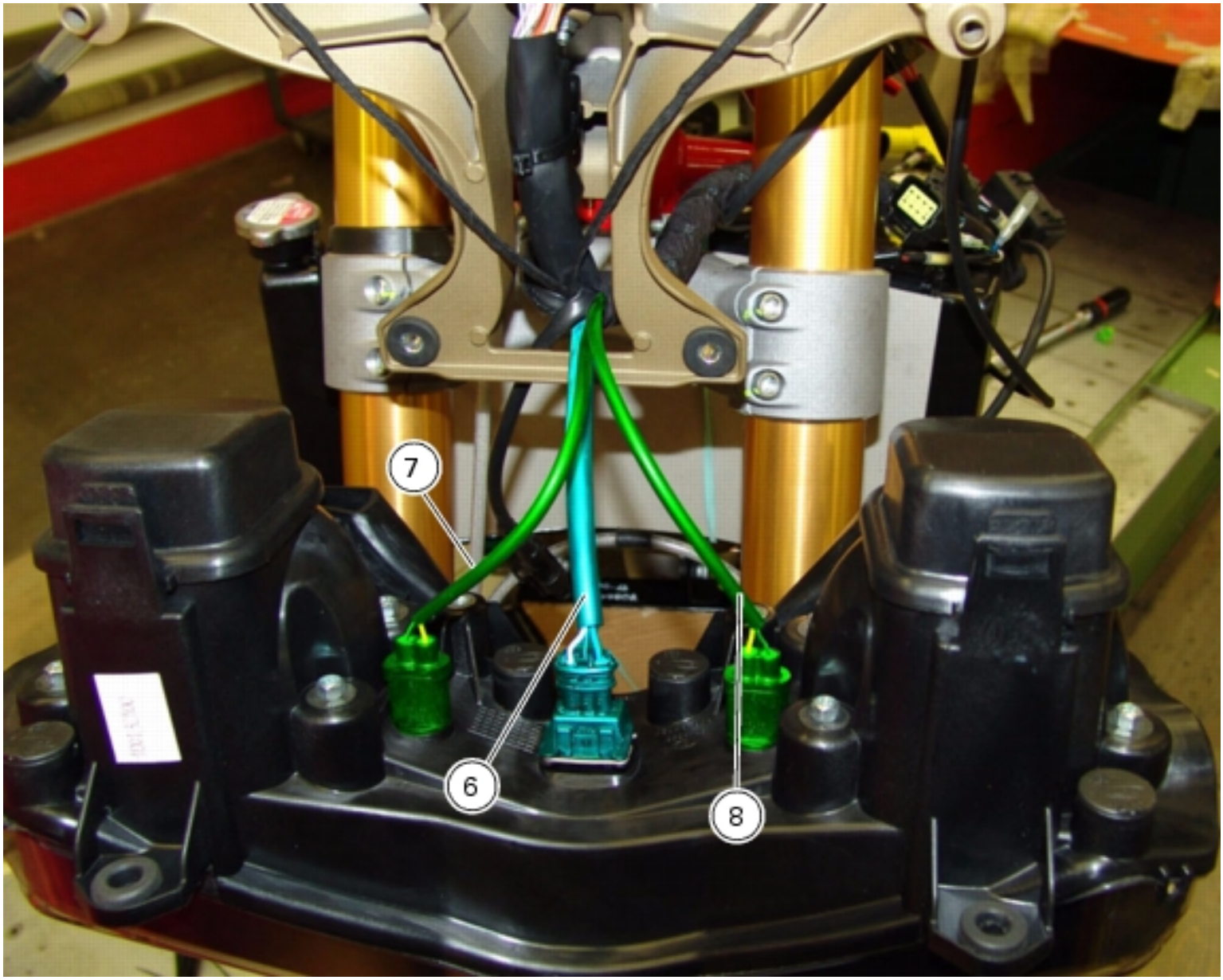

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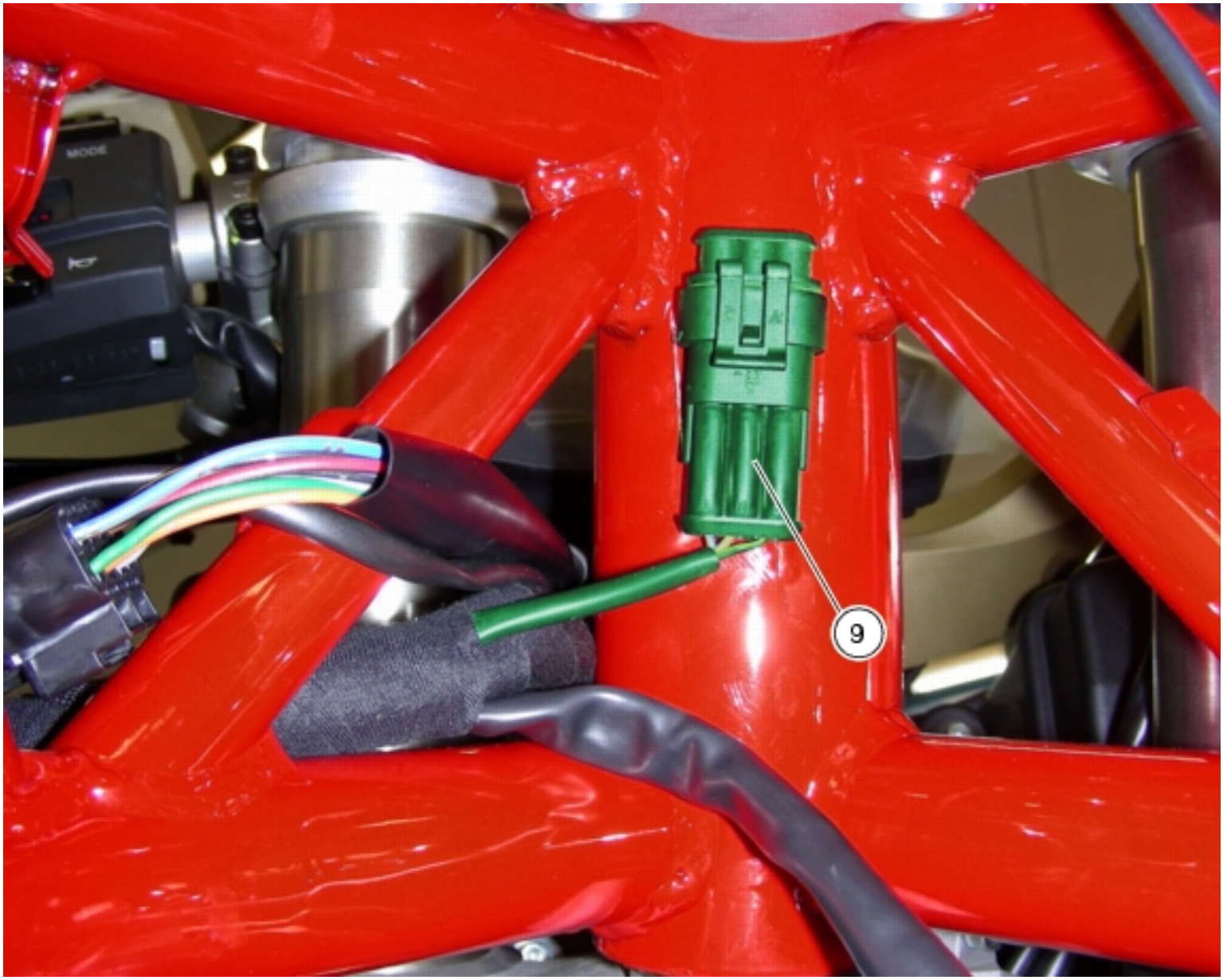

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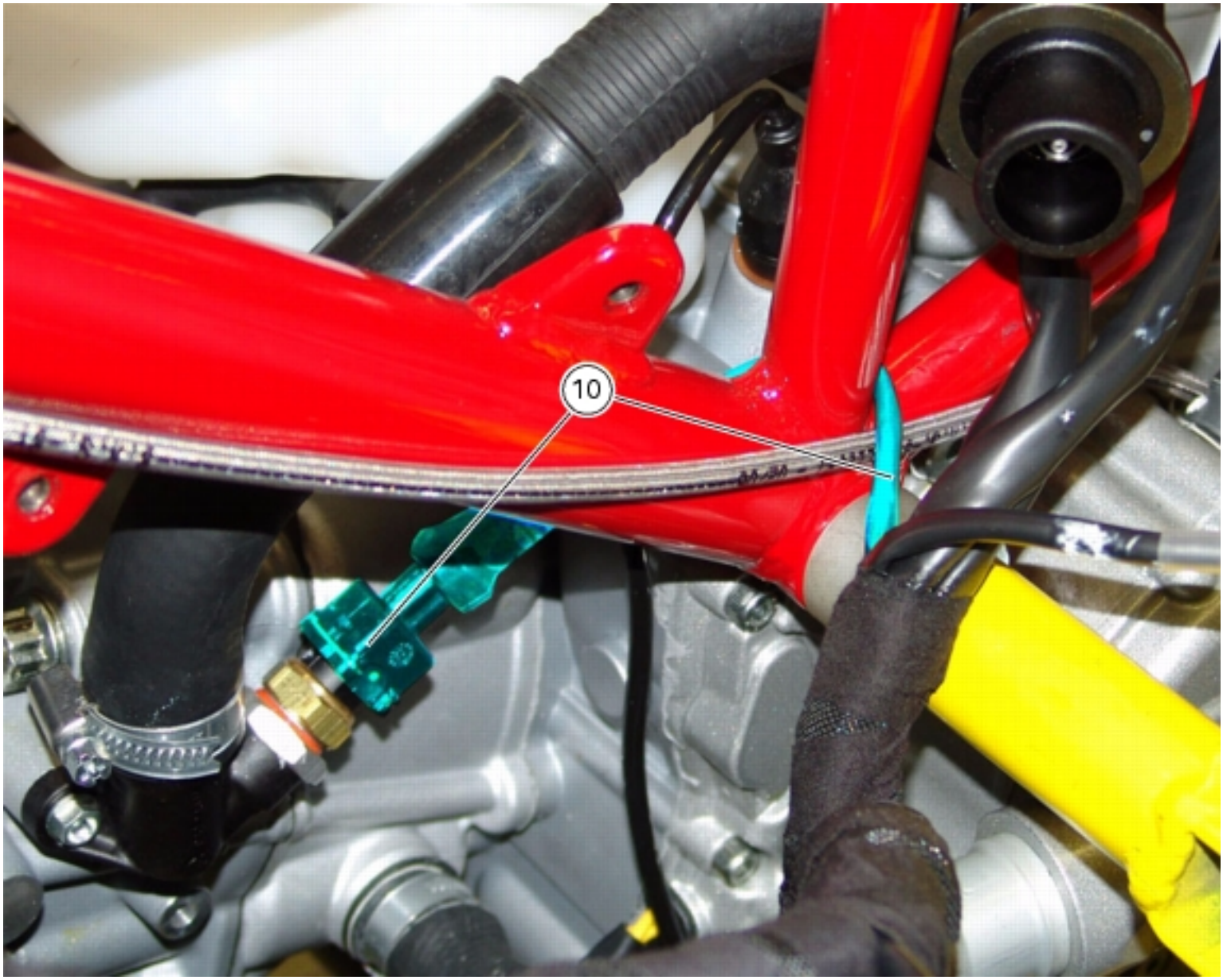

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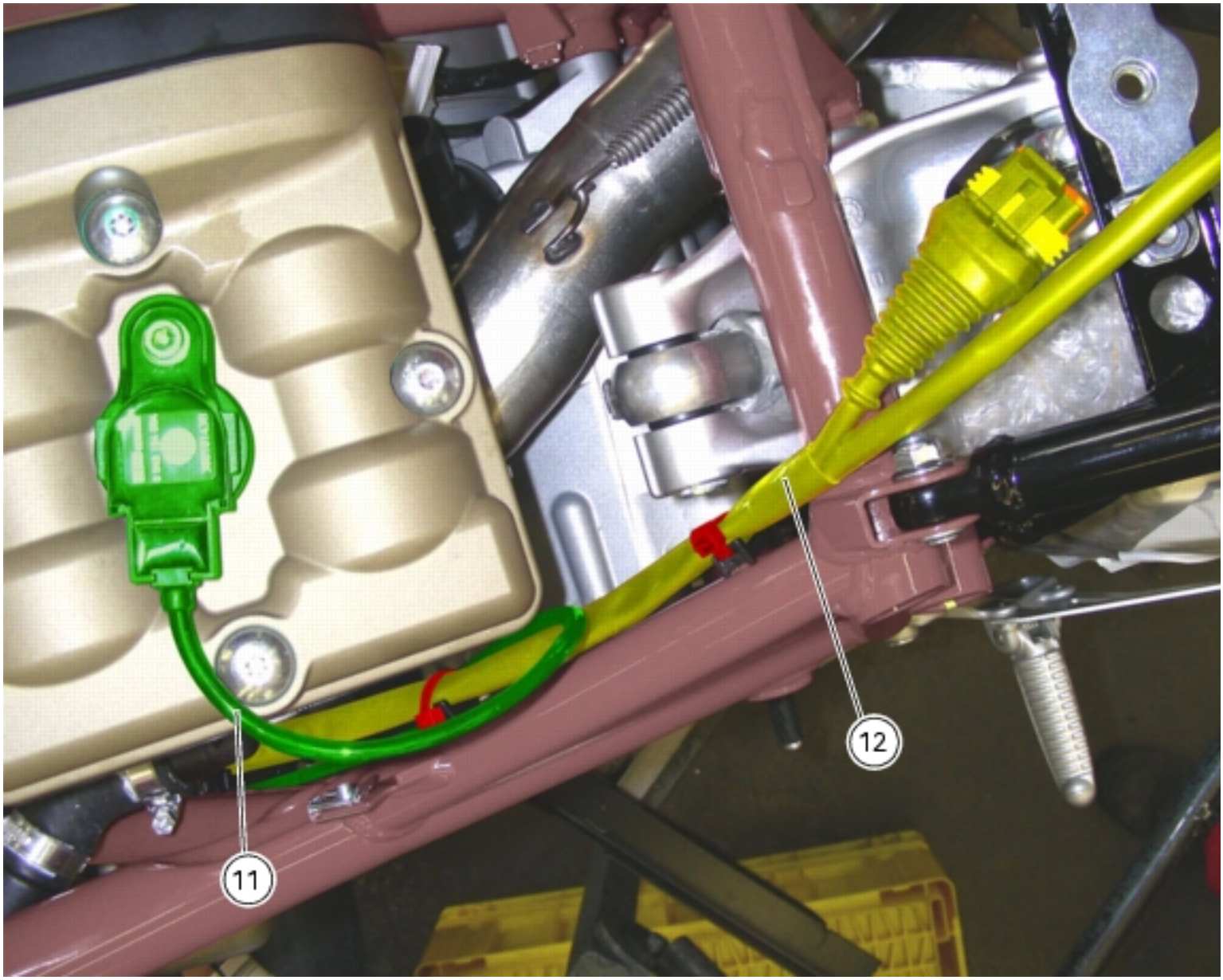

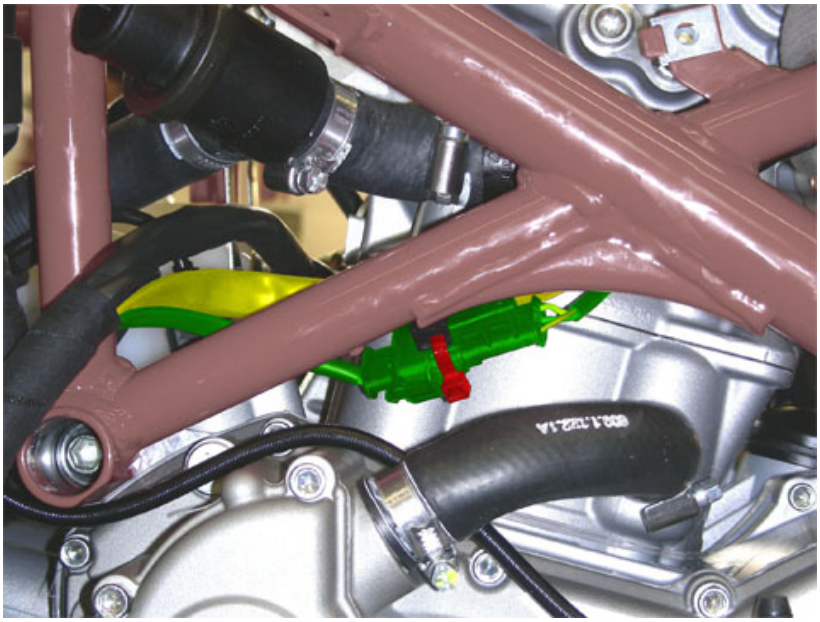

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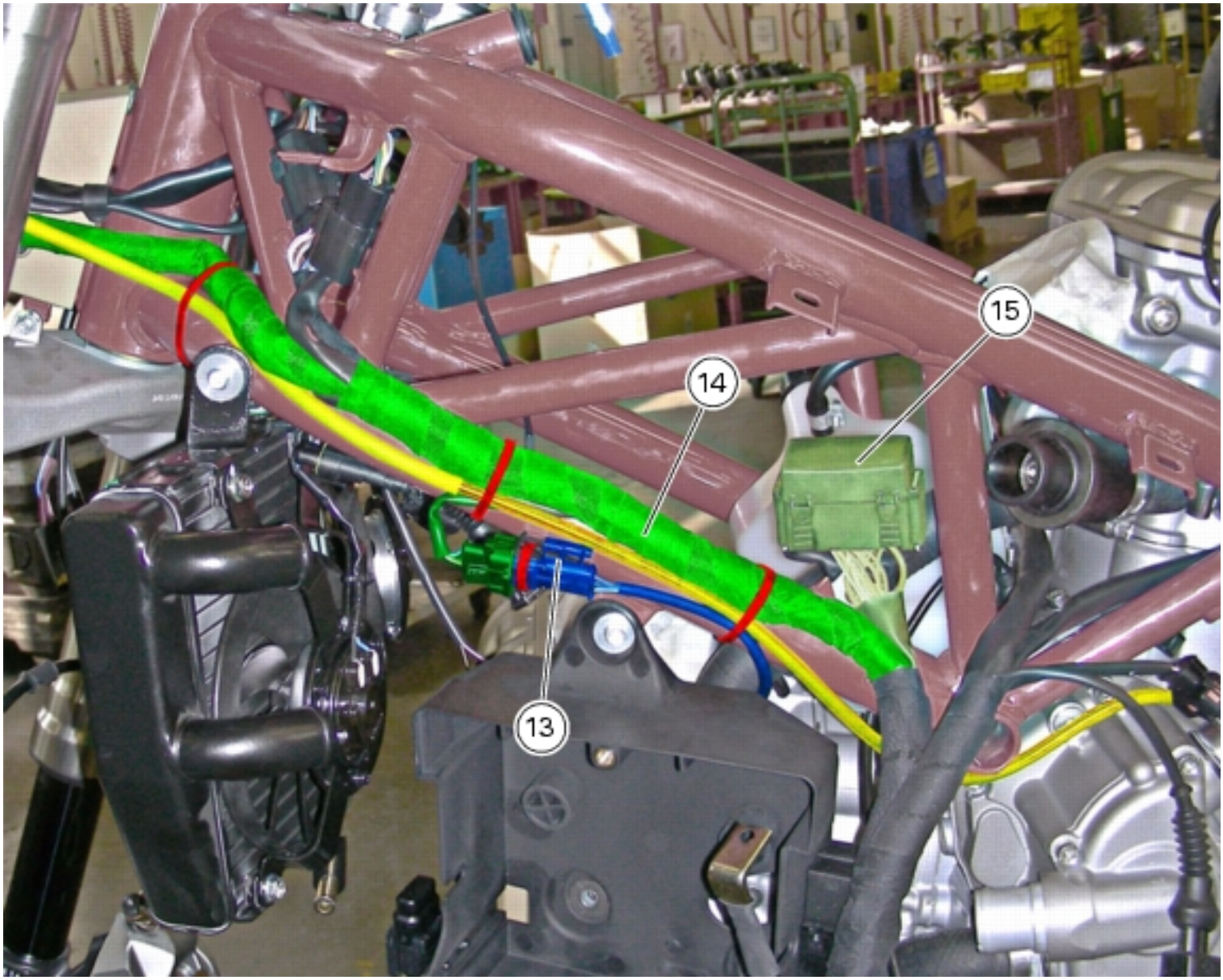
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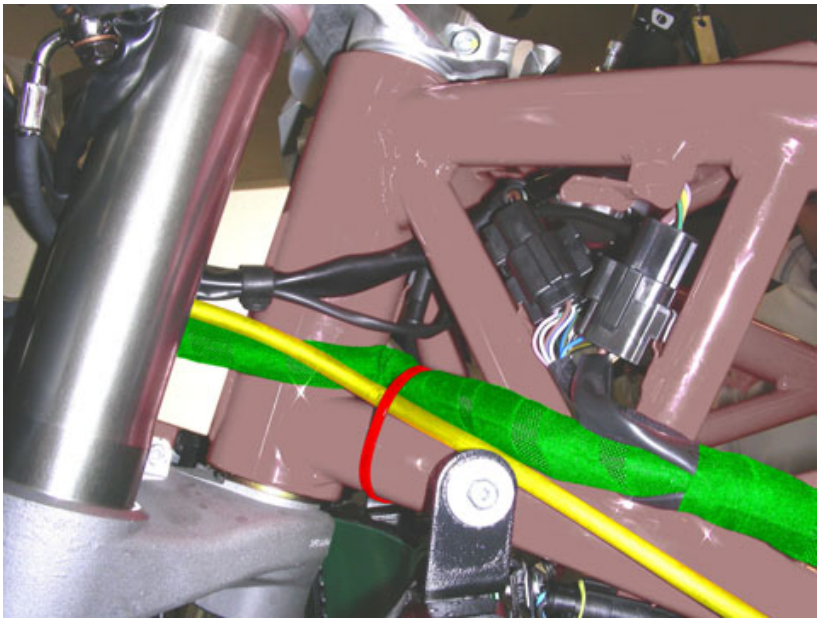

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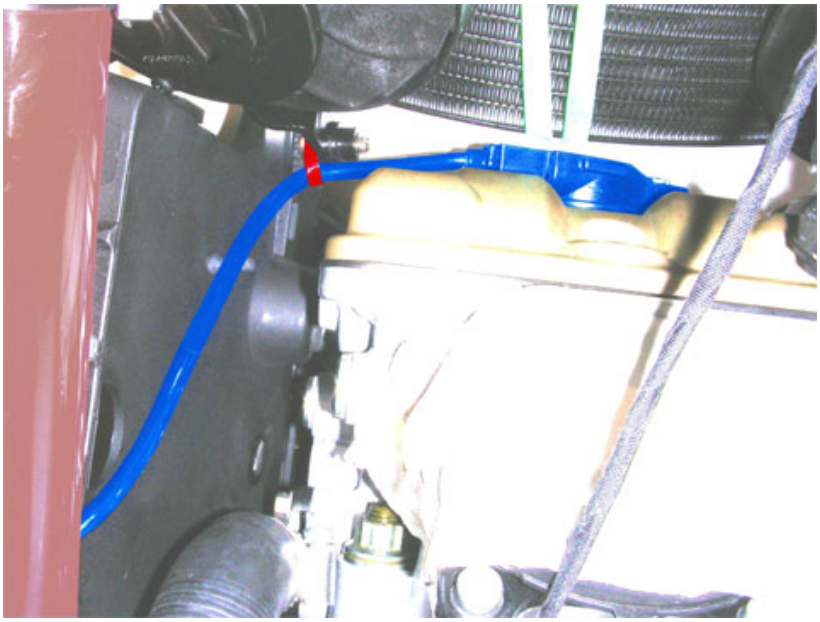

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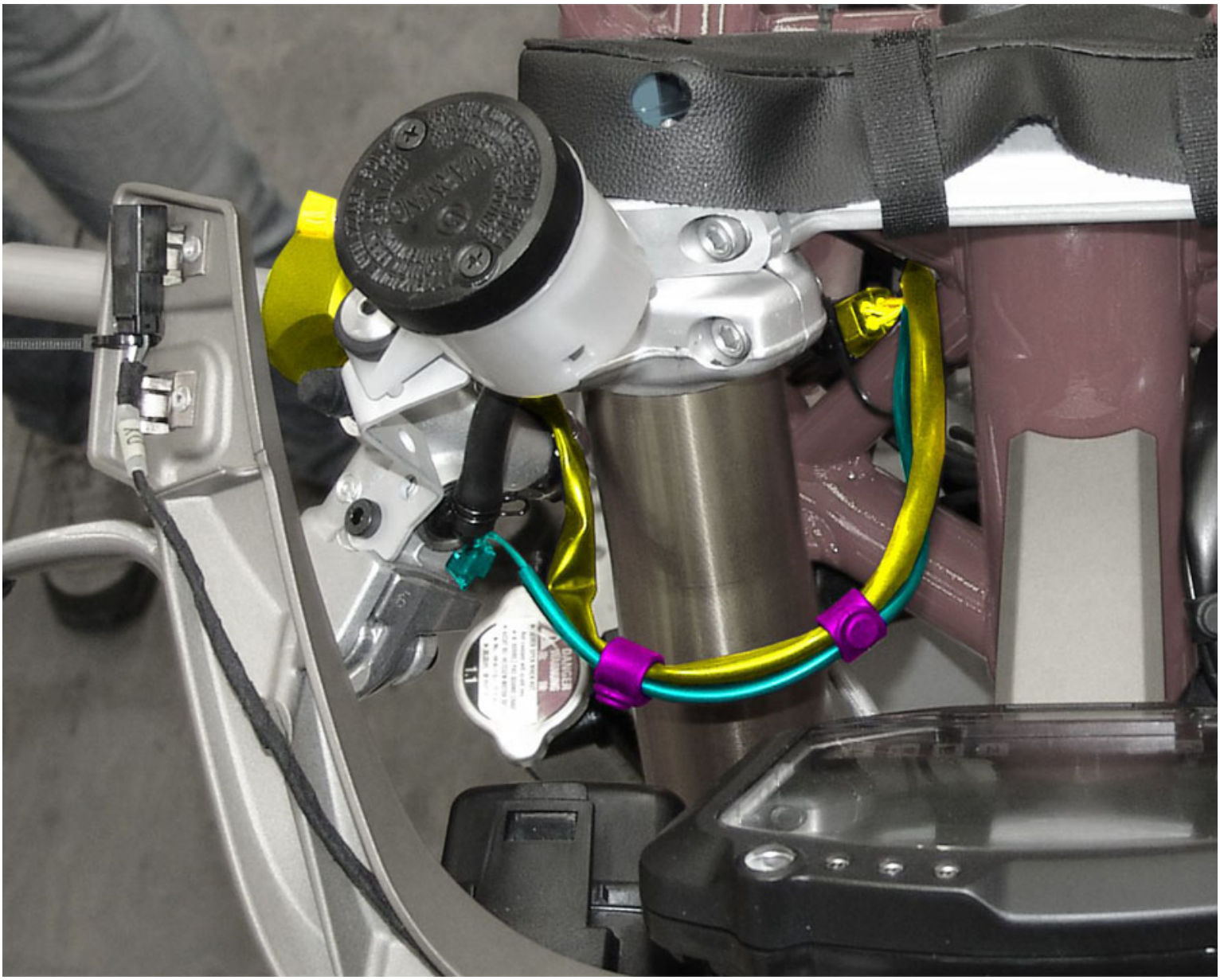

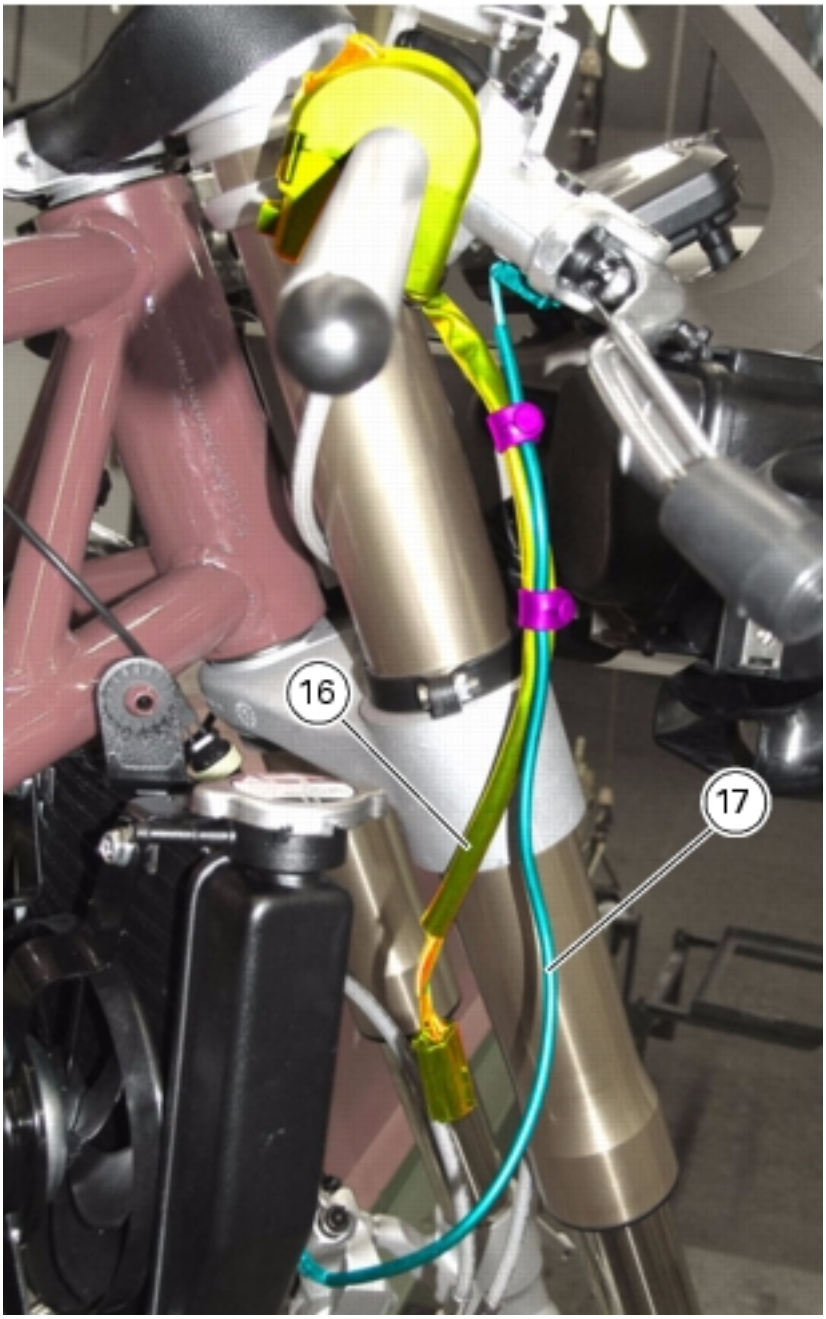

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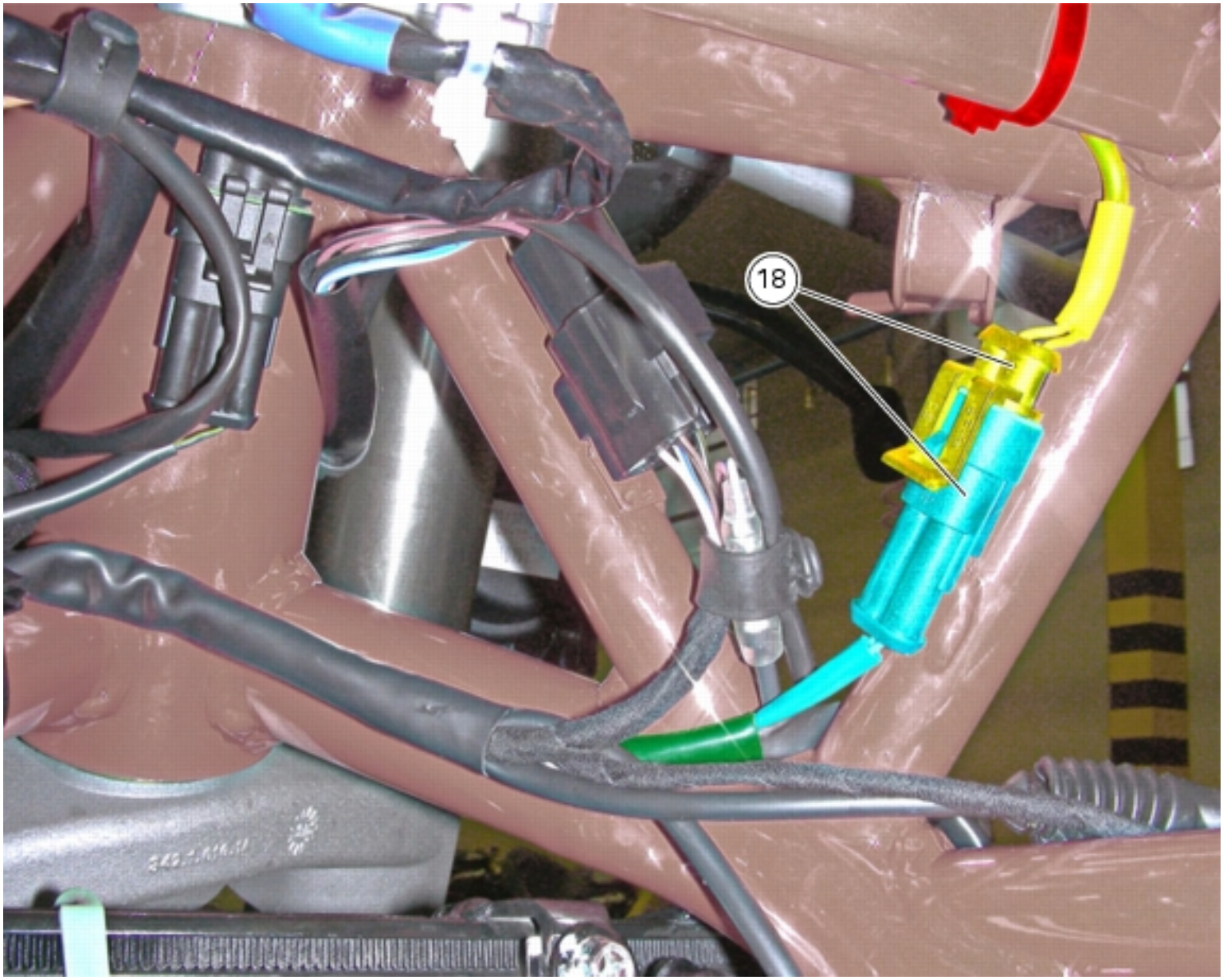

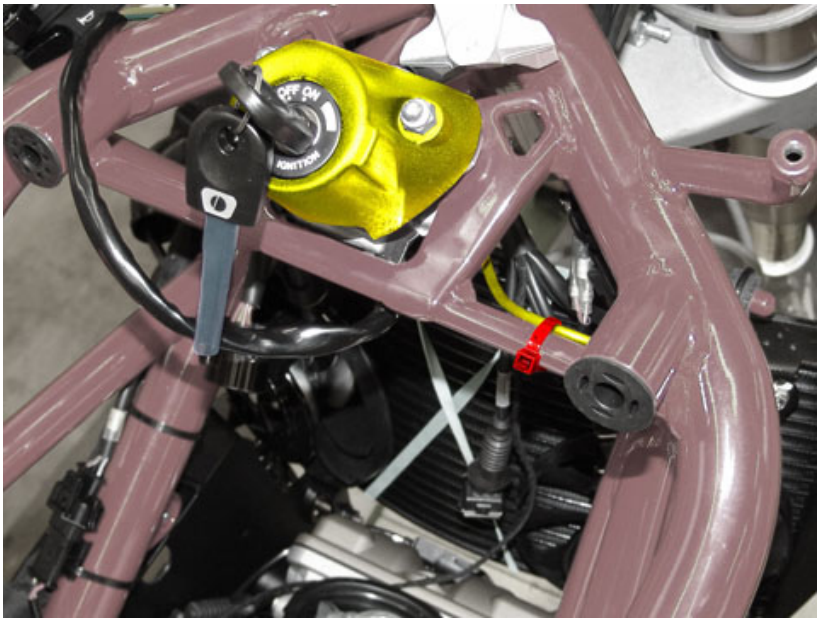

Plate 17

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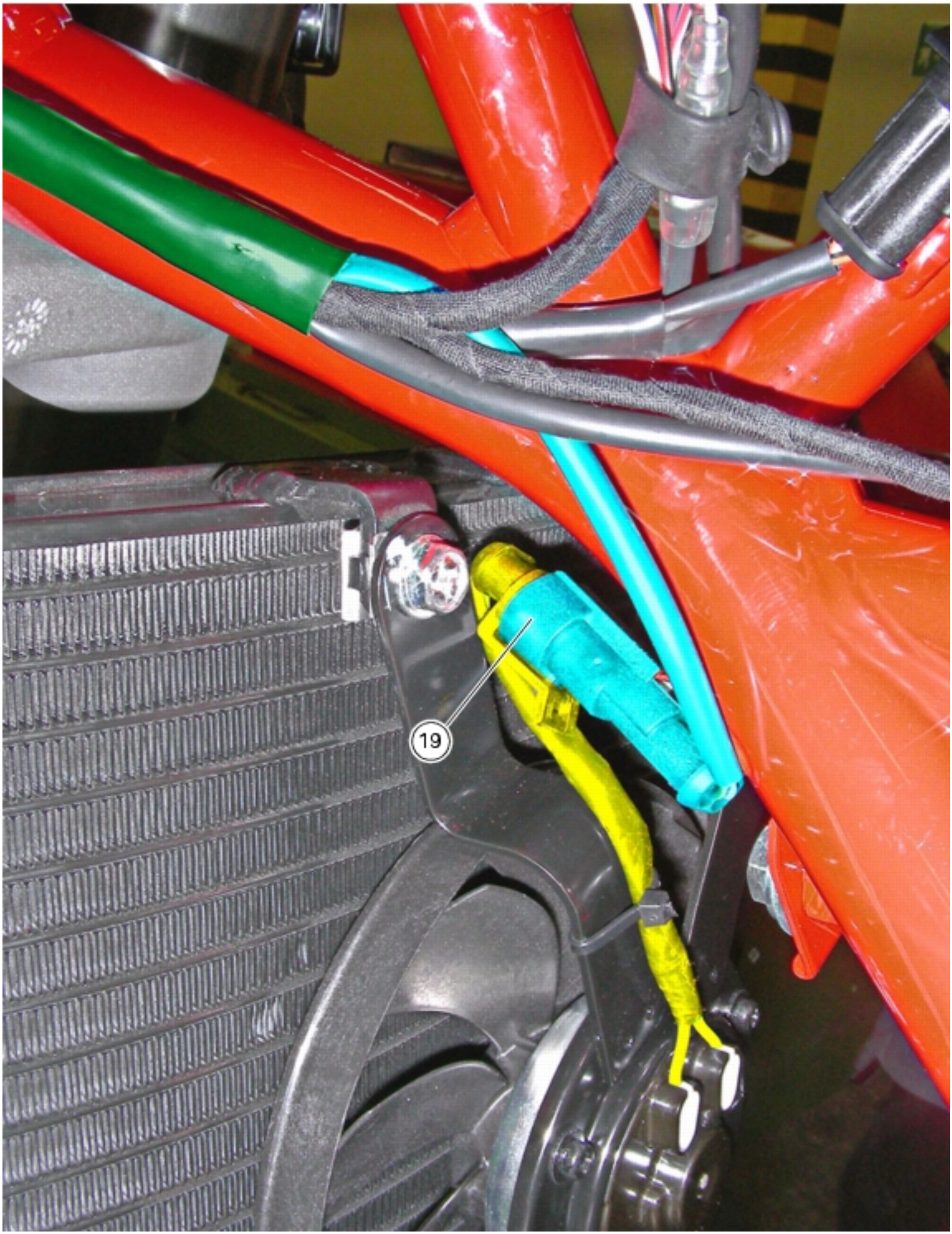

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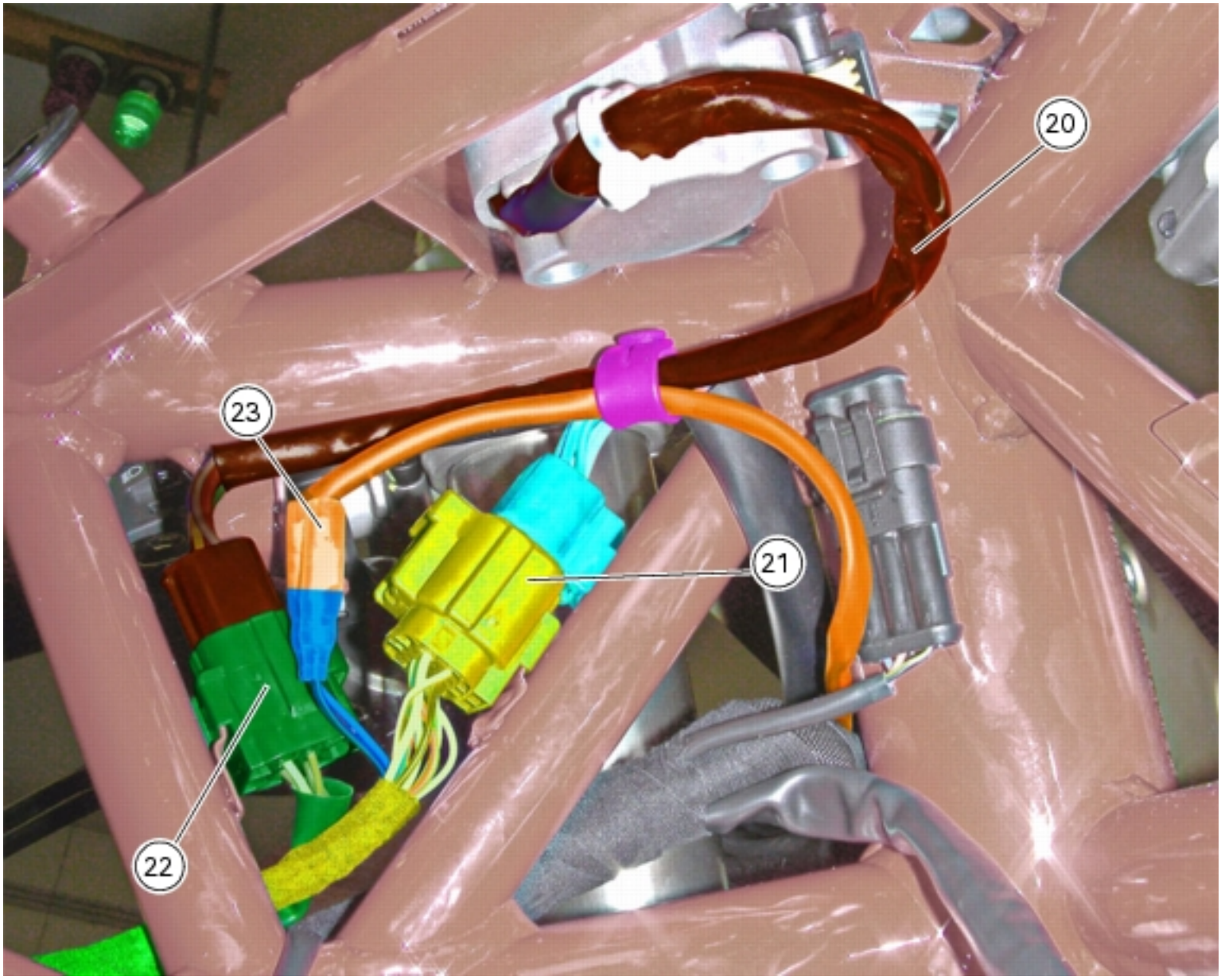
Plate 18



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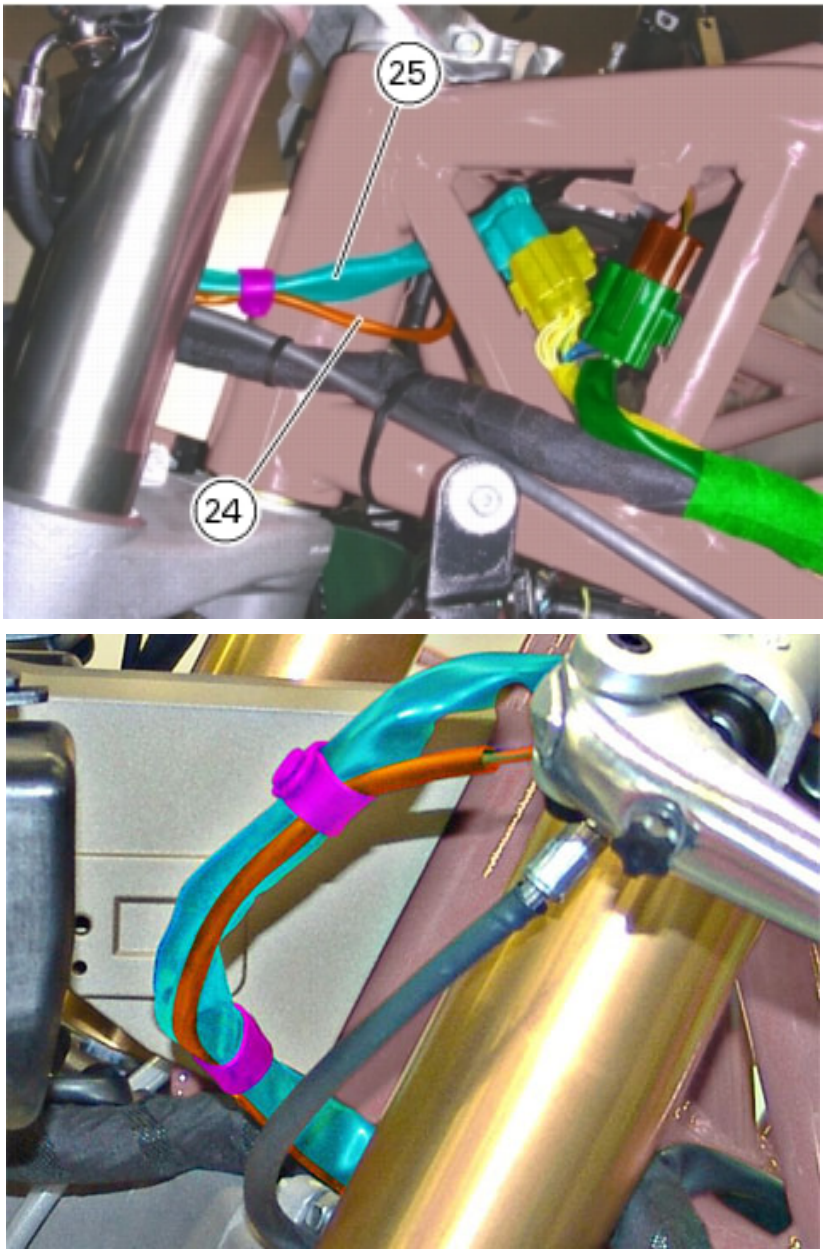

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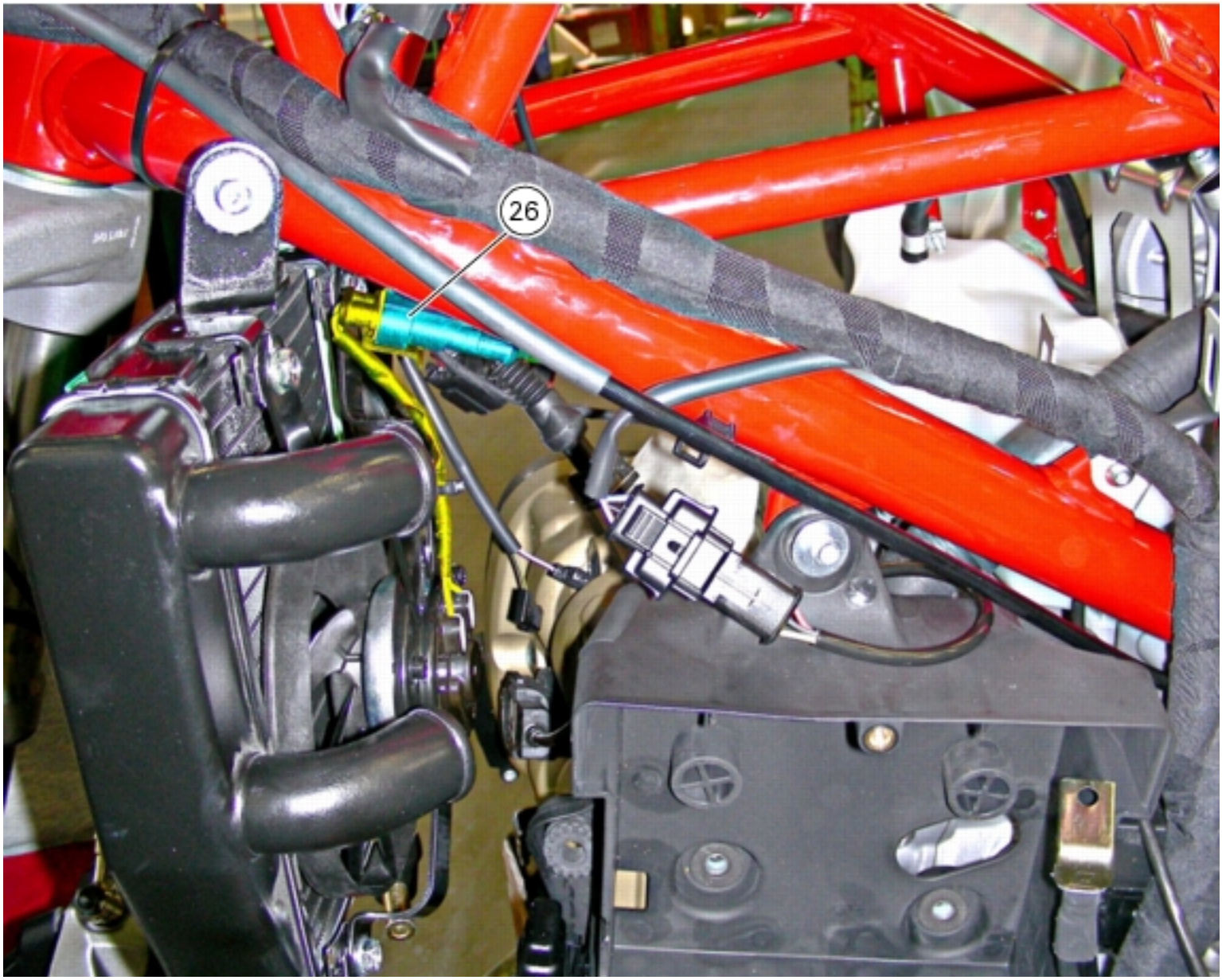
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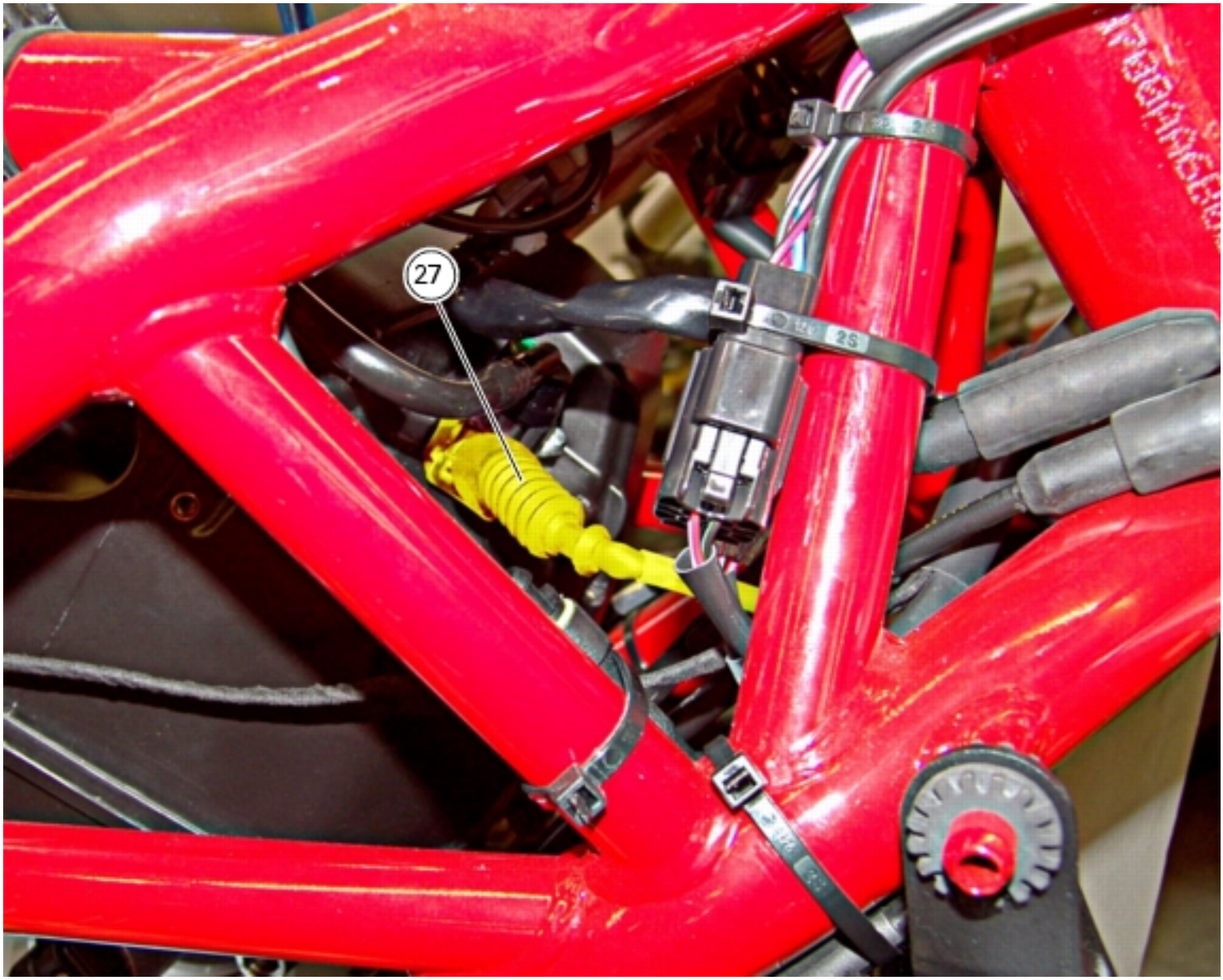

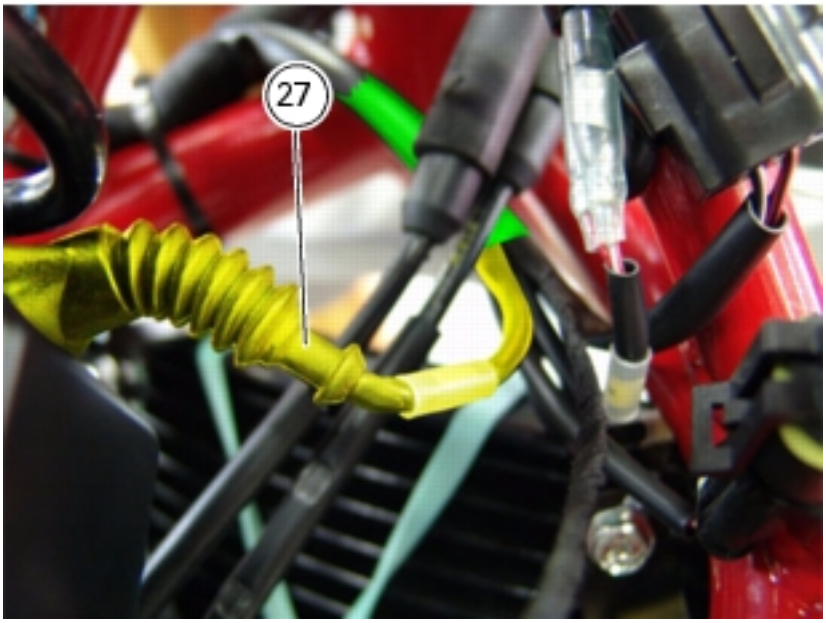

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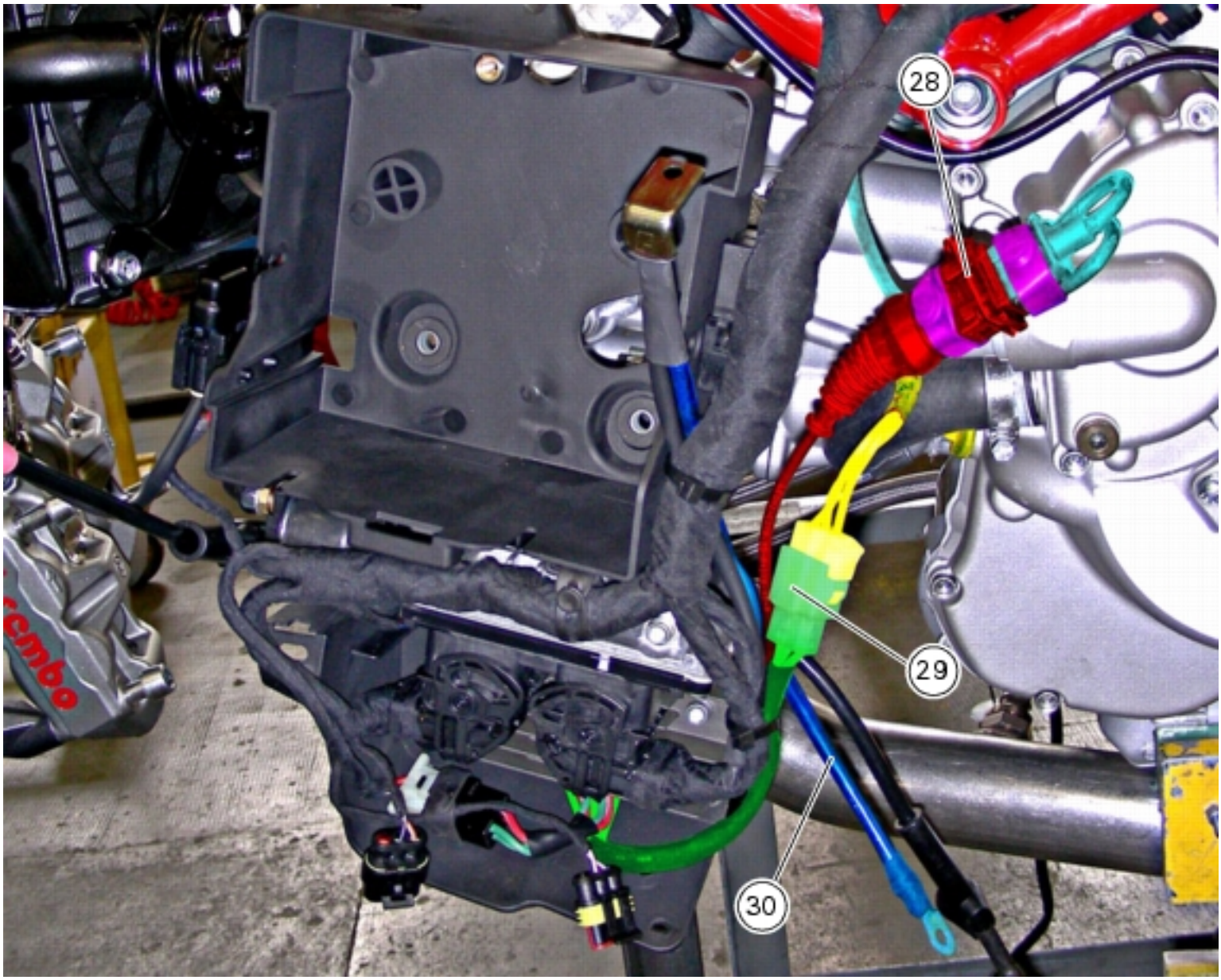
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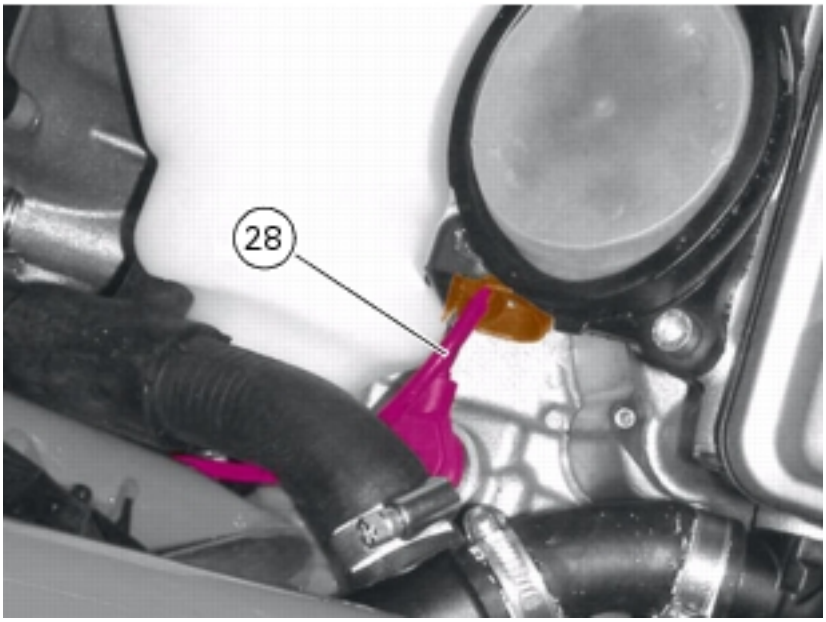
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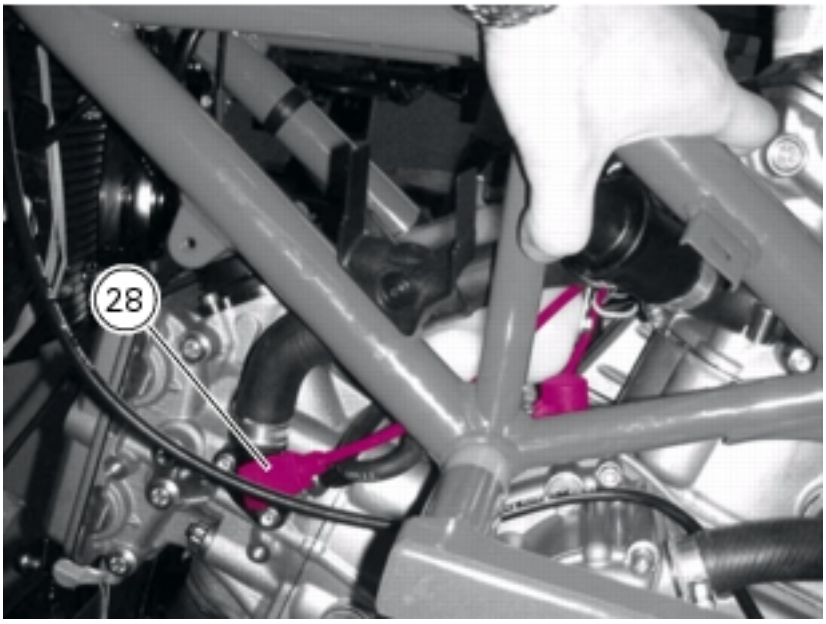

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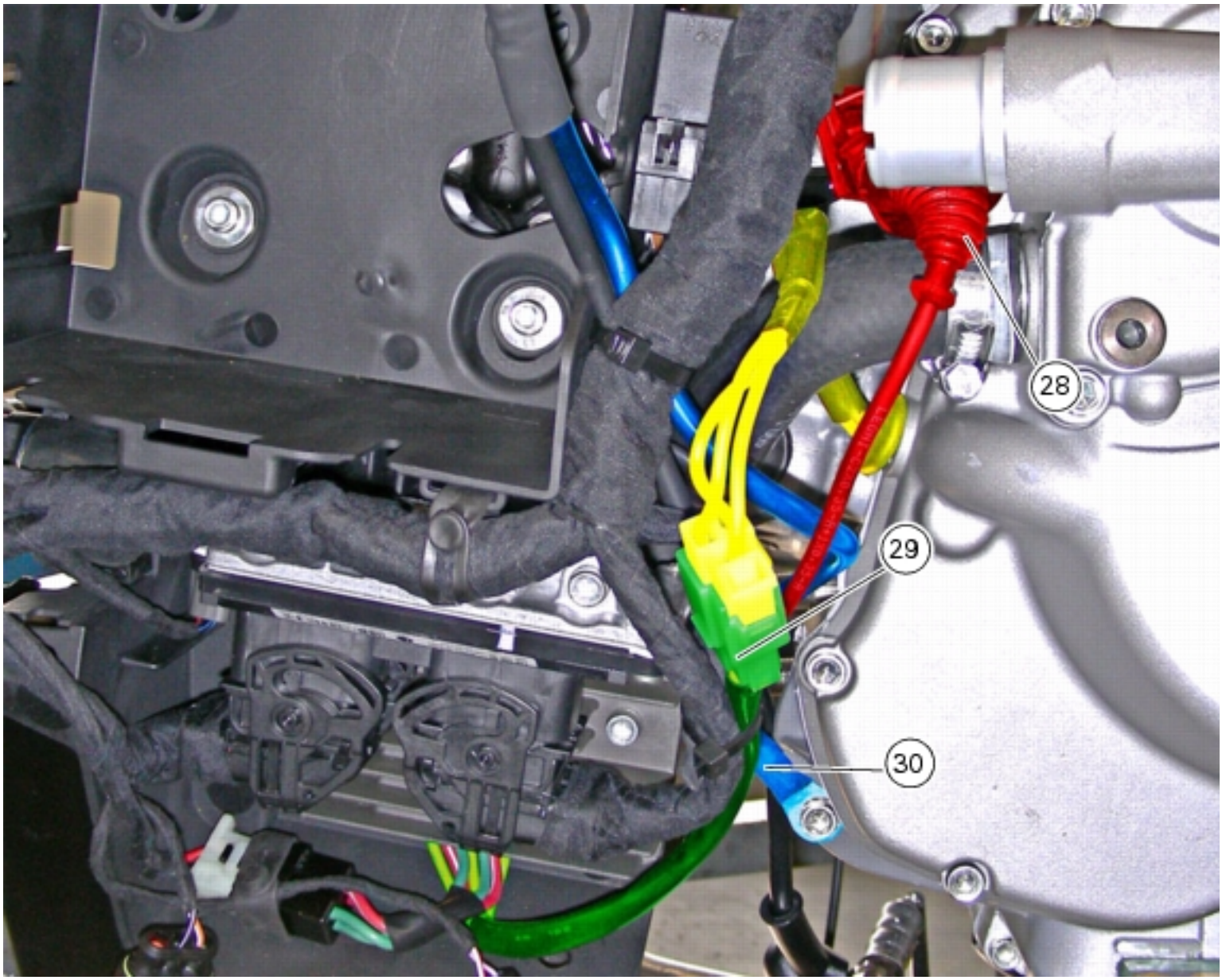

Plate 23

Plate 24

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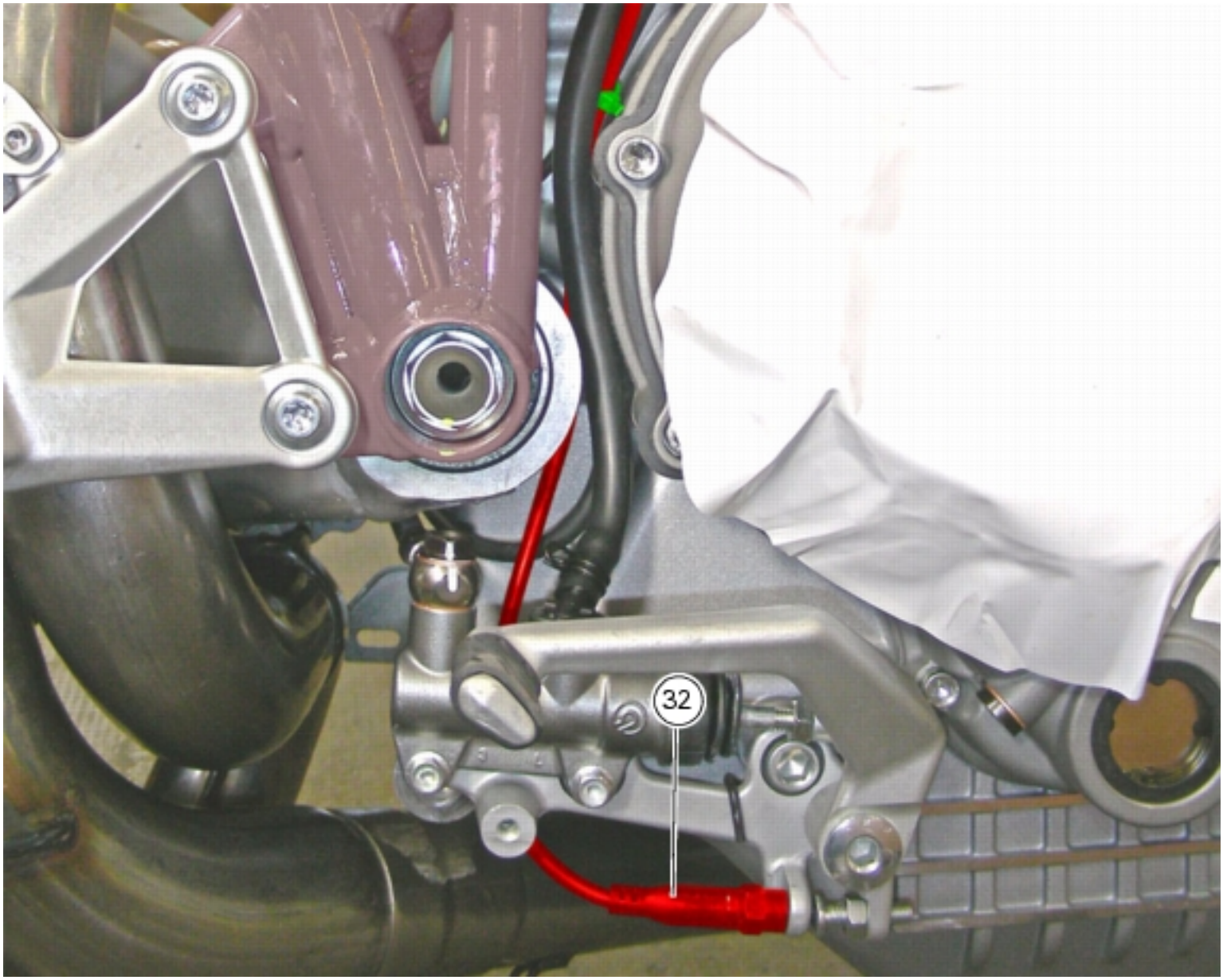

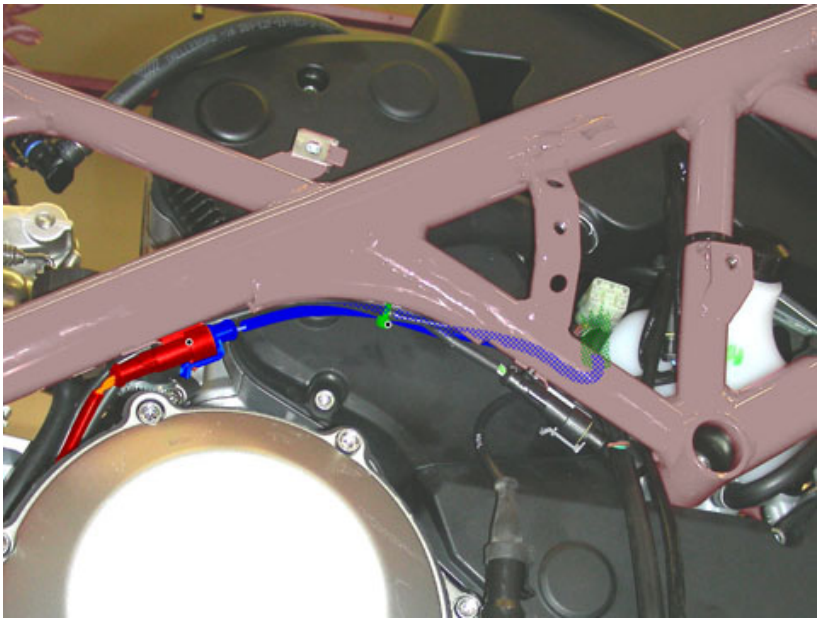

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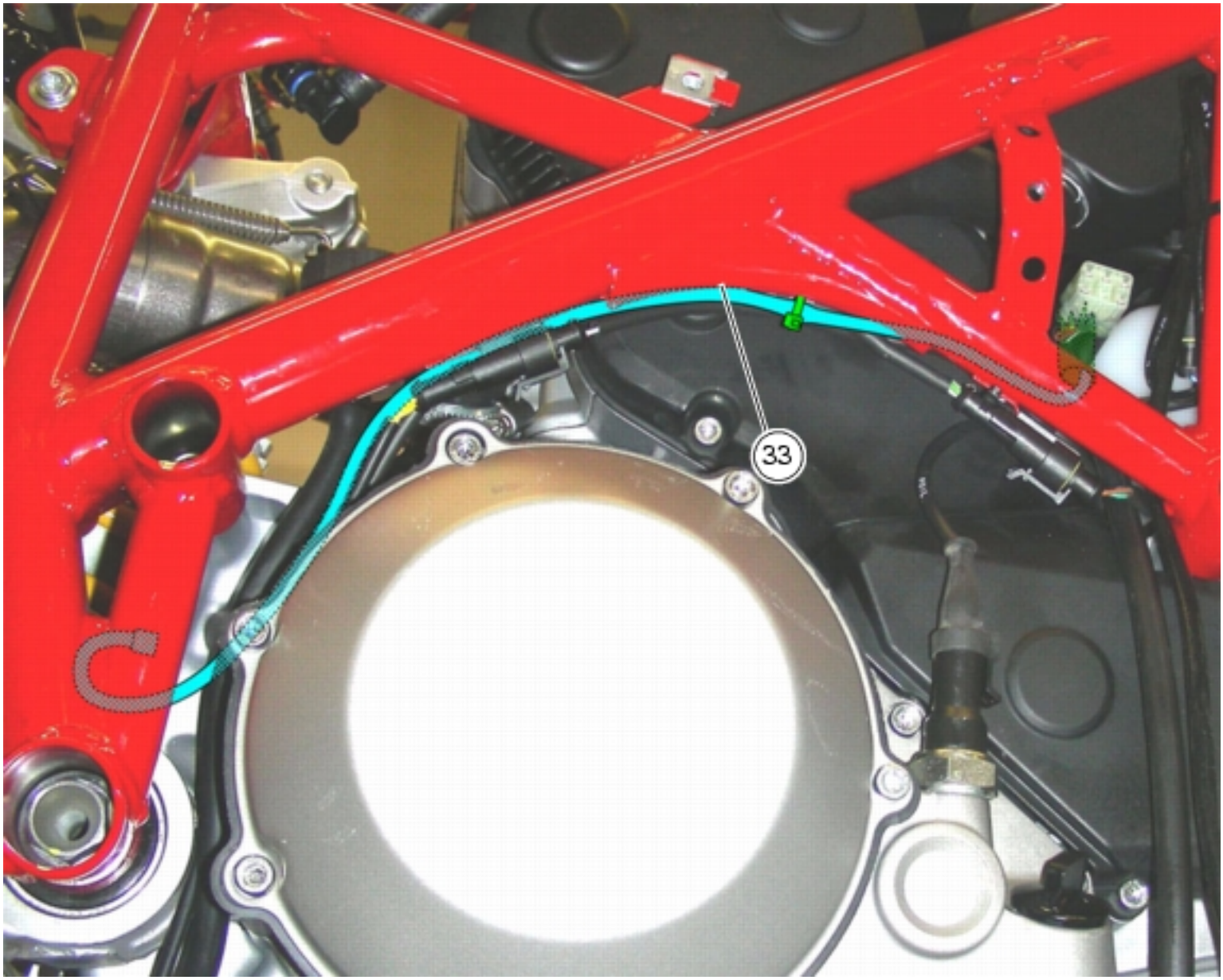

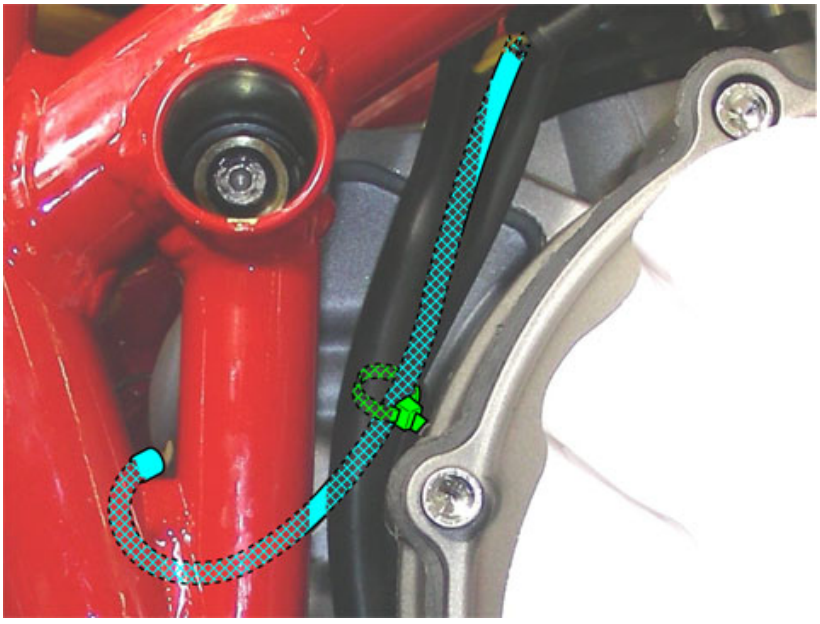

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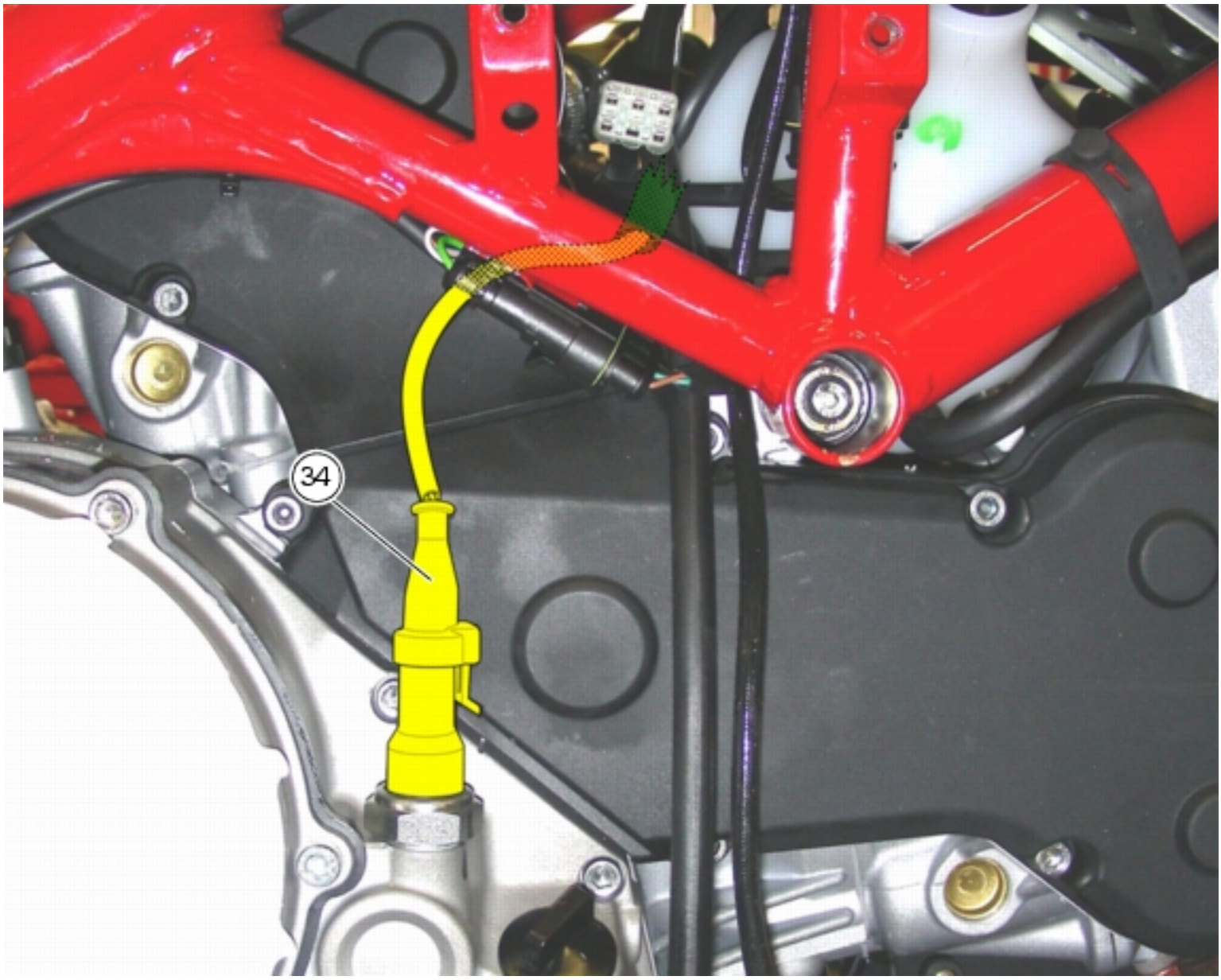

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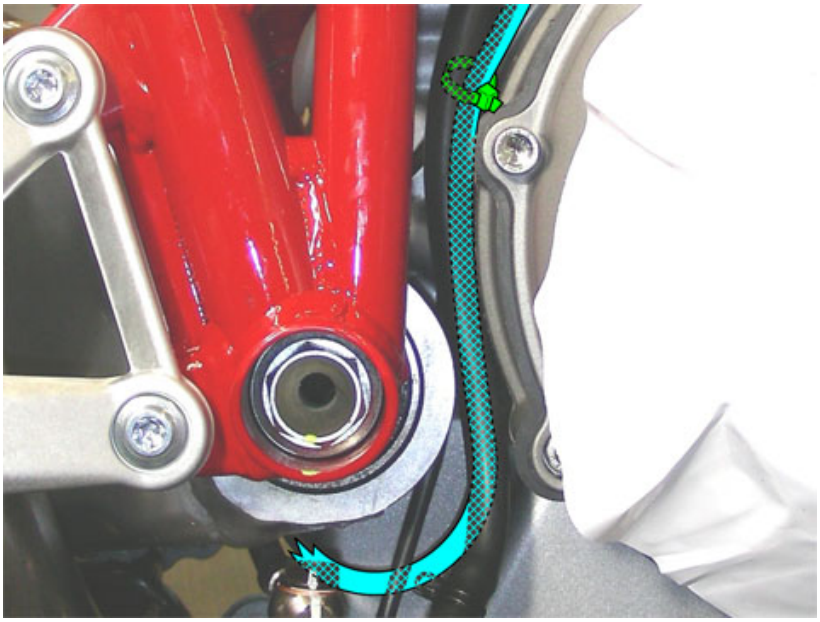

Plate 28

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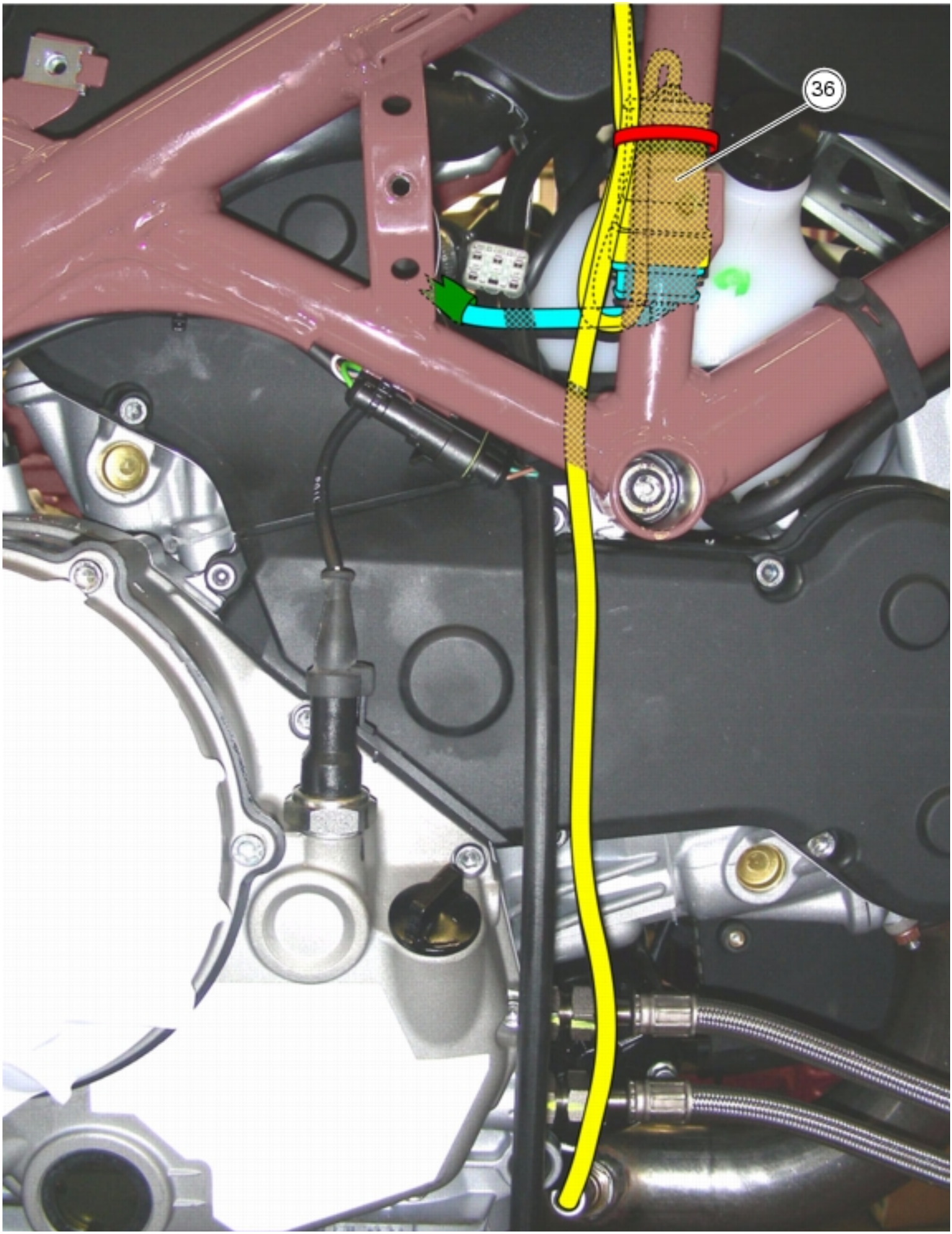

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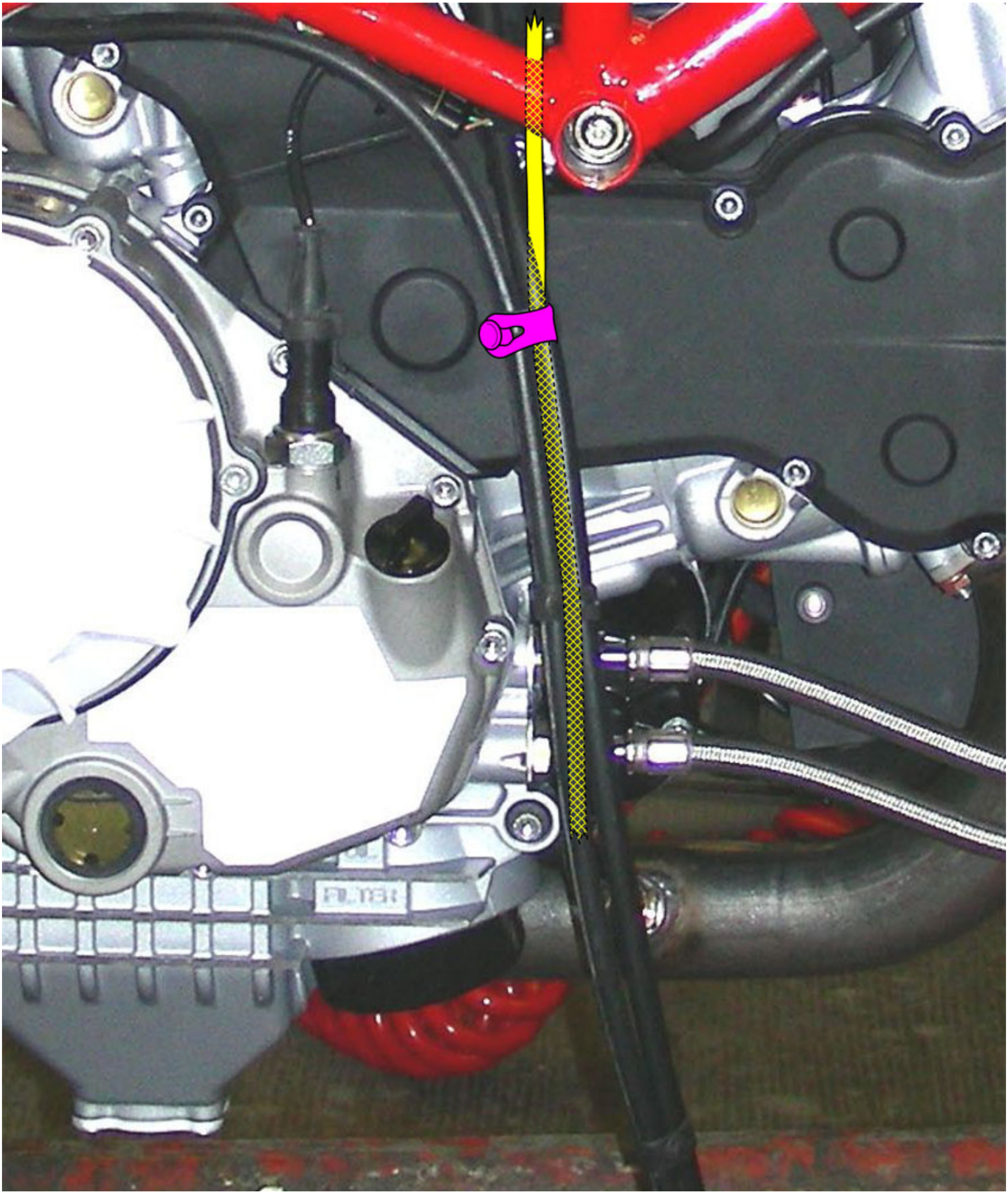

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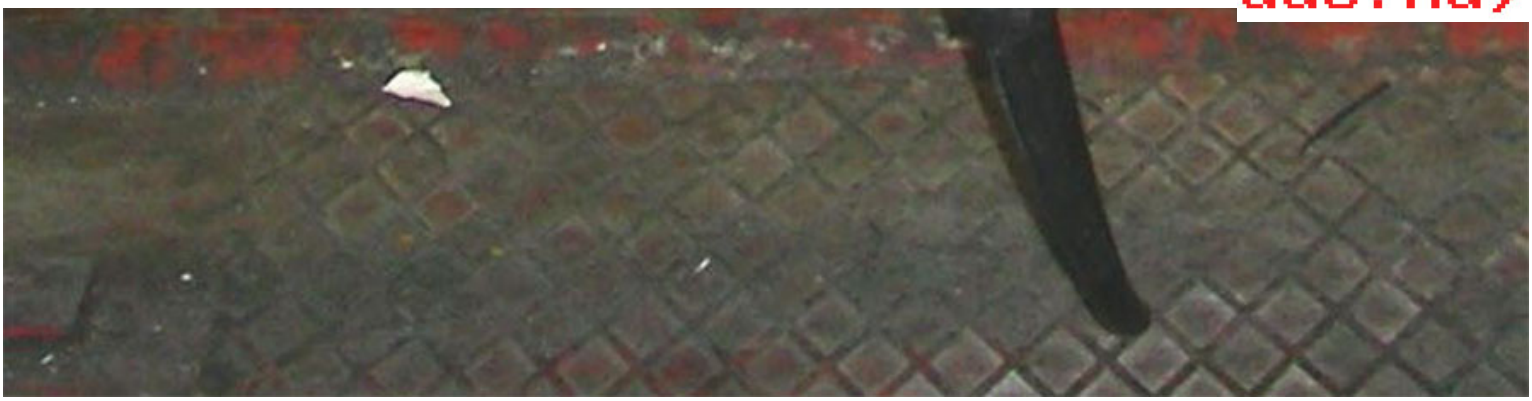

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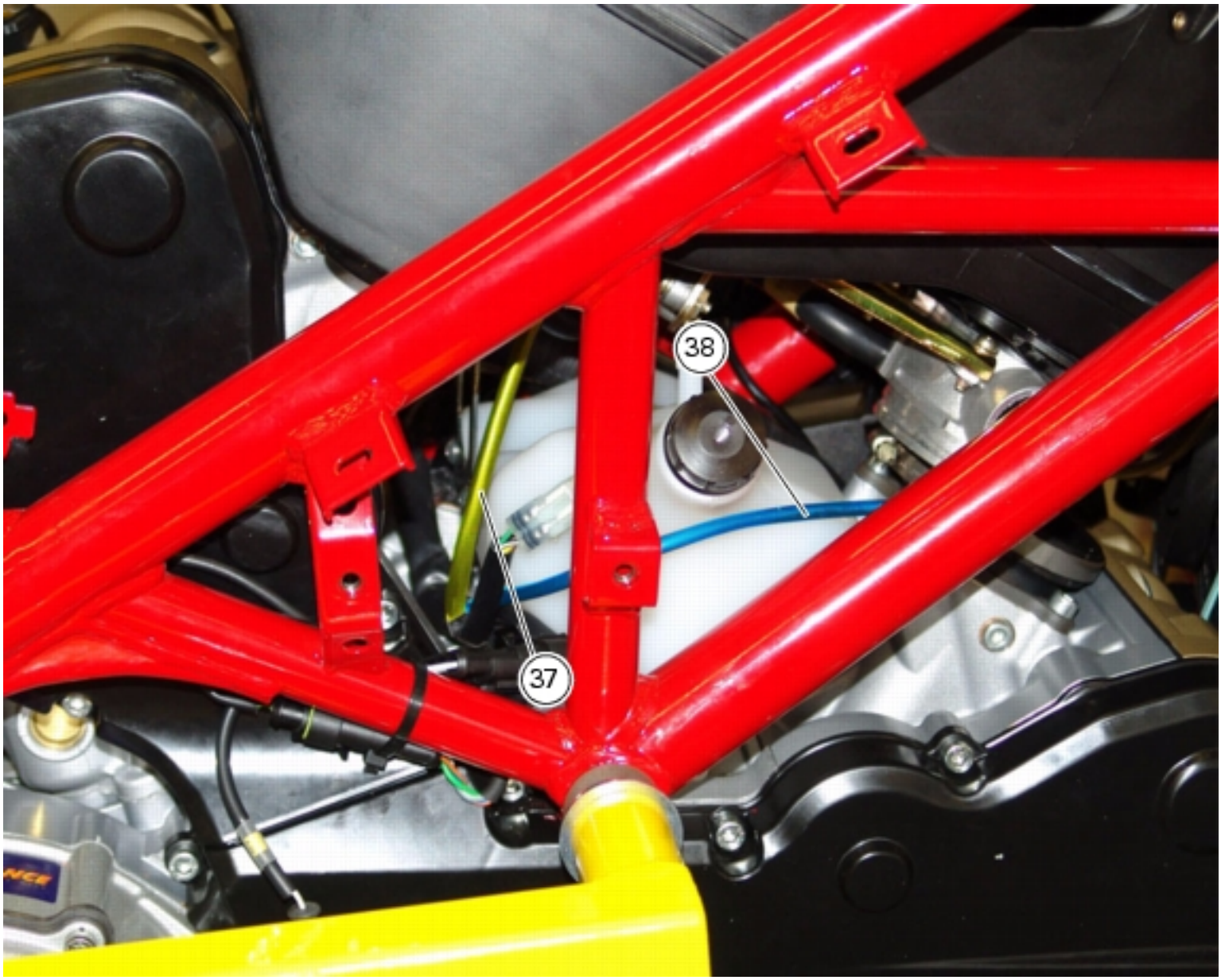

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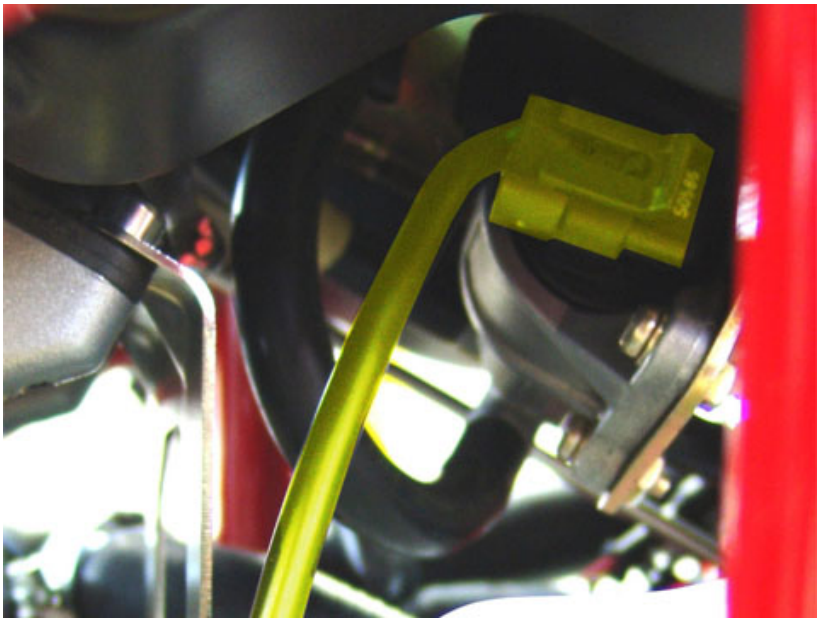

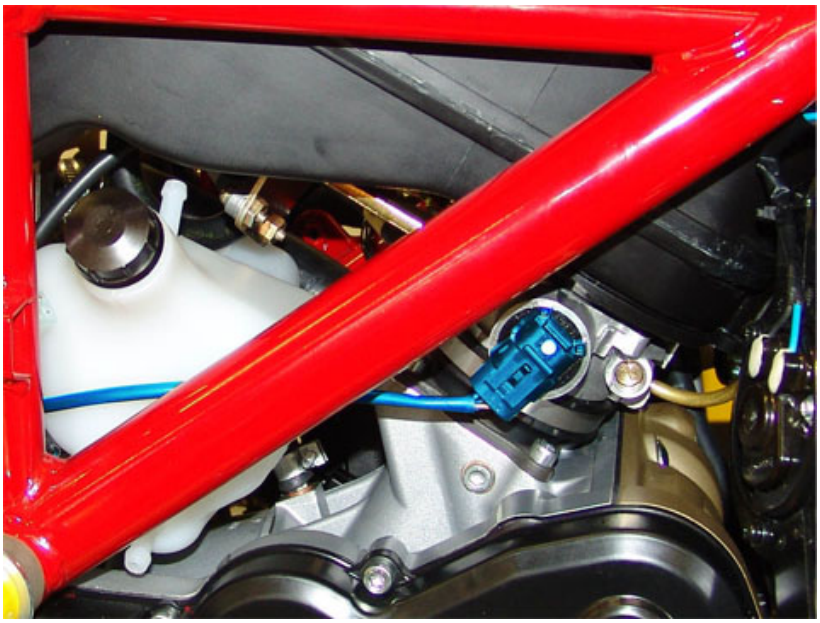

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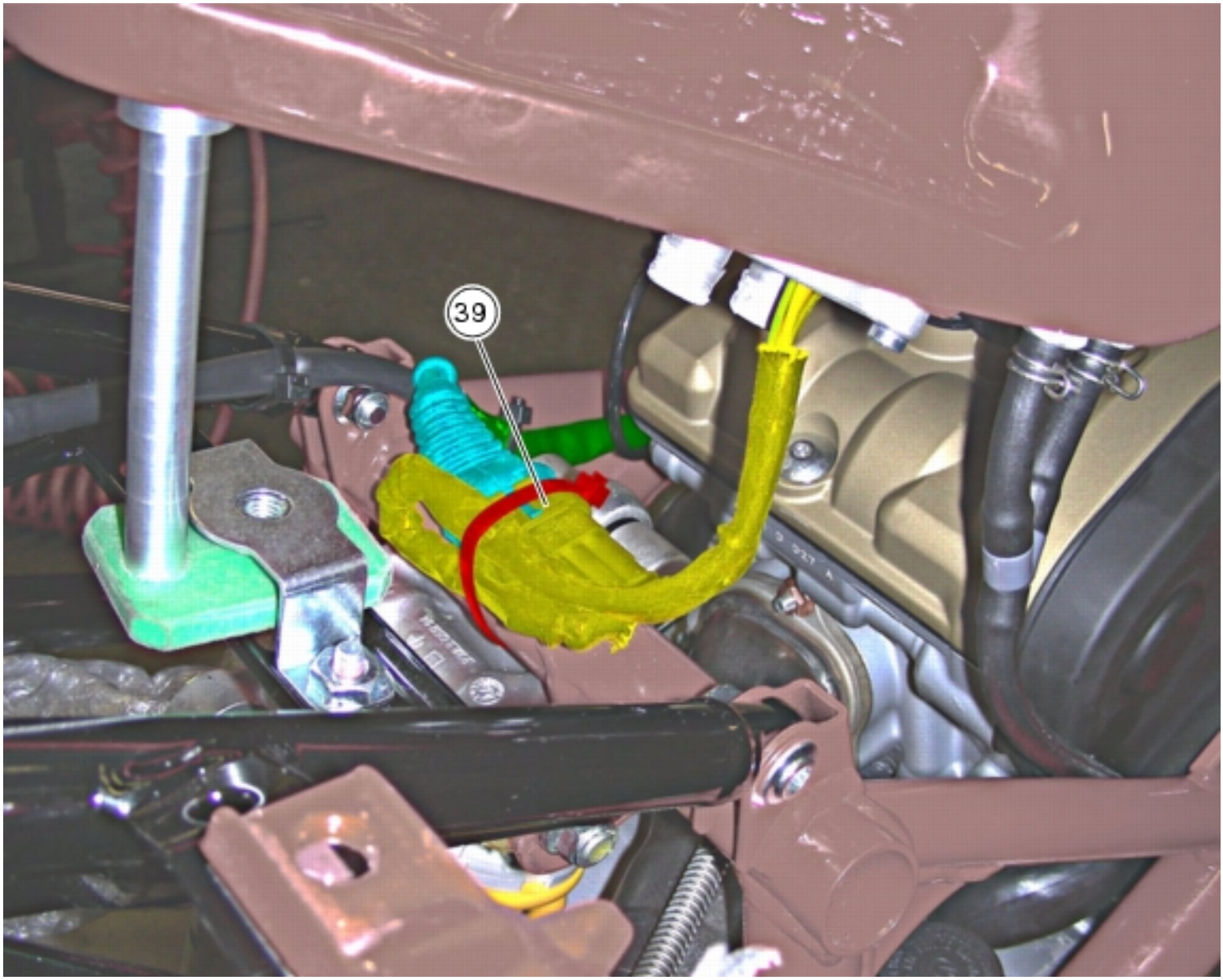

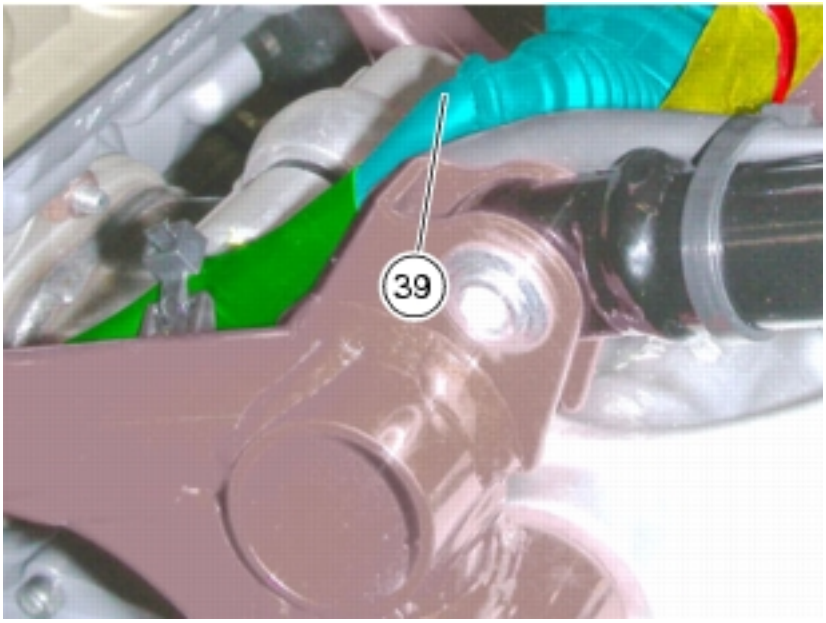

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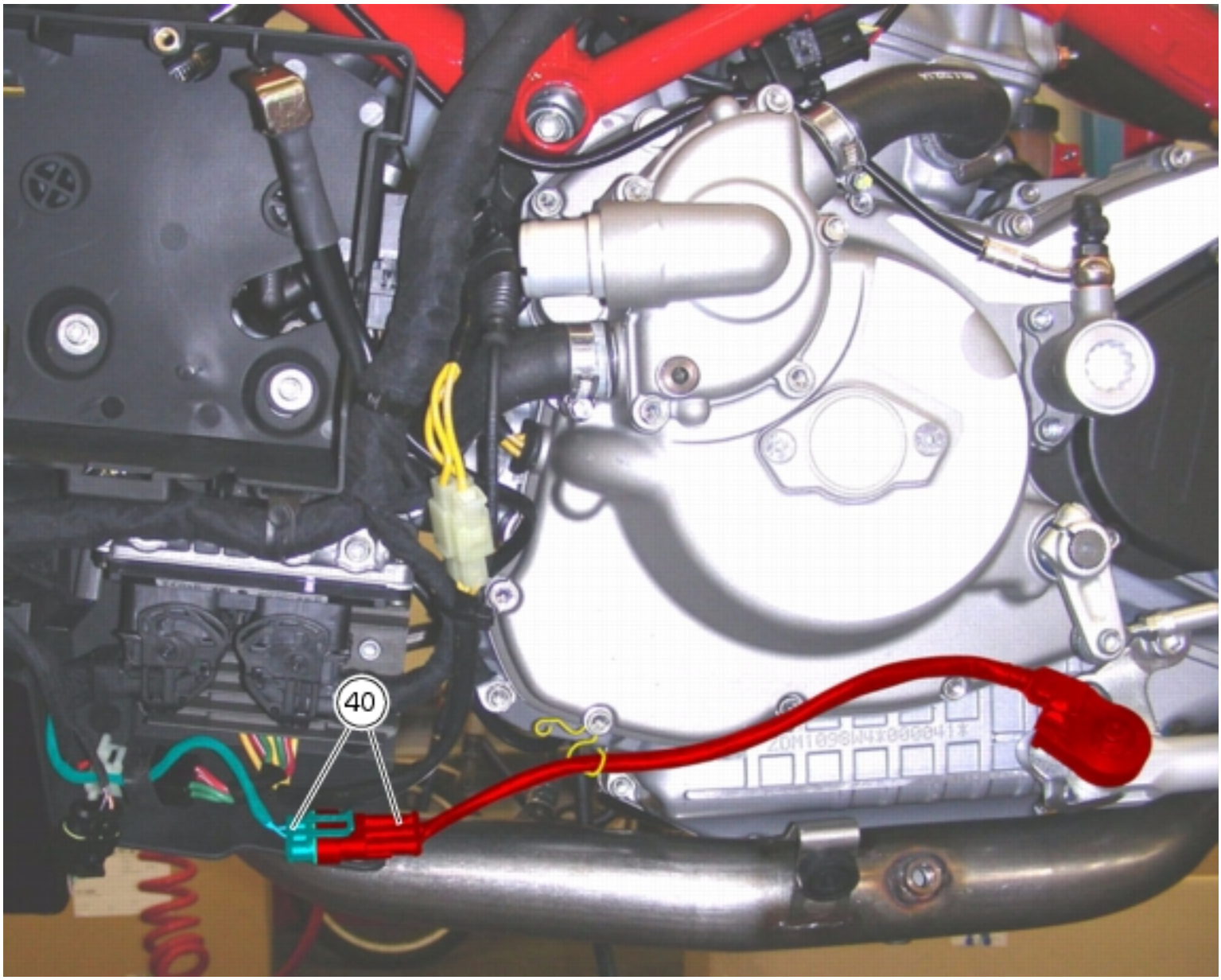

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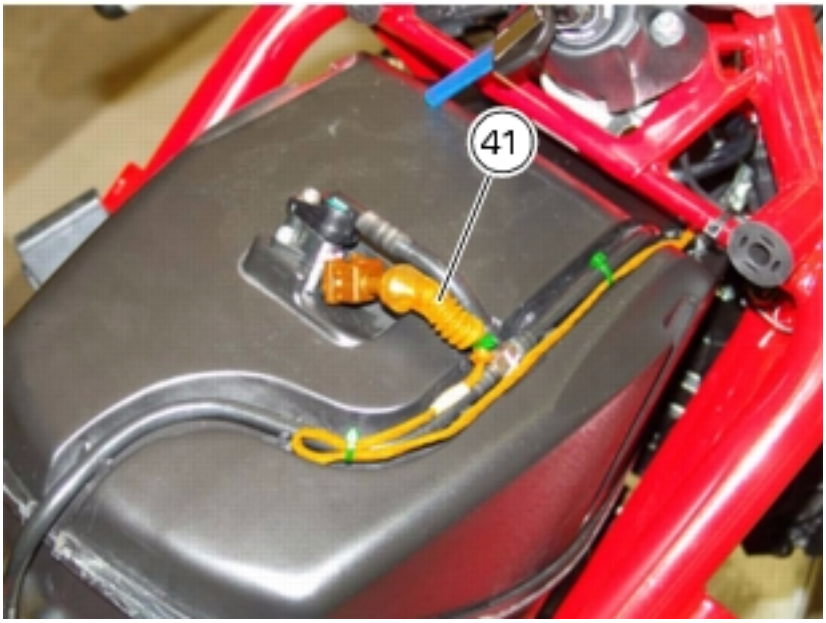

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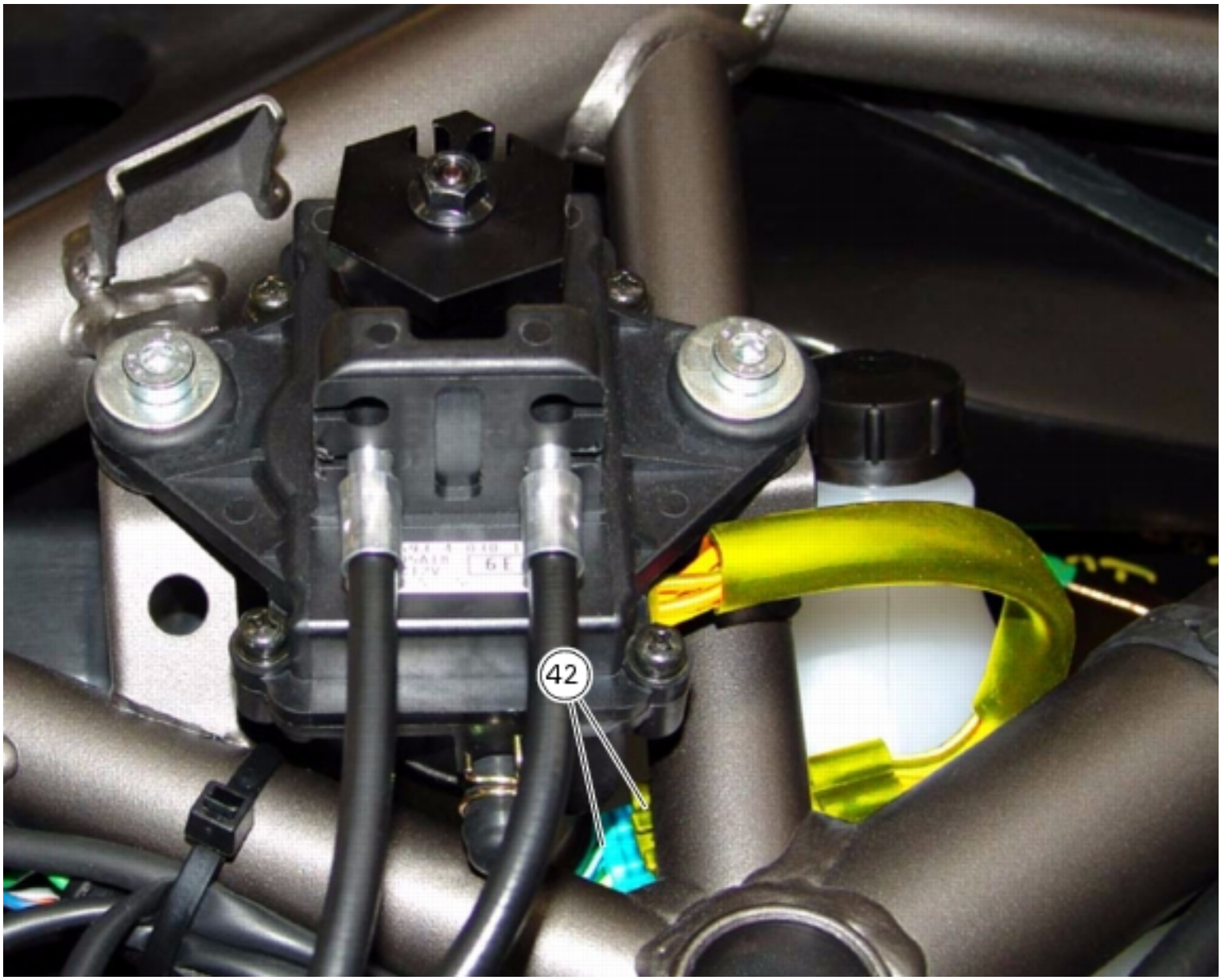
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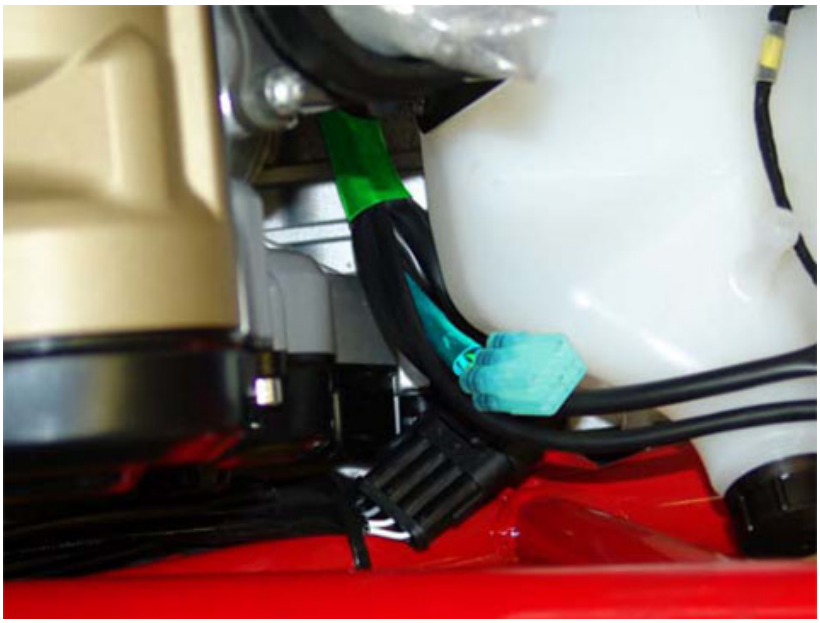

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Plate 34

Plate 35

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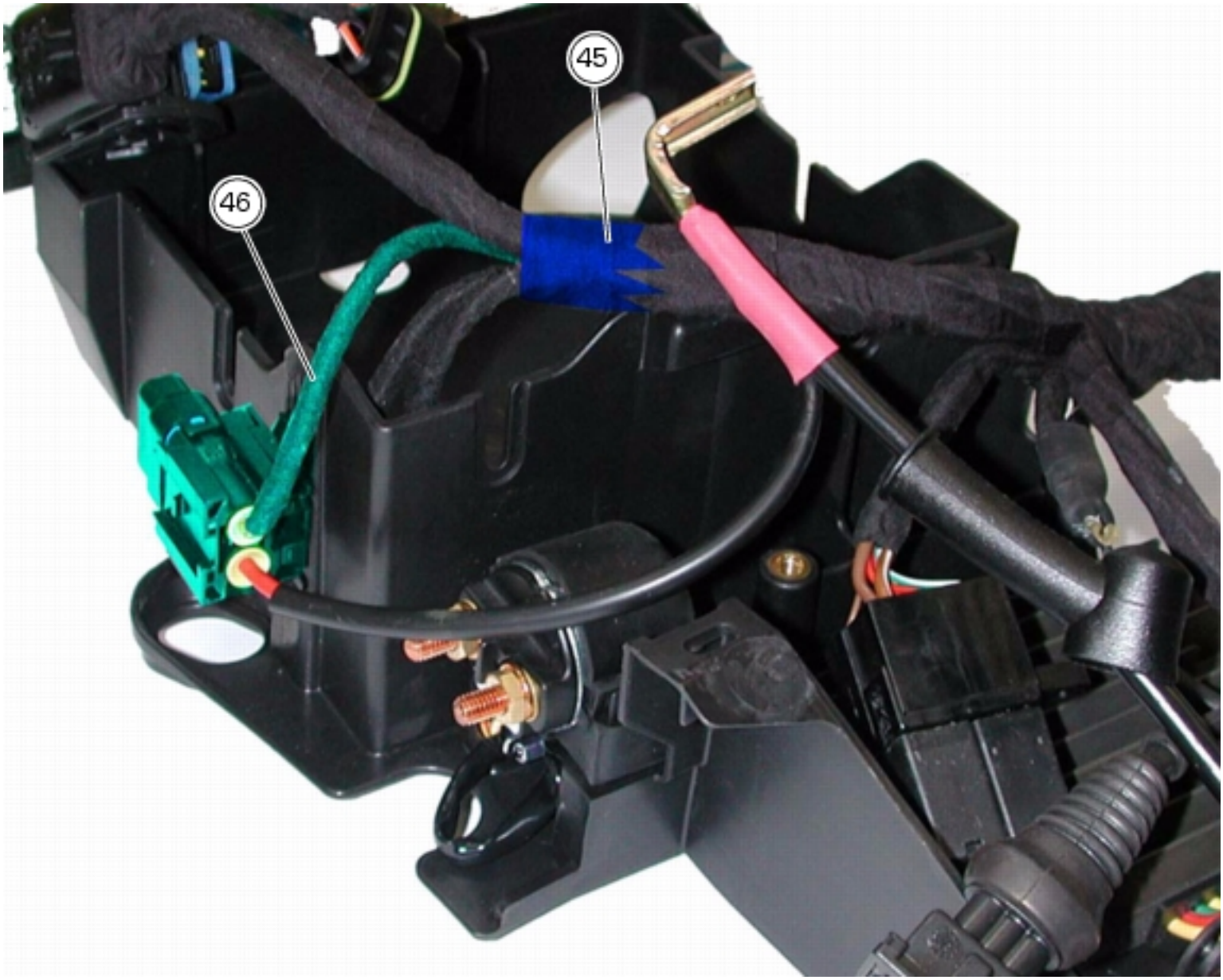

Plate 36

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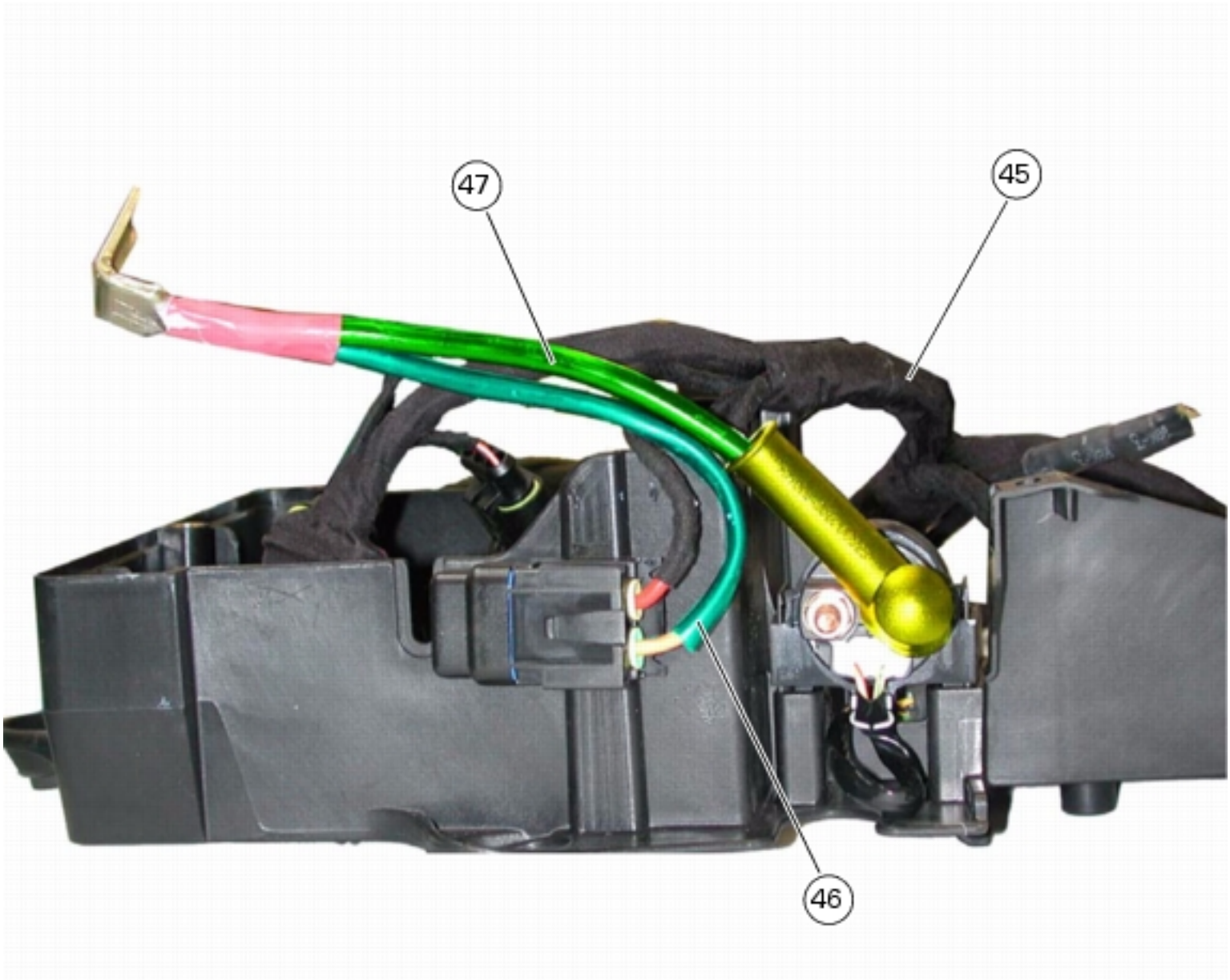

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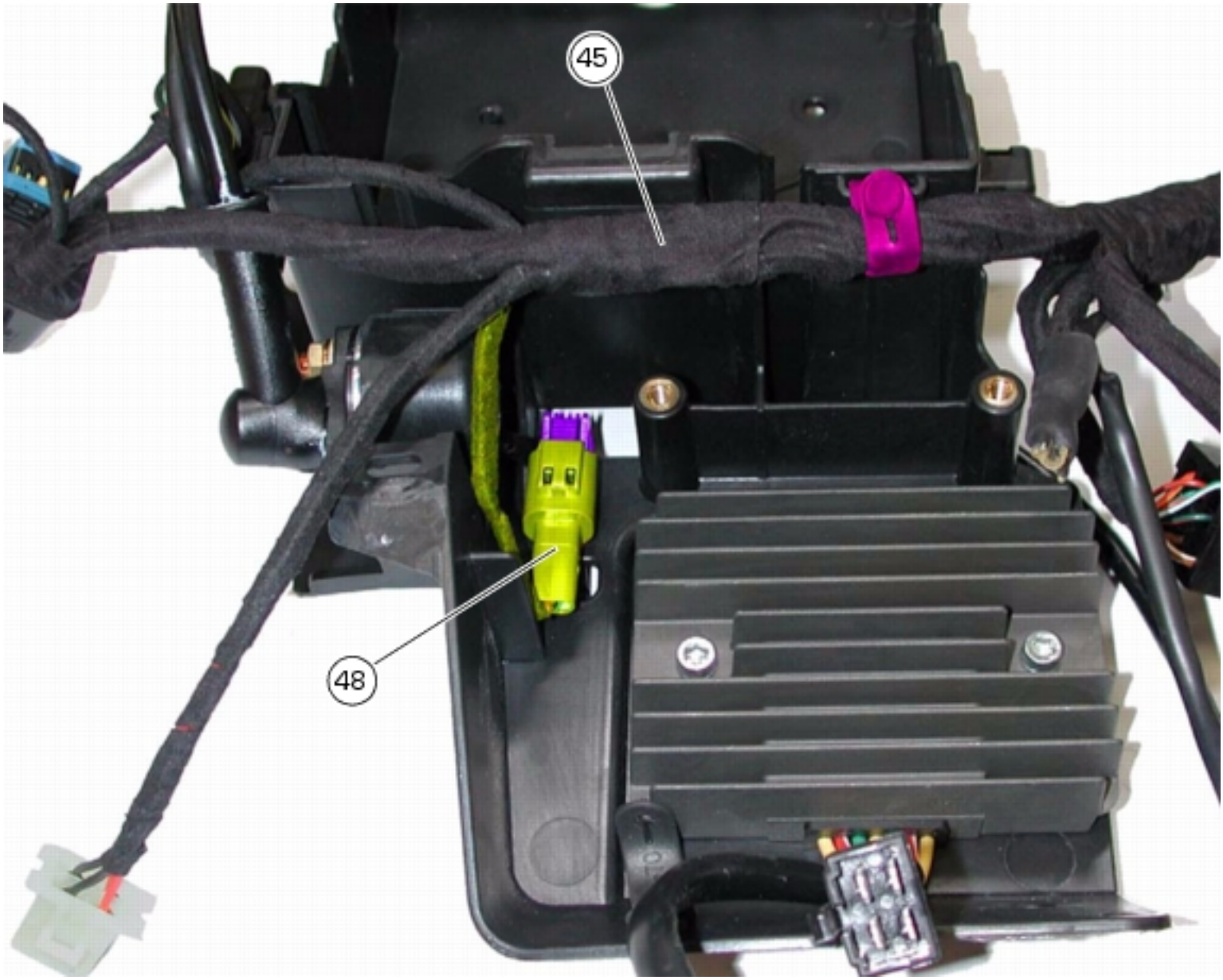
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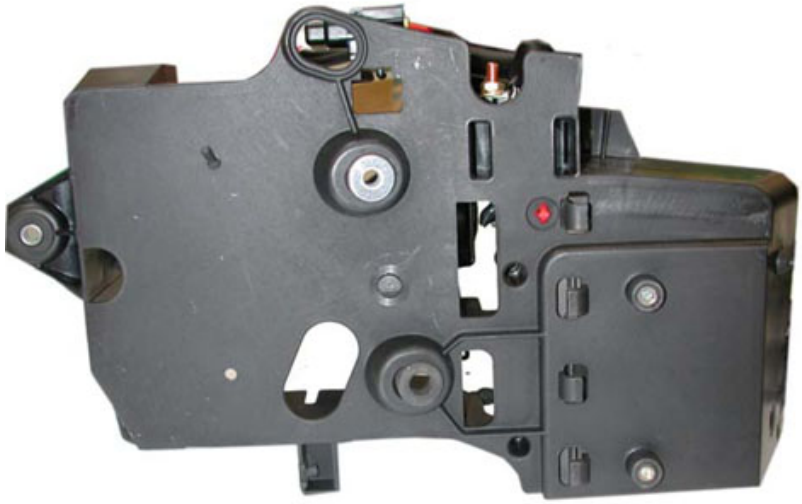

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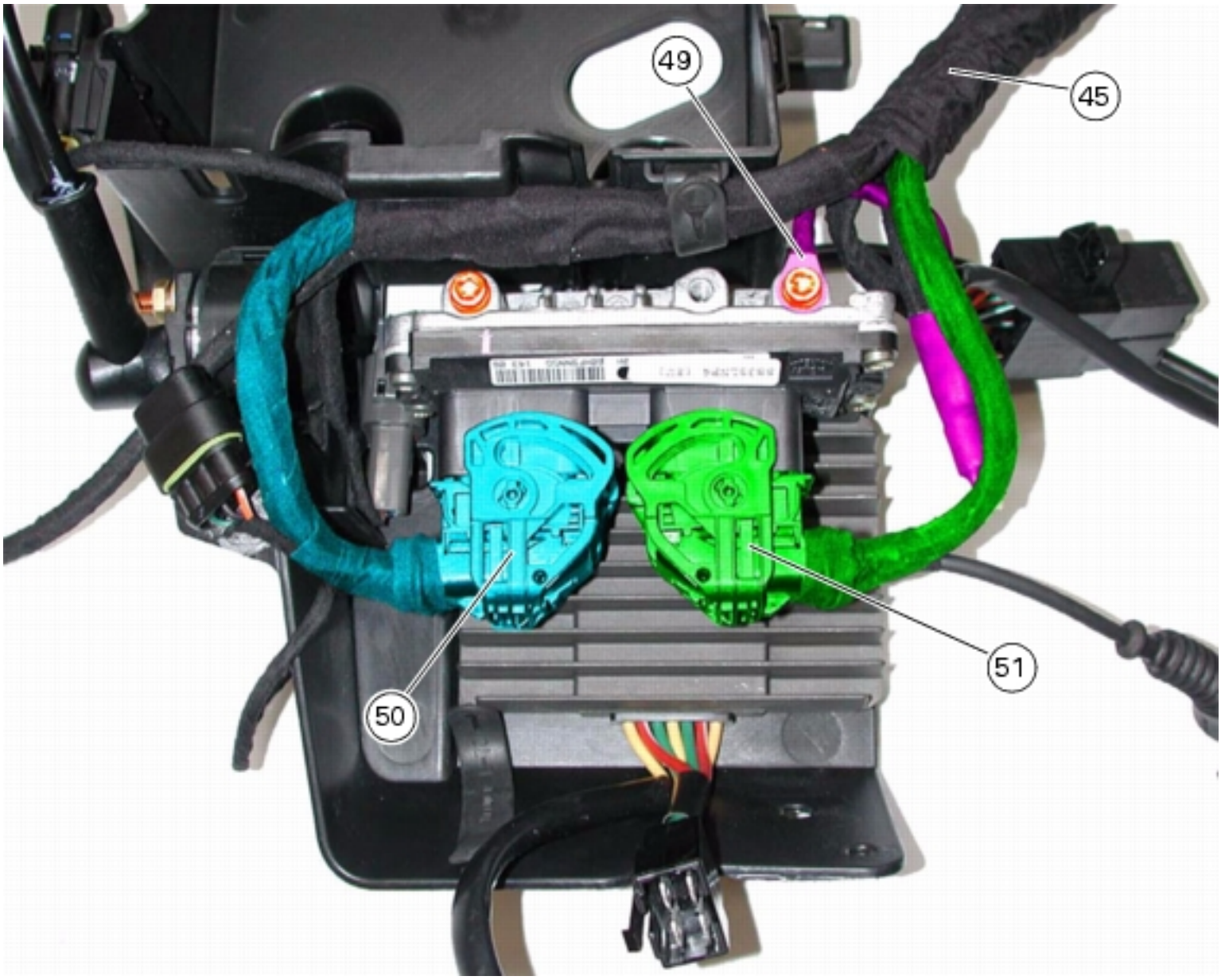

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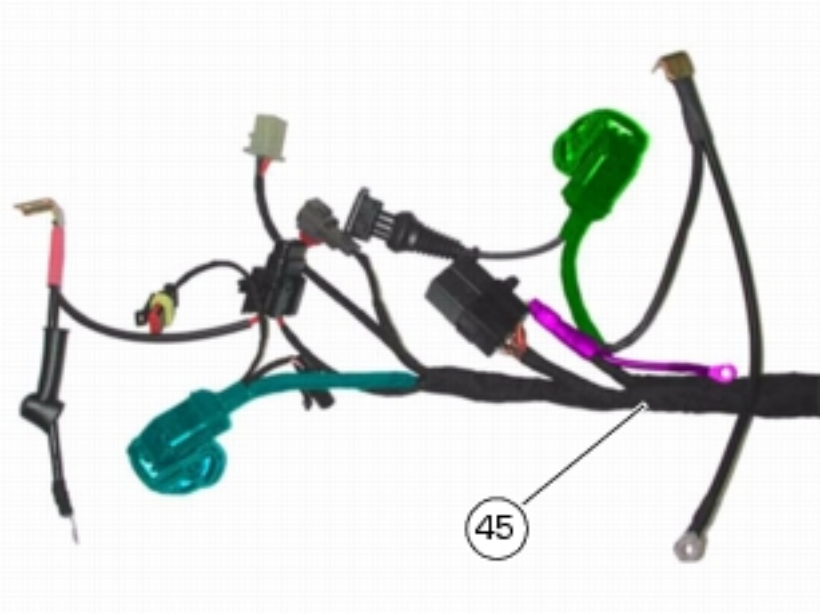

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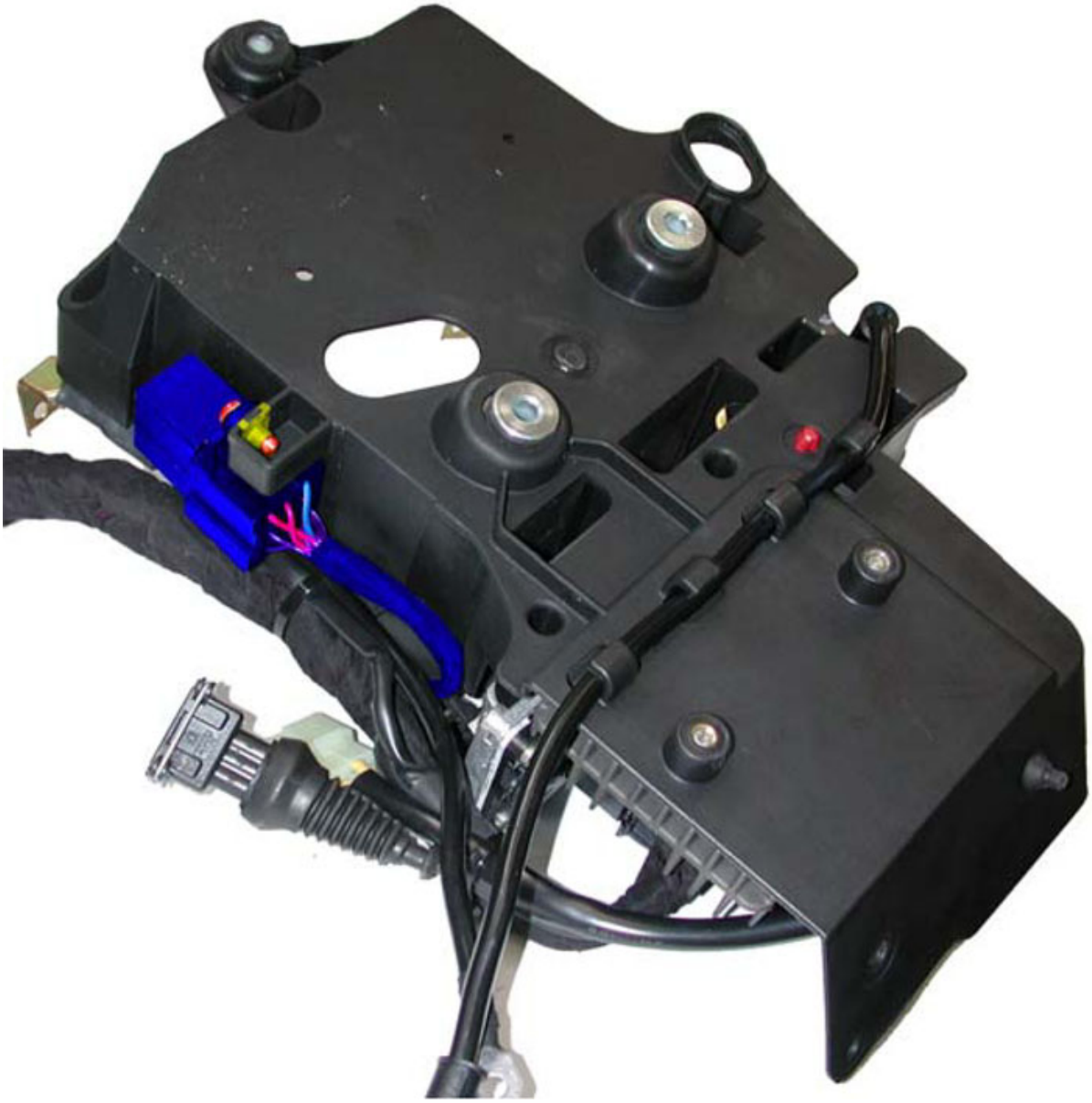

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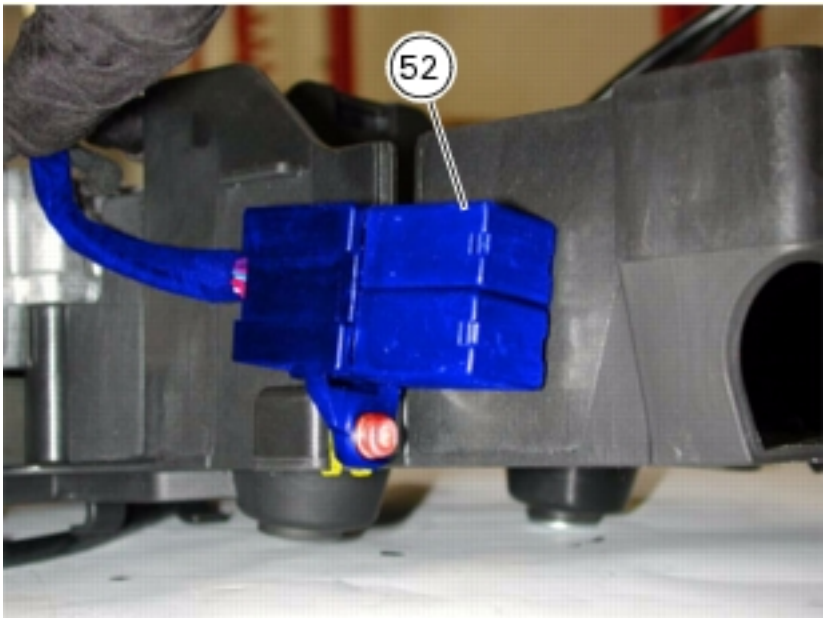

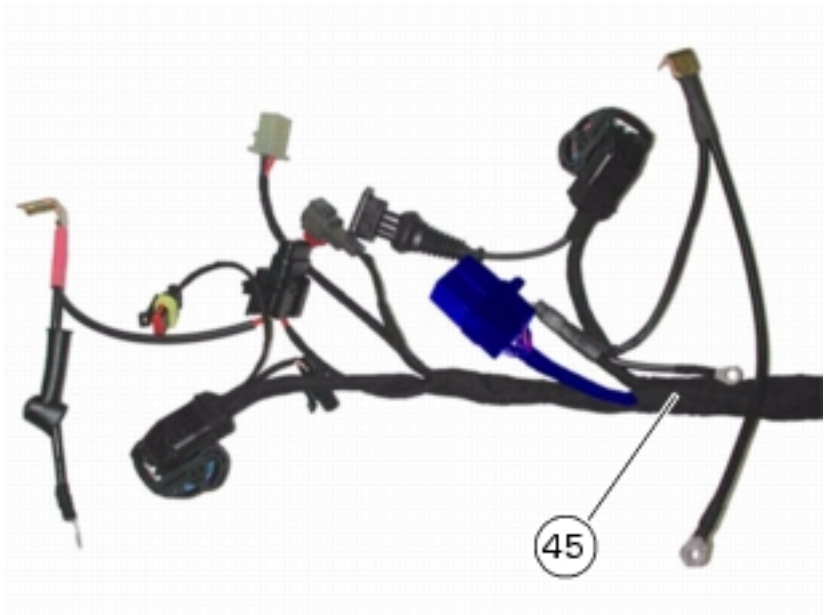

Plate 40

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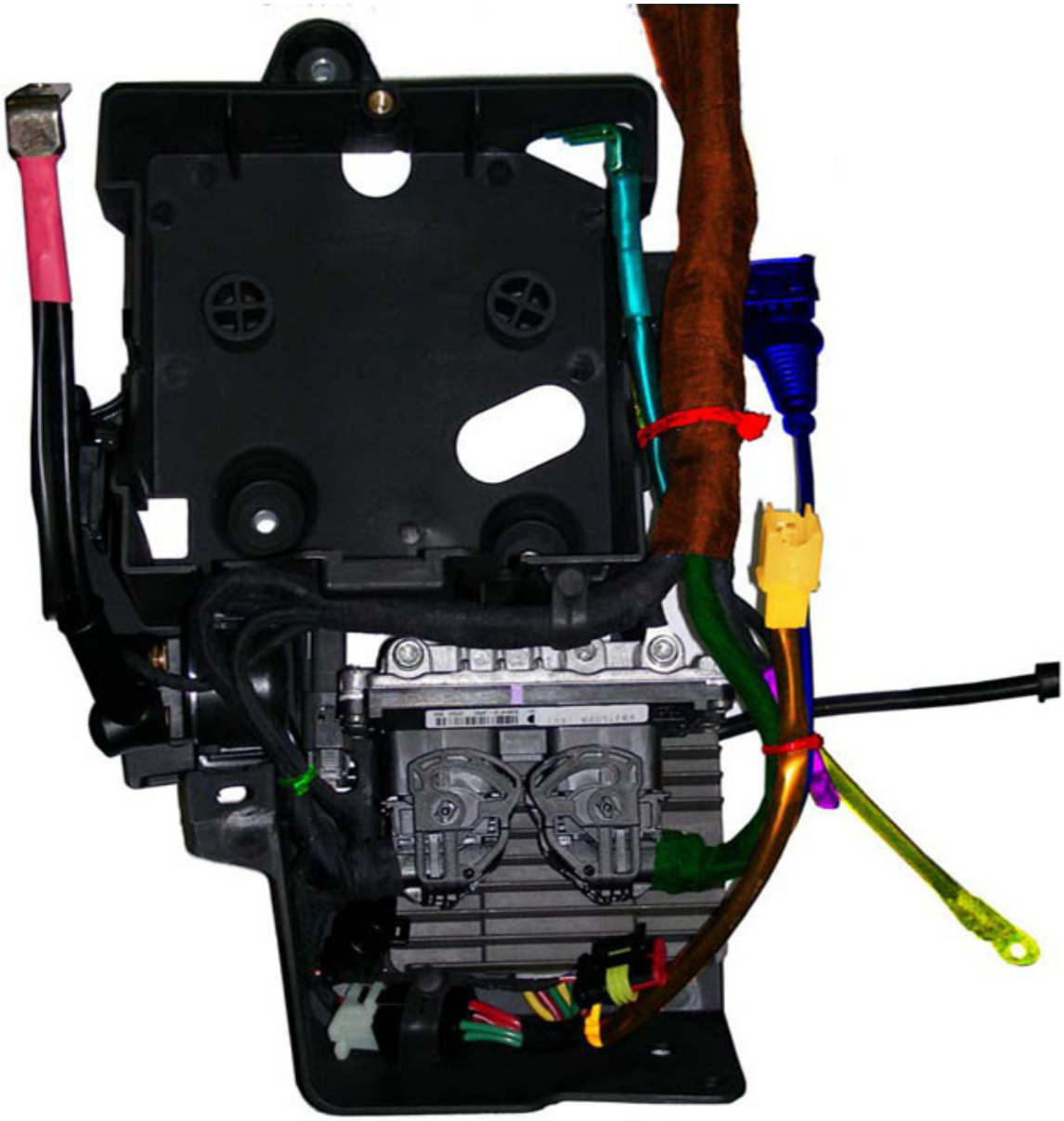
Plate 41



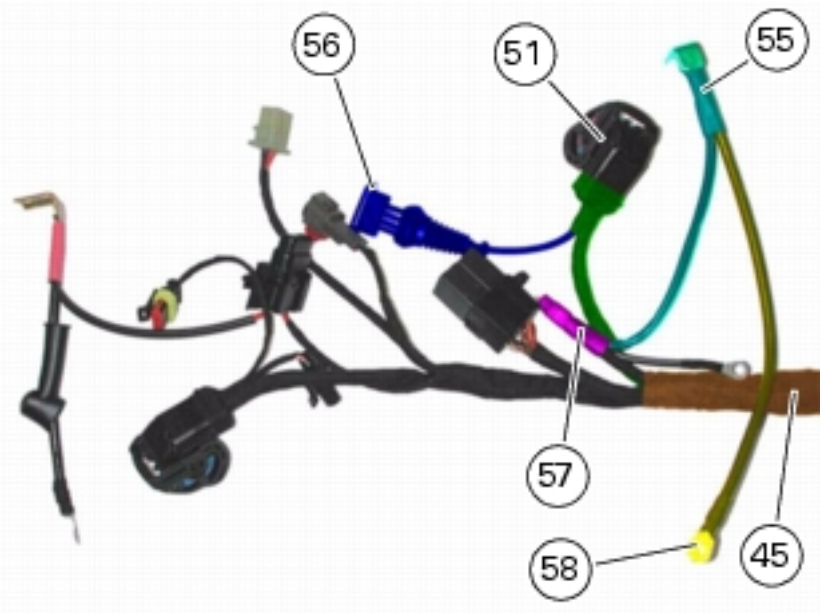

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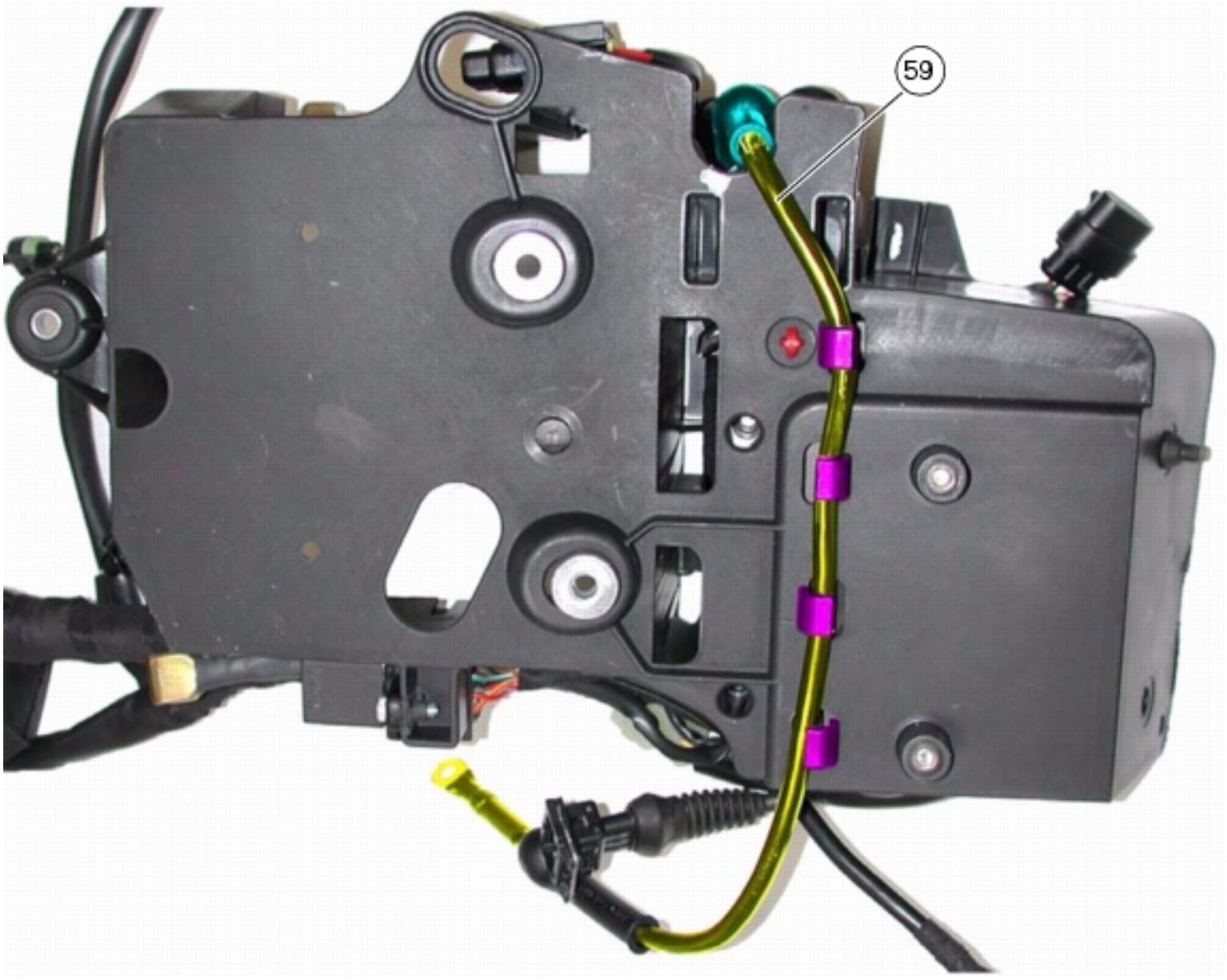
Plate 42



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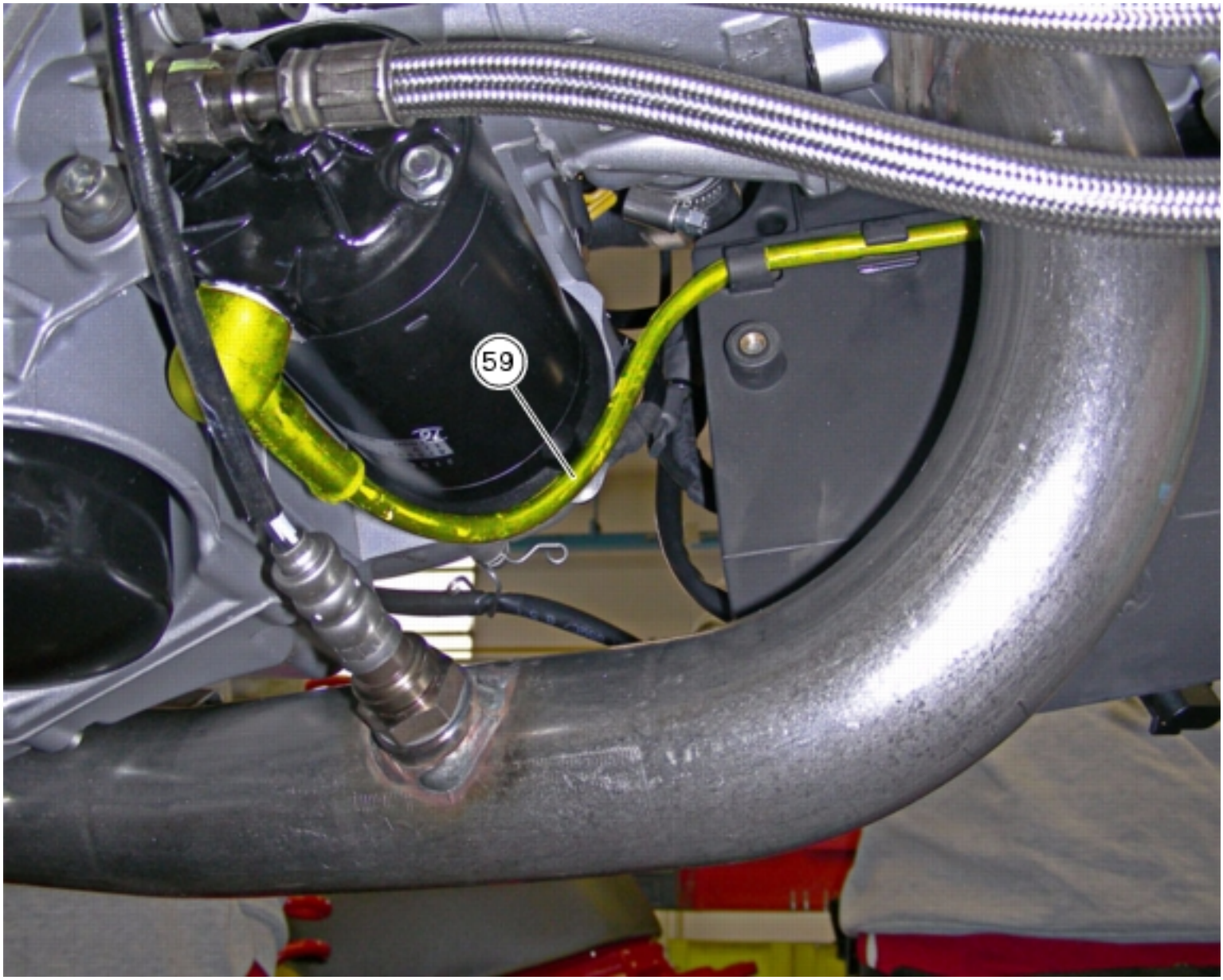

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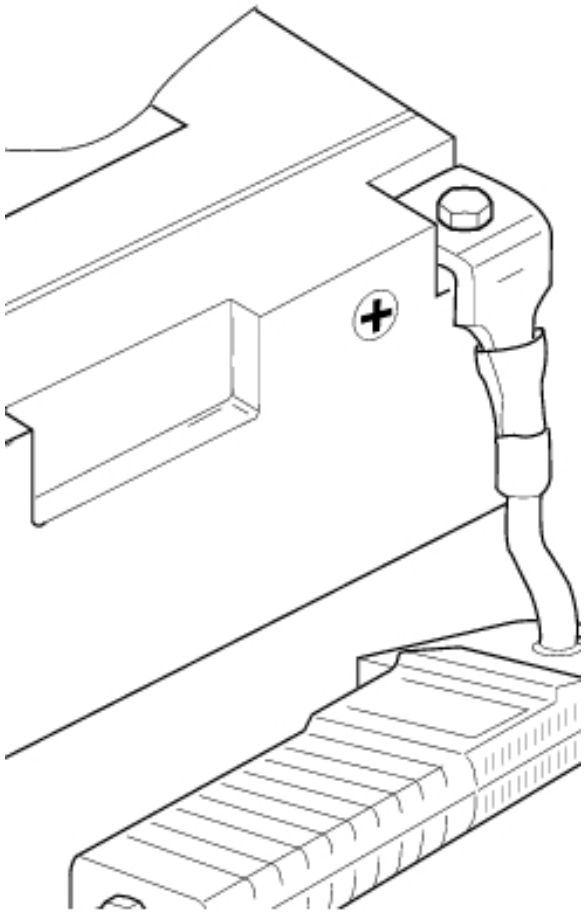
2 - Battery charging system

Checking the battery charging system

To check the current flow in the charging circuit, use the "DDS" tester, which is equipped with an inductive clamp-type ammeter. see the chapter "Testing the battery charging system", Sect. D 5.
With the "DDS" tester you can determine the engine rpm required for the alternator to produce sufficient current to charge the battery, power the injection/ignition system and all the electrical equipment on the motorcycle. When applied to a cable, the ammeter clamp detects the magnetic field generated by the current passing through that cable. The tester performs an automatic calibration routine using its own transducer. If the measured current is a positive quantity, this means that alternator is powering all the electrical loads and charging battery at the same time. A negative value means that charging system is not powering the loads and a significant amount of current must be supplied by the battery, which is discharging at the time of the measurement.
Alternatively, a multimeter can be used (Sect. P 9, Diagnostic instruments); connect the multimeter probes to the battery terminals, select the DC scale on the instrument and check for the presence of **14.5** V±**0.5** at an engine speed of 3000 rpm.

Important
If polarity is reversed when clamping the ammeter onto the cable, the sign of the readings will also be reversed, giving rise to incorrect diagnosis.



Recharging the battery

Examine the label on the battery showing the check intervals in order to determine when to test the voltage.

Charge the battery if the open circuit voltage is lower than **12.8** V. Leaving the battery discharged for more than one month could damage it. Check the battery charge with a voltmeter.
Always check the condition of the battery before recharging and 1 to 2 hours afterwards.

Important

Pay careful attention to recharging times. Stop charging immediately if the battery becomes too hot to the touch. Leave to cool before resuming charging.

Use only constant-voltage battery chargers.
Check that battery terminals are properly connected to the battery charger.
To charge the battery, proceed as follows:

Type of charging	Volt.	Ampere (A)	Time (Hours)
Normal	12	1.8	5-10
Fast	12	9	1

Use fast charging in emergencies only.

Storing the battery

If the battery voltage is less than or equal to 11.5 V, it must be recharged.
Connect the battery charger to the battery.
Use a voltage of 16-17 V.
If the ammeter shows no change, increase the voltage to the maximum of 25 V.
Charge for 5 minutes.
If the ammeter shows a change, return the voltage to 16-17 V; otherwise replace the battery.

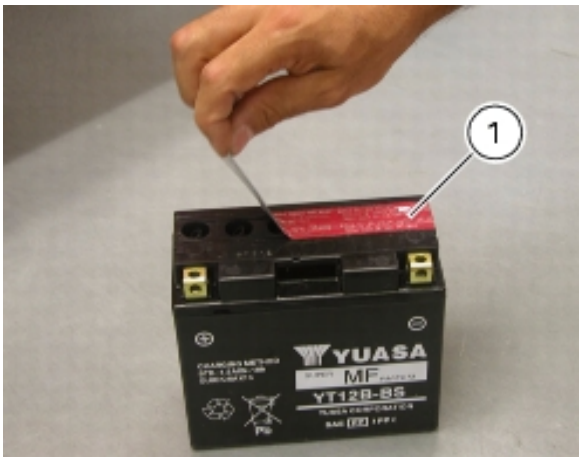
Topping up the electrolyte

Remove the battery from the motorcycle.

Warning

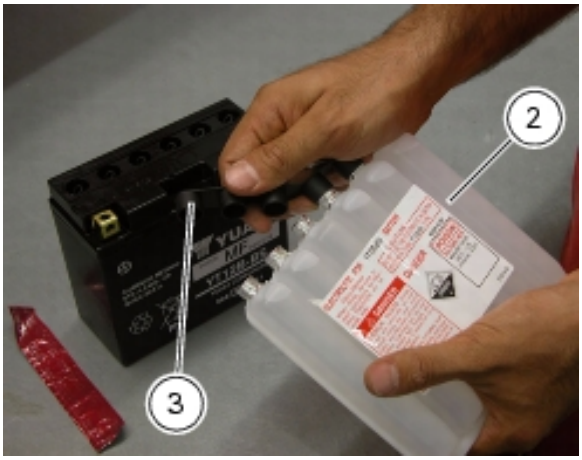
Read carefully the relevant safety rules before working on the battery (Sect. A 3, General safety rules). The electrolyte in the battery is toxic and can cause burns if it comes into contact with the skin because it contains sulphuric acid. Wear protective clothing, a face-mask and goggles when adding electrolyte. If the liquid comes into contact with the skin, wash thoroughly with cold water. If it comes into contact with the eyes, wash thoroughly with water for 15 minutes and consult an ophthalmologist. In the event of accidental ingestion, drink large quantities of water or milk, and continue with milk of magnesia, beaten egg or vegetable oil. Do not allow sparks, flames, cigarettes or any other heat source to come near the battery, as it produces explosive gases. When recharging or using the battery indoors, make sure that the room is adequately ventilated. Do not inhale the gases produced during recharging. KEEP OUT OF REACH OF CHILDREN.

Place the battery on a flat surface. Remove the protective film (1).



Warning
Make certain that the electrolyte is of the specific type for your battery.

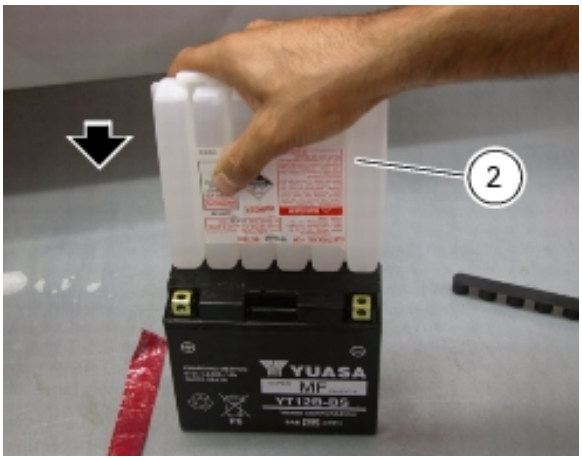
Remove the container with the electrolyte from the vinyl bag. Remove the strip with the caps (3) from the container (2).



Important
Keep the cap strip (3) to hand because it will be used later as plugs for the battery cells.

Warning
Do not peel or perforate the sealed areas.

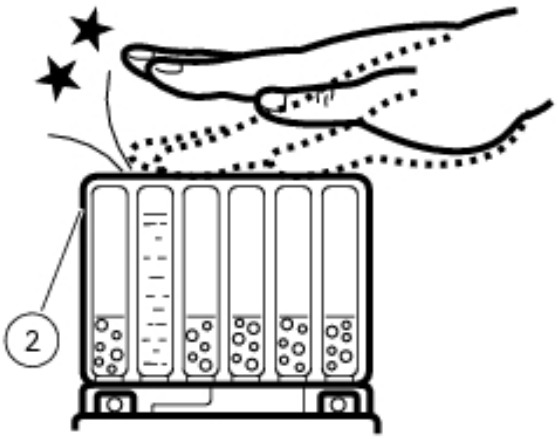
Place the electrolyte container (2) upside down. Align the six sealed elements with the six filler holes on the battery. Push the container (2) downwards with sufficient force to break the seals and allow the liquid to flow out.



Notes

Do not tilt the electrolyte container as this could interrupt the flow temporarily or even permanently.

Make certain that air bubbles emerge from all six filler holes. Leave the container in this position for at least twenty minutes.
If no bubbles emerge from one of the holes, tap gently on the bottom of the respective container.



Important

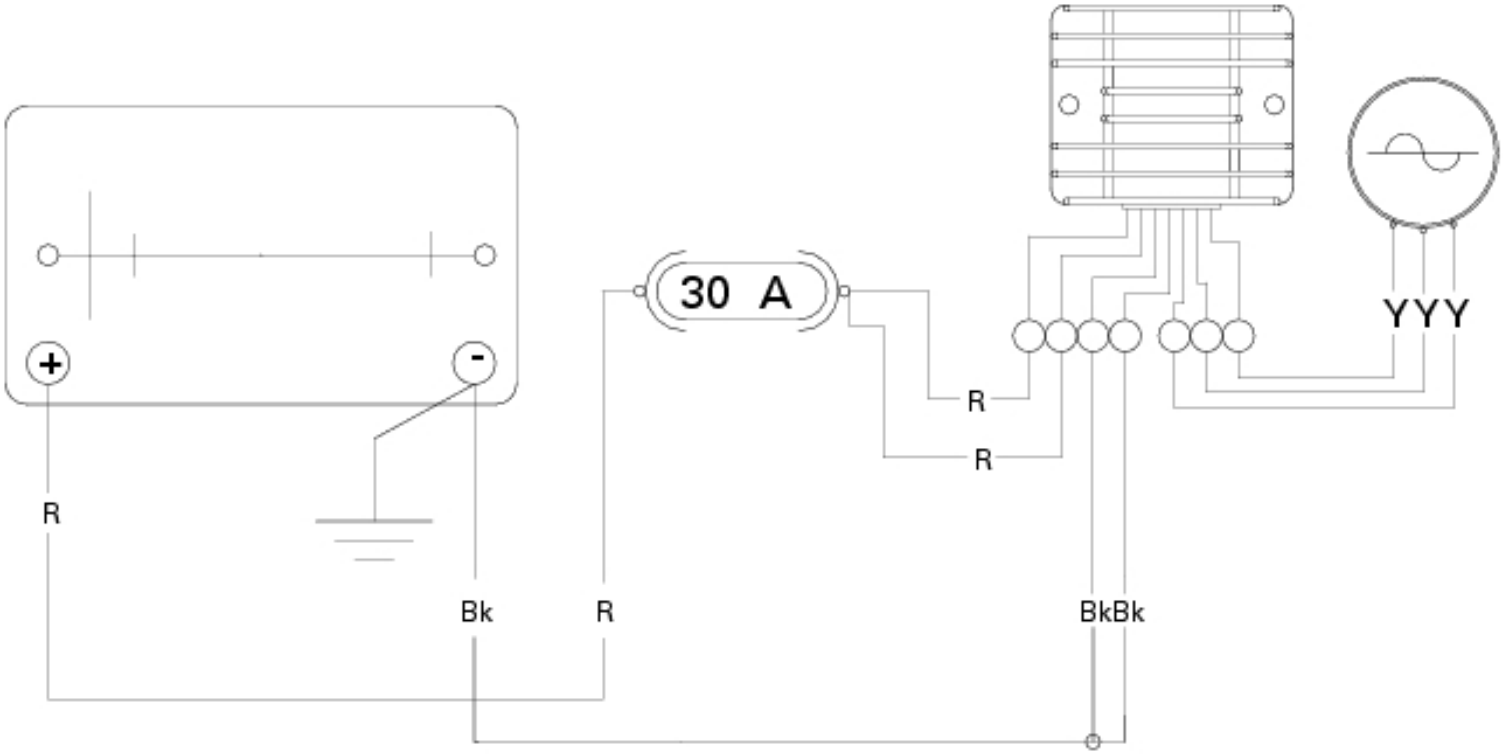
Never move the container away from the battery. Do not cut or puncture the liquid container.

Make sure that all the electrolyte has flowed out. Carefully extract the container (2) from the battery.
Place the cap strip (3) previously removed from the electrolyte container (2) on the battery, making sure that the strip closes all the electrolyte filler holes correctly.

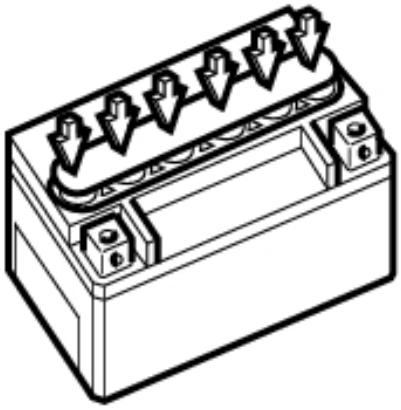
For 3-12 Ah batteries, leave to stand for at least 30 mins.
For batteries of over 12 AH, leave to stand for at least 1 hour.
Rest the cap strip on the filler holes without fixing it. Recharge the battery as described in the paragraph "Recharging the battery".

Notes

If using an automatic charge reducing battery charger, make certain that the charger current (amps) is greater than or equal to the standard (STD) recharging system indicated on the battery.



Press firmly downwards with both hands until the caps are firmly in place (do not use a hammer).



Battery

Battery safety rules

Warning
Read carefully the relevant safety rules before working on the battery (Sect. A 3, General safety rules). When under charge, batteries produce explosive gases. Keep batteries away from heat sources, sparks or open flames.

Instructions for use

The battery is of the sealed, maintenance-free type and requires no work to be done on it at the time of installation.

Notes
Always keep the battery clean. Apply grease around the battery terminal clamps to prevent corrosion.

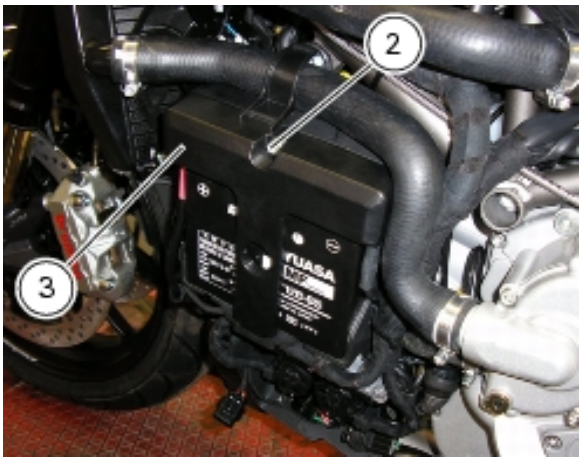
Warning
Never remove the valve cover located on top of the cover. If the block, cover or terminals are broken or if the valve cover has been tampered with **it is essential to change the battery**.

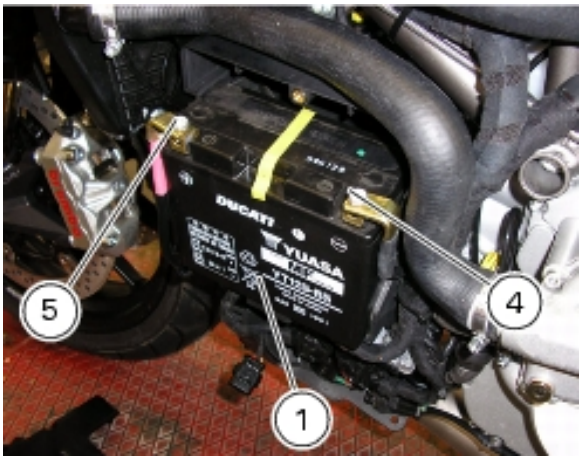
Important
If the motorcycle is left unused for more than 30 days, remove the battery and store it in a safe, cool place.

Always charge the battery before the first use and after long storage periods - such as before selling the vehicle.

Removal of the battery

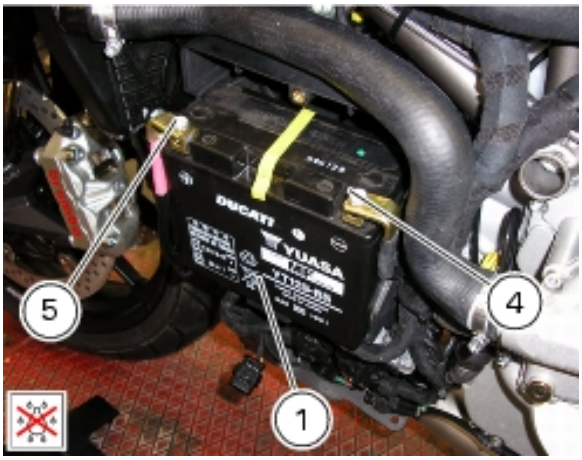
Remove the left-hand side fairing (Sect. E 2, Removal of the side fairings).
Unscrew the bolt (2) and securing the bracket (3), then remove the bracket (A) and (5).
Undo the terminal bolts (4) and (5). Always start with the negative terminal.
Remove the battery (1).





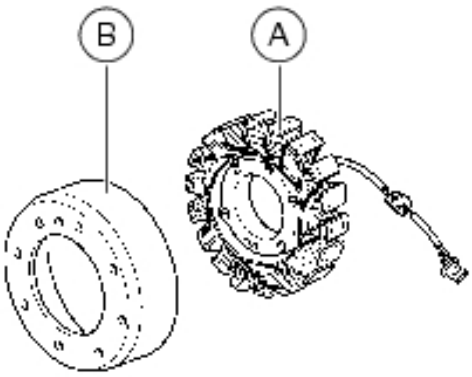
Refitting the battery

Refitting is the reverse of removal. Check the battery terminals (1), which should not show any sign of oxidisation. Tighten the terminal bolts (4) and (5) to the specified torque (Sect. C 3, Frame torque settings) and apply a water repellent spray.



Alternator

The motorcycle is equipped with a **12** V, **520** W alternator, consisting of a stator (A) located in the left-hand side crankcase cover and a rotor (B) fixed to the crankshaft.



Notes

To check the charging system for possible faults, use the "DDS" tester (Sect. D 5, DDS tester).

The absolute value of voltage measured across the terminals of two of the three yellow cables (the measured value will be the same whichever combination of cable is used) must be within the range indicated in the table below. (Ambient temperature: **20** °C)

Important

Before testing, disconnect the alternator wiring from the electrical system when the ignition key is set to OFF.

Engine rpm	2000	6000
effective **V**	**27±10**	**78±10**

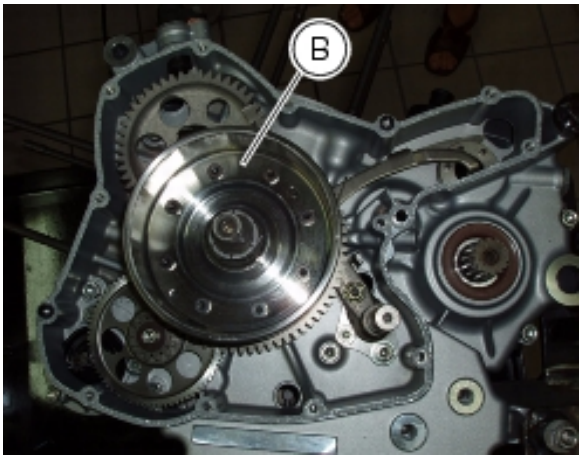
Values significantly lower than those indicated above can be due to:
- partially demagnetised rotor;
- short-circuited windings.

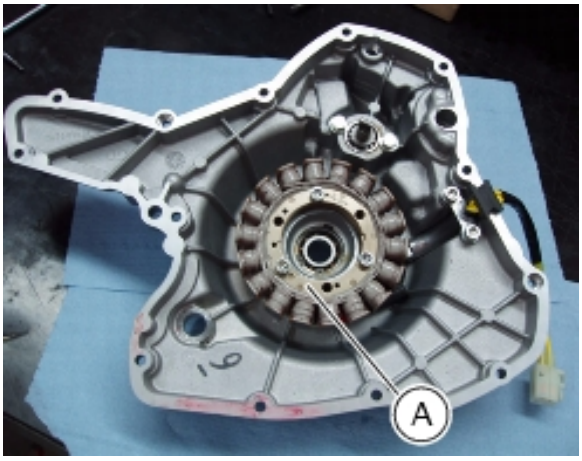
In the above cases the whole alternator assembly (rotor and stator) should be renewed.
If checks have a favourable outcome, reconnect the alternator to the regulator with ignition key on OFF. Make sure that no cables are damaged or disconnected.

Removal of the alternator

Remove the left-hand side fairing (Sect. E 2, Removal of the side fairings).

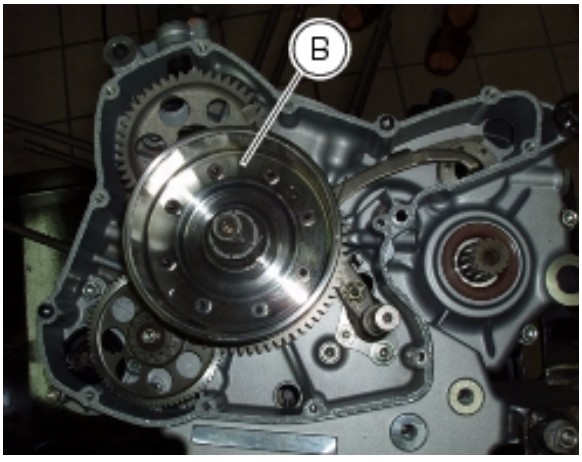
Disconnect the alternator wires from the electrical system (refer to plate in chapter "Routing of wiring on frame", Sect. P 1).
Remove the alternator-side crankcase cover, the stator (A) and rotor (B) (Sect. N 8, Removal of the alternator-side crankcase cover).

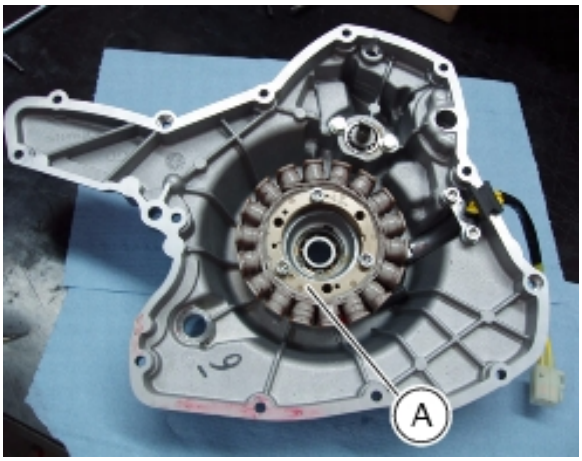




Refitting the alternator

Fit the rotor (B), the stator (A) and the alternator-side crankcase cover.
Reconnect the alternator wires to the electrical system (refer to plate in chapter "Routing of wiring on frame", Sect. P 1).
Refit the left-hand side fairing (Sect. E 2, Refitting the side fairings).





Regulator/rectifier

The regulator (2) is fixed to the battery support (3).
The rectifier/regulator consists of an aluminium casing containing the diodes that rectify the current produced by the alternator. It also contains an electronic device that regulates the current supplied by the alternator in accordance with battery voltage.
If the battery is drained, the current has the value necessary to restore optimum operating conditions of the battery. In contrast, if the battery is fully charged, the current value will be lower.

Notes

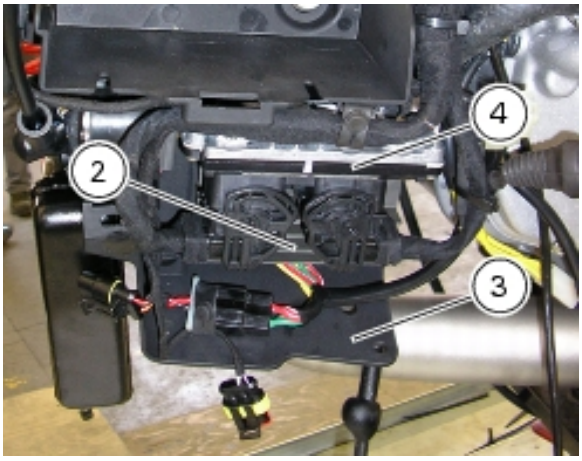
Check the charging current using the "DDS" tester (Sect. D 5, DDS tester).

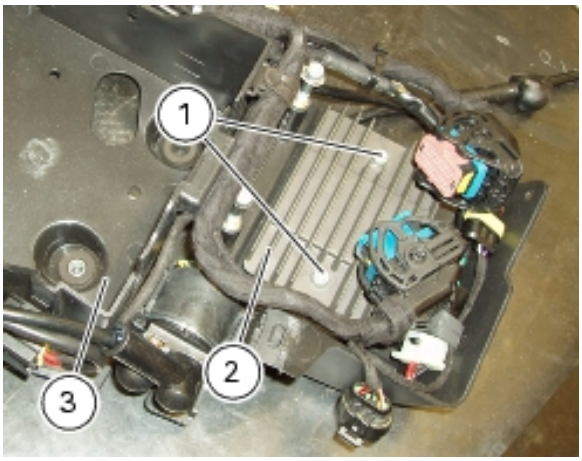
Removal of the regulator

Remove the left-hand side fairing (Sect. E 2, Removal of the side fairings).
To remove the voltage regulator, first remove the ECU (4) and disconnect the voltage regulator wiring (Sect. M 3, Removal of the battery support).
Undo the bolts (1) securing the regulator (2) to the battery support (3).
Remove the regulator (2).

Important

Do not disconnect the battery cables when engine is running because this would cause irreparable damage to the regulator.





Refitting the regulator

Fit the regulator (2) to the battery support (3).
Secure it with the bolts (1) and tighten to the specified torque (Sect. C 3, Frame torque settings).

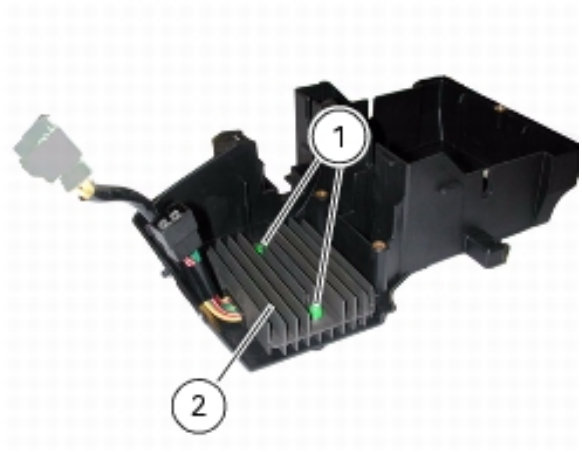
Notes

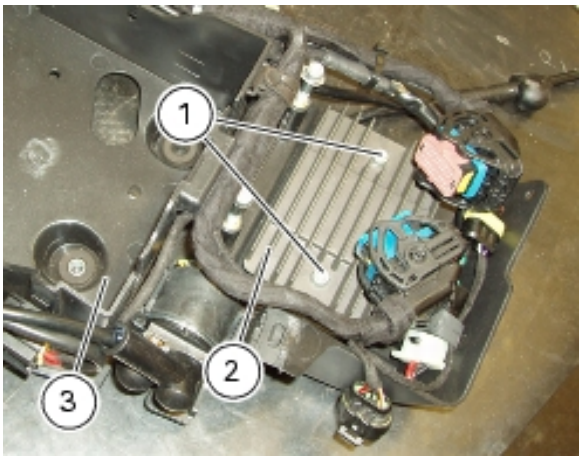
Reconnect the regulator cable to the main wiring loom (Sect. P 1, Plate 40).
Refit the ECU (4) (Sect. M 3, Refitting the battery support).

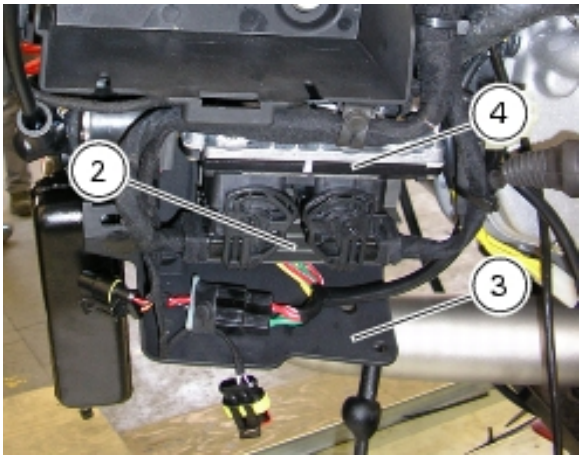
Important

Do not disconnect the battery cables when engine is running because this would cause irreparable damage to the regulator.

Refit the left-hand side fairing (Sect. E 2, Refitting the side fairings).

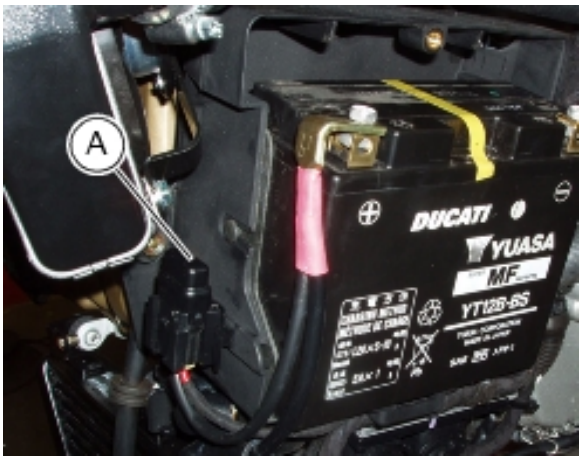




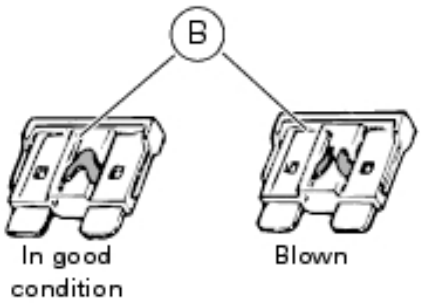


Regulator fuse

The **30** A fuse located at the side of the battery protects the electronic regulator. To gain access to the fuse, remove the left-hand fairing (Sect. E 2, Removal of the side fairings) and remove the protective cap (A).



A blown fuse can be identified by breakage of the inner filament (B).



Important

Switch the ignition key to **OFF** before replacing a fuse to avoid possible short circuits.

Warning

Never use a fuse with a rating other than the specified value. Failure to observe this rule may damage the electric system or even cause fire.

3 - Electric starting system

Notes

The references of the elements shown below are to be found in the "Wiring diagram", in Sect. P 1.

Electric starting system

The key components of the electric starting system are a contactor (6) and a starter motor (5) fed by the battery (7).
The engine starting strategy is managed entirely by the engine ECU (34), which monitors the following inputs:
- Engine Stop switch on right-hand handlebar switch (1)
- Engine starter switch on right-hand handlebar switch (1)
- Neutral sensor (31)
- Sidestand sensor (29)
- Clutch microswitch (36).

When these inputs are combined in the required manner, the engine control unit (34) enables engine starting.

The table lists possible engine starting combinations.
In accordance with the status of specific engine control unit inputs and the indications given in the table, the control unit enables operation of the starter motor (ON status) when the START button is pressed.
X = generic status of neutral sensor, clutch, and sidestand.

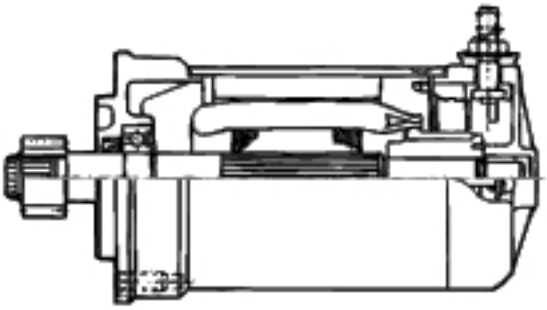
Safety device functions table

duc.nu>>

ECU INPUTS				ECU OUTPUTS
NEUTRAL	CLUTCH	STAND	ENGINE STOP	STARTER MOTOR
ECU ENGINE 14 PIN	ECU BODY 33 PIN	ECU BODY 38 PIN	ECU BODY 27 PIN	ECU BODY 1 PIN
X	X	X	OFF	OFF
NEUTRAL	PULLED	DOWN	ON	ON
NEUTRAL	RELEASED	DOWN	ON	ON
GEAR	RELEASED	DOWN	ON	OFF
GEAR	PULLED	DOWN	ON	OFF
NEUTRAL	PULLED	UP	ON	ON
NEUTRAL	RELEASED	UP	ON	ON
GEAR	RELEASED	UP	ON	OFF
GEAR	PULLED	UP	ON	ON

Starter motor

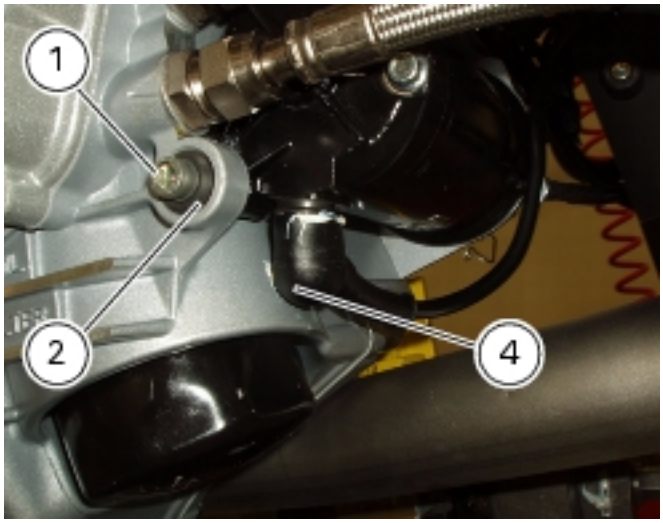
Power:
0.7 kw/**12** V
Direction of rotation:
counterclockwise viewed from power take-off side.



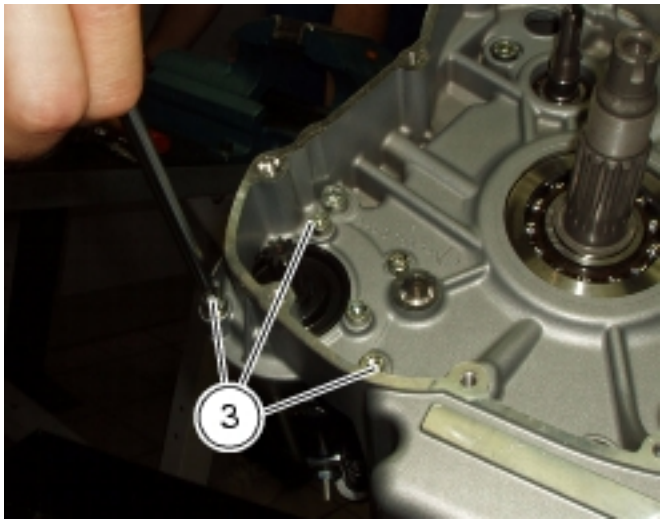
The starter motor is highly compact and reliable and therefore rarely gives any type of problem. In case of malfunction, ensure that the starter motor wiring terminal is properly tightened under the nut and shows no sign of corrosion. If the terminal is properly tightened and free from corrosion, remove the starter motor and test it under no-load conditions (no load applied to the shaft). Secure the starter motor to a test bench, making sure you do not damage the casing. Use a fully charged 12 V battery for the test. Use battery-motor connection cables which are no longer than 70 cm and with the same cross-section as the cable on the motorcycle itself. Connect the negative terminal of the battery to an unpainted area of the starter motor casing and the positive terminal to its electrical terminal. The shaft of the starter motor should rotate freely and at high speed. Take care not to short-circuit the two cables connected to the battery.

Removal of the starter motor

Remove the side fairings (Sect. E 2, Removal of the side fairings).
Remove the alternator-side crankcase cover (Sect. N 8, Removal of the alternator-side crankcase cover).
If the whole starting gear assembly needs to be renewed, remove the timing gears and the starter motor idler gear (Sect. N 9.1, Removal of the starter motor idler gear).
Disconnect the starter motor/starter contactor cable (4) (Sect. P 1, Plate 42, Plate 43).
Remove the fixing screw (1) and, if necessary, the insert (2).



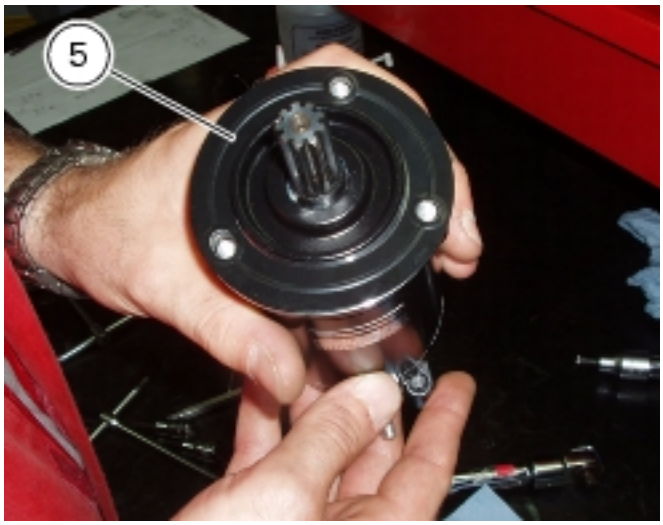
Unscrew the retaining bolts (3).



Notes

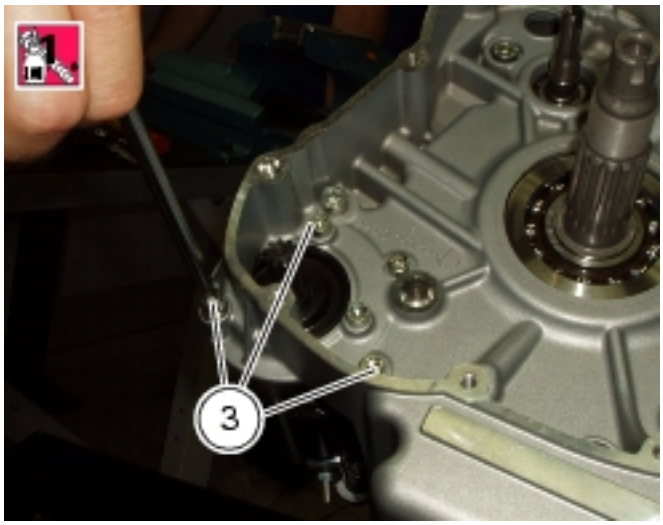
The starter motor retaining bolts are assembled with threadlocker.

Slide out the starter motor and gasket (5).



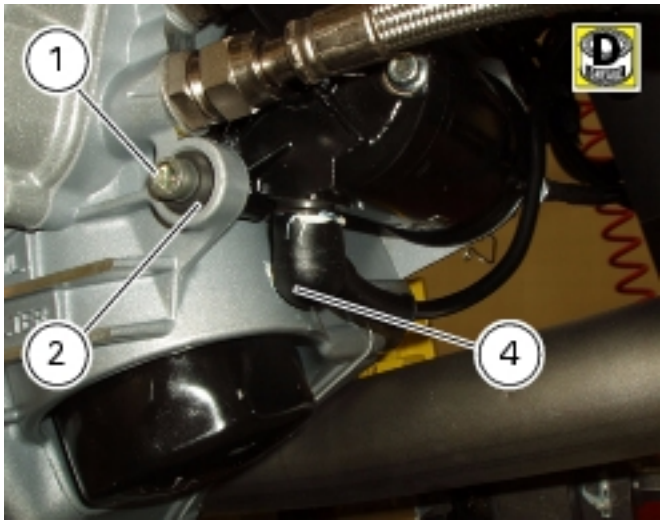
Refitting the starter motor

Inspect the condition of the gasket (5) and renew if necessary.
Locate the gasket (5) and the starter motor on the crankcase and tighten the bolts (3) to the specified torque (Sect. C 3, Engine torque settings.



Locate the insert (2) (if removed) in the crankcase, fit the retaining screw (1) and tighten it to the specified torque (Sect. C 3, Engine torque settings).
Connect the starter motor/contactor cable (4).

Important
Fill the cap with protective grease before fitting it on the starter motor

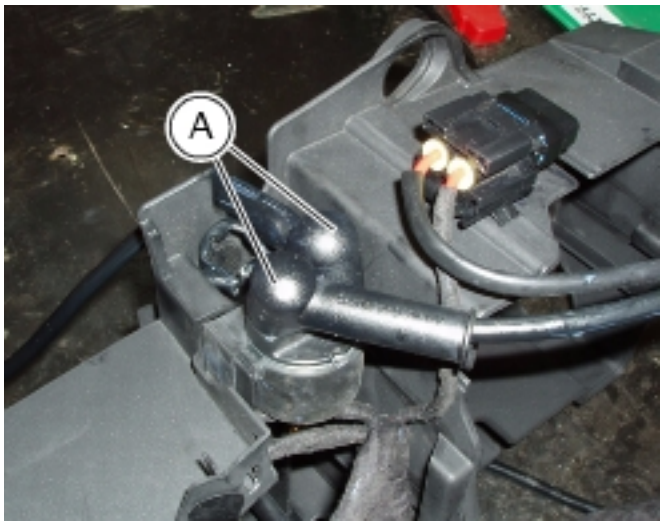


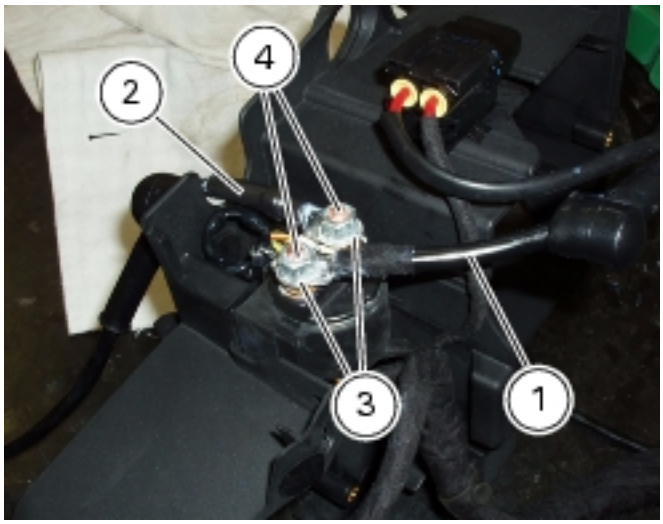
If the starting gears assembly has been renewed, refit the starter motor idler gear and the timing

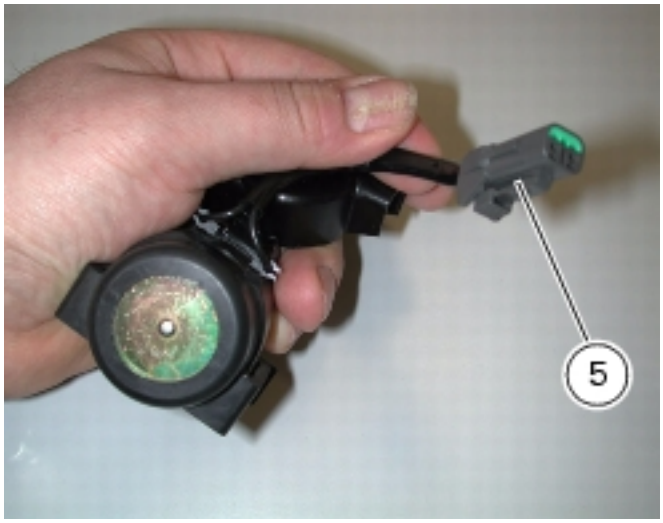
gears (Sect. N 9.1, Removal of the starter motor idler gear).
Refit the alternator-side crankcase cover (Sect. N 8, Refitting the alternator-side crankcase cover).
Refit the side fairings (Sect. E 2, Refitting the side fairings).

Starter contactor

The contactor is elastically mounted to the battery support.
Disconnect the battery (Sect. P 2, Battery).
Remove the protective caps (A).
Unscrew the nuts (4), taking care to recover the spring washers (3).
Remove the starter motor-contactor cable (2). Remove the contactor-battery cable (1).
Disconnect the starter contactor wiring connector (5) from the wiring loom (Sect. P 1, Plate 37).

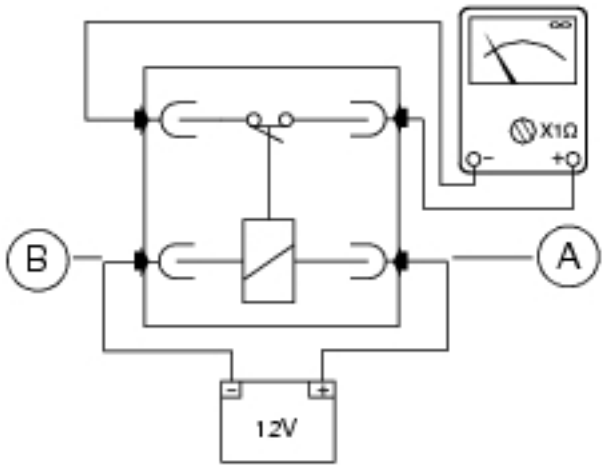


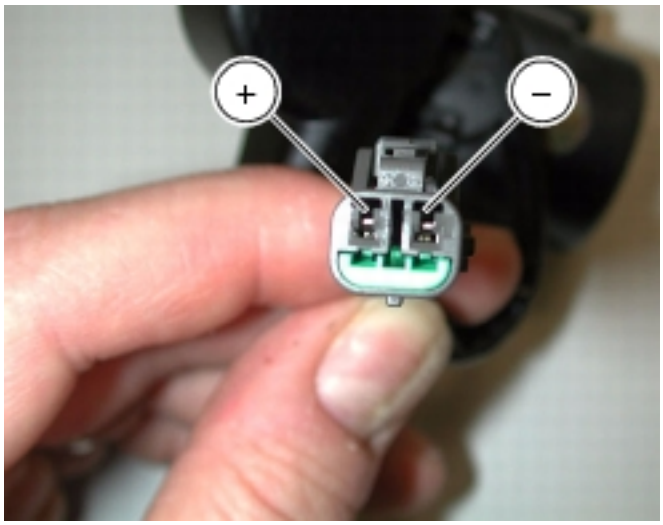




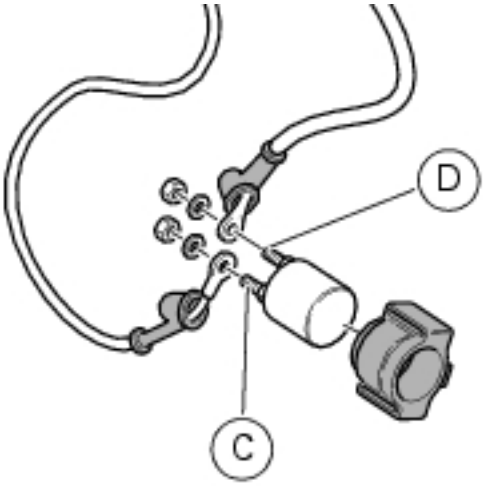
Checking operation of the starter contactor

Apply **12** V (battery voltage) across the positive terminal (A) and negative terminal (B) of the connector.

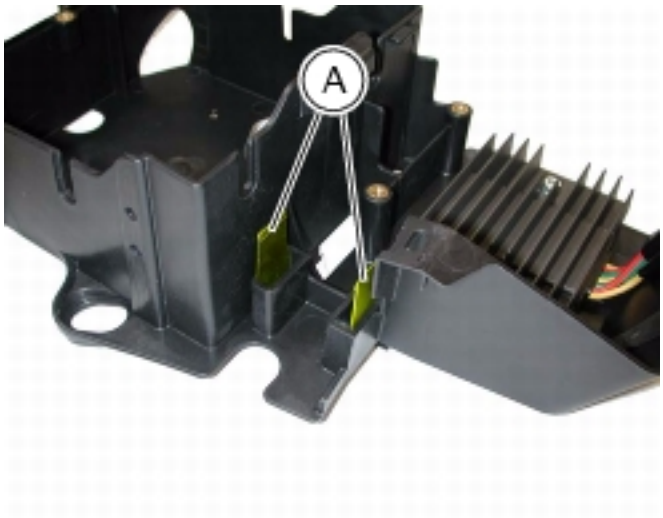




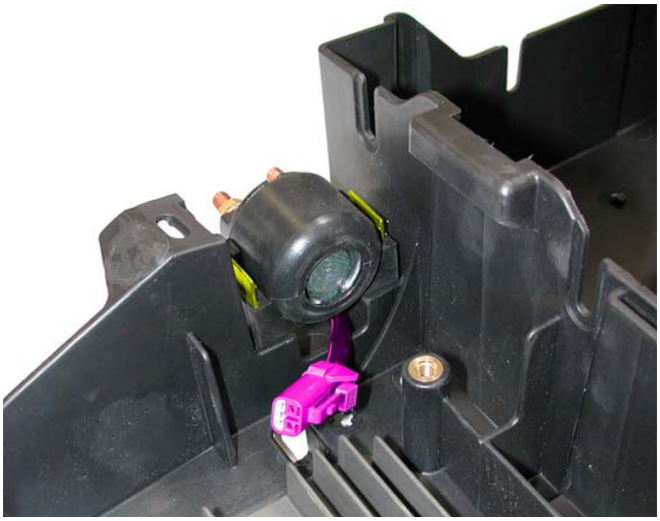
With a multimeter connected between the two poles (threaded studs (C) and (D)) of the contactor, check for electrical continuity (Sect. P 9, Diagnostic instruments). If there is no electrical continuity, renew the contactor.

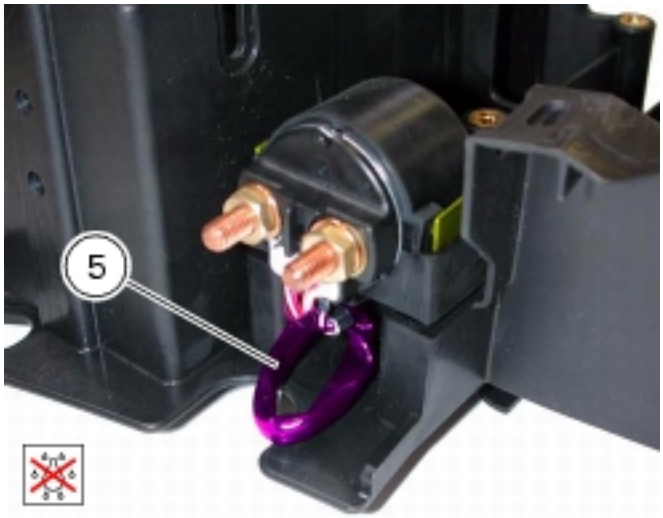


Fit the contactor on the fins (A).

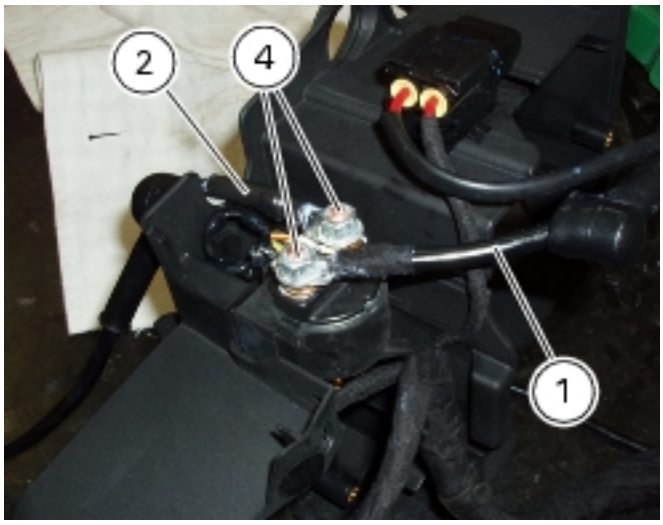


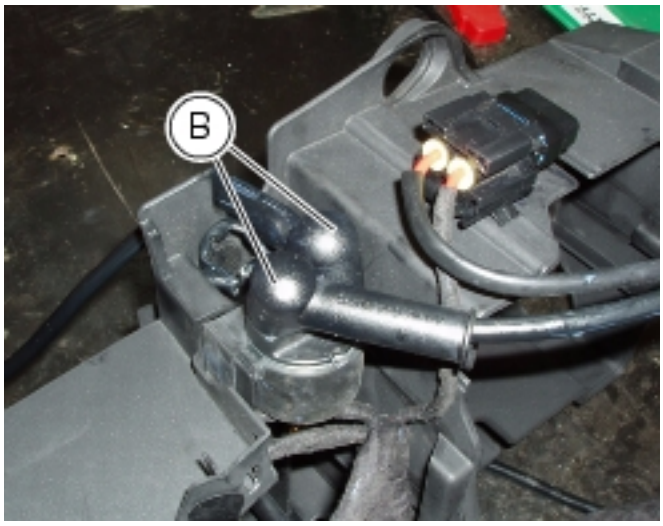
Route the cable (5) beneath the contactor as shown in the figure.
Ensure that the terminals are not oxidized and apply water repellent spray.





Connect the cables (1) and (2) to the contactor terminals (Sect. P 1, Plate 36, Plate 42).
Tighten the nuts (4) to the specified torque (Sect. C 3, Engine torque settings).
Reconnect the contactor wiring connector to the wiring loom (Sect. P 1, Plate 37).
Refit the protective caps (B).





4 - Lights and indicating devices

Changing light bulbs

Changing the headlight bulbs

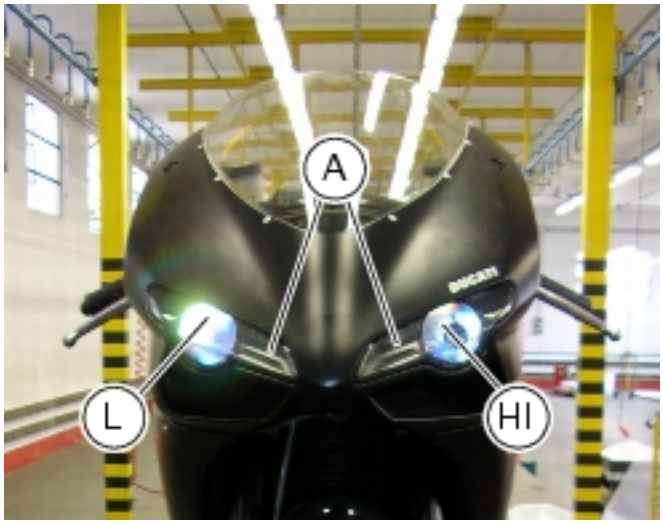
Before replacing a burnt out light bulb, ensure that the replacement bulb has the same voltage and power rating as specified for the lighting device in question (Sect. C 1.1, Lights/instrument panel).

Warning

The halogen light bulbs in the headlight become hot when switched on and remain hot for some time after they are switched off. Allow bulbs to cool before replacing them.

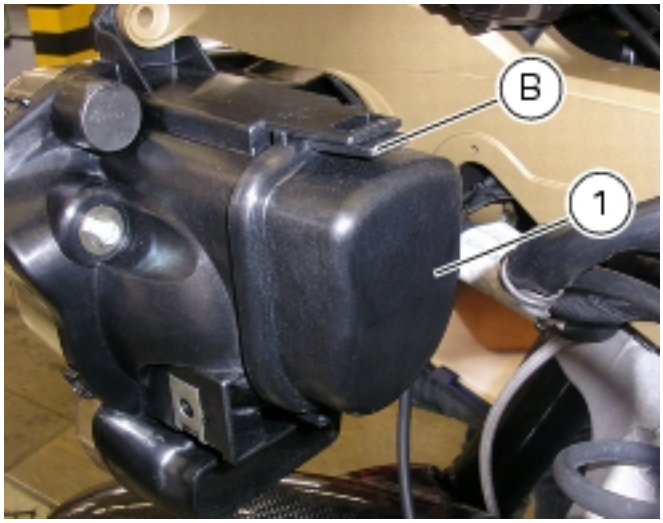
The position of the light bulbs in the headlight is as indicated below: low beam (LO), high beam (HI) and side light (A).

To access the headlight bulbs, remove the air scoop covers of the headlight shell (Sect. E 1, Removal of the air scoop covers).



High beam bulb (HI)

Remove the cover (1) by pressing the tab (B).



Remove the bulb lead (2) and remove the bulb from the lead.

Notes

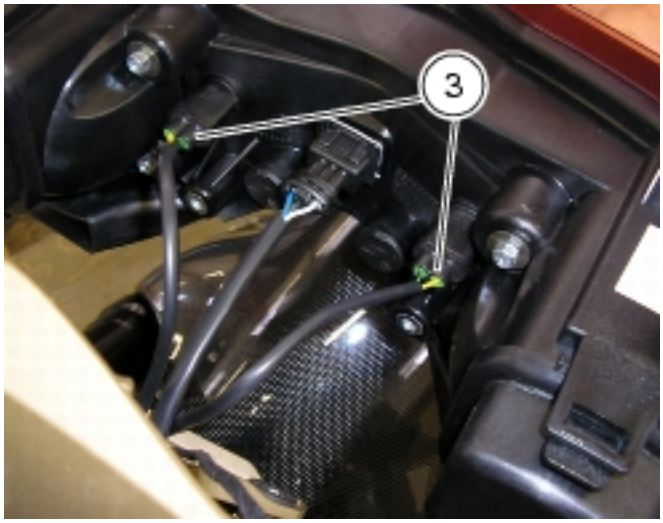
Do not touch the transparent part of the bulb with your fingers, this will darken it and cause a loss of brightness.

Low beam bulb (LO)

Repeat the operations for removal of the high beam bulb, but this time working on the right-hand side of the motorcycle.

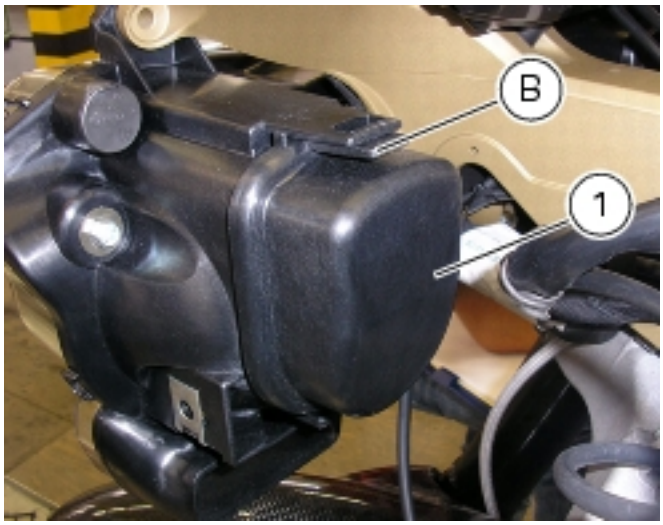
Side lights (A)

To replace the side light bulb withdraw the bulb holder (3) from the rear of the headlight. Remove the bulbs and replace them.



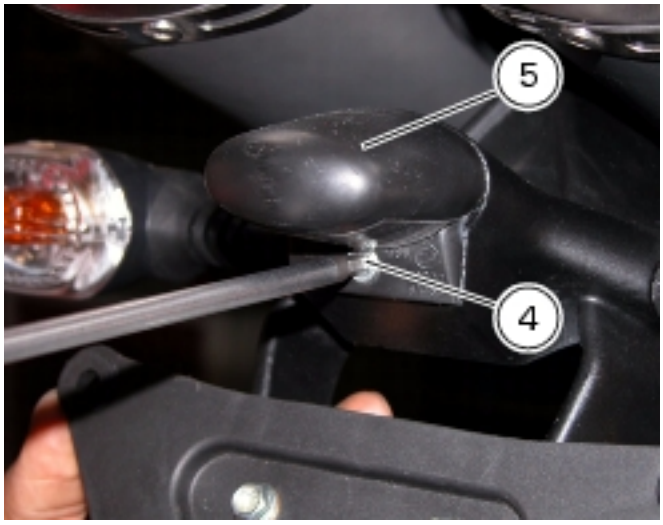
Refitting the bulbs

After replacing the bulbs as required, reconnect the bulb holders to the lights assembly. Reposition the covers (1) and secure them to the headlight assembly with the clips (B).



Changing the number plate light bulb

To access the number plate light bulb, unscrew the two screws (4) securing the cover (5). Extract the bulb and renew it.

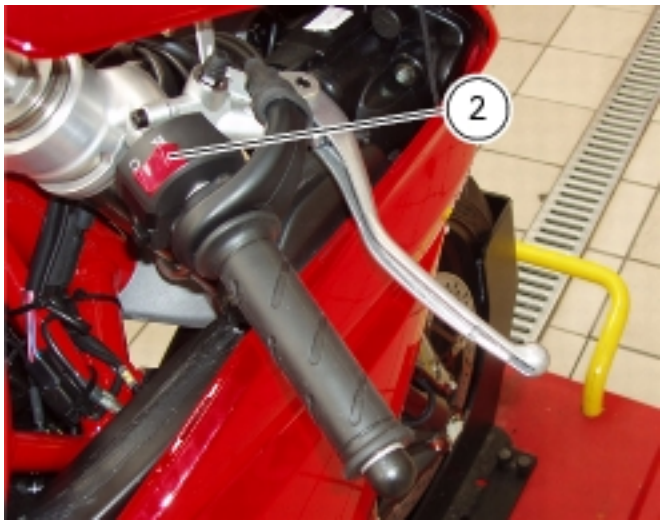


High beam headlights relay

The headlights relay (1) is located on the front subframe. To gain access to this component you must first remove the headlight shell (Sect. E 1, Removal of the headlight shell). A low beam lights relay (1) has been introduced into the system in order to reduce battery power consumption by automatically switching off the headlight.

The device is triggered in two cases:

- in the first case, if you turn the key from OFF to ON but do not start the engine, After 60 seconds the headlight will be deactivated and will only be reactivated the next time the key is turned from OFF to ON or the engine is started;
- in the second case, after normal use of the motorcycle with the lights on, if the engine is shut off using the engine Stop switch (2). In this case, 60 seconds after the engine is stopped, the headlight will be turned off and will only be turned on again the next time the engine is started.



Notes

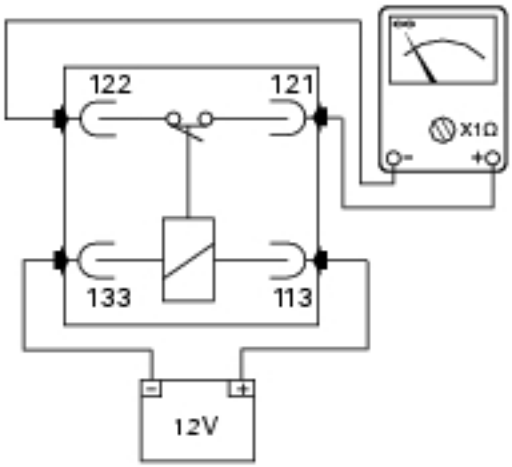
Also during engine starting, the system turns the headlight off and turns it back on once the engine has started.

If this strategy is not performed, check the correct operation of the various parts involved.

Checking operation of the high beam lights relay

Disconnect the relay (1) from the electrical system and apply 12 V (battery voltage) between contacts

(113) and (133) (small contacts): you should hear a click that confirms that the internal electromagnet has switched.
Connect a multimeter to contacts (121) and (122) (big contacts) to check for the full scale reading (analogue tester) or buzzer (digital tester). If this does not occur, the part must be renewed.



Headlight aim

The motorcycle must be perfectly upright with the tires inflated to the correct pressure and with a rider seated, perfectly perpendicular to the longitudinal axis.
Position the motorcycle 10 metres from a wall or a screen.
On the wall or surface, draw a horizontal line at the same height from the ground as the centre of the headlight and a vertical line aligned with the longitudinal axis of the motorcycle.

Notes

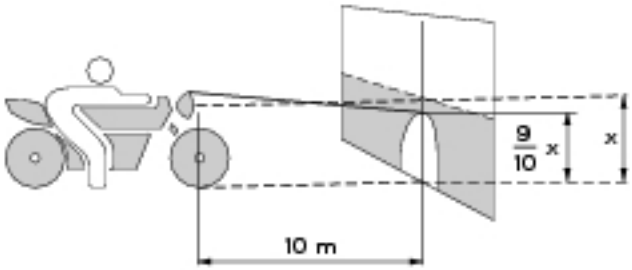
If possible, perform this check in conditions of low ambient light.

Switch on the low beam. The height of the upper limit between the dark area and the lit area must not be more than nine tenths of the height of the centre of the headlight from the ground.

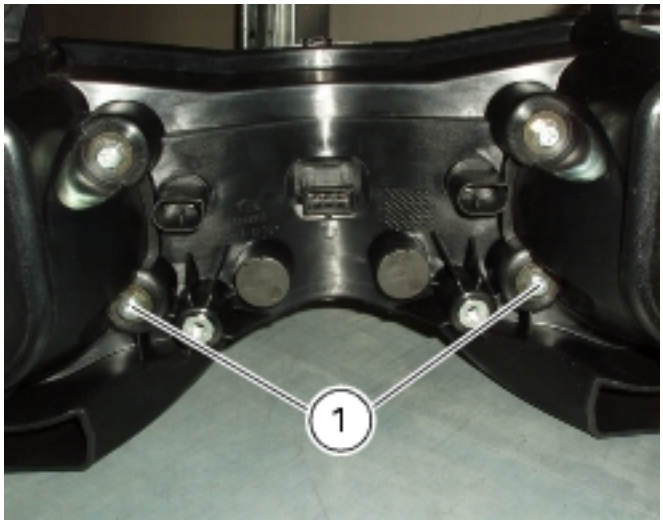
Notes

This is the procedure specified by Italian regulations for checking the maximum height of the light

beam.



Vertical alignment is adjusted by way of the adjuster screws (1) on the rear of the headlight.



5 - Indicating devices

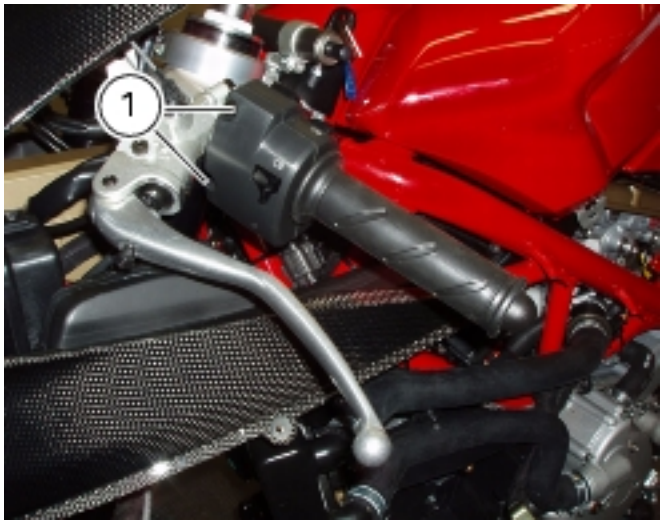
Checking the indicating system components

In the event of a fault, the internal connections of the device must be checked in all operating conditions. To do this, disconnect the switch connector from the main wiring loom (Sect. P 1, Routing of wiring on frame).
Test the device using either an analogue or digital multimeter (Sect. P 9, Diagnostic instruments.

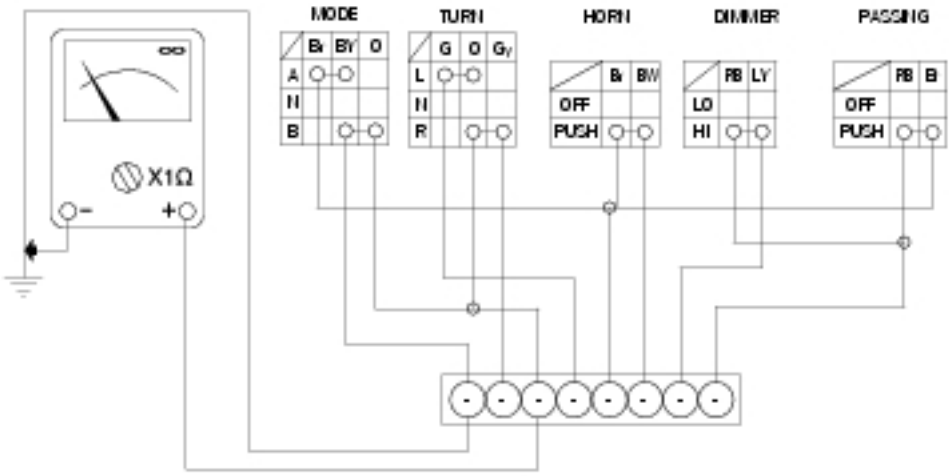
Notes
The same check can also be performed using the "DDS" tester (Sect. D 5, DDS tester).

Checking the left-hand handlebar switch

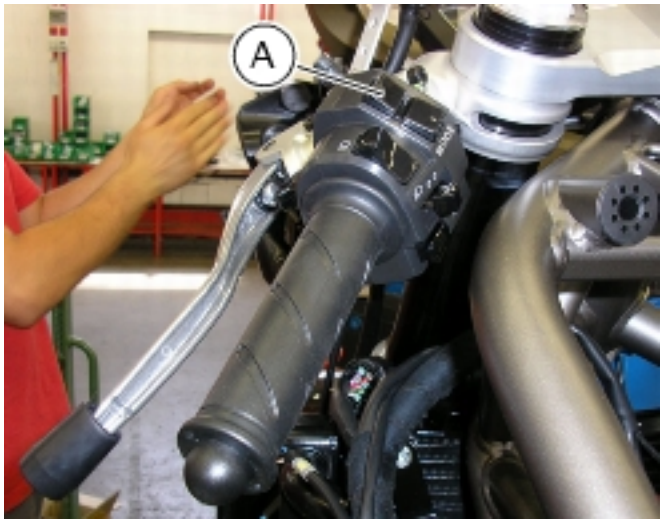
To remove the left-hand handlebar switch, undo the fixing bolts (1) and disconnect it from the electrical system.



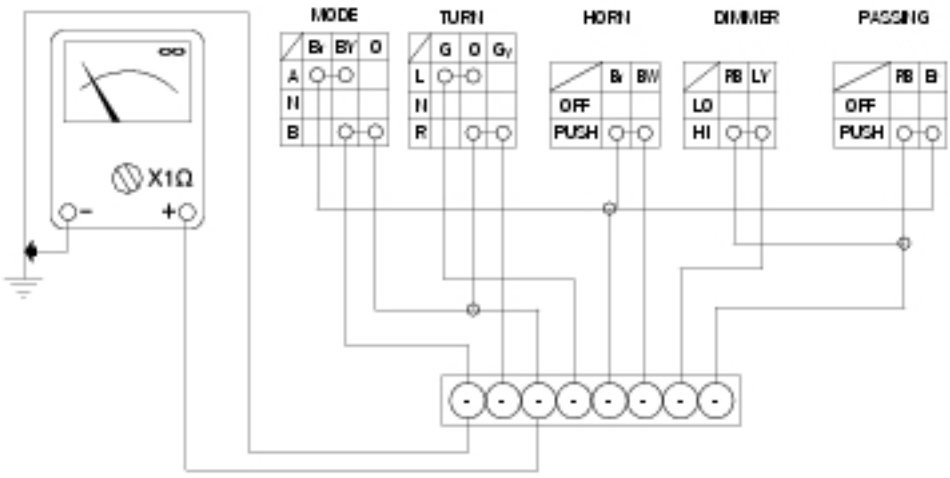
The colours mentioned in the following descriptions refer to the colours of the wires from the switch and not to the colours of the wires of the main electrical system.
HORN button
Connect the terminals of a multimeter to the Black/White and Brown wires to check for electrical continuity, which must be present when the HORN is pressed (see Sect. P 9, Diagnostic instruments, concerning operation of the multimeter) When the horn button is pressed, the resistance value shown by the multimeter should be close to zero and, if available, a continuity beep should be heard. When the horn button is not pressed, the resistance value should be infinity (there is no continuity as the electrical contacts inside the pushbutton are open) and no continuity beep should be heard. If these conditions are not met, the device must be replaced.



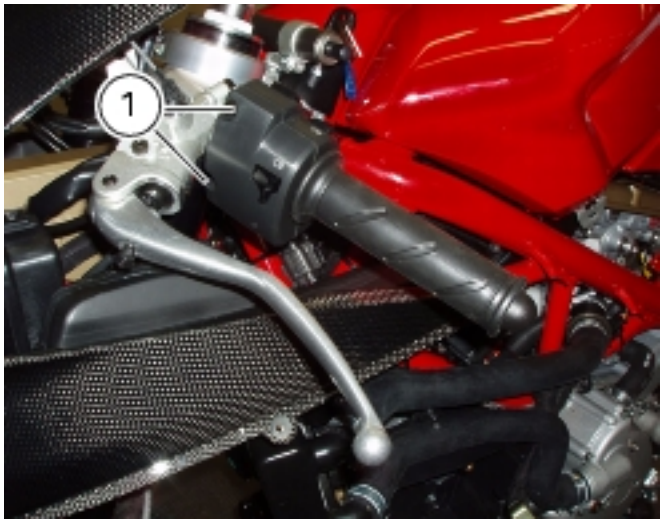
Turn signal switch (TURN)
Connect the multimeter to the Orange and Green wires from the turn signal switch and check for electrical continuity when operating the right turn signals (see Sect. P 9, Diagnostic instruments concerning operation of the multimeter). Repeat the above procedure for the left turn signal but connect the multimeter to the green and orange wires. The above colours refer to the colour of wires from the switch and not to the colour of wires of the main electrical system.
Low and high beam headlights (DIMMER)
The test method is the same; connect the meter to the Red/Blue and Light blue/Yellow wires.
Control switch (MODE)
Connect the multimeter to the Blue/Yellow and Orange wires from the function selector switch and check that there is electrical continuity when the pushbutton (A) is pressed (Sect. P 9, Diagnostic instruments – multimeter operation). Repeat the same procedure, operating the pushbutton (A) in the other position and connecting the multimeter to the Brown and Blue/Yellow wires.



Flasher (PASSING)
Check for continuity across the Red/Blue and Brown wires.

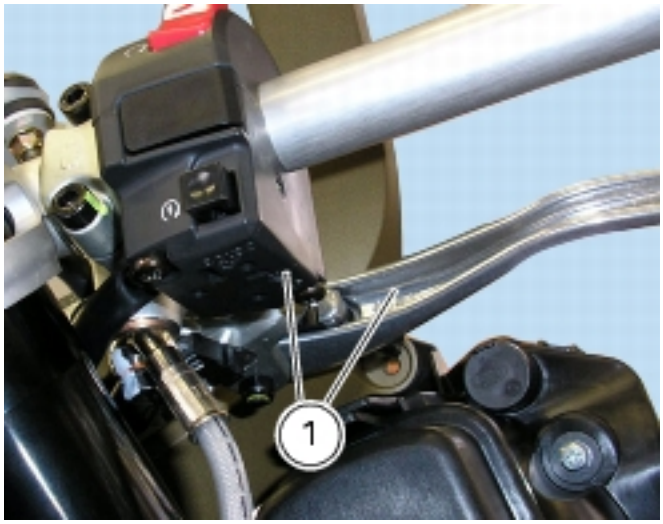


Refit the left-hand handlebar switch and tighten the bolts (1) to the specified torque (Sect. C 3, Frame torque settings).



Checking the right-hand handlebar switch

To remove the right-hand handlebar switch, undo the retaining bolts (1) and disconnect the wiring connector from the electrical system.



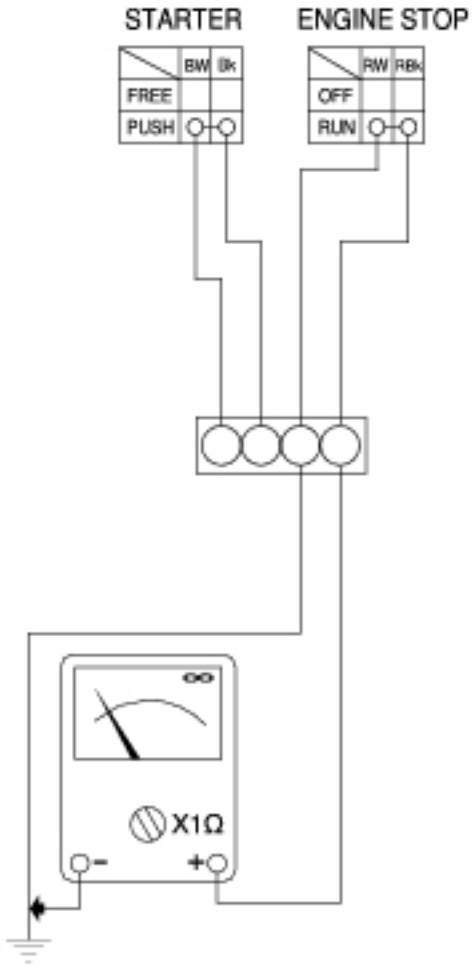
The colours mentioned in the following descriptions refer to the colours of the wires from the switch and not to the colours of the wires of the main electrical system.

Engine Stop button

Using a multimeter, check for continuity between the Red/Black and Red/White wires (see Sect. P 9, Diagnostic instruments for information on the operation of the multimeter). When the button is in RUN position, there should be electrical continuity between the two wires. When the button is in the OFF position, there should be no electrical continuity between the two wires. If these conditions are not met, the engine stop switch is not working correctly and must be renewed. The colours indicated above refer to the colour of wires coming from the switch and not to the colour of wires of the main electrical system.

Starter switch

Proceed as described for the engine stop button and check for continuity between the blue/white and black wires when the starter button is pressed (see Sect. P 9, Diagnostic instruments concerning operation of the multimeter). If there is no continuity, the starter button is faulty and must be renewed. The colours indicated above refer to the colour of wires coming from the switch and not to the colour of wires of the main electrical system.

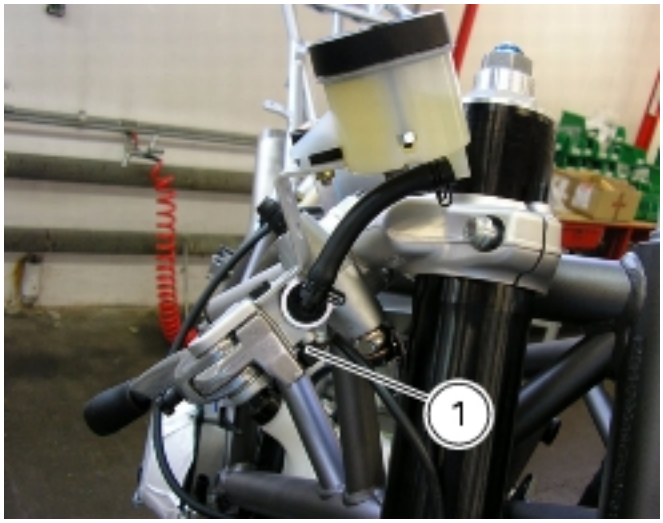


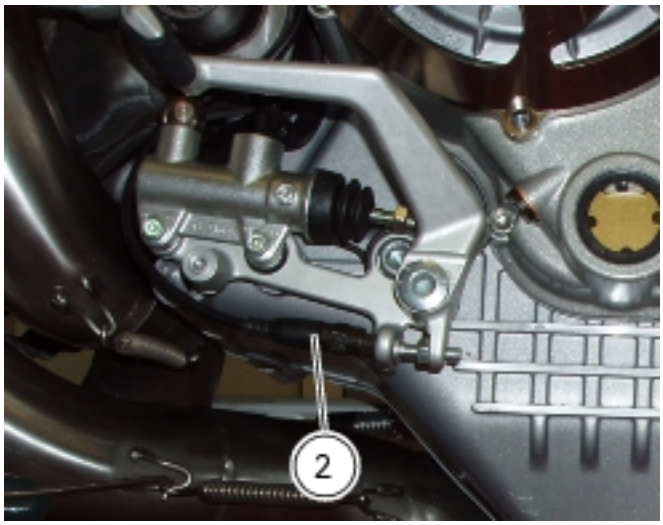
Refit the left-hand handlebar switch and tighten the bolts (1) to the specified torque (Sect. C 3, Frame torque settings).

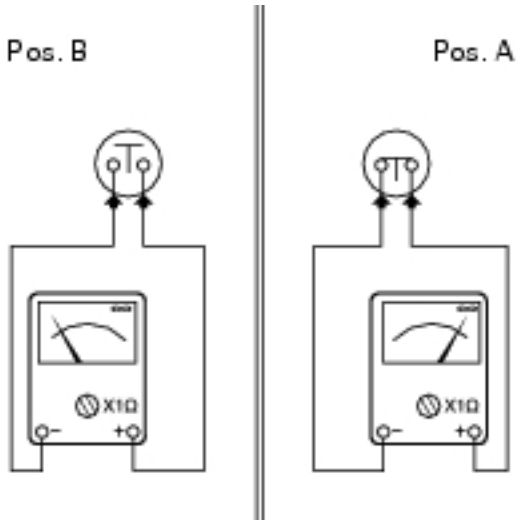
Checking the front and rear brake light switches, neutral light switch, oil pressure switch and clutch switch

Brake light switches

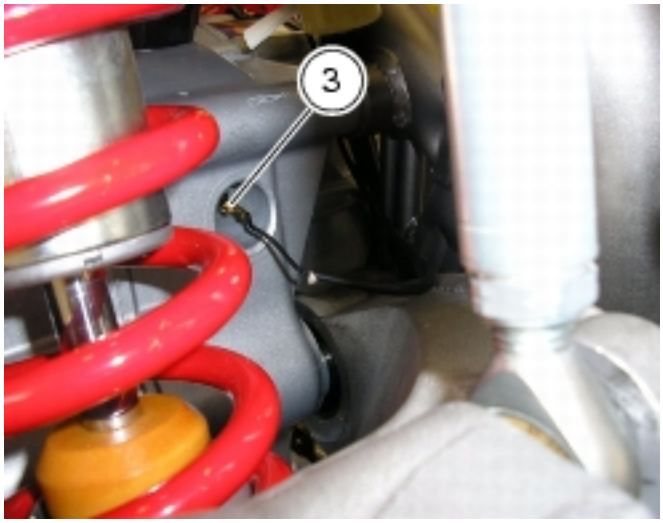
To check operation of the front (1) and rear (2) brake light switches, use a multimeter to check for electrical continuity (Pos. A) between the terminals of the corresponding switch when the front or rear brake is applied (see Sect. P 9, Diagnostic instruments on operation of the multimeter). When the brake is released, there must be no electrical continuity between the terminals of the corresponding switch (Pos. B). If these tests fail to produce positive results, the part in question must be renewed.





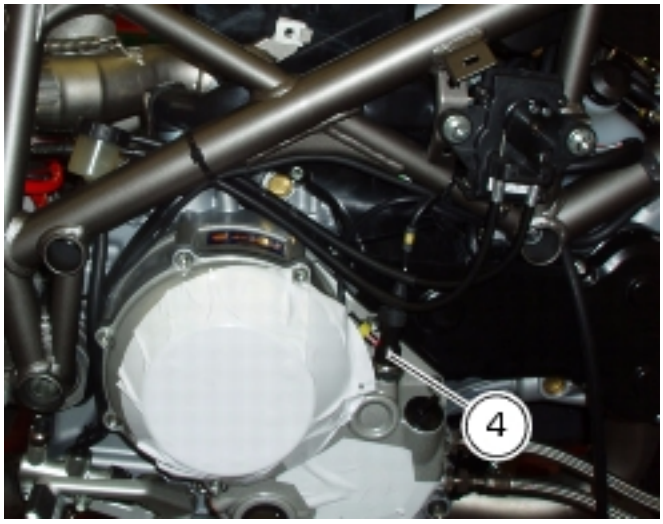


Neutral indicator light
To check the neutral light switch (3) proceed as follows:



The neutral light does not illuminate on the instrument panel.
Remove the electric terminal connected to the neutral switch. Switch on the ignition switch (ignition key to ON position) and ensure that the light illuminates when the terminal is earthed. If the light switches on, the neutral light switch should be changed. If the light stays off, switch off the ignition (ignition key set to OFF) to switch off the instrument panel and check for electrical continuity between the neutral switch and engine ECU with a multimeter.
The neutral light on the instrument panel is permanently illuminated.
Switch on the ignition (ignition key set to ON) and remove the electrical terminal from the neutral switch. If the light switches off, the neutral light switch should be changed. If the light stays off, switch off the ignition (ignition key set to OFF) and use a multimeter to check whether the section of circuit between neutral switch and engine ECU is earthed.

Oil pressure sensor
To test the operation of the engine oil pressure sensor (4), proceed as follows:



Use the tester to check that oil pressure into engine oil circuit complies with the specified values (Sect. D 5, Checking the engine oil pressure).
If the engine oil pressure value is outside the specified range, check the oil circuit components and service as necessary.
If engine oil pressure value is within the specified range and the oil pressure warning light on the instrument panel stays off, switch on the instrument panel (ignition key set to ON) without starting the engine, and disconnect the electrical terminal from the pressure sensor and connect it to earth. If the warning light now illuminates, this means the sensor is defective and must be replaced. If the warning light does not illuminate, use a multimeter and check for electrical continuity in the section of the circuit between sensor and warning light on the instrument panel (this check must be performed with

the ignition key set to OFF, i.e. with instrument panel off).
If the engine oil pressure complies with the stated values and the engine oil pressure warning light on the instrument panel is continuously illuminated, switch on the instrument panel (ignition key set to ON) and start the engine, then disconnect the electrical terminal normally inserted on the pressure sensor. If the warning light now switches off, this means the sensor is defective. If the warning light does not switch off, use a multimeter to check that the section of the circuit between sensor and warning light on the instrument panel is not connected to earth (this check must be performed with the ignition key set to OFF, i.e. instrument panel off).
Clutch switch
For the clutch switch (5) proceed in the same manner as for the brake light switches (see beginning of this paragraph).

Coolant temperature sensor

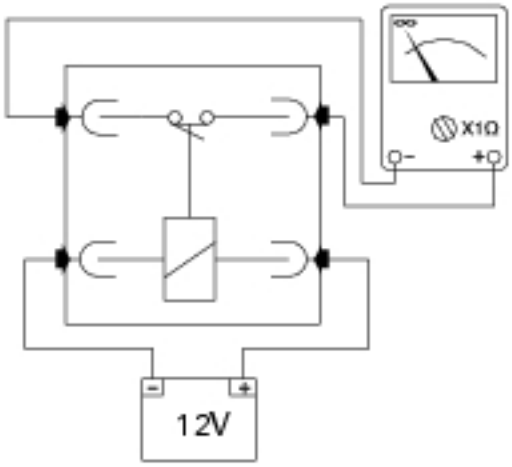
The coolant temperature sensor (6) sends an electrical signal to the engine ECU, which shares it with the instrument panel over the **CAN** line. To check that the sensor (6) is functioning correctly, connect the DDS tester to the diagnostics socket of the ECU and follow the instructions given in the paragraph "Guided diagnosis" (Sect. D 5). After making the correct selections from the menu, read the value of the coolant temperature from the parameters shown on the tester display. With the engine completely cold, the air temperature (also read using the DDS tester) should be similar to that of the coolant. With the engine hot and the cooler fan only just activated, the coolant temperature should be more or less equal to the fan activation temperature. If these tests do not give a positive result, renew the coolant temperature sensor. If the DDS reads an error in the ECU memory of the type "coolant temperature sensor short circuit or broken circuit", check the circuit connecting the sensor to the ECU. If this circuit is not faulty (not broken, not shorted and not earthed), renew the sensor.

Fan relay

The fan relay (7) is located on the right-hand side of the battery support.
To gain access to the fan relay, first remove the left-hand side fairing (Sect. E 2, Removal of the side fairings).

Checking operation of the fan relay

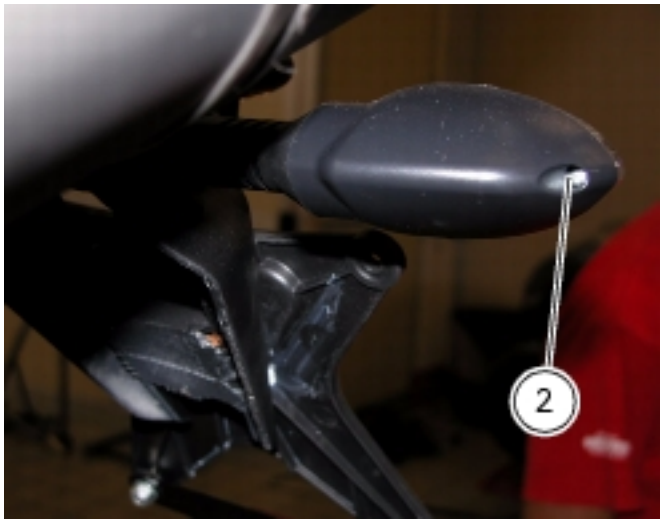
Disconnect the relay from the electrical system and apply **12** V (battery voltage) between the small contacts: you should hear a click that confirms that the internal electromagnet has switched.
Connect a multimeter to the big contacts to check for electrical continuity (Sect. P 9, Diagnostic instruments). The resistance reading should be near zero and, if present, the continuity sound signal should be emitted. If this does not occur, the part must be renewed.



Changing light bulbs

Changing the turn signal light bulbs

Rear turn signals.
To gain access to the rear turn signal bulbs, undo the screw (2) and detach the cover (3) from the turn signal support. Remove the bulb (1) from the bulb holder.
Fit a new bulb (1) into the bulb holder. Refit the cover (3) to the turn signal support.
Refit and tighten the screw (2).

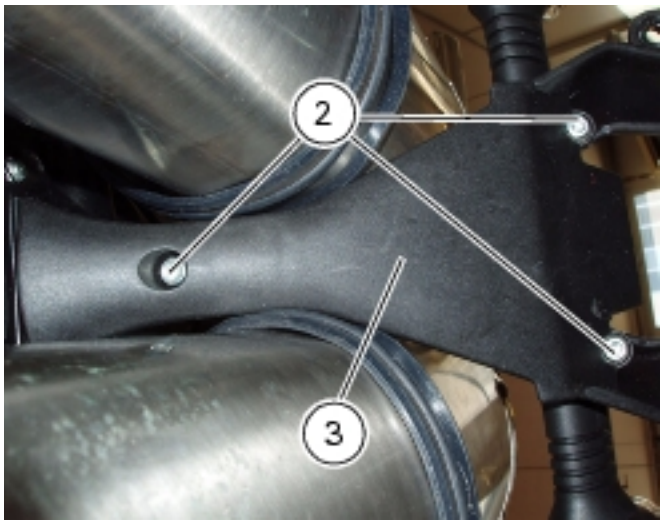


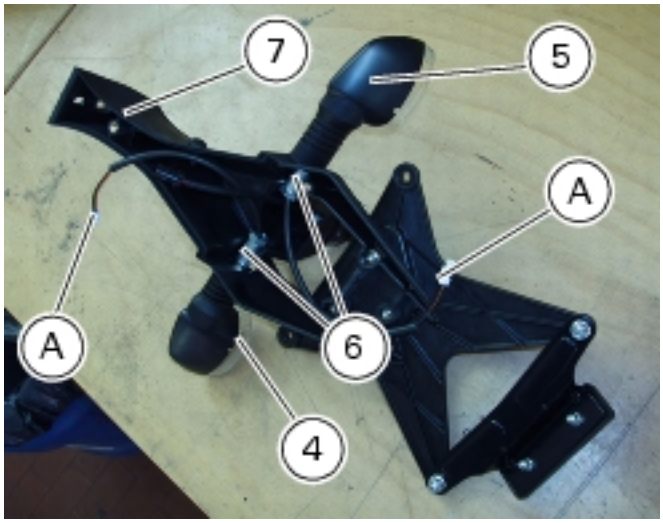
Changing the front turn signals

The front turn signals (1) are built into the rear-view mirrors (Sect. E 1, Removal of the rear-view mirrors) and in the event of malfunction, the mirror/turn signal assembly must be renewed as a complete unit.

Changing the rear turn signal bulbs

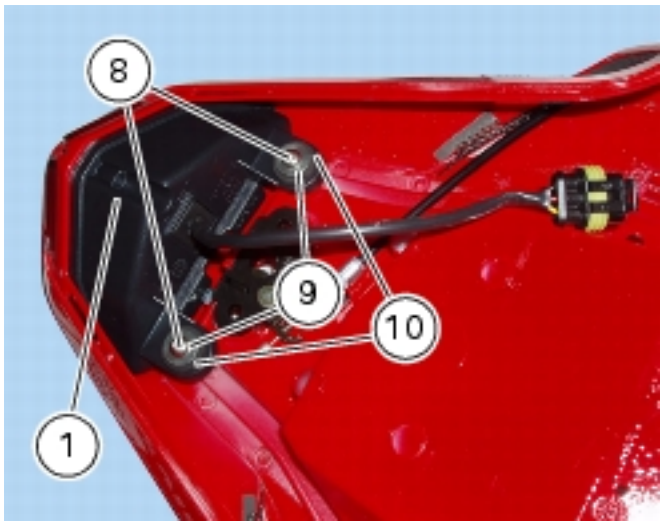
Undo the screws (2) and remove the cover (3).
Disconnect the wiring (A) of the turns signals (4) and (5). Unscrew the nuts (6) and remove the turn signals.
When refitting, position the turn signals by inserting the wires (A) through the relative apertures in the number plate holder (7). Slide the nuts (6) along the wires (A) and screw them onto the turn signals to secure them to the number plate holder. Tighten the nuts (6) to the specified torque (Sect. C 3, Frame torque settings).
Refit the cover (3) and tighten the bolts (2) to the specified torque (Sect. C 3, Frame torque settings).





Renewal of the rear side light and brake light

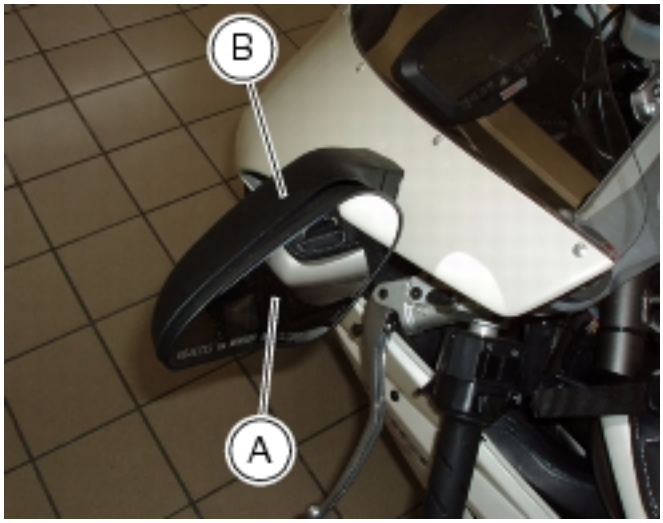
Remove the seat cowling as indicated in Sect. E 3, Removal of the side panels and seat cowling. Unscrew the bolts (8) and remove the side light and brake light unit (11). Remove the spacers (9) and grommets (10) from the old unit and fit them to the new unit (11). Fit the new side light and brake light unit (11) to the seat cowling, tightening the bolts (8) to the specified torque (Sect. C 3, Engine torque settings).



Refit the seat cowling as indicated in Sect. E 3, Refitting the side panels and seat cowling.

Rear view mirror adjustment

Grasp the outer part of the mirror surface (A) and move it manually to the required position relative to the mirror support (B).


B
A

6 - Protection and safety devices

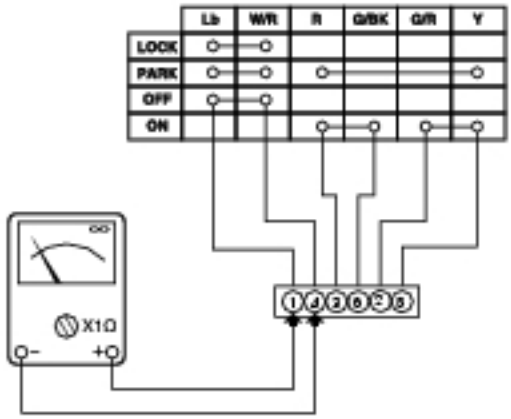
Checking protection and safety device components

Checking the key switch

Disconnect the ignition switch (A) from the wiring loom by opening its connector (Sect. P 1, Plate 18) and use a multimeter to check its internal connections as follows:
turn the key to **OFF** and connect a multimeter to contacts (1) and (4) to check electrical continuity (Sect. P 9, Diagnostic instruments on operation of the multimeter). The resistance reading should be near zero and, if present, the continuity sound signal should be emitted.
turn the key to **ON** and connect the multimeter to contacts (3) and (6) and then to (2) and (5) to check for electrical continuity. The resistance reading should be near zero and, if present, the continuity sound signal should be emitted.
turn the key to **PARK** and connect the multimeter to contacts (1) and (4) and then to (3) and (5) to check for electrical continuity. The resistance reading should be near zero and, if present, the continuity sound signal should be emitted.
turn the key to **LOCK** and connect the multimeter to contacts (1) and (4) to check for electrical continuity. The resistance reading should be near zero and, if present, the continuity sound signal should be emitted.

Notes

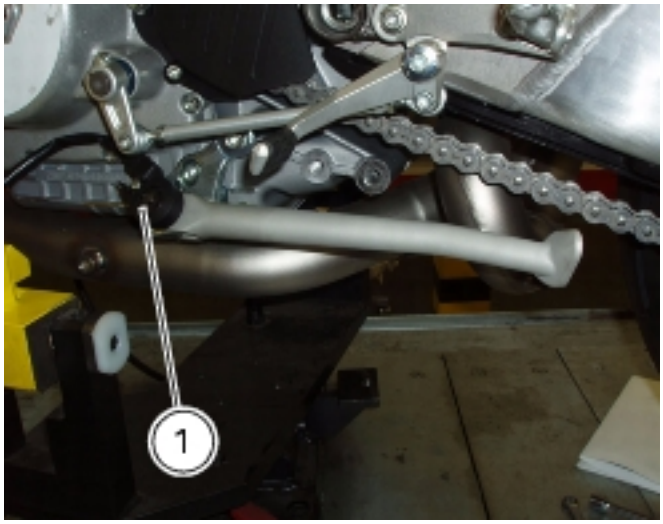
The same check can also be performed using the "DDS" tester (Sect. D 5, DDS tester).

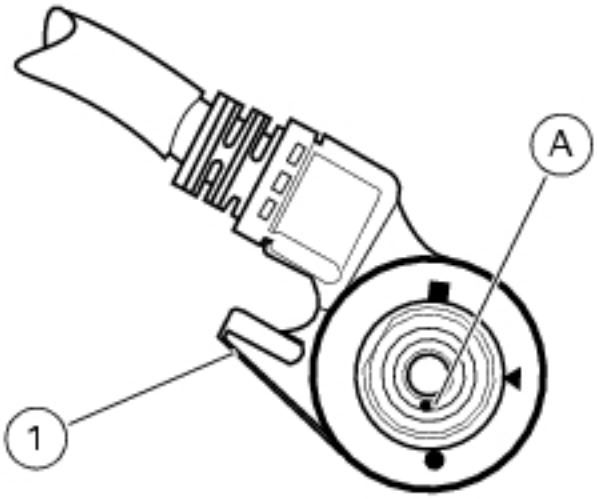


Checking the sidestand switch

Remove the switch (1) from the sidestand and disconnect the main wiring loom connector from the switch (Sect. P 1, Plate 31).

Use an analogue or digital multimeter (Sect. P 9, Diagnostic instruments) to check operation of the switch (see table).





Notes

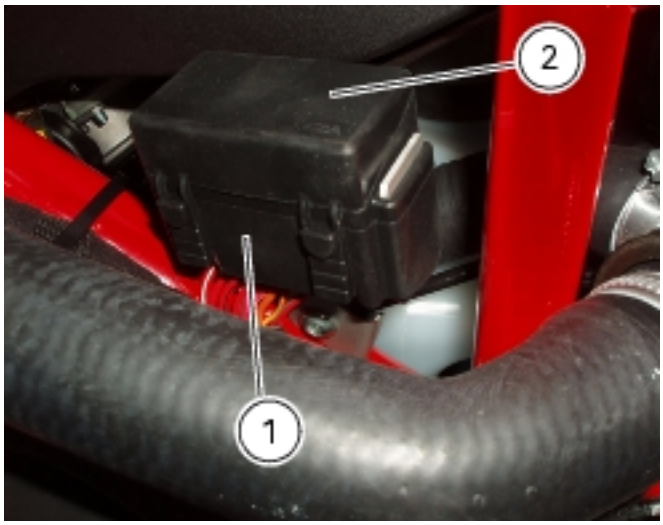
The same check can also be performed using the "DDS" tester (Sect. D 5, DDS tester).

Pos. pin (A)	Device	Val.
● - ▲	0	X
▲ - ■	X	0
Multimeter pos.	Green/ Green White	Green/ Yellow Black

0 = open contact
X = Closed contact

Checking the fuses

The main fusebox (1) is located on the left-hand side of the motorcycle and is accessed by removing the left-hand side fairing (Sect. E 2, Removal of the side fairings).
The fuses are accessed by removing the cover (2), which shows the ampere ratings and fuse positions.

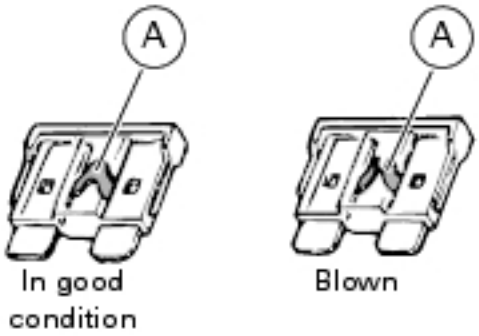


For ampere ratings, refer to the "Wiring diagram", Sect. P 1.

Important

Before replacing a damaged fuse with a new one of the same rating, identify the cause of the problem.

A blown fuse can be identified by the breakage of inner filament (A).



Important

Switch the ignition key to **OFF** before replacing a fuse to avoid possible short circuits.

Warning

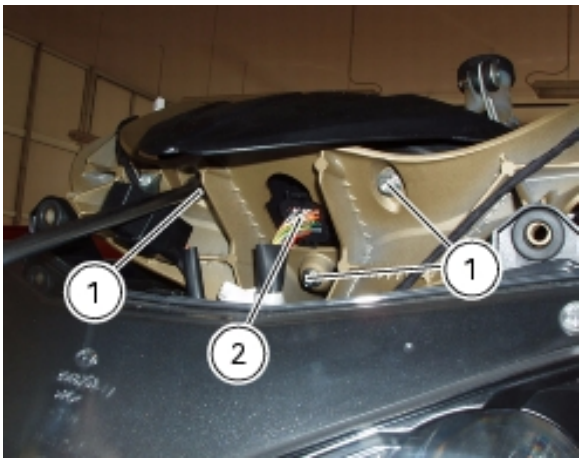
Never use a fuse with a rating other than the specified value. Failure to observe this rule may damage the electric system or even cause fire.

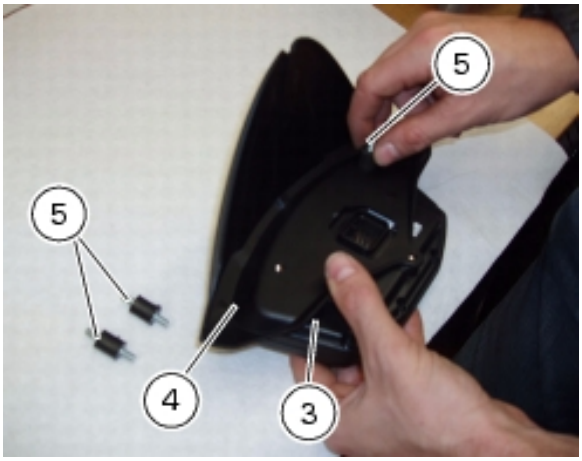
As well as the fuses in the fusebox, the motorcycle has a **30** A fuse located alongside the battery support to protect the electronic regulator (Sect. P 2, Regulator/rectifier).

7 - Instruments

Instrument panel

Remove headlight shell (Sect. E 1, Removal of the headlight shell).
Unscrew the nuts (1). Disconnect the wiring to the instrument panel (2).
Remove the instrument panel (3) complete with the cover (4).
To remove the cover (4) from the instrument panel, remove the rubber mountings (5).
On refitting, tighten the nuts (1) to the specified torque (Sect. C 3, Frame torque settings).





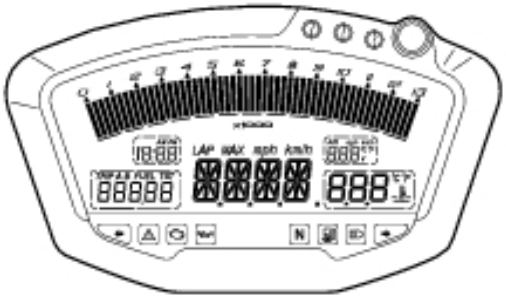
Notes
The instrument panel is supplied as a single component; its internal components cannot be renewed separately.

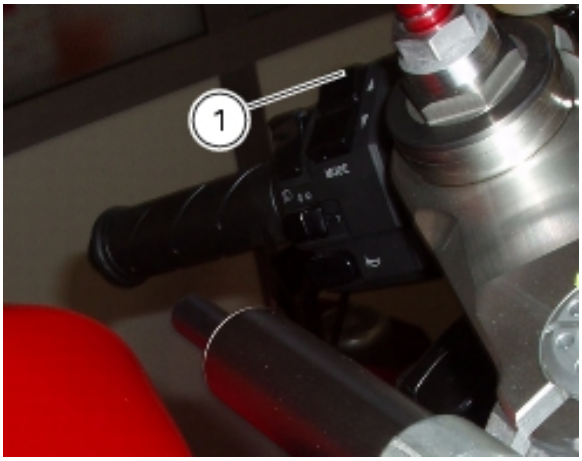
Important
Whenever the instrument panel is renewed, the ignition key programming procedure must be repeated.

Instrument panel system

The instrument panel comprises a LCD digital display unit.
The information on the display can be accessed using a 2-position switch (1) and the headlight flasher button (2) on the left-hand handlebar switch. Underneath the digital display there are eight indicator lights (four per side) and a further four auxiliary lights used to signal reaching of the limiter threshold.
The instrument panel is equipped with a sensor that detects the intensity of the ambient light. The instrument panel automatically switches its backlighting on or off according to the intensity of light detected. The instrument panel also has an internal temperature sensor which, if the temperature rises above 70 °C, switches off the backlighting to prevent possible damage.
The instrument panel also houses the atmospheric pressure sensor: the engine ECU acquires this signal via the CAN

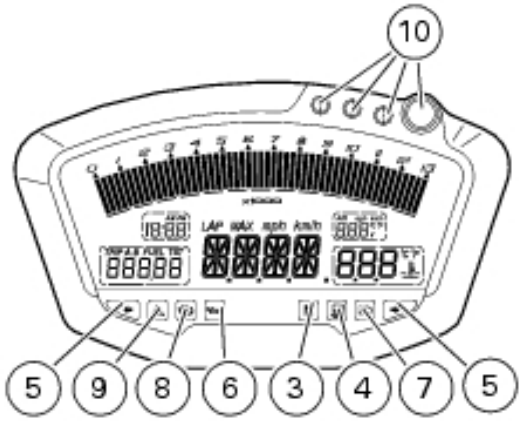
(Controller Area Network) serial communication line.





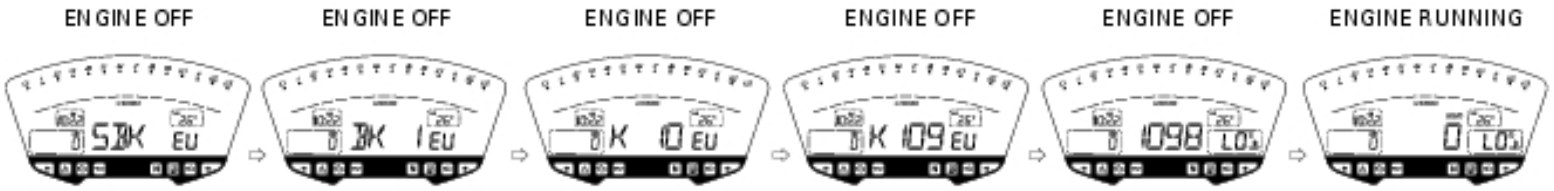
Indicator lights

The following indicator lights are mounted on the instrument panel.
3) Neutral light (green): illuminates when the gearbox is in neutral.
4) Low fuel light (yellow): illuminates when there are approximately 3 litres of fuel left in the tank.
5) Turn signal lights (green): illuminate and flash when the corresponding turn signal is in operation.
6) Engine oil pressure light (red): illuminates when the engine oil pressure is too low. This light should come on when the ignition is switched to ON and normally goes out a few seconds after engine starts. It may come on briefly if the engine is very hot, but should go out again as engine speed increases.
7) High beam warning light (blue): illuminates when the high beam headlight is on.
8) Engine diagnostics warning light (amber): switches on permanently in the event of a problem with the engine and/or injection system.
9) Motorcycle diagnostics warning light (amber): switches on permanently in the event of a problem with the motorcycle.
10) Limiter indicator lights.

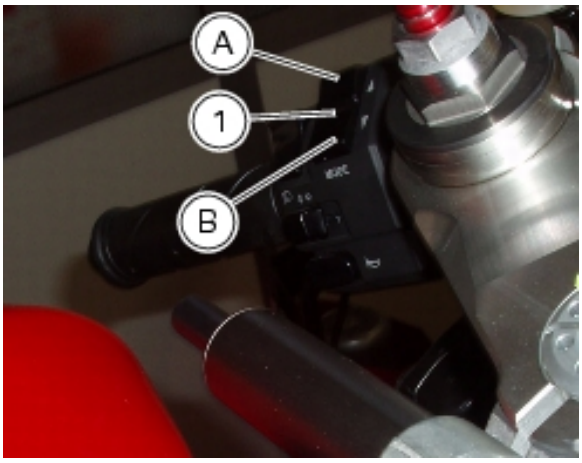


Display settings and functions

On switching on the power (key turned from OFF to ON), the instrument panel activates all the digits of the LCD for 1 second and switches on all the warning lights in sequence.
It then reverts to "normal" display mode and, in place of motorcycle speed, shows the model and, for 2 seconds, also the version (EU, UK, USA, CND, FRA, JAP).
The model is displayed cyclically until the engine is started.



At Key-On, the instrument panel always shows the following information (de-activating any previously activated functions):
Odometer
Air temperature
Clock
Speed
Coolant temperature
Engine rpm
At this point, with switch (1) in position B "▼" it is possible to switch from the odometer display function to the following functions:
TRIP A
TRIP B
TRIP FUEL (only if active)
before returning to Odometer.
If, however, you press switch (1) in position A "▲" the system enters MENU mode and displays the following functions in sequence:
Error (only if active)
BATT
RPM
LAP (OFF or ON)
LAP MEM
USB (OFF or ON)
Erase USB
TIME Set
CODE (only if active)

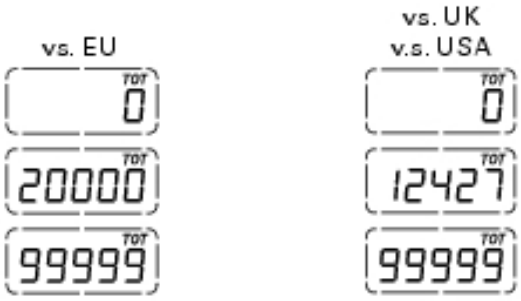


Important

This menu is active only if the speed of the motorcycle is less than 20 km/h. If this menu is on the display and the speed of the motorcycle exceeds 20 km/h, the instrument panel automatically exits the menu and returns to the initial display. It is possible to exit the menu at any time, however, by pressing switch (1) in position A "▲" for 3 seconds.

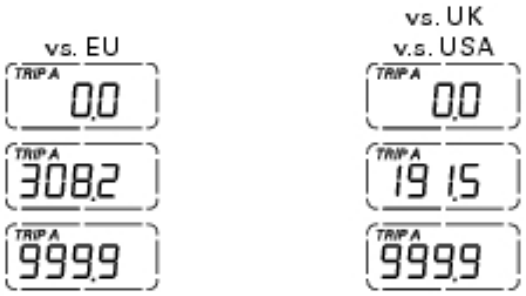
Total distance travelled indicator (odometer)

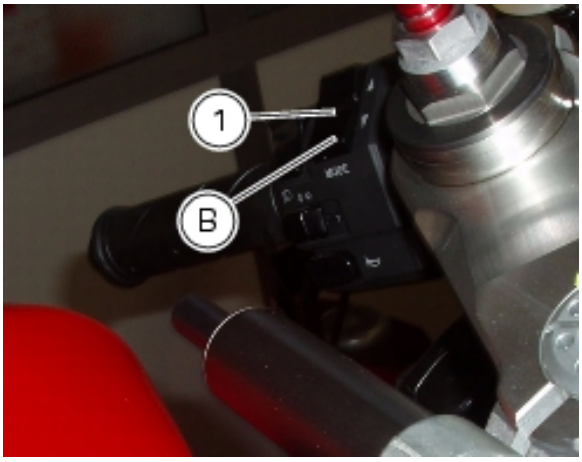
At Key-On the system automatically enters this function.
The reading is saved permanently and cannot be reset.
If it exceeds 99999 km (or 99999 miles), the reading "99999" remains displayed permanently.



Trip meter "TRIP A"

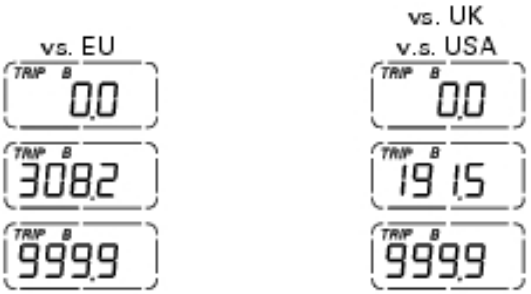
While in this function, if you press switch (1) in position B "▼" for 3 seconds, the reading is reset to zero.
If the reading exceeds 999.9, it is reset to zero and the count restarts automatically.
If the system's units of measurement are changed at any time with the "Setting Special" function, the reading in this function is reset and the count restarts from zero in the newly set unit of measurement.

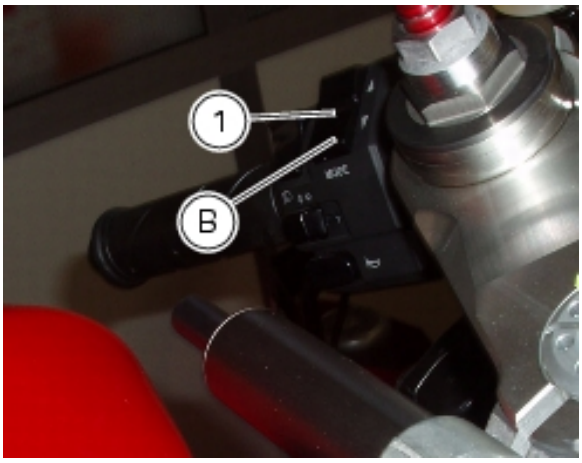




Trip meter “TRIP B”

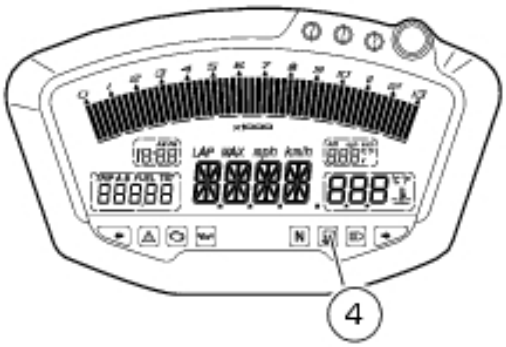
While in this function, if you press switch (1) in position B "▼" for 3 seconds, the reading is reset to zero.
If the reading exceeds 999.9, it is reset to zero and the count restarts automatically.
If the system's units of measurement are changed at any time with the "Setting Special" function, the reading in this function is reset and the count restarts from zero in the newly set unit of measurement.





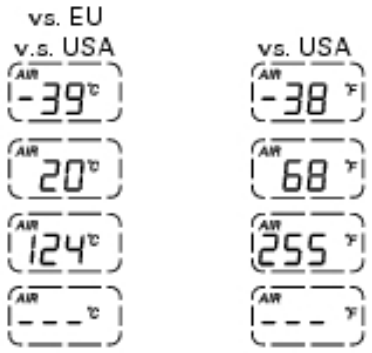
"TRIP FUEL" (distance travelled on reserve fuel) indicator

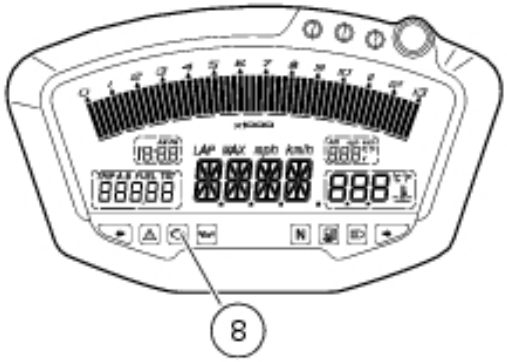
When the fuel warning light (4) comes on, the TRIP FUEL meter is activated automatically, regardless of the function displayed. If the fuel level remains in reserve, the reading is saved even after Key-Off.
At the next Key-On, the fuel warning light comes back on after a few seconds and the TRIP FUEL meter is displayed after 60 seconds (although it starts counting the distance travelled as soon as the motorcycle moves off).
The count stops automatically when the fuel level rises above reserve.
If the reading exceeds 999.9, it is reset and the count restarts automatically.



Air temperature indicator

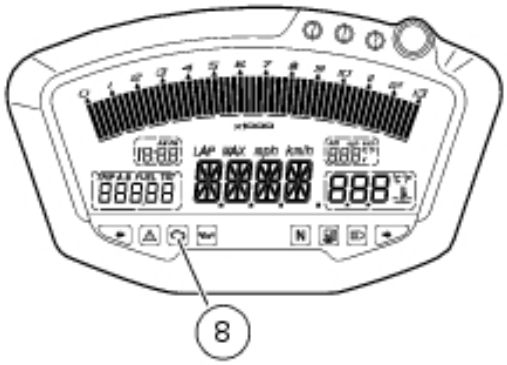
Shows the outside air temperature.
Display limits: -39 °C to +124 °C.
In the event of a sensor FAULT (-40 °C, +125 °C or disconnected) a series of dashes "- - -" is displayed steadily and the engine diagnostics warning light (8) comes on.

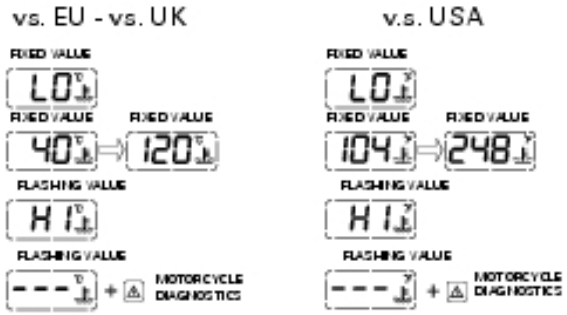




Coolant temperature indicator

Displays the engine coolant temperature:
if the reading is less than or equal to -40 °C (-40 °F), the display shows a series of flashing dashes ("---") and the Engine Diagnostics warning light comes on (8);
if the reading is between -39 °C (-38 °F) and +39 °C (+102 °F), the message "LO" is displayed steadily;
if the reading is between +40 °C (+104 °F) and +120 °C (+248 °F), it is displayed steadily;
if the reading is between +121 °C (+250 °F) and +124 °C (+255 °F), the message "HI" flashes on the display;
if the reading is greater than or equal to +125 °C (+257 °F), the display shows a series of flashing dashes ("---") and the Engine Diagnostics warning light (8) comes on.
In the event of a sensor FAULT, a series of flashing dashes ("") appears and the Engine Diagnostics warning light (8) comes on.





Service indicator (SERV)

Indicates that the next service is due.
The message "SERV" appears on the display at the following intervals:
after the first 1000 km on the odometer;
every 12000 km on the odometer.
The messsage is displayed only at Key-On for 5 seconds.
After servicing, the system must be reset with the DDS tester.

Instrument panel diagnostics

Important
The instrument runs the system diagnostics correctly 60 seconds after the last Key-Off.

Any errors detected in the behaviour of the motorcycle are displayed.
If there are several errors, they are displayed in rolling mode every 3 seconds.
The table below shows the errors that can be displayed.

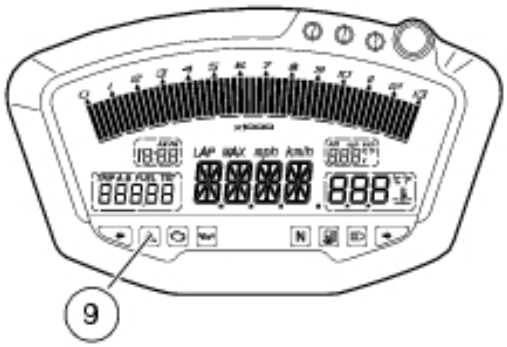
Warning light	Error message	Error
	COIL 10.1	Horizontal cylinder coil error
	COIL 10.2	Horizontal cylinder coil error
	COIL 11.1	Vertical cylinder coil error
	COIL 11.2	Vertical cylinder coil error

	INJE 12.1	Horizontal cylinder injector error
	INJE 12.2	Horizontal cylinder injector error
	INJE 13.1	Vertical cylinder injector error
	INJE 13.2	Vertical cylinder injector error
	PUMP 16.0	Fuel pump relay error
	FAN 18.1	Fan relay error
	FAN 18.2	Fan relay error
	STRT 19.1	Starter contactor error
	STRT 19.2	Starter contactor error
	STEP. 21.1	Stepper motor error
	STEP. 21.2	Stepper motor error
	STEP. 21.3	Stepper motor error
	LAMB. 22.1	Lambda heater error
	LAMB. 22.2	Lambda heater error
	EXVL 23.1	Exhaust valve motor error
	EXVL 23.2	Exhaust valve motor error
	EXVL 23.3	Exhaust valve motor error
	EXVL 23.4	Exhaust valve motor error
	EXVL 23.5	Exhaust valve motor error
	TPS 1.1	Throttle position sensor error
	TPS 1.2	Throttle position sensor error
	PRESS 2.1	Pressure sensor error
	PRESS 2.2	Pressure sensor error
	T.WAT 3.1	Engine coolant temperature sensor error
	T.WAT 3.2	Engine coolant temperature sensor error
	AIR 4.1	Air temperature sensor error
	AIR 4.2	Air temperature sensor error

⚠	BATT 5.1	Battery voltage error
⚠	BATT 5.2	Battery voltage error
	LAMB 6.1	Lambda sensor error
	TILT 6.2	Lambda 2 sensor error
⚠	DTC 8.0	Traction control unit error (the error can only occur if the bike has been fitted with the traction control kit available from Ducati performance)
	ECU 30.0	Engine ECU error
	PK.UP 34.0	Pick-up sensor error
⚠	SPEE. 36.0	Speed sensor error
⚠	IMMO 37.0	Immobilizer error
	IMMO 37.1	Immobilizer error
	IMMO 37.3	Immobilizer error
	IMMO 37.4	Immobilizer error
	IMMO 37.5	Immobilizer error
	CAN 38.0	CAN line error

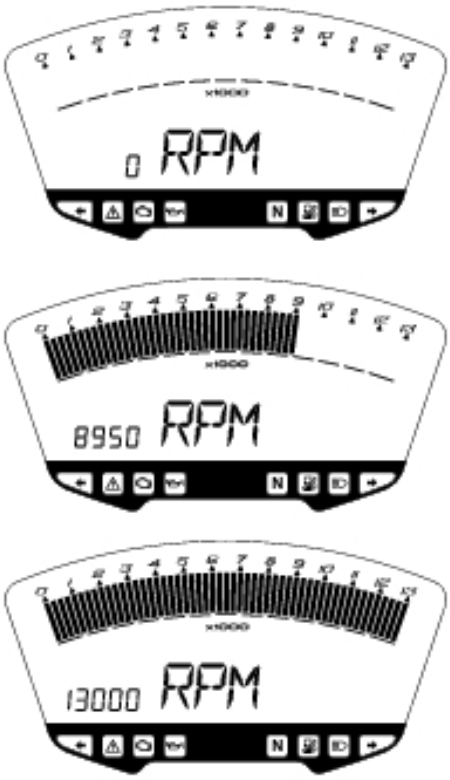
Battery voltage indicator (BATT)

To display this function, go into the menu and select the "BATT" page.
The battery voltage reading is displayed as follows:
if the reading is between 12.1 and 14.9 Volts, it is steadily illuminated on the display;
if the reading is between 10.0 and 12.0 Volts or between 15.0 and 16.0 Volts, it flashes on the display;
if the reading is less than or equal to 9.9 Volts, the message "LO" flashes on the display and the Motorcycle Diagnostics warning light (9) comes on;
if the reading is greater than or equal to 16.1 Volts, the flashing message "HI" appears on the display and the Motorcycle Diagnostics warning light (9) comes on.



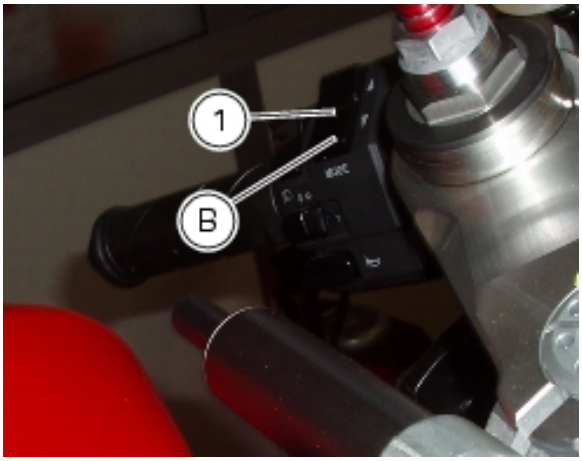
Adjusting the engine idle speed (rpm)

To display the function, access the menu and select the "RPM" page.
In addition to the upper rev counter scale, the display also shows engine rpm numerically so that you can adjust the idle speed more precisely.

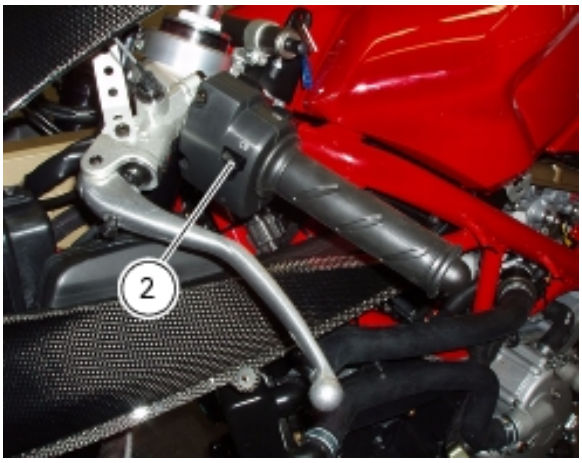


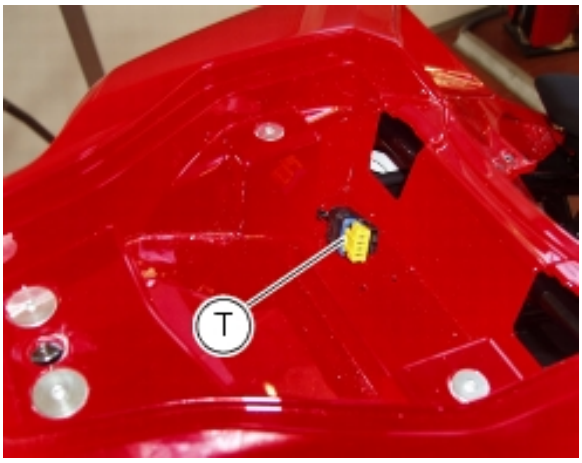
LAP function

To activate this function, enter the menu and set the "LAP" function to "On" by keeping switch (1) in position B "▼" for 3 seconds.

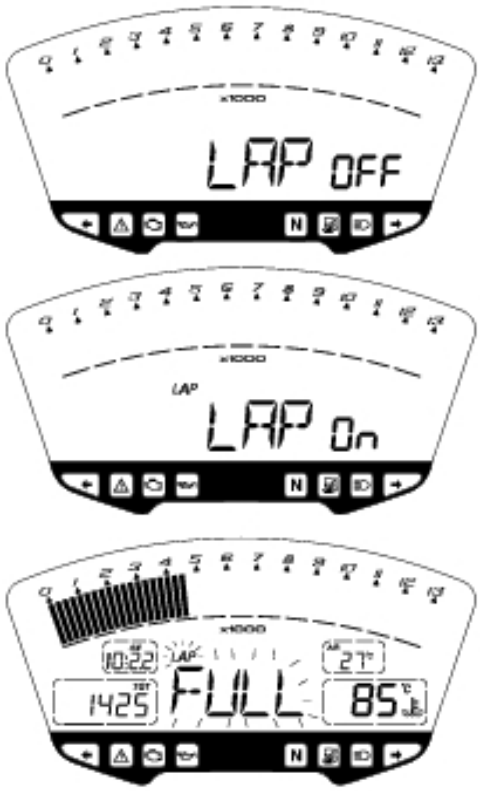


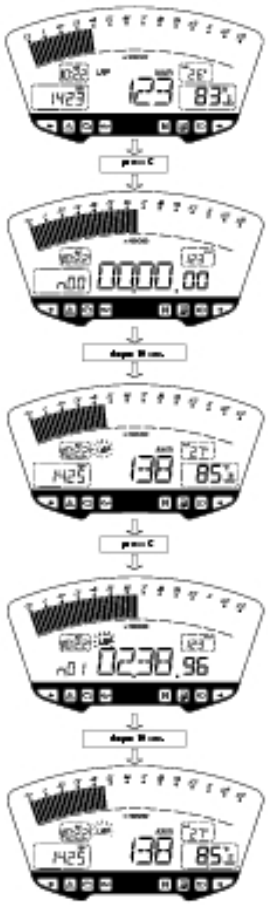
The function is now enabled and awaiting the start command.
START and STOP the timer by pressing the high beam FLASH switch (2) on the left-hand handlebar switch.
Alternatively, these functions can be performed automatically by the MT 906/D and MT 907/D infrared system by Magneti Marelli, by connecting the latter to data acquisition connector (T).
When the LAP function is active, each time you press the FLASH button, the display will show the lap time for 10 seconds, before reverting to normal mode.
During these 10 seconds, the speed reading remains on the display in place of the air temperature reading.
You can save a maximum of 30 laps in the memory.
If the memory is full, each time you press the FLASH button, the display will not save any more lap times and will display the flashing message "FULL" for 3 seconds until the memory is reset by means of the "LAP MEMORY" function.





When you switch the LAP function off using the menu, the lap in progress is not saved.
If the LAP function is active and the display is suddenly switched off (Key-Off), the LAP function is switched off automatically (even if the timer was ON, the lap in progress is not saved).
If the timer is not stopped, when it reaches 99 minutes, 59 seconds and 99 hundredths, it restarts from 0 (zero) and continues until the function is switched off.
If, however, the LAP function is switched on and the memory has not been cleared, but fewer than 30 laps have been saved (e.g. 18 laps), the display will save any remaining laps until the memory is saturated (in this case, it will save a further 12 laps).
In this function, lap time only is displayed, but other data are also saved (MAX speed, MAX rpm, rev limiter if reached) for viewing at a later date in the Lap Memory function.

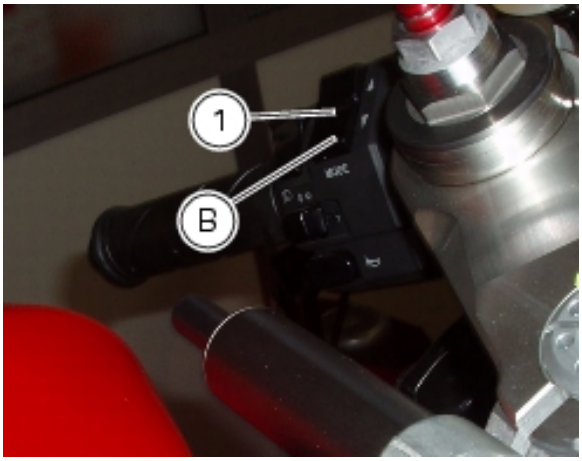




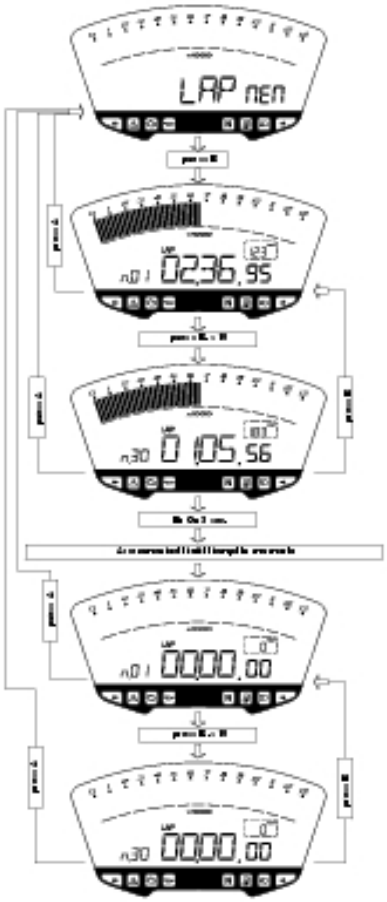
LAP Memory display

Displays the data saved with the LAP function: lap time, MAX speed and MAX rpm (and limiter if reached).

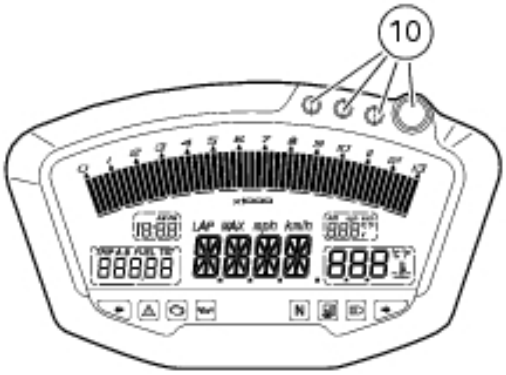
To display the saved lap times, enter the menu and select the "LAP MEM" page.
From this page, if you hold switch (1) in position B "▼" for 3 seconds, the data for the first lap will appear. The display will show the lap number, lap time, MAX speed and the MAX rpm reached for the lap in question.
If you press the switch (1) in position B "▼", the display scrolls through the 30 saved times, before returning to the 1st lap.
If you hold the switch (1) in position B "▼" for 3 seconds while displaying the saved times, the display immediately resets all the saved times. In this case, if the LAP function was active, it is switched off automatically.



The MAX speed saved is the maximum speed indicated on the display in Lap function.
During saving, if the MAX speed shown exceeds 299 km/h (186 mph), the speed reached is displayed (e.g. 316 km/h).
If there is no reading in the memory, the 30 times are shown, with the display showing "00.00.00", MAX rpm = 0 and MAX speed = 0.

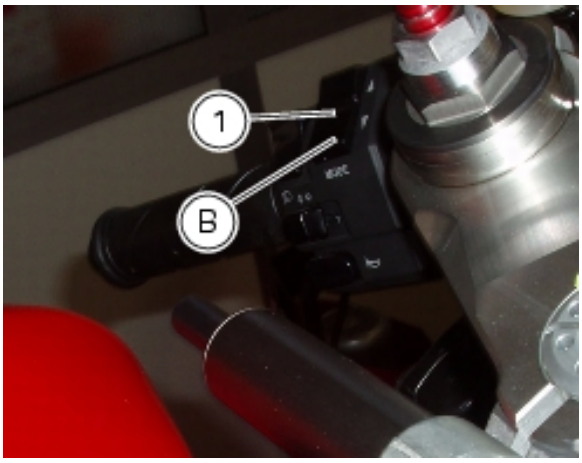


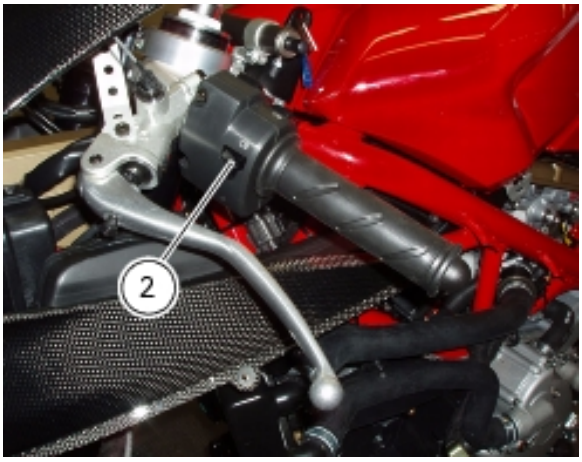
During the lap, if the engine reaches one of the two thresholds before the limiter or the limiter itself, the respective warning lights (10) come on during the display of the saved times.



USB DAQ (Switching ON/OFF)

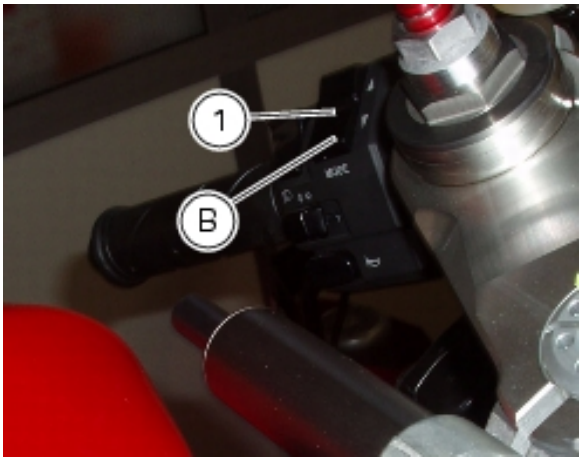
This function activates the USB Data Acquisition (DAQ) (can be purchased as replacement parts). In order to acquire data, the DAQ must be connected to the motorcycle wiring loom.
To activate the DAQ, enter the menu and set the USB DAQ to "On" by holding the switch (1) in position B "▼" for 3 seconds.
Data will now be saved to the DAQ. During acquisition, each time the FLASH button (2) is pressed, one LAP will be saved, containing the "DDA" data.
The first LAP starts when the DAQ is switched on; the last LAP stops when the DAQ is switched off.
If the USB function is active and the display is suddenly switched off (Key-Off), the function is switched off automatically.

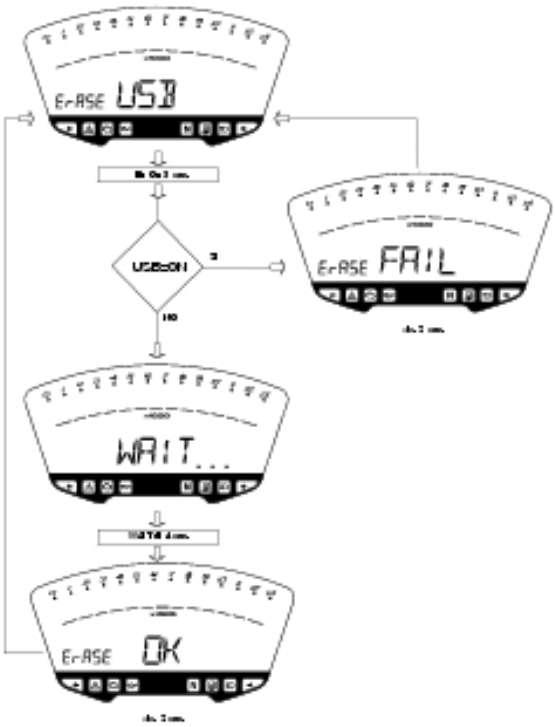




Erase USB

This function enables you to delete the data saved on the USB DAQ: in order to delete data, the DAQ must be connected to the motorcycle wiring loom.
To delete the data, enter the menu and select the "Erase USB" page.
If you hold the switch (1) in position B "▼" for 3 seconds and the USB DAQ is OFF, the message "WAIT..." appears on the display for 10 seconds. After 10 seconds, the message "OK" appears for 2 seconds, to confirm that the data has been deleted.
If, however, you hold the switch (1) in position B "▼" for 3 seconds and the USB DAQ is ON, the DAQ memory is not cleared and the display shows the message "ERASE FAIL" for 2 seconds.



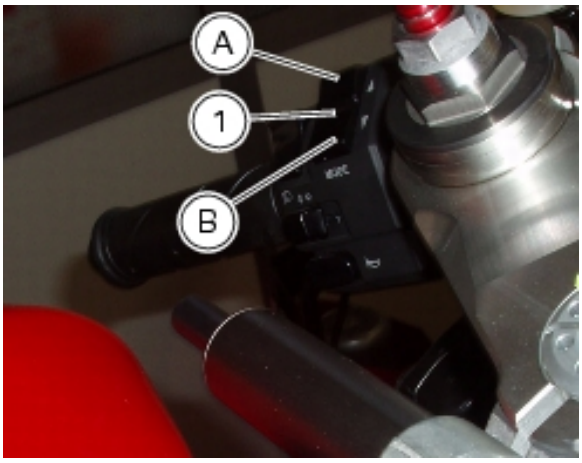


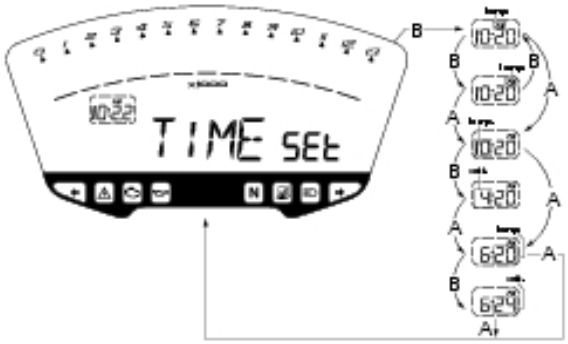
Clock setting

To set the clock, enter the menu and select the "TIME Set" page.
From this page, if you press the switch (1) in position B "▼" for 3 seconds, you enter clock setting mode.
On entering this mode, the message "AM" will flash on the display; pressing the switch (1) in position B "▼" will switch the display to "PM" (flashing); pressing the switch (1) in position B "▼" will take you back to the previous display (if the time is exactly 00:00, when the display switches from AM to PM the time will appear as 12:00); press switch (1) in position A "▲" to enter the hours setting mode (the hour digits flash). Each time you press the switch in position B "▼", the count advances cyclically in steps of 1 hour; if you hold the switch down in position B "▼", the count advances cyclically in steps of 1 hour every second (when the switch is held down continuously, the hours do not flash).
If you press the switch (1) in position A "▲", you enter the minutes setting mode and the minute digits will start flashing. Each time you press the switch in position B "▼", the count advances cyclically in steps of 1 minute; if you hold the switch down in position B "▼", the count advances cyclically in steps of 1 minute every second. If the switch is held pressed in position B "▼" for more than 5 seconds, the minutes advance by 1 every 100 ms (when the switch is held in position B "▼" continuously, the seconds do not flash). If you press the switch in position A "▲", the system exits setting mode and displays the newly set time.

Notes

If the power supply is disconnected (Battery-Off), the time setting is lost. When power is restored (Battery-On), the display will show 0:00. Set the time according to the normal procedure.





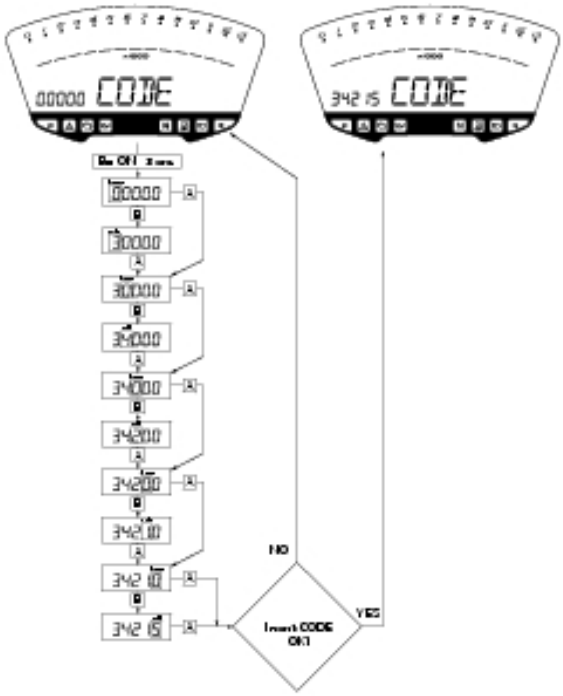
Immobilizer override procedure

Should the immobilizer become locked, you can perform the "Immobilizer Override" procedure from the instrument panel by entering the respective function as follows:
Select the "CODE" page from the menu.

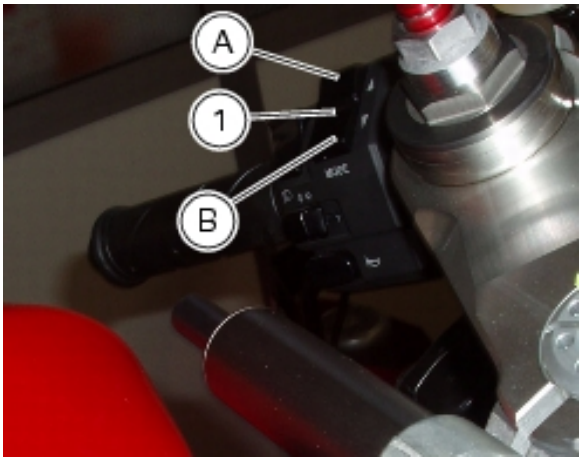
Notes

This menu should be active only if there is at least one immobilizer error.

With this page selected, the initial code is always displayed as "00000". If you press the switch (1) in position B "▼" for 3 seconds, you will access the procedure for entering the electronic code given on the Code Card.

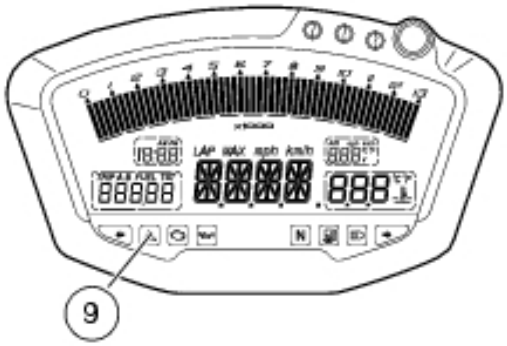


Entering the code:
on entering this function, the first digit on the left starts flashing.
Switch (1):
each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
If you press the switch in position A "▲", you can set the second digit, which will start flashing. Each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
If you press the switch in position A "▲", you can set the third digit, which will start flashing. Each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
If you press the switch in position A "▲", you can set the fourth digit, which will start flashing. Each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
If you press the switch in position A "▲", you can set the fifth digit, which will start flashing. Each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
Press position A "▲" to confirm the code.



If the code entered is incorrect, the initial code "00000" will re-appear on the display. There is no limit to the number of times the code may be entered incorrectly.
If the code has been entered correctly, the message CODE and the code itself will flash simultaneously for 4 seconds. The motorcycle diagnostics warning light (9) will go off. The instrument panel then automatically exits the menu, thus

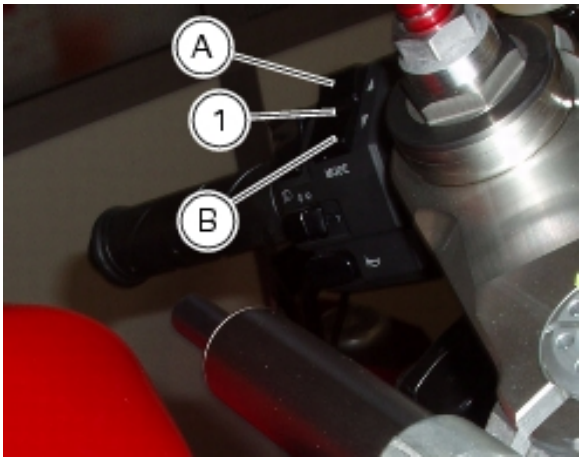
allowing "temporary" starting of the motorcycle.



If the error persists, at the next key-on, the instrument panel will return to an error state and immobilize the engine.

Intelligent headlight switch-on

This function allows programmed activation of the headlight even with the motorcycle off (Key-Off).
Immediately after key-off, the instrument panel remains active for 60 seconds, thus allowing the headlight to be switched on if the switch (1) is pressed in position B "▼" or A "▲".
During these 60 seconds, each time the switch (1) is pressed in position B "▼" or A "▲", the instrument enables you to switch on the headlight for 30 seconds. Each time you press the switch (1) in position B "▼" or A "▲", a further 30 seconds will be added to the switch-on time, up to a maximum of 6 presses (the maximum time is 180 seconds).
After the first time you press the switch (1) in position B "▼" or A "▲", the period of 30 seconds starts, thus switching on the headlight. Further switch-on time can be added only if you press the switch again within these 30 seconds. If the 30 seconds have elapsed, no further multiples of 30 seconds can be added, and the instrument panel will switch off the headlight.
To reset this function, you must perform at least one Key-On/Key-Off.
If the battery power is interrupted at any time while this function is active, when power is restored, the instrument panel will de-activate the function (the instrument panel does not remain active for 60 seconds).



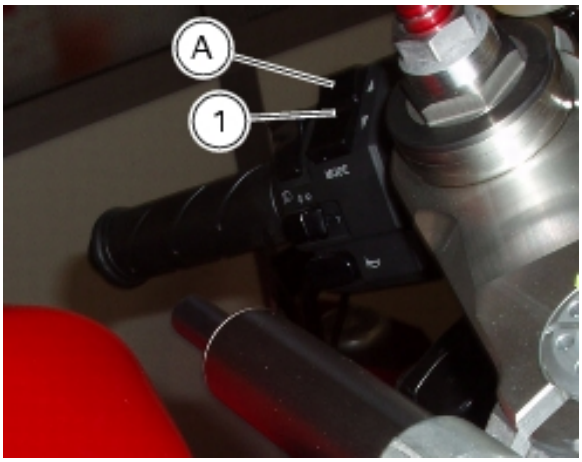
Intelligent headlight switch-off

This function helps reduce battery use by automatically switching off the headlight. The device is triggered in 2 cases:
- in the first case, if you turn the key from OFF to ON and do not start the engine within 60 seconds, the headlight is turned off and will be turned on again only when the engine is next switched on.
- in the second case, after the normal use of the motorcycle with the lights on, if the engine is stopped using the RUN-STOP button on the right-hand handlebar switch. In this case, the headlight is switched off 60 seconds after the engine is switched off, and only switched on again the next time the engine is started.

Service Menu

The instrument panel has a service menu, which must be used only by the dealer if necessary.
To enter the service menu, hold the switch (1) in position A "▲" while simultaneously turning the key switch from Off to On. Release switch (1) after about 2 seconds.

The menu contains three functions:
Reprogramming the immobilizer (REPR. CODE);
Setting the units of measurement (SET UNIT);
Moving the exhaust valve "manually" (SET EXVL).

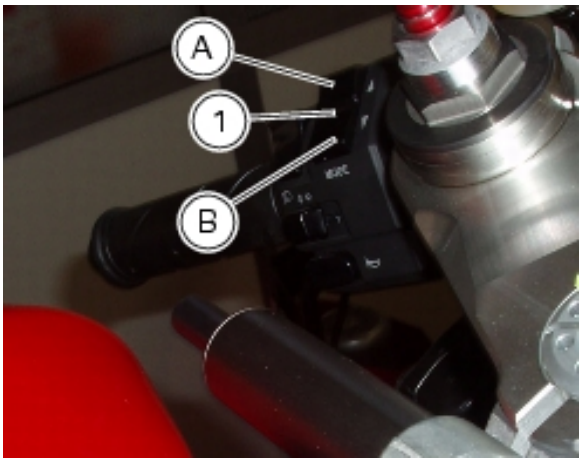


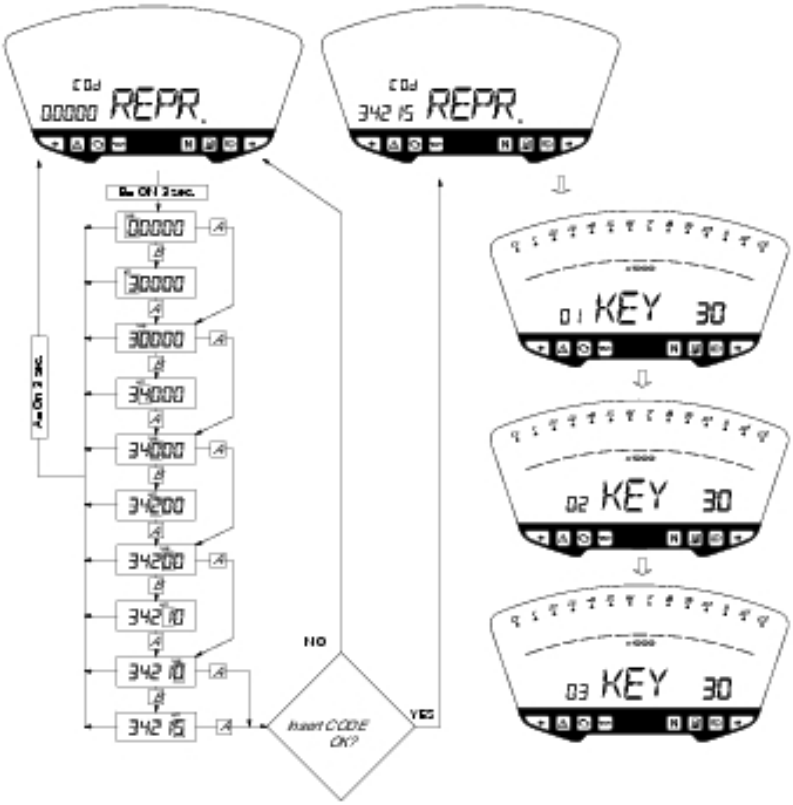
Reprogramming the immobilizer

This function is for reprogramming the immobilizer system in the event of loss or damage to one or both of the keys.
To display this function, go into the service menu and select the page "Cod. REPR.".
To reprogramme the immobilizer, enter the electronic code shown on the CODE CARD.
Entering the code:
press switch (1) in position B "▼" for 3 seconds; the first digit on the left will start flashing;
each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
If you press the switch in position A "▲", you can set the second digit, which will start flashing. Each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
If you press the switch in position A "▲", you can set the third digit, which will start flashing. Each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
If you press position A "▲", you can set the fourth digit, which will start flashing. Each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
If you press the switch in position A "▲", you can set the fifth digit, which will start flashing. Each time you press the switch in position B "▼", the number increases cyclically in steps of one digit every second.
Press position A "▲" to confirm the code.
At this point, if the code was entered incorrectly, the display will show the initial code "00000". There is no limit to the number of times the code may be entered incorrectly.
On entering the fifth and last digit, if the code has been entered correctly, the message "REPR.", the message "Cod" and the code entered will flash simultaneously; at this point, it is necessary to turn the key switch to off.
From this moment on, the immobilizer system is waiting to be programmed with the new key (or keys); at the next Key-On, reprogramme the keys using the procedure described in "Programming the Immobilizer".

Notes

At this stage, the immobilizer system will immobilize the engine until the keys have been reprogrammed.





Loss of the Code Card

Without knowing the electronic code on the CODE CARD, it is impossible to:
reprogramme the immobilizer system in the event of loss of one or both of the keys;
temporarily override the immobilizer in the event of a fault.
To restore the entire system to full operation, it is necessary to renew the KEY SET (2 black keys + new CODE CARD) and the instrument panel, and thus programming the immobilizer again.

Loss of one key

After purchasing a new key, perform the Reprogramming procedure (by entering the code shown on the CODE CARD) with the new key and the remaining key.

Loss of both keys

After purchasing two new keys, perform the Reprogramming procedure (by entering the code shown on the CODE CARD) with the new keys.

Renewal of the key kit (new locks, nuew Code Card, new keys)

After installing a new key kit, the two new keys must be reprogrammed (by entering the electronic code on the old CODE CARD).
Keep the new CODE CARD as it could become "active" in the event of future renewal of the instrument panel and the consequent programming of the immobilizer system.

Renewal of the instrument panel

After purchasing the new instrument panel, perform the normal "Programming" procedure for the immobilizer system.

Renewing the instrument panel after renewing one or both of the keys

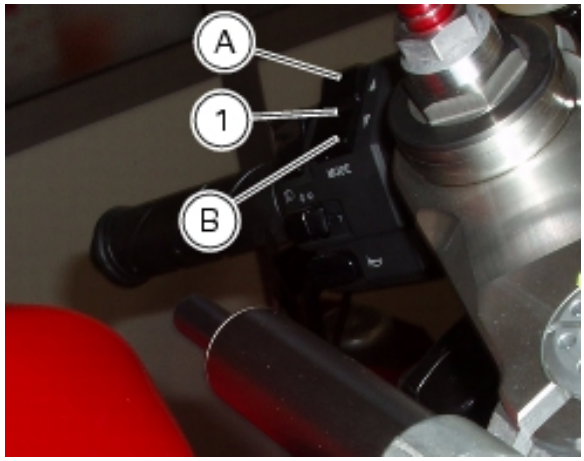
In this case, if you want the immobilizer to be fully functional, before programming the immobilizer, first renew the KEY SET as well (2 black keys + new CODE CARD).
If the new instrument panel is programmed with the keys renewed previously, it will be possible to start the motorcycle but the electronic code shown on the CODE CARD will no longer enable you to:
reprogramme the immobilizer system in the event of loss of one or both of the keys;
temporarily override the immobilizer in the event of a fault.

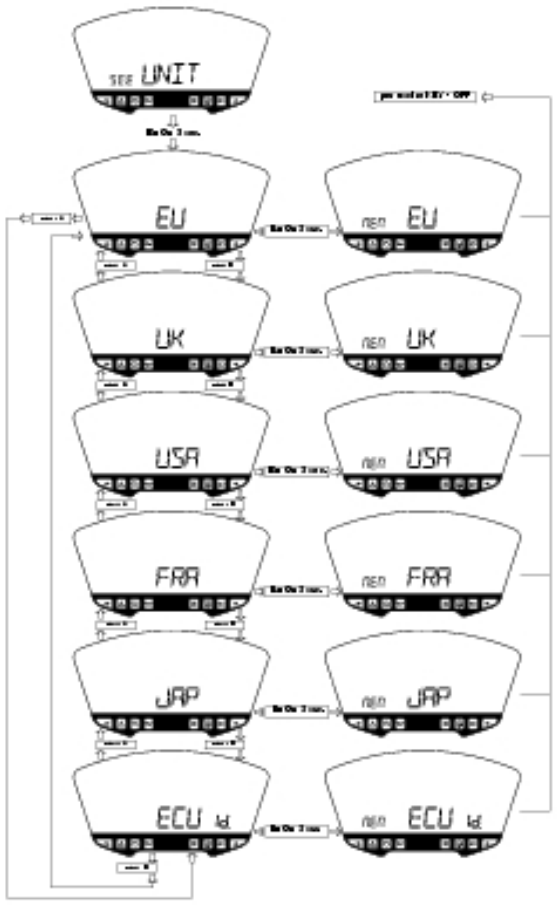
Special settings (vehicle model and units of measurement)

This function allows you to select the units of measurement displayed on the instrument panel.
The ECU automatically communicates to the instrument panel the motorcycle model and the units of measurement to be used on the display: to change these parameters, go into the "Service Menu " and select the SET UNIT function.
Now press switch (1) in position B "▼" for 3 seconds.
Each time you press switch (1) in position B "▼", the instrument panel scrolls through the following sequence of options, which flash on the display:

	Units of measurement		
COUNTRY	Speed	Coolant temperature	Counters
EU	km/h	°C	km
UK	Mph	°C	miles
USA	Mph	°F	miles
CND	km/h	°C	km
FRA	km/h	°C	km
JAP	km/h	°C	km
ECU Id.	The instrument configures the unit of measurement parameters in accordance with information relayed from the ECU		

If you press switch (1) in position B "▼" for 5 seconds, the option currently displayed will be saved to memory and the word "MEM" will appear. The new parameter setting will applied at the next Key-On.



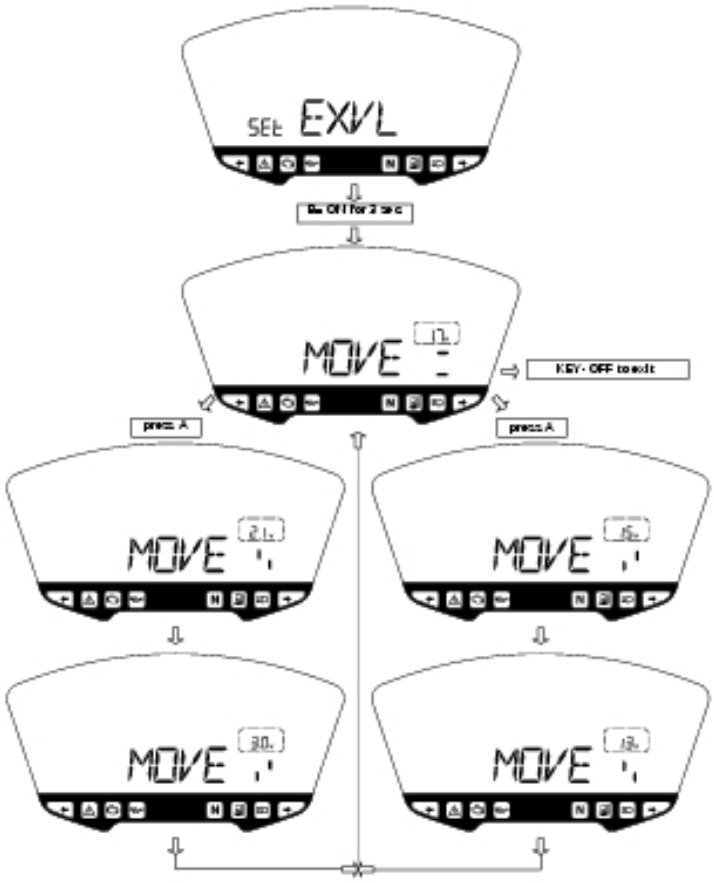


Operating the valve motor to facilitate cable fitting

With this function, it is possible to operate the motor that moves the exhaust valve to facilitate cable fitting.
When renewing cables, if the valve motor is not restrained and the key switch is inadvertently turned to On, the motor will turn over for a few seconds and stop in a random position. This makes it impossible to fit the cables.
To return the motor to a position in which cables can be fitted, it is necessary to use this function.
To display the function, go into the SERVICE MENU and select the "Set EXVL" page.
If you press switch (1) in position B "▼" for 3 seconds, the system goes into "MOVE" mode and the motor can be moved.
If you hold switch (1) in position A "▲" the valve motor turns clockwise; if you hold switch (1) in position B "▼" the valve motor turns counterclockwise.
To enable the cables to be fitted, turn the motor until the display shows a value of "1.7 v".
To exit this function, turn the key switch from On to Off.

Notes

If the battery voltage is < 11 Volts, the motor will not work when switch (1) is pressed. In this function, furthermore, no diagnostics can be run and engine starting is disabled.



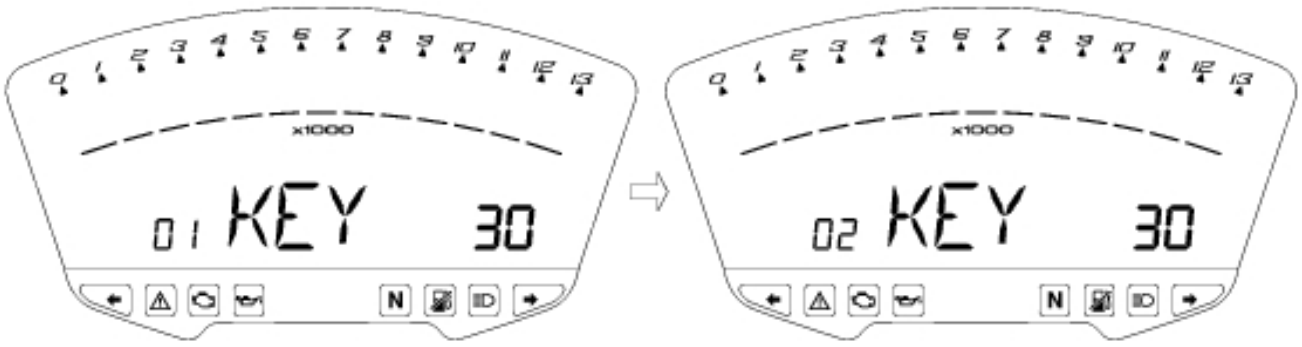
Programming the immobilizer

This instrument panel function enables programming of the Immobilizer System.

Notes

Only 2 keys may be programmed.

Insert KEY 1 (one of the two black keys) and turn the ignition switch from Off to On;
within 3 seconds turn the ignition switch from On to Off;
within 15 seconds insert KEY 2 (the other black key) and turn the ignition switch from Off to On;
within 3 seconds turn the ignition switch from On to Off;
within 15 seconds, insert KEY X again (either Key 1 or Key 2) and turn the ignition switch from Off to ON.



If the procedure was successful, the instrument panel will display the message "PROG" steadily for 3 seconds before returning to normal display mode.

Programming aborted:
if you allow the 3 second countdown after Key-On or the 15 second countdown after Key-Off to elapse, or you make a mistake in the programming procedure, the instrument panel will abort the programming operation and display the message "OFF" for 3 seconds before returning to the normal display mode.

Important

During the programming procedure, the instrument panel, in addition to saving the key codes in its memory, retrieves two "electronic" codes from the insertion of KEY 1 (the first black key to be inserted) and KEY 2 (the second black key to be inserted).

If the immobilizer is reprogrammed, the key codes will be erased and replaced with the new codes of the new keys; the two "electronic" codes, however, remain permanently in memory and cannot be deleted or overwritten.
The code on the Code Card corresponds to one of the two electronic codes and is used for Immobilizer Recovery and Immobilizer Reprogramming.

8 - Immobilizer and transponder

The immobilizer allows the vehicle to be started only if the rider uses the special ignition key which sends the identification code to a decoder housed in the instrument panel. The transmission-receiving system is composed of a TRANSPONDER housed in the ignition key heads and an antenna in the vicinity of the ignition switch.

Keys with transponder

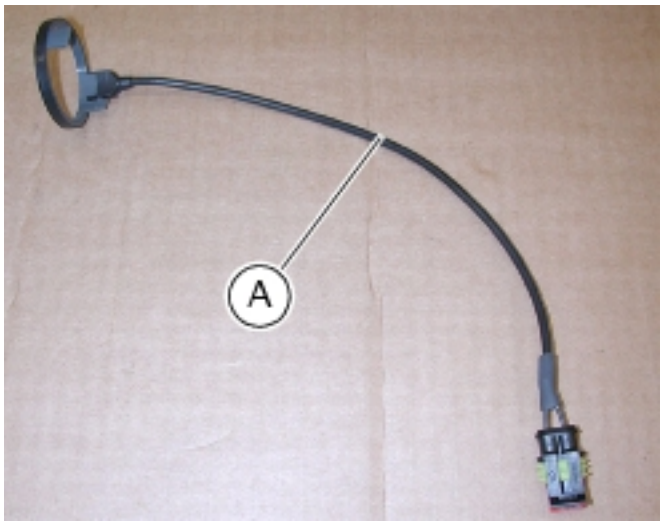
The two keys contain the secret code used for programming the immobilizer and allowing the engine to be started;
The transponder is fitted inside the key grip and consists of a power supply circuit, a ROM (Read-Only Memory) and a transmission circuit. The transponder is supplied with power by the magnetic field generated by the antenna which is enabled as soon as the instrument panel is switched on. Since the transponder is very compact and needs no external battery power supply, it is moulded permanently into the key grip.

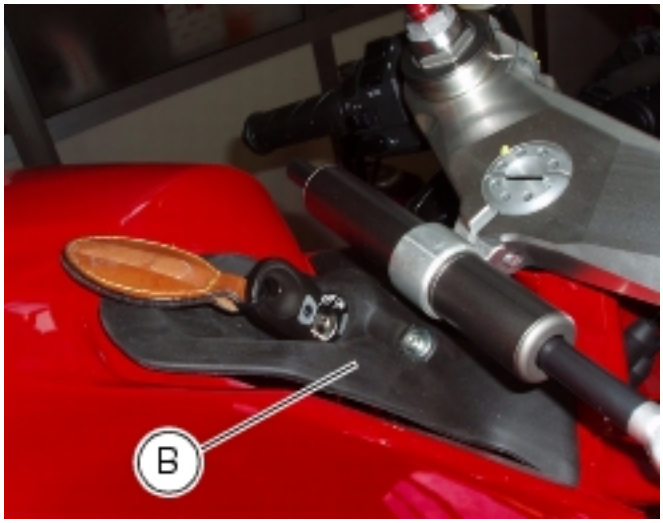
Warning

The circuits in the key grips are not shockproof and may therefore be damaged by violent impact.

Immobilizer antenna

The antenna consists of a plastic-coated copper coil connected to a cable that is terminated with a connector.
The antenna (A) is fitted onto the cover (B) of the ignition lock, which is specifically modified for the purpose to create a seat in which the antenna is inserted and engaged.





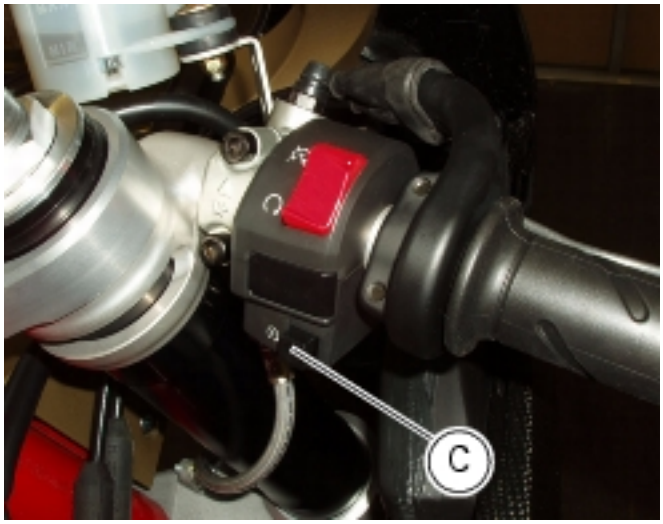
Immobilizer operating principle

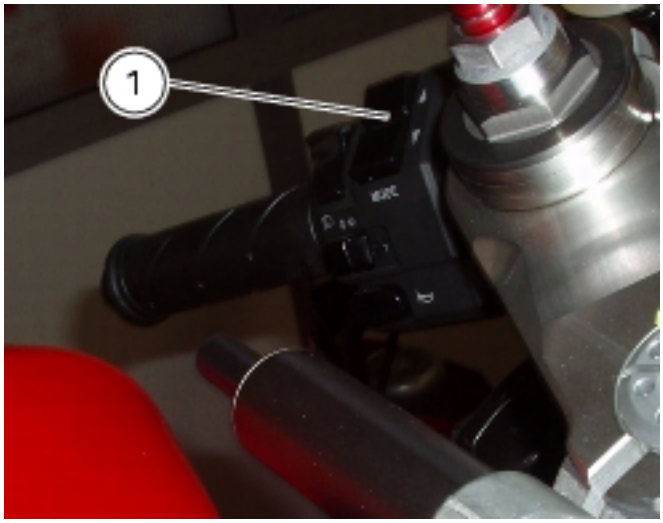
At key-on (switching on the instrument panel by turning the key) the decoder (incorporated in the instrument panel) activates the antenna, which emits an electromagnetic field that serves to power the transponder in the key grip. The transponder responds by transmitting the code that is stored on its internal ROM memory, and which is picked up by the antenna and relayed to the decoder. Here the transponder code is compared to a second code. If the outcome of the comparison is positive, engine starting is enabled.

Warning light signals and immobilizer indications

Whenever the ignition key is turned from ON to OFF, the immobilizer system activates the engine start protection system.
When the engine is started and the key is turned from OFF to ON, the system generates the following signals:

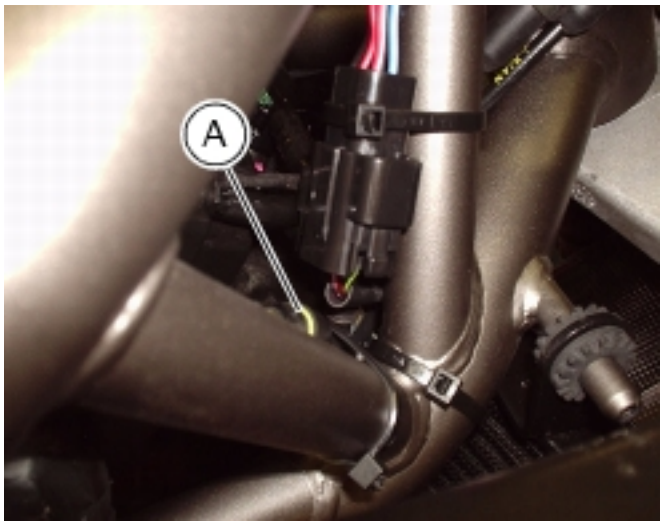
- if the code is recognised, the protection system releases the engine lock. When you press the START button (C), the engine starts;
- if the code is not recognised, the motorcycle diagnostics warning light (9) comes on. When you press switch (1) in position A "▲", the "Error IMMO" message appears on the display, along with the error code denoting the type of IMMO error. In this case, turn the ignition key back to OFF and then to ON again. If the engine still does not start, contact your dealer.



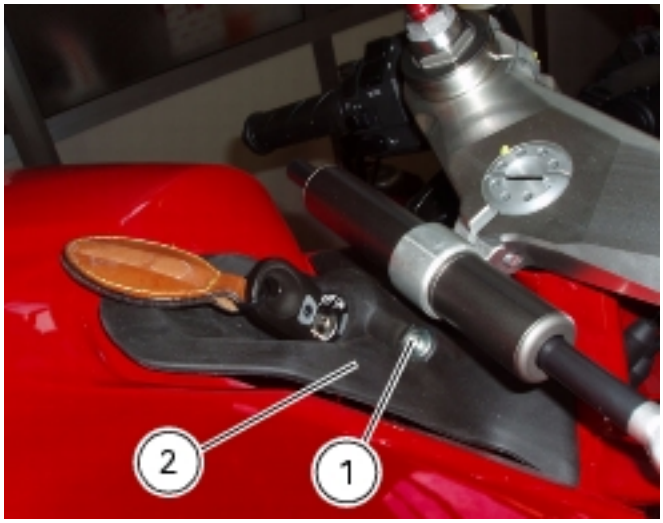


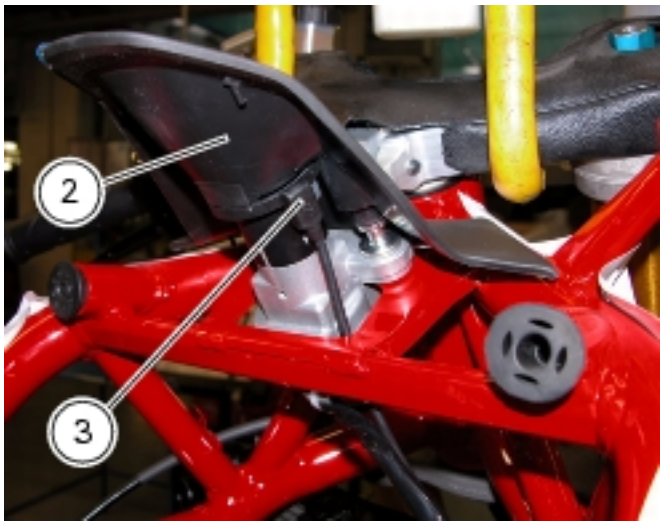
Removal of the immobilizer

Set the ignition switch to **OFF**.
Remove the right-hand side fairing (Sect. E 2, Removal of the side fairings).
Disconnect the antenna wiring connector (A) from the main wiring loom.



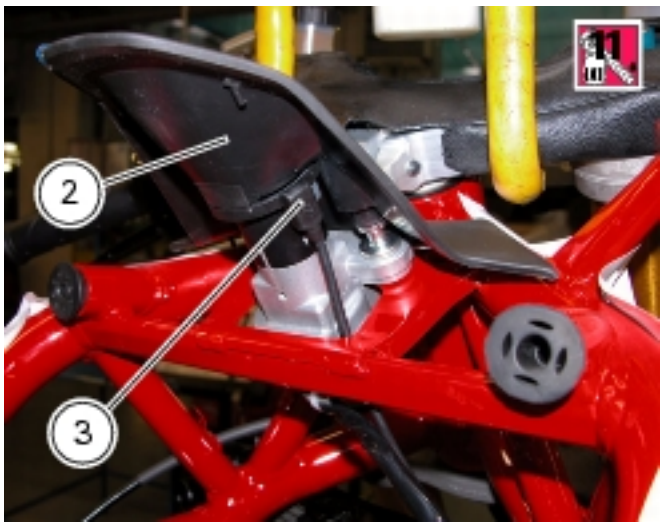
Unscrew the two nuts (1) and remove the keyswitch cover (2) with the immobilizer antenna (3).

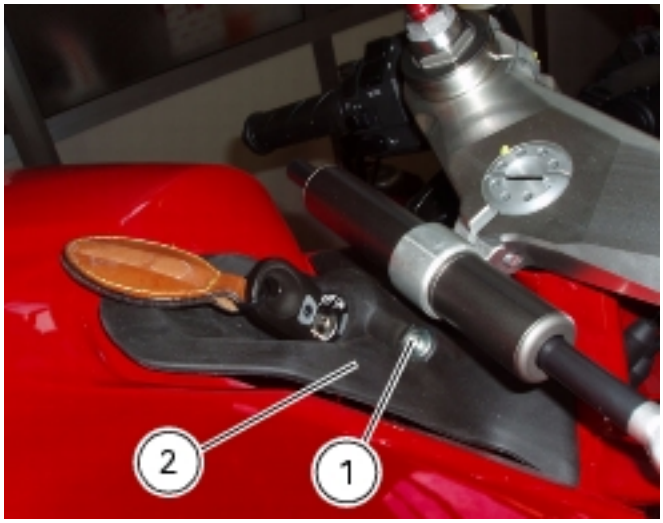




Refitting the immobilizer

Apply the recommended threadlocker to the inside of the cover (2) in two points of the seat of the immobilizer antenna (3) and install the antenna (3) in the cover (2).
Position the cover to the keyswitch block and tighten the nuts (1) to the specified torque (Sect. C 3, Frame torque settings).

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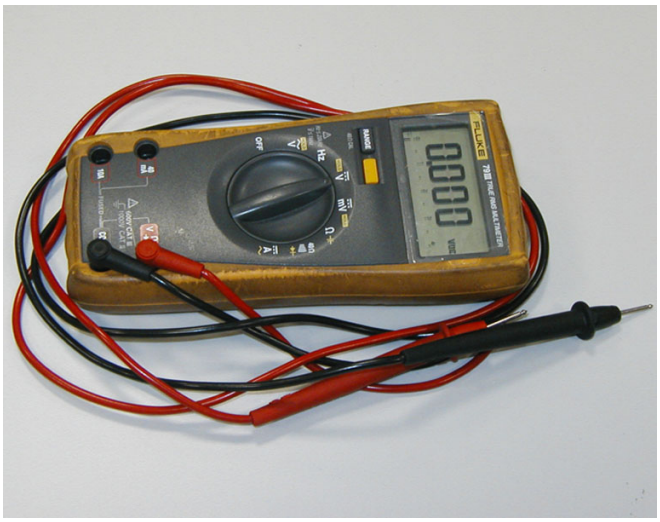
9 - Diagnostic instruments

For information on the "DDS" tester, refer to Sect. D 5, DDS tester.

Using a multimeter to check the electrical systems

Introduction

This instrument allows you to measure resistances, voltages, and current values. Multimeters can be divided into two basic types: those with an analogue display and those with a digital display Units of the first type are equipped with a dial and needle. The dial is marked with the scales to be used for measurement of the various parameters. Digital units are equipped with a dial that displays numbers corresponding to the values of the measured parameters. The type of measurement to be carried out (voltage, current or resistance) is set by means of a selector or by means of several different sockets in which to insert the two test probe connector terminals. In certain cases it is essential to set the full scale value before proceeding. For example, in order to measure a 12 V signal, you need to set a full scale that is close to this value (e.g. 15 V or 20 V). It would be illogical to set a full scale value of 10 V; the same applies when setting current (Amps) or resistance (Ohms) full scale values. Sometimes the instrument can set the required full scale value automatically. Never exceed the maximum value allowed by the tester when measuring voltage or current signals.



Notes

The DDS tester (Sect. D 5, DDS tester) can perform the functions of a digital multimeter.

Voltage measurement

Voltage measurements must be carried out by connecting the terminals of the tester in parallel to the load (e.g. to the wires feeding a light bulb or a relay, the two battery terminals, or the two wires supplying power to a control unit). Voltages can be constant over time (DC voltage) or variable over time (AC voltage). In the first case, it is important to consider the negative and positive polarity of the application. It is therefore necessary to select on the multimeter the type of voltage you intend to measure. (DC voltage is shown by the symbol = while AC voltage is denoted by ~).

Current measurement

Current measurements must be made by connecting the multimeter terminals in series with the load (e.g. disconnect one of the wires feeding power to a light bulb and connect one terminal of the multimeter to the free end of wire and the other terminal to the light bulb. When the lights switch is set to ON, the bulb will illuminate normally and the tester will show the absorbed current, i.e. the amount of current passing through the wire. Warning: connections in series must be made and removed only when the power is switched off. Never attempt to make or break a series connection when a device is powered. Always make sure that the connection in series of the tester terminals on the electrical device is made is a safe manner in such a way that it cannot be broken accidentally.

Measurement of resistance values and electrical continuity

Resistance measurements must be taken only when the electrical device or section of the circuit is not powered and isolated from the main electrical system (i.e. not connected to the main electrical system). These measurements can be utilised to check the resistance value across several sensors. For example, after disconnecting the electrical wiring to the rpm/ignition - injection system timing sensor (on the camshaft drive gear) the relative internal resistance can be checked by connecting a multimeter to its terminals. This makes it possible to check the electrical continuity of the winding inside the sensor (a reading of infinite resistance indicates that the winding is interrupted). Resistance measurement can also be used to check the continuity of sections of the electrical circuit or relay type switches. For example, to check the condition of a section of the electrical circuit between two connections, disconnect the connections and connect the terminals of the multimeter to the ends of the electrical cable in question to check that the specified resistance value is present. If this value is close to zero (i.e. lower than approximately 0.3 ohm) this means that the cable is not interrupted. Some instruments feature an audible signal that is emitted when the resistance approaches a value of zero. The same procedure must be adopted to check whether, for example, two contacts of a switch (relay or manual type) are making the contact correctly when closed. In this case the terminals of the multimeter must be connected to the switch terminals, checking that the resistance value is close to zero (or listening for the audible signal) when the switch is closed. To check that the multimeter is functioning correctly in "electrical continuity test" mode, short out the two test probes. The resistance value indicated must be almost nil and the audible signal must be activated.

Protections and precautions

The multimeter is equipped with protective fuses and batteries. These components must always be in perfect condition to ensure that the instrument is functioning correctly. When making electrical measurements always use the maximum caution to avoid short circuits, which can otherwise cause irreparable damage to the electrical system and constitute a personal injury hazard. All maintenance work must be performed exclusively when the system is not live (disconnect the battery in advance). NEVER connect the multimeter in parallel to make current measurements, and NEVER connect it in series to carry out voltage measurements.