# DUCATI



# HYPERMOTARD 796 SERVICE MANUAL

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# 0A - Impianto elettrico

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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

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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).

How to use this manual

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.



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



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



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
â	DOT 4 special hydraulic brake fluid.	SHELL Advance Brake DOT 4
<b>E</b>	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.  GREASE C Bearing/joint grease for parts subject to prolonged mechanical stress. Temperature range: -10 to 110 °C. Retinax LX2  GREASE D Protective grease, with anti-corrosive and waterproofing properties.  GREASE E PANKL grease - PLB 05.	
mechanical stress. Temperature range: -10 to 110 °C. Retinax LX2  GREASE D Protective grease, with anti-corrosive and waterproofing properties.  GREASE E PANKL grease - PLB 05.	
Waterproofing properties.  Retinax HD2  GREASE E PANKL grease - PLB 05.	
CDEACE E OPTIMOL STORE DACTE MULTE T	
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 Loctite 510 and solvents. Resists high temperatures (up to 200 ° C) and pressures up to 350 bar; fills gaps up to 0.4 mm.	
LOCK 5 Permanent adhesive for smooth or threaded Loctite 128455 cylindrical fasteners on mechanical parts. High resistance to mechanical stress and solvents. Temperature range: -55 to 175 °C.	
LOCK 6 Pipe sealant for pipes and medium to large fasteners. Loctite 577 For water and gases (except oxygen). Maximum filling capacity: 0.40 diameter clearances up to 0.40 mm.	
LOCK 7 Speed bonder for rubber and plastics with elastomer Loctite 480 charged ethylic base.	
LOCK 8 High-strength retaining compound for threaded parts, Loctite 601 bearings, bushes, splines and keys. Temperature range: -55 to 150 °C.	
LOCK 9 Medium-strength threadlocker. Loctite 406	
LOCK 10 Product for metal parts to seal and lock cylindrical Loctite 128443 freely sliding or threaded couplings. Resistant to high mechanical stress and high temperature, excellent resistance to solvents and chemical attack.	

LOCK 11	Medium-strength threadlocker.	Loctite 401
LOCK 12	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.	Molykote D321R
	Emulsion for lubrication of rubber.	P 80

### 3 - Hazardous Products - Warnings

### General safety rules

Carbon monoxide

When a maintenance operation must be performed with the engine running, make 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.

Brake fluid

Hazardous Products - Warnings



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.

**Battery** 



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 to those essential 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 - Impianto elettrico

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Hypermotard identification data 3

# 1 - Identification data

### Hypermotard identification data

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).









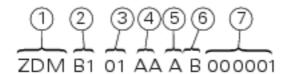
Please quote these numbers, which identify the motorcycle model, when ordering spare parts.

Data stamped on the frame

### Europe version

- 1 Manufacturer: Ducati Motor Holding
- 2 Type, same on all Hypermotard models
- 3 Variant (01= EC homologation; 02= 25 kW homologation)
- 4 Version
- 5 Year of manufacture (A = 2010)
- 6 Manufacturing facility
- 7 Progressive serial No.

Data stamped on the frame Europe 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 (A = 2010)
- 5 Manufacturing facility
- 6 Progressive serial No.

### Data stamped on engine

### Europe version

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

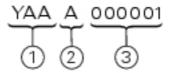
Data stamped on engine Europe version

Data stamped on engine

**US** version

- 1 Engine type
- 2 Model year (A = 2010)
- 3 Progressive production No.

Data stamped on engine USA version



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Gearbox 5

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Rear wheel 6

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# OC - Impianto elettrico

# 1.1 - Technical specifications

### General

Motorcycle dimensions	Total length	2170±20 mm
Wictordy Great Million Stories	Total width	900±20 mm
	Maximum height	1130±20 mm
	Wheelbase	1460±20 mm
	Height of handlebar grip from ground	1060 mm
	Seat height	815 mm
	Height of pillion passenger foot rest	320 mm
	Minimum ground clearance	147 mm
 Frame	Type	High-strength tubular steel trellis frame
Tramo	Steering head angle	24°
	Steering angle (on each side)	32°
	Trail	102 mm
	Front wheel	Light alloy, five spokes
	Front wheel size	MT 3.50x17"
	Front tyre size	120/70 - ZR 17
	Rear wheel	Light alloy, five spokes with cush drive dampers
	Rear wheel size	MT 5.50x17"
	Rear tyre size	180/55 - ZR 17
	Type of tyre	Radial tubeless tyre
	Front brake	Semi-floating drilled dual disc
	Rear brake	With fixed drilled steel disc
Engine	Type	Longitudinal 90° "L" twin cylinder, four-stroke
	Bore	88 mm
	Stroke	66 mm
	Displacement	803 cm <sup>3</sup>
	Compression ratio	11±0.5:1
	Timing system	Desmodromic with two valves per cylinder, operated by four rocker arms (two opening rockers and two closing rockers) and one overhead camshaft. The camshaft is driven by the crankshaft through spur gears, belt rollers and toothed belts
	Lubrication system	Pump-forced
	Oil pump type	Gear pump
	Cooling system	Air-cooled
	Air filter	One filtering element
	Crankshaft type	One-piece
	Cylinder arrangement	"L" at 90°

### Colours

	Description	Code no	
796	Ducati Anniversary Red Transparent Red frame with black wheels	F_473.101 (PPG) 228.880 (PPG)	

Technical specifications			
StreetFig	ghter pearl white	L2909004 (LECHLER)	
Basecoa	•	L0050786 (LECHLER)	
Transpai	rent	923I1281 (PALINI)	
Black fra	me with black wheels	,	
Matt bla Black fra	ck ame with black wheels	291.501 (PPG)	

### Transmission

	Reference	Technical specifications
	Clutch	Wet multiplate
	Clutch control	Hydraulic
	Gearbox	6 speed
	Primary drive	33/61
	Transmission ratio	1.85
	Final drive	15/42
	Final drive ratio	2.8
	Gearbox type	With constant mesh straight-tooth gears, operated by a lever on the left side of the motorcycle
Transmission	Gear ratios	
	1 <sup>st</sup>	13/32
	2 <sup>nd</sup>	18/30
	3rd	21/28
	<sub>4</sub> th	23/26
	<sub>5</sub> th	22/22
	6 <sup>th</sup>	26/24

### Timing system/valves

	Reference	Adjusting clearance	Checking clearance
Timing diagram	With 1 mm valve clearance		
	Intake	Opening 18° B.T.D.C. Closing 60° A.B.D.C.	
	Exhaust system	Opening 53° B.B.D.C. Closing 23° A.T.D.C.	
	Intake valve diameter Exhaust valve diameter	44 mm 38.5 mm	
Valve lift	With 0 mm valve clearance	Intake 11.20 mm Exhaust 10.80 mm	
	Opening rocker arm - intake	0.10 to 0.15 mm	0.10 to 0.15 mm
	Opening rocker arm - exhaust	0.10 to 0.15 mm	0.10 to 0.15 mm
	Closing rocker arm - intake	0 to 0.05 mm	0 to 0.05 mm
	Closing rocker arm - exhaust	0 to 0.05 mm	0 to 0.05 mm
	Reference	Adjusting clearance (new belt)	Reset value (used belt)
Belt tensioning when cold	DDS	145±5 Hz (horizontal) 160±5 Hz (vertical)	100±5 Hz (horizontal) 100±5 Hz (vertical)
	Limit value of used belt when cold		70 Hz

### Exhaust system

Exhaust system	Catalytic converter with lambda	Euro 3
	sensor	

# Cylinder/Piston

	Reference	Standard value	Service limit
Cylinder barrel	Max. bore ovality		0.03 mm
	Max. bore taper		0.03 mm
	Nominal diameter	88 mm	
	Class A	88.000 to 88.010 mm	
	Class B	88.010 to 88.020 mm	
	Class C	88.020 to 88.030 mm	
Piston-to-cylinder bore clearance		0.025 to 0.045 mm	
Piston	Nominal diameter	88 mm	
	Class A	87.965 to 87.975 mm	
	Class B	87.975 to 87.985 mm	
	Class C	87.985 to 87.995 mm	
Connecting rod	Connecting-rod big-end	43.67 mm	
	diameter		
Crankshaft - Big-end journal diameter		Ø 40.017 mm/0 to	
		0.016 mm	
Gudgeon pin-to-piston clearance		0.015 to 0.024 mm	
	Nominal diameters	Ø 18 mm	
	Piston	Ø 18 mm/0.020 to	
		0.015	
	Gudgeon pin	Ø 18 mm/0 to 0.004	
Gudgeon pin-to-connecting rod clearance		0.028 to 0.041 mm	
Cylinder compression	Standard	11 to 13 bar	
- ·	Minimum		min 10 bar
	Max. permissible difference		max 2 bar

### Gearbox

	Reference	Standard value	Service limit
Gearbox shafts	Endfloat		0.05 to 0.20 mm
Selector drum	Endfloat 0.10 to		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
Туре	Air-cooled: heat dispersion through the extensive finning on the two cylinder barrel/head assemblies	

### Front wheel

	Reference	Standard value	Service limit
Minimum tread depth	In the most worn part		2 mm
Tyre pressure	Cold	2.2 bar	
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
Туре		Marzocchi hydraulic upside-down forks, non- adjustable, Ø 43 mm
	Travel along leg axis	165 mm
Fork	Not adjustable	
	Oil charge per leg	450 cc (right fork) 470 cc (left fork)

### Rear wheel

	Reference	Standard value	Service limit
Minimum tread depth	In the most worn part		2 mm
Tyre pressure	Cold	2.2 bar	
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	DID	
	Туре	525 HV2	
	Dimensions	5/8" x 5/16"	
	No. of links	104	

### Rear suspension

	Reference	Technical specifications
Туре		Sachs, progressive, with adjustable rebound, compression and spring preload
Shock absorber	Stroke	59.5 mm
	Hydraulic damping standard setting. Turn the adjusters fully clockwise until they stop, then turn them anticlockwise	Compression: NON ADJUSTABLE Rebound: 12±2 clicks
	Spring preload	23 mm
	Wheel travel	135 mm

# Hydraulic brakes

Reference	Standard value	Service limit
F	RONT	
Туре	Drilled semi-floating dual disc	
Shim	4.5 mm	4 mm (min.)
Flange material	Steel	
Braking surface material	Steel	
Diameter	305 mm	
Braking surface	84 cm <sup>2</sup>	
Make	Brembo	
Туре	30/34 - 4 piston	
Caliper cylinder diameter	30-34 mm	
Pad friction material	FERIT I/D 450-FP	
Туре	PSC18	
Master cylinder diameter	18	
	REAR	
Туре	Fixed drilled disc	
Shim	5 mm	4.5 mm (min.)
Material	Steel	
	Type Shim Flange material Braking surface material Diameter Braking surface Make Type Caliper cylinder diameter Pad friction material Type Master cylinder diameter  Type Shim	Shim 4.5 mm  Flange material Steel  Braking surface material Steel  Diameter 305 mm  Braking surface 84 cm²  Make Brembo  Type 30/34 - 4 piston  Caliper cylinder diameter 30-34 mm  Pad friction material FERIT I/D 450-FP  Type PSC18  Master cylinder diameter 18  REAR  Type Fixed drilled disc  Shim 5 mm

specifications

	Braking surface material	Steel
	Diameter	245 mm
	Braking surface	25 cm <sup>2</sup>
Brake caliper	Make	Brembo
	Туре	34 - 2 piston
	Caliper cylinder diameter	34 mm
	Pad friction material	FERIT I/D 450 FF
Brake master cylinder	Туре	PS11
	Master cylinder diameter	11

# Charging system/alternator

	Reference	Technical specifications
Battery	Voltage	12 V
	Capacity	10 Ah
	Туре	Sealed, maintenance free
Alternator	Capacity	12 V - 480 W

# Ignition system

	Reference	l ecnnical specifications
gnition	Туре	Inductive electronic ignition
Spark plugs	Make and type	NGK DCPR8E - Champion RA 4 HC
	Electrode gap	0.7 to 0.8 mm
Starting	Туре	Electric starter motor, 12 V - 0.7 kW

# Fuel system

Make	Туре
Unleaded fuel	95-98 RON
Throttle body	Ø 45
Injectors per cylinder	1
Holes per injector	8

# Fuel system

	Make	Туре
Electronic Control Unit	Siemens	M3C

# Lights/instrument panel

	Reference	Technical specifications
Headlight	Bulb type (single bulb)	H4 (12 V - 55 W/60 W)
Side light	Bulb type	W3W (12 V - 3 W)
Turn signals	Bulb type	Front: LED Rear: 12 V - 3 W
Tail light and brake light		LED
Number plate light	Bulb type	12 V - 5 W
Fuses		
Key to fusebox	Key on, starter contactor, lambda, eng. stop	10 A
	Lights	15 A
	Loads	15 A
	Injection	20 A

### Technical specifications

ECU	5 A
Instrument panel	5 A
DDA and battery charging	5 A
Spare	20 A
Spare	20 A
Spare	15 A

# 1.2 - Dimensions



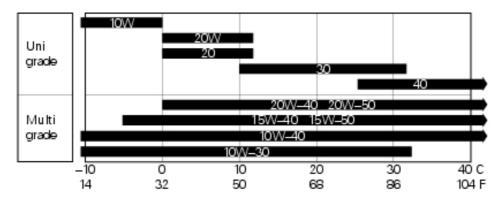


## 2 - Fuel, lubricants and other fluids

luids and lubricants	Туре	dm³ (litres)
Fuel tank, including a reserve of 3.3 dm <sup>3</sup> (litres)	Unleaded fuel with 95 fuel octane rating (at least)	12.4
Lubrication circuit	SHELL Advance Ultra 4	3.4
Front/rear brake and clutch circuits	Special hydraulic system fluid - SHELL Advance Brake Dot 4	-
Protection for electrical contacts	SHELL Advance Contact Cleaner spray for electrical systems	-
Front fork	SHELL Advance Fork 7.5 or Donax TA	450 cc (right fork) 470 cc (left fork)



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 15W-50

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

		11 100/ T-1	No
Accessories	and aguinment	Nm ± 10% Tolerand	e Notes
Bolt securing hand guard to handlebar (rh+lh)	nnd equipment M6x1	10	
Bolt securing hand guard mounting clamp/stud to	M5x0.8	3	
handlebar (rh+lh)			
Bolt securing front turn signal to hand guard (rh+lh)	AF2.9	0.33	
Bolt securing hand guard to stud (rh+lh)	M5x0.8	3	
Bolt securing front turn signal to hand guard (rh+lh)	AF3.5	0.33	
Bolt securing mirror to pivot mounting (rh+lh)	M4	1.1	
Mirror pivot mounting bolt (rh+lh)	M8	2.6	
Bolt securing mirror arm to hand guard (rh+lh)	M5	0.6	
	stand		
Sidestand pivot bolt	M10x1.25	20	
Sidestand pivot safety bolt	M10x1.25	25	
Bolt securing sidestand assembly to engine	M10x1.5	36	LOCK 5 (on front bolt only)
Sidestand sensor bolt	M6x1	5	
Front s	procket		
Pinion lock plate bolt	M5x0.8	6*	LOCK 2
Pinion cover bolt	M6x1	8	
Lights and	l reflectors		
Fastener securing numberplate holder half shell to bracket	M6x1	10	
Fastener joining number plate holder half shells	M4x0.7	3	
Fastener securing number plate holder to support	M6x1	6	
Fastener securing number plate holder to support	AF6	4	
Fastener securing reflector support to number plate holder	M6x1	4	For EU model only
Rear turn signal fastener (rh+lh)	M6x1	6	
Fastener securing light to number plate holder	M6x1	1.5	
Lower fastener securing rear light to passenger grab rail	M5x0.8	2	
Fastener securing vibration damper to rear light	AF4.5	0.65	
Fastener securing to rear light vibration damper bracket to grab handle	M5x0.8	2	
Fastener securing passneger grab handle to subframe	M8x1.25	18*	
Seat to grab handle fastener adjustment	M5x0.8	5	
TPRT fastener	push fit	_	
Fastener securing headlight to steering head	M6x1	10	
Fastener securing headlight to headlight support	AF5	3	
Instru	ments		
Instrument panel fastener	M5x0.8	2.5	
Fron	t fork		
Front axle clamp fastener (rh+lh)	M6x1	8.5*	GREASE B Sequence 1-2-1
Fastener clamping forks to bottom yoke (rh+lh)	M6x1	8*	GREASE B Sequence 1-2-3-1-2 from the bottom up
Fastener clamping forks to top yoke (rh+lh)	M8x1.25	22*	GREASE B
Steering stem nut	M35x1	30*	GREASE B
Steering limit (rh+lh)	M8x1.25	16	LOCK 2 (on nut thread only)

Fastener securing lower headlight fairing support	M6x1	10			
Electrical system					
Fastener securing voltage regulator and horn to frame	M6x1	10	LOCK 2		
Immobilizer antenna	_	_	Assembled in line apply LOCK 11 or LOCK 12 between antenna and commutator cover		
Speed sensor fastener	M6x1	10			
Commutator fastener (rh+lh)	M4x0.75	1.3			
Fastener securing battery lead and starter motor lead to contactor	M6x1	4			
Fastener securing ECU to support	AF5	6			
Fastener securing earth cable to crankcase	M6x1	10	torque to be verified		
Fastener securing HC coil to airbox	M5x0.8	5			
Fastener securing contactor-starter motor cable to starter motor	M6x1	6	torque to be verified		
Fastener securing upper hose guides to crankcase	M6x1	10			
Fastener securing connectors support plate and tank	M5x0.8	4			
fFastener securing ECU support to frame	M8x1.25	10			
Ignition switch cover fastener	M6x1	7			
Fastener securing upper plate to tank for battery rubber retaining strap	M8x1.25	10			
Fastener securing lower plate to tank for battery rubber retaining strap	M6x1	8			
Fastener securing VC coil to airbox	M5x0.8	5			
Front	brake				
Front brake caliper fastener (rh+lh)	M10x1.25	45*	GREASE B		
Fastener securing front brake master cylinder to handlebar	<sup>-</sup> M6x1	10	Sequence 1-2-1		
Brake bleed valve	M6x1	10			
Brake hose connection fitting	M10x1	23			
Bolt securing brake hose guide to bottom yoke	M6x1	TBD			
Swir	ngarm				
Swingarm pivot shaft fastener	M48x1.5	75*	GREASE B		
Chain tensioner eccentric screw	M12x1.25	31*	GREASE B Sequence 1-2-1		
Caliper mounting bracket pin fastener	M12x1.25	33*	LOCK 5		
Chain slider fastener (upper and lower)	M6x1	10	LOCK 2		
Chain guard fastener (upper and lower)	M6x1	10	LOCK 2		
Fastener securing heat shield to swingarm	M6x1	10	LOCK 2		
Rear	brake				
Brake bleed valve on caliper	M6x1	10			
Brake hose connection on caliper and master cylinder	M10x1	23			
Rear brake caliper fastener	M8x1.25	25*	GREASE B		
Rear brake pushrod adjustment	M6x1	8			
Brake pedal adjuster screw	M6x1	2.3			
Rear brake pedal light switch fastener	M8x1	5			
Rear brake master cylinder fastener	M6x1	10	LOCK 2		
Rear brake fluid reservoir fastener	M6x1	2			
Handlebar -	Clutch lever				
Handlebar clamp fastener	M8x1.25	25*	GREASE B Sequence 1-2-3-4-3 starting from the side arrowed		
Top yoke clamp fastener	M10x1.25	45*			
Clutch slave cylinder fastener	M6x1	10	Sequence 1-2-3-1		

Throttle twistgrip fastener	M6x1	6	Sequence 1-2-1		
Clutch master cylinder fastener	M6x1	10	Sequence 1-2-1		
Rear su	spension				
Fastener securing shock absorber/tie-rod to swing arm	M10x1.25	45*	GREASE B		
Fastener securing the shock absorber to suspension rocker arm	M10x1.25	45*	GREASE B		
Fastener securing tie-rod to suspension rocker arm	M10x1.25	45*	GREASE B		
Fastener securing suspension rocker arm to frame	M10x1.25	45*	GREASE B		
Front m	udguard				
Mudguard support stud fastener (rh+lh)	M8x1.25	12	LOCK 2		
Fastener securing mudguard to stud (rh+lh)	M6x1	5	LOCK 2		
Front fork guard fastener (rh+lh)	M5x0.8	3	LOCK 2		
Footrests	and Levers				
Fastener. securing UNIBALL fitting between gearchange lever shaft and link rod and adjustment	M6x1	10	Stake the bolt		
Gearchange pedal pivot bolt	M8x1.25	23*	LOCK 2		
Footrest bracket to crankcase fastener (rh+lh)	M10x1.5	36			
Footrest bracket to swingarm pivot shaft fastener (rh+lh)	M12x1.25	30	GREASE B		
Fastener securing brake lever spring to rh footrest	M6x1	10	LOCK 2		
Fastener securing gearchange lever to selector claw	M6x1	10	LOCK 1		
Fastener securing rubber dampers to front footrest (rh+lh)	M6x1	10			
Footrest bracket to crankcase fastener (rh+lh)	M10x1.5	36			
Gearchange pedal pivot bolt	M8x1.25	23*	LOCK 2		
	udguard				
Fastener securing rear sprocket gspray guard to bracket	M6x1	4.5	GREASE B		
Fastener securing spray guard bracket to eccentric	M5x0.8	5	LOCK 2		
3 1 3 3					
Front	wheel				
Front wheel axle fastener	wheel M25x1.25	63*	GREASE B (apply to thread, underside of nut and axle)		
Front wheel axle fastener			(apply to thread,		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)	M25x1.25	63*	(apply to thread, underside of nut and axle)		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)	M25x1.25	63*	(apply to thread, underside of nut and axle)		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear	M25x1.25 M8x1.25 wheel	63*	(apply to thread, underside of nut and axle) LOCK 2 GREASE B		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener  Rear wheel fastener	M25x1.25  M8x1.25  wheel  M33x1.5	63* 25** 156*	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener  Rear wheel fastener  Driving pin fastener	M25x1.25 M8x1.25 wheel M33x1.5 M38x1.5	63* 25** 156* 177*	(apply to thread, underside of nut and axle) LOCK 2  GREASE B GREASE B LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener  Rear wheel fastener  Driving pin fastener  Rear sprocket fastener	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25	63* 25** 156* 177* 11* 48*	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1	63* 25** 156* 177* 11*	(apply to thread, underside of nut and axle) LOCK 2  GREASE B GREASE B LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25	63* 25** 156* 177* 11* 48*	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8	63*  25**  156* 177* 11* 48* 25**	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8	63*  25**  156*  177*  11*  48*  25**  5  4.5	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener Fastener securing cable clip to fuel tank	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7	63*  25**  156* 177* 11* 48* 25**  5 4.5	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener Fastener securing cable clip to fuel tank Fuel tank filler flange fastener	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M4x0.7  M5x0.8	63*  25**  156* 177* 11* 48* 25**  5 4.5 2	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener  Driving pin fastener Rear sprocket fastener  Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener  Fastener securing cable clip to fuel tank Fuel tank filler flange fastener  Fastener securing tank to subframe	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7  M5x0.8  M8x1.25	63*  25**  156* 177* 11* 48* 25**  5 4.5 2 5 12	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener Fastener securing cable clip to fuel tank Fuel tank filler flange fastener Fastener securing tank to subframe Fuel tank rubber mounting fastener	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7  M5x0.8  M8x1.25  M6x1	63*  25**  156* 177* 11* 48* 25**  5 4.5 2 5 12	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2 LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener Fastener securing cable clip to fuel tank Fuel tank filler flange fastener Fastener securing tank to subframe Fuel tank rubber mounting fastener Fuel tank hose clamp fastener	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7  M5x0.8  M8x1.25  M6x1  M4x0.7	63*  25**  156* 177* 11* 48* 25**  5 4.5 2 5 12 10 1	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener  Driving pin fastener  Rear sprocket fastener  Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank  BITRON flange cover fastener  Fastener securing cable clip to fuel tank  Fuel tank filler flange fastener  Fastener securing tank to subframe  Fuel tank rubber mounting fastener  Fuel tank hose clamp fastener  Fastener securing BITRON flange to tank	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7  M5x0.8  M8x1.25  M6x1  M4x0.7  M5x0.8	63*  25**  156* 177* 11* 48* 25**  5 4.5 2 5 12	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2 LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener Fastener securing cable clip to fuel tank Fuel tank filler flange fastener Fastener securing tank to subframe Fuel tank rubber mounting fastener Fuel tank hose clamp fastener Fastener securing BITRON flange to tank  Exhaus	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7  M5x0.8  M8x1.25  M6x1  M4x0.7  M5x0.8	63*  25**  156* 177* 11* 48* 25**  5 4.5 2 5 12 10 1 5	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2 LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener Fastener securing cable clip to fuel tank Fuel tank filler flange fastener Fastener securing tank to subframe Fuel tank rubber mounting fastener Fuel tank hose clamp fastener Fastener securing BITRON flange to tank  Exhaus Fastener securing manifold to head (HR+VR)	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7  M5x0.8  M8x1.25  M6x1  M4x0.7  M5x0.8  t system  M8x1.25	63*  25**  156* 177* 11* 48* 25**  5 4.5 2 5 12 10 1 5	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2 LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener  Fastener securing cable clip to fuel tank Fuel tank filler flange fastener Fastener securing tank to subframe Fuel tank rubber mounting fastener Fuel tank hose clamp fastener Fastener securing BITRON flange to tank  Exhaus Fastener securing manifold to head (HR+VR)  CO plug (HR+VR)	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7  M5x0.8  M8x1.25  M6x1  M4x0.7  M5x0.8  t system  M8x1.25  G1/8	63*  25**  156* 177* 11* 48* 25**  5 4.5 2 5 12 10 1 5	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2 LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener  Rear sprocket fastener Rear brake disc fastener  Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener  Fastener securing cable clip to fuel tank Fuel tank filler flange fastener  Fastener securing tank to subframe Fuel tank rubber mounting fastener Fuel tank hose clamp fastener Fastener securing BITRON flange to tank  Exhaus Fastener securing manifold to head (HR+VR)  CO plug (HR+VR)  Exhaust pipes joining clamp	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7  M5x0.8  M4x0.7  M5x0.8  M4x0.7  M5x0.8  M8x1.25  M6x1  M4x0.7  M5x0.8  t system  M8x1.25  G1/8  M8x1.25	63*  25**  156* 177* 11* 48* 25**  5 4.5 2 5 12 10 1 5 24 25 19	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2 LOCK 2		
Front wheel axle fastener  Fastener securing front brake disc to wheel (rh+lh)  Rear Rear wheel axle fastener Rear wheel fastener Driving pin fastener Rear sprocket fastener Rear brake disc fastener  Fuel Fastener securing BITRON flange and cover to tank BITRON flange cover fastener  Fastener securing cable clip to fuel tank Fuel tank filler flange fastener Fastener securing tank to subframe Fuel tank rubber mounting fastener Fuel tank hose clamp fastener Fastener securing BITRON flange to tank  Exhaus Fastener securing manifold to head (HR+VR)  CO plug (HR+VR)	M25x1.25  M8x1.25  wheel  M33x1.5  M38x1.5  M6x1  M10x1.25  M8x1.25  tank  M5x0.8  M5x0.8  M4x0.7  M5x0.8  M8x1.25  M6x1  M4x0.7  M5x0.8  t system  M8x1.25  G1/8	63*  25**  156* 177* 11* 48* 25**  5 4.5 2 5 12 10 1 5	(apply to thread, underside of nut and axle) LOCK 2 GREASE B GREASE B LOCK 2 GREASE B LOCK 2 LOCK 2		

Silencer joint clamp fastener	M8x1.25	19	
Silencer joint bracket fastener	M8x1.25	24	
Fastener securing silencers bracket to subframe	M8x1.25	24	
Fastener securing number plate bracket to silencers	M8x1.25	24	
Under-silencer spray guard fastener	M6x1	10	
Fastener securing presilencer stay to bracket	M6x1	10	
	Seat		
Fastener securing seat to tank	M5x0.8	3	
Fastener securing seat adjustment slide	M6x1	10	
Fastener securing side panel to subframe (rh+lh)	M5x0.8	3	
Fastener securingsie panel to silencer (rh+lh)	M6x1	10	
	rame		
Nut for engine-frame bolt	M12x1.25	60*	
Fastener securing rear subframe to frame	M8x1.25	35*	
Bolt securing rear subframe and tank pin	_	_	JOIN UPPER AND LOWER BOLTS
Starter switch fastener	M6x1	to shear point	LOCK 2
Fastener securing seat bracket to frame	M6x1	10	LOCK 2
Oil	cooler		
Connection fitting	M14x1.5	23	Counterhold oil cooler with LOCK 1
Oil cooler fastener	M6x1	10	
Oil pipe union on cooler with Twin Seal O-ring	M16x1.5	18*	Lubricate with engine oil
Oil pipe union on crankcase with Twin Seal O-ring	M16x1.5	25*	Lubricate with engine oil
Fastener securing wire to crankcase	M5x0.8	5	LOCK 2
Air Intake	- Oil Breather		
Union for stepper motor hose	M20x1	25	
Fastener securing airbox to frame	M6x1	10	
Oil breather valve hose clamp	_	2	
Clamp securing hose to airbox	_	1.1	
Clamp securing throttle body to intake manifold	_	1.1	
Airbox support pin	M5x0.8	5	LOCK 2
Airbox cover fastener	M5x0.8	5	
Fastener securing sound absorbing panel to airbox	AF4.5	1	
EVAP syste	m canister filter		
Clamp securing throttle body to intake manifold	_	2	
Fastener securing canister support to bracket	M6x1	10	
Fastener securing canister support to engine	M6x1	10	
Fa	airings		
Fastener securing fairing to frame (rh+lh)	M5x0.8	3	
Fastener securing fairing to tank (rh+lh)	M5x0.8	3	
Fastener securing tank cover to tank	M5x0.8	3	
Fastener securing tank cover to tank filler flange	M5x0.8	3	
Rear grab handle cover fastener	M4x0.7	1	
Fastener securing headlight fairing to headlight support	M5x0.8	3	
Fastener securing headlight fairing to headlight support bracket	M5x0.8	0.33	Wellnut fastener

<sup>\*</sup> dynamic safety-critical point; tightening torque must be within Nm  $\pm 5\%$ . \* \* dynamic safety-critical point.



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

### Engine torque settings

Part	Thread/pitch (mm)	Nm	Min.	Max.	Notes
Oil temperature sensor holder nut	M30x1.5	38	34	42	LOCK 4
Camshaft timing belt pulley nut	M15x1	71	64	78	GREASE A
Oil temperature sensor	M12x1.5	18	16	19	LOCK 4
Cylinder head nut:	M10x1.5				GREASE C on face
Stage 1		15	13	17	under cylinder head
Stage 1 Stage 2		30 48	28 46	32 50	and stud threads
Intake flange stud	M8x1.25	15	13	17	LOCK 2 or TB1324
Intake manifold nut	M8x1.25	23	20	26	
Exhaust flange stud	M8x1.25	15	13	17	LOCK 2 or TB1324
Timing hole cover	M8x10	10	9	11	
Bolt securing vertical cylinder oil temperature	M8	9	8.5	9.5	
Sensor  Cylinder head corvice helt (aluminium)	M6x1	3	2	3	LOCK 5 or TB1375B
Cylinder head service bolt (aluminium)  Intake/exhaust valve cover bolts	M6x1	10	9	<u>၂</u> 11	LOCK 5 OF TB13/5B
Valve cover bolts	M6x1	10	9	11	
Timing belt cover bolt	M6x1	10	9	11	LOCK 2 or TB1324
Timing belt cover bolt	M6x1	10	9	11	
Pulley flange retaining bolt	M6	10	9	11	
Canister plug bolt	M6x1	3	2.7	3.2	LOCK 2 or TB1324
Canister plag bott  Canister nipple (USA version)	M6x1	3	2.7	3.2	LOCK 2 or TB1324
CAMOZZI union screw	M5x0.8	3	2.7	3.2	LOCK 2 or THREE BOND 1324
Blow-by valve	M40x1.5	34	30	38	
Pick-up filter housing plug	M32x1.5	42	38	46	
Oil pick-up filter	M22x1.5	42	38	46	
Oil drain plug with magnet	M22x1.5	42	38	46	LOCK 2 or TB1324
Oil filter nipple	M16x1.5	42	38	46	LOCK 2 or TB1324
Oil pump intake service hole plug	M15x1	25	22	28	LOCK 5 or TB1375B
Oil cooler nipple	M14x1.5	32	29	35	LOCK 2 or TB1324
Radiator connection blanking plug	M14x1.5	32	29	35	LOCK 2 or TB1324
Main oil way plug	M10x1.5	Fully seate	ed with	n tool	LOCK 5 or TB1375B
		15	13	17	
Neutral warning light switch	M10x1.5	10	9	11	
Cylinder barrel/head stud	M10x1.5	25	23	26	LOCK 2 or TB1324
Crankcase bolt	M8x1.25				
Initial tightening		19 25	17 22	21 28	
Final tightening	MO 4 05	25			
Crankcase drilled bolt	M8x1.25	20	18	22	
Crankcase bolt	M6x1	9	8.5	9.5	
Blow-by valve screw	M6x1	10	9	11	
Radial pick-up bolt	M6x1	10	9	11	LOCK 2 or TD1224
Clutch side primary bearing retaining plate bolt	M6x1	10	9	11	LOCK 2 or TB1324
Gearbox bearing plate bolt	M6x1	10	9	11	LOCK 2 or TB1324
Adler clutch oil calibration screw	M6	6	5	7	
Starter motor mounting bolt	M6x1	10	9	11 11	
Outer starter motor mounting bolt	M6x1	10	7	1.1	

Idler gear shaft retaining bolt   M6x1   10   9   11   LOCK 2 or TB1324     Alternator rotor nut   M24x1   270   256   284   LOCK 5     Primary drive gear nut   M22x1   190   171   209   GREASE B     Steel/aluminium crankshaft blanking cap   M20x1   15   13.5   16.5   TB 1375B     Connecting rod bolt   M10x1   35   35   45   TB 1375B     Connecting rod bolt   M10x1   35   35   45   TB 1375B     Connecting rod bolt   M10x1   35   35   45   TB 1375B     Connecting rod bolt   M10x1	Starter motor rear bolt	M6x1	10	9	11	
Alternator rotor nut  M24x1 270 256 284 LOCK 5 Primary drive gear nut  M22x1 190 177 209 GREASE B Steel/aluminium crankshaft blanking cap  M2x1 15 13.5 16.5 TB 1375B  Connecting rod bolt Tighten at 50 rpm 2 second pause, then back off through 360" at 30 rpm Stage 2 at 30 rpm Stage 2 at 30 rpm Tighten through 65° ±1° at 14 rpm Torque check  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  Drilled crankshaft grub screw  M8x1.25 13 11 15 LOCK 5 or TB1375B  Card detent lever bolt  M8x1.25 18 16 20 LOCK 2 or TB1324  Selector claw bolt  M8x1.25 25 22 28  Selector claw bolt  M8x1.25 18 16 20 LOCK 2 or TB1324  Selector claw bolt  M8x1.25 25 22 28  Selector claw bolt  M8x1.25 25 22 28  Selector claw bolt  M8x1.25 26 23 29  Tilling belt driveshaft gear nut  M15x1 71 64 78 GREASE A  Timing belt driveshaft gear nut  M15x1 71 64 78 GREASE A  Timing belt driveshaft gear nut  M8x1.25 26 23 29  Idler pulley retaining bolt  M8x1.25 26 23 29  Idler pulley retaining bolt  M8x1.25 5 5 6  GIl filler plug  M2x1.5 5 5 6  GIl filler plug  M2x2.5 5 5 6  GIl filler plug  M2x2.5 5 5 6  GIl filler plug  M2x2.5 5 5 6  GIl filler plug  M2x1.5 5				9		LOCK 2 or TB1324
Primary drive gear nut         M22x1         190         171         209         GREASE B           Steel/aluminium crankshaft blanking cap         M20x1         15         13.5         16.5         TB 1375B           Connecting rod bolt Tighten at 50 rpm         35         35         45         Apply GREASE B to thread           1 Stage 2 at 30 rpm         35         35         45         Apply GREASE B to thread           1 Stage 2 at 30 rpm         35         35         45         45         Apply GREASE B to thread           2 Stage 2 at 30 rpm         35         35         11         15         LOCK 5 or TB1378B           5 Stage 2 at 10 rpm         13         11         15         LOCK 5 or TB1378B           6 Crankshaft grub screw         M8x1.25         13         11         15         LOCK 5 or TB1378B           6 Selector draw bott         M8x1.25         18         16         20         LOCK 2 or TB1324           6 Selector claw bott         M6x1         9         8.5         9.5           6 Selector claw bott         M6x1         9         9         11           6 Selector claw locator nut         M6x1         9         9         11           6 Selector claw bott         M6x1						
Steel/aluminium crankshaft blanking cap						
Connecting rod bolt Tighten at 50 rpm   2 second pause, then back off through 360° at 30 rpm   35   35   35   35   35   35   35   3		M20x1	15	13.5	16.5	TB 1375B
360° at 30 rpm   Stage 2 at 30 rpm   Stage 2 at 10 rpm   Tighten through 65° ±1° at 14 rpm   Torque check   T	Tighten at 50 rpm	M10x1	35			
Torque check         M8X1.25         13         11         15         LOCK 5 or TB1375B           Orlilled crankshaft grub screw         M8X1.25         13         11         15         LOCK 5 or TB1375B           Selector drum locating screw         M16x1.5         30         27         33           Gear detent lever bolt         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           Carnshaft pulley retaining nut         M15x1         71         64         78         GREASE A           Timing belt driveshaft gear nut         M15x1         71         64         78         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Timing belt driveshaft gear nut         M8x1.25         26         23         29           Idler pulley retaining bolt         M8x1.25	360° at 30 rpm Stage 2 at 30 rpm Stage 3 at 10 rpm					
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 detent lever bolt         M8x1.25         18         16         20         LOCK 2 or TB1324           Selector claw locator nut         M6x1         10         9         11         Selector claw bolt           Selector claw bolt         M6x1         9         8.5         9.5         Selector claw bolt           Camshaft pulley retaining nut         M15x1         71         64         78         GREASE A           Timing belt driveshaft gear nut         M15x1         71         64         78         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Timing belt driveshaft gear nut         M15x1         20         18<			70 to 103			
Drilled crankshaft grub screw         M8x1.25         13         11         15         LOCK 5 or TB1375B           Selector drum locating screw         M16x1.5         30         27         33           Gear detent lever bolt         M8x1.25         18         16         20         LOCK 2 or TB1324           Selector claw bolt         M8x1.25         25         22         28           Selector claw bolt         M6x1         9         8.5         9.5           Camshaft pulley retaining nut         M15x1         71         64         78         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Tensioner pulley retaining bolt         M8x1.25         26         23         29           Idler pulley retaining bolt         M8x1.25         26         23         29           Idler pulley retaining bolt         M8x1.25         26         23         29           Idler pulley retaining bolt         M8x1.25         26         23         29           Verture over bolt         M6x1         6         5.5         6.5           Wet clutch cover bolt         M6x1         6         5.5         6.5           O	·	M8x1.25	13	11	15	LOCK 5 or TB1375B
Selector drum locating screw         M16x1.5         30         27         33           Gear detent lever bolt         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           Camshaft pulley retaining nut         M15x1         71         64         78         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Tensioner pulley retaining bolt         M8x1.25         26         23         29           Idler pulley retaining bolt         M8x1.25         26         23         29           Idler pulley retaining bolt         M8x1         20         18         22         LOCK 2 or TB1324           Plastic cover bolt         M6x1         10         9         11         11         20         18         22         LOCK 2 or TB1324           Plastic cover bolt         M6x1         6         5.5         6.5         6         50         6         6		M8x1.25	13	11	15	LOCK 5 or TB1375B
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           Camshaft pulley retaining nut         M15x1         71         64         78         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Tensioner pulley retaining bolt         M8x1.25         26         23         29           Idler pulley retaining bolt         M8x1         20         18         22         LOCK 2 or TB1324           Plastic cover bolt         M6x1         10         9         11         11         11         12		M16x1.5	30	27	33	
Selector claw locator nut	Gear detent lever bolt	M8x1.25	18	16	20	LOCK 2 or TB1324
Selector claw bolt         M6x1         9         8.5         9.5           Camshaft pulley retaining nut         M15x1         71         64         78         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Tensioner pulley retaining bolt         M8x1.25         26         23         29           Idler pulley retaining bolt         M8x1         20         18         22         LOCK 2 or TB1324           Plastic cover bolt         M6x1         10         9         11           Carbon fibre cover bolts         M6x1         6         5.5         6.5           Wet clutch centre nut         M25x1.5         190         180         200         GREASE B           Oil filler plug         M22x1.5         5         5         6         6         6           Oil way blanking plug         M10x1         15         13         17         LOCK 5 or TB1375B           Oil pressure sensor         M10x1         19         17         21           Clutch cover bolt         M6x1         10         9         11           Clutch cover bolt with cable guide         M6x1         9.5         8.5         9	Selector claw bolt	M8x1.25	25	22	28	
Camshaft pulley retaining nut         M15x1         71         64         78         GREASE A           Timing belt driveshaft gear nut         M14x1         55         50         60         GREASE A           Tensioner pulley retaining bolt         M8x1         26         23         29           Idler pulley retaining bolt         M8x1         20         18         22         LOCK 2 or TB1324           Plastic cover bolt         M6x1         10         9         11         Carbon fibre cover bolts         M6x1         6         5.5         6.5           Wet clutch centre nut         M25x1.5         190         180         200         GREASE B           Oil filler plug         M22x1.5         5         5         6         5         6           Oil filler plug         M20x2.5         5         5         6         6         5         6	Selector claw locator nut	M6x1	10	9	11	
Timing belt driveshaft gear nut  M14x1  M8x1.25  M8x1.25  M8x1.25  M8x1.25  M8x1  M8	Selector claw bolt	M6x1	9	8.5	9.5	
Tensioner pulley retaining bolt   M8x1.25   26   23   29     Idler pulley retaining bolt   M8x1   20   18   22   LOCK 2 or TB1324     Plastic cover bolt   M6x1   10   9   11     Carbon fibre cover bolts   M6x1   6   5.5   6.5     Wet clutch centre nut   M25x1.5   190   180   200   GREASE B     Oil filler plug   M22x1.5   5   5   6     Oil filler plug   M20x2.5   5   5   6     Oil way blanking plug   M10x1   15   13   17   LOCK 5 or TB1375B     Oil pressure sensor   M10x1   19   17   21     Clutch cover bolt   M6x1   10   9   11     Clutch cover bolt   M6x1   9.5   8.5   9     Wet clutch cover screw   M6x1   9.5   8.5   9     Wet clutch spring screw   M6x1   10   9   11     Alternator cover inspection plug   M15x1   20   18   22   TB 1215     Pick-up sensor inspection bolt   M12x1   15   13   17   LOCK 2 or TB1324     Spark plug   M12x1.25   20   18   22     Alternator-side crankcase cover bolt   M6x1   10   9   11     Inspection cover bolt   M6x1   13   11   15   LOCK 2 or TB1324     Alternator rataon retaining bolt   M6x1   13   11   15   LOCK 5     Stator wiring clamp bracket bolt   M5x0.8   5   5   7     Sy-pass pump cap   M15x1   25   22   28   LOCK 5 or TB1375B     Oil pump retaining bolt   M8x1.25   26   23   29     Oil pump retaining bolt   M6x1   10   9   11	Camshaft pulley retaining nut	M15x1	71	64	78	GREASE A
Idler pulley retaining bolt         M8x1         20         18         22         LOCK 2 or TB1324           Plastic cover bolt         M6x1         10         9         11           Carbon fibre cover bolts         M6x1         6         5.5         6.5           Wet clutch centre nut         M25x1.5         190         180         200         GREASE B           Oil filler plug         M22x1.5         5         5         6           Oil filler plug         M20x2.5         5         5         6           Oil way blanking plug         M10x1         15         13         17         LOCK 5 or TB1375B           Oil pressure sensor         M10x1         19         17         21           Clutch cover bolt         M6x1         10         9         11           Clutch cover bolt with cable guide         M6x1         9.5         8.5         9           Wet clutch cover screw         M6x1         9.5         8.5         9           Wet clutch spring screw         M6x1         10         9         11           Alternator cover inspection plug         M15x1         20         18         22         TB 1215           Pick-up sensor inspection bolt         M12x1	Timing belt driveshaft gear nut	M14x1	55	50	60	GREASE A
Plastic cover bolt         M6x1         10         9         11           Carbon fibre cover bolts         M6x1         6         5.5         6.5           Wet clutch centre nut         M25x1.5         190         180         200         GREASE B           Oil filler plug         M22x1.5         5         5         6         6           Oil filler plug         M20x2.5         5         5         6           Oil way blanking plug         M10x1         15         13         17         LOCK 5 or TB1375B           Oil pressure sensor         M10x1         19         17         21           Clutch cover bolt         M6x1         10         9         11           Clutch cover bolt with cable guide         M6x1         9.5         8.5         9           Wet clutch cover screw         M6x1         9.5         8.5         9           Wet clutch cover screw         M6x1         10         9         11           Alternator cover inspection plug         M15x1         20         18         22         TB 1215           Pick-up sensor inspection bolt         M12x1         15         13         17         LOCK 2 or TB1324           Spark plug         M12x1 <td>Tensioner pulley retaining bolt</td> <td>M8x1.25</td> <td>26</td> <td>23</td> <td>29</td> <td></td>	Tensioner pulley retaining bolt	M8x1.25	26	23	29	
Carbon fibre cover bolts         M6x1         6         5.5         6.5           Wet clutch centre nut         M25x1.5         190         180         200         GREASE B           Oil filler plug         M22x1.5         5         5         6           Oil filler plug         M20x2.5         5         5         6           Oil way blanking plug         M10x1         15         13         17         LOCK 5 or TB1375B           Oil pressure sensor         M10x1         19         17         21           Clutch cover bolt         M6x1         10         9         11           Clutch cover bolt with cable guide         M6x1         9.5         8.5         9           Wet clutch cover screw         M6x1         9.5         8.5         9           Wet clutch spring screw         M6x1         10         9         11           Alternator cover inspection plug         M15x1         20         18         22         TB 1215           Pick-up sensor inspection bolt         M12x1         15         13         17         LOCK 2 or TB1324           Spark plug         M12x1.25         20         18         22           Alternator-side crankcase cover bolt         M6x1	Idler pulley retaining bolt	M8x1	20	18	22	LOCK 2 or TB1324
Wet clutch centre nut         M25x1.5         190         180         200         GREASE B           Oil filler plug         M22x1.5         5         5         6           Oil filler plug         M20x2.5         5         5         6           Oil way blanking plug         M10x1         15         13         17         LOCK 5 or TB1375B           Oil pressure sensor         M10x1         19         17         21           Clutch cover bolt         M6x1         10         9         11           Clutch cover bolt with cable guide         M6x1         9.5         8.5         9           Wet clutch spring screw         M6x1         9.5         8.5         9           Wet clutch spring screw         M6x1         10         9         11           Alternator cover inspection plug         M15x1         20         18         22         TB 1215           Pick-up sensor inspection bolt         M12x1         15         13         17         LOCK 2 or TB1324           Spark plug         M12x1.25         20         18         22           Alternator-side crankcase cover bolt         M6x1         10         9         11           Inspection cover bolt         M6x1 <td>Plastic cover bolt</td> <td>M6x1</td> <td>10</td> <td>9</td> <td>11</td> <td></td>	Plastic cover bolt	M6x1	10	9	11	
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Oil pressure sensor         M10x1         19         17         21           Clutch cover bolt         M6x1         10         9         11           Clutch cover bolt with cable guide         M6x1         9.5         8.5         9           Wet clutch cover screw         M6x1         9.5         8.5         9           Wet clutch spring screw         M6x1         10         9         11           Alternator cover inspection plug         M15x1         20         18         22         TB 1215           Pick-up sensor inspection bolt         M12x1         15         13         17         LOCK 2 or TB1324           Spark plug         M12x1.25         20         18         22           Alternator-side crankcase cover bolt         M6x1         10         9         11           Inspection cover bolt         M6x1         4.5         4.5         6           Alternator stator retaining bolt         M6x1         10         9         11         LOCK 2 or TB1324           Alternator rotor/flywheel bolt         M6x1         13         11         15         LOCK 5           Stator wiring clamp bracket bolt         M5x0.8         5         5         7           By-pass pump cap	Oil filler plug	M20x2.5	5	5	6	
Clutch cover bolt         M6x1         10         9         11           Clutch cover bolt with cable guide         M6x1         9.5         8.5         9           Wet clutch cover screw         M6x1         9.5         8.5         9           Wet clutch spring screw         M6x1         10         9         11           Alternator cover inspection plug         M15x1         20         18         22         TB 1215           Pick-up sensor inspection bolt         M12x1         15         13         17         LOCK 2 or TB1324           Spark plug         M12x1.25         20         18         22           Alternator-side crankcase cover bolt         M6x1         10         9         11           Inspection cover bolt         M6x1         4.5         4.5         6           Alternator stator retaining bolt         M6x1         10         9         11         LOCK 2 or TB1324           Alternator rotor/flywheel bolt         M6x1         13         11         15         LOCK 5           Stator wiring clamp bracket bolt         M5x0.8         5         5         7           By-pass pump cap         M15x1         25         22         28         LOCK 5 or TB1375B      <	Oil way blanking plug	M10x1	15	13	17	LOCK 5 or TB1375B
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Wet clutch cover screw         M6x1         9.5         8.5         9           Wet clutch spring screw         M6x1         10         9         11           Alternator cover inspection plug         M15x1         20         18         22         TB 1215           Pick-up sensor inspection bolt         M12x1         15         13         17         LOCK 2 or TB1324           Spark plug         M12x1.25         20         18         22           Alternator-side crankcase cover bolt         M6x1         10         9         11           Inspection cover bolt         M6x1         4.5         6           Alternator stator retaining bolt         M6x1         10         9         11         LOCK 2 or TB1324           Alternator rotor/flywheel bolt         M6x1         13         11         15         LOCK 5           Stator wiring clamp bracket bolt         M5x0.8         5         5         7           By-pass pump cap         M15x1         25         22         28         LOCK 5 or TB1375B           Reducer bush         M10x1         -         -         -         LOCK 5 or TB1375B           Oil pump retaining bolt         M6x1         10         9         11	Clutch cover bolt	M6x1	10	9	11	
Wet clutch spring screw         M6x1         10         9         11           Alternator cover inspection plug         M15x1         20         18         22         TB 1215           Pick-up sensor inspection bolt         M12x1         15         13         17         LOCK 2 or TB1324           Spark plug         M12x1.25         20         18         22           Alternator-side crankcase cover bolt         M6x1         10         9         11           Inspection cover bolt         M6x1         4.5         4.5         6           Alternator stator retaining bolt         M6x1         10         9         11         LOCK 2 or TB1324           Alternator rotor/flywheel bolt         M6x1         13         11         15         LOCK 5           Stator wiring clamp bracket bolt         M5x0.8         5         5         7           By-pass pump cap         M15x1         25         22         28         LOCK 5 or TB1375B           Reducer bush         M10x1         -         -         -         LOCK 5 or TB1375B           Oil pump retaining bolt         M6x1         10         9         11	Clutch cover bolt with cable guide	M6x1	9.5	8.5	9	
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Pick-up sensor inspection bolt         M12x1         15         13         17         LOCK 2 or TB1324           Spark plug         M12x1.25         20         18         22           Alternator-side crankcase cover bolt         M6x1         10         9         11           Inspection cover bolt         M6x1         4.5         6           Alternator stator retaining bolt         M6x1         10         9         11         LOCK 2 or TB1324           Alternator rotor/flywheel bolt         M6x1         13         11         15         LOCK 5           Stator wiring clamp bracket bolt         M5x0.8         5         5         7           By-pass pump cap         M15x1         25         22         28         LOCK 5 or TB1375B           Reducer bush         M10x1         -         -         -         LOCK 5 or TB1375B           Oil pump retaining bolt         M6x1         10         9         11	Wet clutch spring screw	M6x1	10	9	11	
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Inspection cover bolt M6x1 4.5 4.5 6  Alternator stator retaining bolt M6x1 10 9 11 LOCK 2 or TB1324  Alternator rotor/flywheel bolt M6x1 13 11 15 LOCK 5  Stator wiring clamp bracket bolt M5x0.8 5 5 7  By-pass pump cap M15x1 25 22 28 LOCK 5 or TB1375B  Reducer bush M10x1 LOCK 5 or TB1375B  Oil pump retaining bolt M8x1.25 26 23 29  Oil pump retaining bolt M6x1 10 9 11	Spark plug	M12x1.25	20	18	22	
Alternator stator retaining bolt M6x1 10 9 11 LOCK 2 or TB1324  Alternator rotor/flywheel bolt M6x1 13 11 15 LOCK 5  Stator wiring clamp bracket bolt M5x0.8 5 5 7  By-pass pump cap M15x1 25 22 28 LOCK 5 or TB1375B  Reducer bush M10x1 LOCK 5 or TB1375B  Oil pump retaining bolt M8x1.25 26 23 29  Oil pump retaining bolt M6x1 10 9 11	Alternator-side crankcase cover bolt	M6x1	10	9	11	
Alternator rotor/flywheel bolt M6x1 13 11 15 LOCK 5  Stator wiring clamp bracket bolt M5x0.8 5 5 7  By-pass pump cap M15x1 25 22 28 LOCK 5 or TB1375B  Reducer bush M10x1 LOCK 5 or TB1375B  Oil pump retaining bolt M8x1.25 26 23 29  Oil pump retaining bolt M6x1 10 9 11	Inspection cover bolt	M6x1	4.5	4.5	6	
Stator wiring clamp bracket bolt         M5x0.8         5         5         7           By-pass pump cap         M15x1         25         22         28         LOCK 5 or TB1375B           Reducer bush         M10x1         -         -         -         LOCK 5 or TB1375B           Oil pump retaining bolt         M8x1.25         26         23         29           Oil pump retaining bolt         M6x1         10         9         11	Alternator stator retaining bolt	M6x1	10	9	11	LOCK 2 or TB1324
By-pass pump cap         M15x1         25         22         28         LOCK 5 or TB1375B           Reducer bush         M10x1         -         -         -         LOCK 5 or TB1375B           Oil pump retaining bolt         M8x1.25         26         23         29           Oil pump retaining bolt         M6x1         10         9         11	Alternator rotor/flywheel bolt	M6x1	13	11	15	LOCK 5
Reducer bush M10x1 LOCK 5 or TB1375B  Oil pump retaining bolt M8x1.25 26 23 29  Oil pump retaining bolt M6x1 10 9 11	Stator wiring clamp bracket bolt	M5x0.8	5	5	7	
Oil pump retaining boltM8x1.25262329Oil pump retaining boltM6x110911	By-pass pump cap	M15x1	25	22	28	LOCK 5 or TB1375B
Oil pump retaining bolt M6x1 10 9 11	Reducer bush	M10x1	-	-	-	LOCK 5 or TB1375B
	Oil pump retaining bolt	M8x1.25	26	23	29	
Oil pump assembly bolt M6x1 10 9 11	Oil pump retaining bolt	M6x1	10	9	11	
	Oil pump assembly bolt	M6x1	10	9	11	



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

# 4 - Service tools

Parts catalogue

### Workshop service tools

# Specific tools for the engine

Code No	Description	
88700.5644	Socket wrench for camshaft pulley nut	
88713.3218	Timing belt roller tool	
88713.2423	Torque wrench for tightening front sprocket nut	
88713.2676	Wrench for tightening cylinder head nuts	
88713.2103	Stand for cylinder head assembly	

98112.0002	Timing degree wheel	From a second
88713.0123	Timing check tool	
97900.0215	DDS (Ducati Diagnosis System) + cylinder vacuum measuring kit	
88713.0137	Front sprocket holding wrench	
88765.1581	Valve lift gauge	
88713.2878	Spacer and fork feeler gauge 0.2/0.3 mm	

88713.2783	Tool for fitting spring and closing rocker	
88713.2282	Pulley holding tool	
88713.2011	Crankshaft holding tool	
88700.5749	Crankcase assembly cap	
88713.3334	Plate for gear selector fork positioning	
88713.1749	Puller for drive pulley and cover	

88765.1297	TDC gauge	* Control of the second
88713.2092	Primary drive gears puller	
88713.1010	Exhaust gases pick-up connector	
88713.2036	Alternator holding tool for tightening nut	
88713.2442	Valve seal installer Ø 7	
88713.2906	Oil filter cartridge wrench	

Service tools		
88713.2556	Clutch drum holding tool	
88713.2591	Clutch screw	
88713.3220	Engine repair bench	



### Workshop service tools

# Specific tools for the frame

Code No	Description	
88713.2409	Swingarm ball bearing installer	
88713.1058	Wrench for steering stem nut	

88713.1062	Tool for installing steering head bearings	Co Co
88713.3203	MARZOCCHI fork disassembly rod	
88713.1068	Tool for installation of swingarm roller bearings	
88713.1071	Drift to drive rocker arm needle rollers	
88713.1038	Wrench for adjustment of the eccentric hub	
88713.1073	Rear wheel balancing tool	

88713.1344	Chain assembly tool	
8000.70139	Front wheel axle wrench	
88713.3204	Tool for overhaul of MARZOCCHI forks - oil seal installer	
88713.1072	Drift to install half bearing in bottom yoke	

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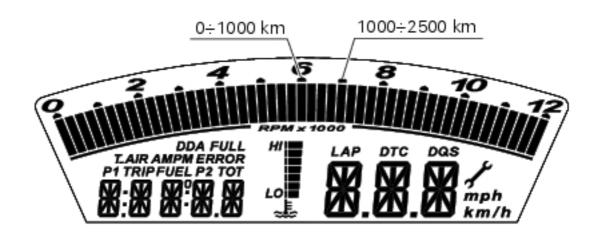
## 1 - Preliminary checks

### 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 engine speed must not exceed **5500-6000** rpm. During the first hours of riding, it is advisable to run the engine at varying load and rpm, while keeping within the recommended limit.

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. Avoid sudden or prolonged braking. This will allow the friction material on the brake pads to bed in against the 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

During this stage you can use more of your engine's power, being careful, however, never to exceed **7000** rpm. Keeping strictly to these recommendations will extend the life of your engine and reduce the likelihood of overhauls or tune-ups.



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 shall release Ducati Motor Holding S.p.A. from all liability for any engine damage or shorter engine life.

Preliminary checks

#### Pre-ride checks



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.

**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 of the same rating (Sect. C 1.1, <u>Lights/instrument panel</u>).

Key locks

Check that the fuel filler cap, pillion seat lock, and right-hand side compartment lock are securely closed (Sect. E 2, Fairings).

Sidestand

Make sure the sidestand operates smoothly (Sect. P 6, <u>Checking the fuses</u>) and is in the correct position (Sect. H 5, <u>Refitting the sidestand</u>).

# 2 - Starting - Engine warmup

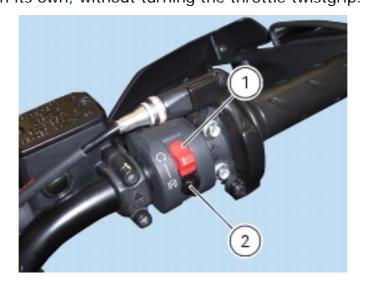
### Starting the engine

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 Section M 3, Stepper motor.

Turn the ignition switch to **ON**.

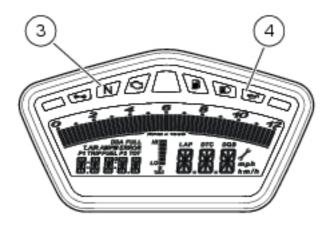


Check the neutral indicator light N (3), and the red oil pressure warning light (4) on the instrument panel are both illuminated (Sect. P 7, <u>Instrument panel system</u>) and that the engine stop switch (1) is in the position (RUN), then press the starter button (2). Allow the engine to start on its own, without turning the throttle twistgrip.





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, <u>Instrument panel system</u>). Never start the engine when the oil pressure is too low.





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.



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

Change the engine oil Change the engine oil filter Clean the engine oil pick-up 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 Cheak throttle body synchronisation and idle speed setting (1) Check the brake and clutch fluid levels Change the clutch and brake fluid Check and dijust 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 brake pads. Renew if necessary Check the drive chain tension, alignment and lubrication Check the drive chain tension, alignment and lubrication Check the indicators and lighting Check the indicators and lighting Check the sidestand Check to extreme the ear wheel axle nut Check the sidestand Check the external fuel hoses Change the front fork oil	48	36	36	24	12		km x1000			
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		•	•				Change the front fork oil			
Check the forks and rear shock absorber for oil leaks  • • •	•	•	•	•	•		Check the forks and rear shock absorber for oil leaks			
Check the front sprocket retaining bolts   • • •	•	•	•	•	•		Check the front sprocket retaining bolts			
General lubrication and greasing   • • •	•	•	•	•	•		General lubrication and greasing			
Check and recharge the battery   • • •	•	•	•	•	•		Check and recharge the battery			
Road test the motorcycle   • • • •	•	•	•	•	•	•	Road test the motorcycle			
General cleaning   • • •	•	•	•	•	•			eneral cleaning		

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

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

	km x1000	
	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		•

<sup>(1)</sup> Operation to be carried out only at the specified distance intervals.

* 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

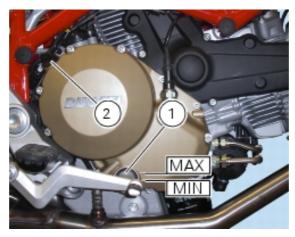
Check the engine oil level through the sight glass (1) on the right-hand side of the oil sump.

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 level is low, top it up.

Remove the filler cap (2) and top up with the recommended oil.

Refit the cap (2).



If the level is below the bottom mark, top up with SHELL Advance Ultra 4 engine oil.

### Changing the engine oil and filter cartridge



#### Notes

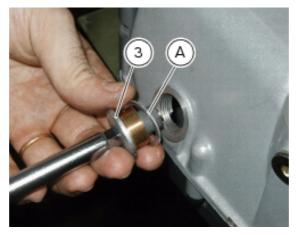
Change the oil when the engine is hot (but with the engine stopped). In these conditions the oil is more fluid and will drain more rapidly and completely.

Remove the drain plug (3) with gasket (A) from the oil sump and allow the oil to drain off.



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). Refit the drain plug complete with gasket (A) to the sump.



Tighten to the specified torque (Sect. C 3, <u>Engine torque settings</u>). Remove the oil sump filter cartridge (4) using service tool **88713.2906**.



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

Fit a new cartridge (4) using service tool 88713.2906: lubricate the seal with engine oil.



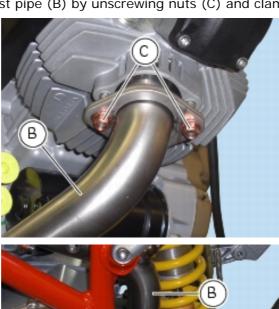
Notes

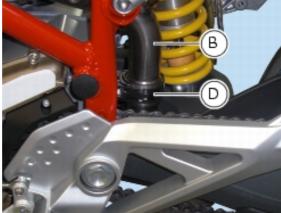
It is advisable to fill the filter cartridge (4) with engine oil before installing it: this enables the recommended oil level to be maintained without topping up.

Screw the filter into place and tighten to the specified torque (Sect. C 3, <u>Engine torque settings</u>), using service tool **88713.2906**.

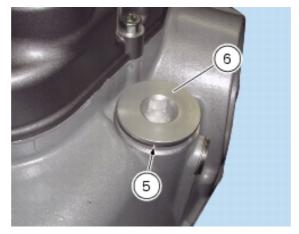


Every two oil changes, clean the oil pickup gauze filter. Remove the horizontal cylinder exhaust pipe (B) by unscrewing nuts (C) and clamp (D).

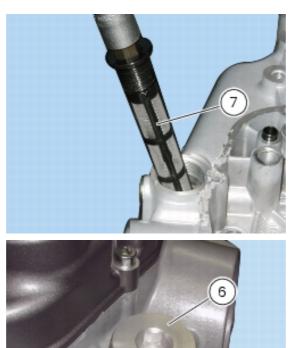




Unscrew the outer plug (6) with the seal (5).



Unscrew the filter (7) and withdraw it from the crankcase.
Clean the filter with petrol and compressed air. Take care not to damage the gauze.
Replace the pick-up filter (7), fit the seal (5) to the plug (6) and tighten to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>).





Remove the filler cap (2) and fill with oil of the recommended type (Sect. C 2, <u>Fuel, lubricants and other fluids</u>) up to the MAX line in the sight glass.

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

In order to check the valve clearances, it is necessary to gain access to the four valve covers on the cylinder heads and then remove the parts listed below.

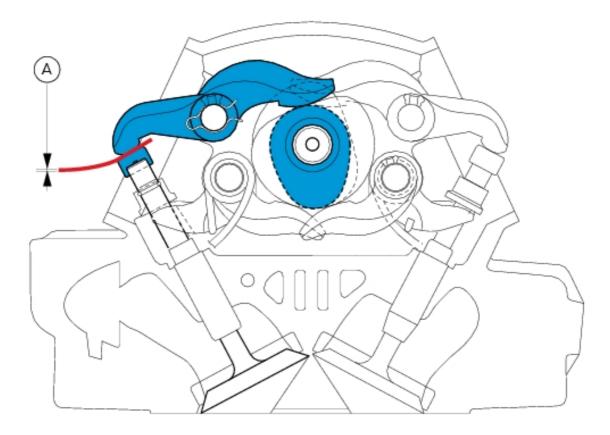
Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the side fairings	E 2, Removal of the side fairings
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the oil cooler	N 2.2, Removal of the oil cooler
Remove the valve covers	N 4.3, Removal of the valve covers

Remove the inspection cover on the alternator side of the crankcase, insert the handle of service tool **88713.0123** in the holes of the alternator-side crankcase cover in order to rotate the crankshaft to bring the valve being checked to its rest position.

With the valve in the rest position, slide a feeler gauge between the opening rocker and the opening shim to measure the clearance.

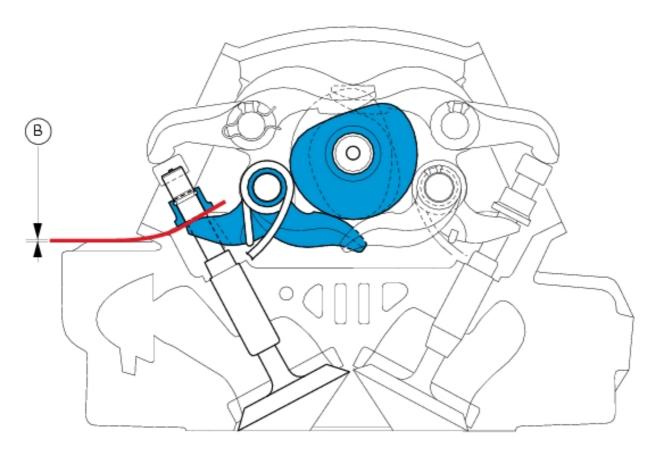
The clearances must be within the specified limits:

Opening rocker arm		
Intake:	(A)	
Adjusting clearance	0.10 to 0.15 mm	
Checking clearance	0.10 to 0.15 mm	
Exhaust:	(A)	
Adjusting clearance	0.10 to 0.15 mm	
Checking clearance	0.10 to 0.15 mm	



With the valve in the rest position, slide a feeler gauge between the closing rocker arm and the closing shim to measure the clearance:

Closing rocker arm	
Intake:	(B)
Adjusting clearance	0 to 0.05 mm
Checking clearance	0 to 0.05 mm
Exhaust:	(B)
Adjusting clearance	0 to 0.05 mm
Checking clearance	0 to 0.05 mm



If the measured clearances are outside the prescribed limits, replace the opening and/or closing shim, as described in the paragraph "Removal of the rocker arms, shims and valves" (Sect. N 4.4), with one of suitable height to obtain the specified clearance.



#### Notes

Replacement opening shims are available in sizes ranging from 1.8 to 3.45 mm, while closing shims are available in sizes from 2.2 to 4.5. Each shim is marked with its size.

Refit all the removed parts in the reverse order to that in which they were removed.

### Changing and cleaning the air filters

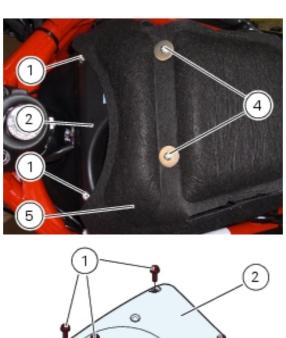
The air filter must be renewed at the intervals indicated in the "Routine maintenance table" (Sect. D 3).

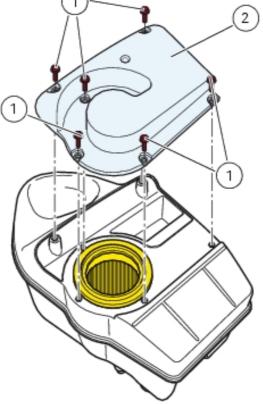
Operation	Section reference
	E 3, Removal of the seat/Removal of the rear side panels
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank

Unscrew the bolts (4) and remove the pad (5).

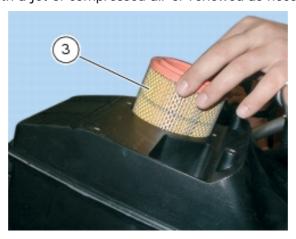
Unscrew the six bolts (1) securing the airbox cover (2).

Remove the cover (2).





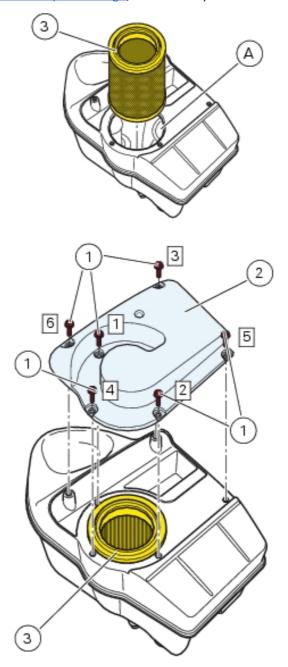
Remove the filter cartridge (3). The filter cartridge can be cleaned with a jet of compressed air or renewed as necessary.





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 run the engine without the air filter. This would draw foreign material present in the air into the engine and could damage the engine.

Install the cartridge (3) in its housing (A) in the airbox cover and replace all the removed parts; tighten the bolts (1) to the specified torque (Sect. C 3, Frame torque settings): in the sequence 1-2-3-4-5-6.





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

### 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

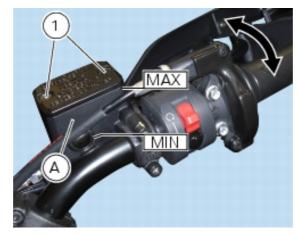
Loosen the bolts (1) and remove the cover and membrane from the front brake fluid reservoir.

Siphon the brake fluid from the reservoir (A).

Fill the reservoir (A) with new clutch fluid up to the MAX mark.

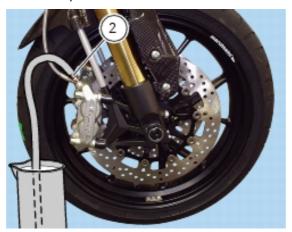
Operate the clutch lever two or three times until the circuit is pressurized.

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.

Loosen the bleed valve (2) to allow fluid to escape.





While filling the circuit, keep the fluid level above the MIN mark at all times to prevent the formation of air bubbles in the circuit.

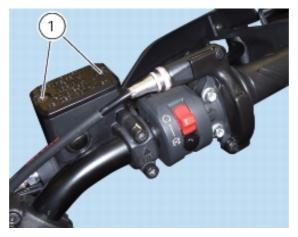
Allow the fluid to flow from the bleed valve (2) until it changes colour.

Tighten the bleed valve (2) to the specified torque (Sect. C 3, <u>Frame torque settings</u>) and top up the reservoir fluid level.



Repeat this operation on each brake caliper.

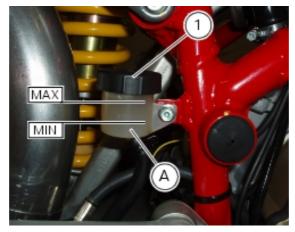
Replace the cover and membrane from the front brake fluid reservoir and refit the bolts (1).



Changing the rear brake circuit fluid

Unscrew the cover (1) and remove internal membrane (2) of rear brake 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 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 (2) and insert the other end of the tubing in a container placed on the floor.

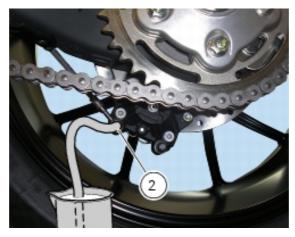


Warning

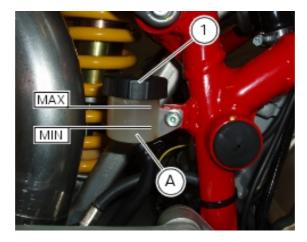
While filling the circuit, keep the fluid level above the MIN mark at all times to prevent the formation of air bubbles in the circuit.

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, <u>Frame torque settings</u>) and top up the reservoir fluid level.



Replace the cover (1) of the rear brake fluid reservoir (A).



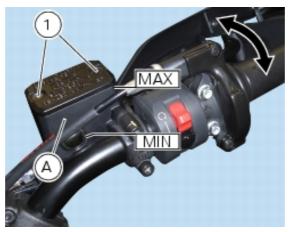
#### Draining the brake circuits



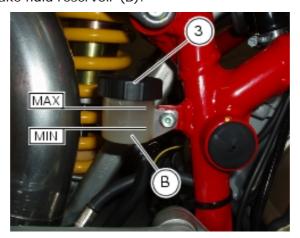
### Warning

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 (1) and remove the cover and membrane from the front brake fluid reservoir (A).



Unscrew the cover (3) of the rear brake fluid reservoir (B).

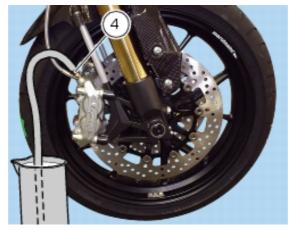


Connect a commercially available brake bleeder to the bleed valve (4) or (5).



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

Open the bleed valve (4) or (5) and pump with the bleeder until no more fluid emerges. If you do not have a bleeder available, attach a length of transparent plastic tubing to the bleed valve (4) 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.

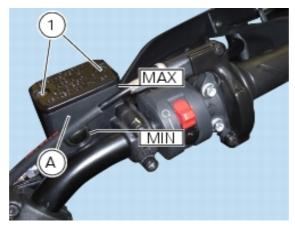
### Filling the brake circuits

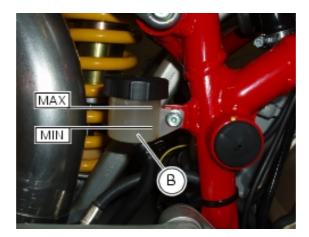


### ■ Warning

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 reservoirs (A) and (B) with the recommended fluid (Sect. C 2, <u>Fuel, lubricants and other fluids</u>) from a previously unopened container.







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 the caliper bleed valve (4) or (5).



Notes

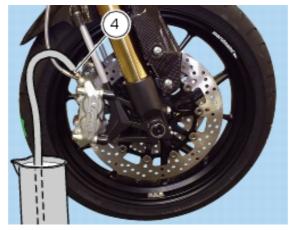
Follow the manufacturer's instructions when using a commercial brake bleeding tool.

Open the bleed valve (4) 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 emerging from the tube is completely free of air bubbles.

Tighten the bleed valve (4) or (5) to the specified torque (Sect. C 3, Frame torque settings).

If you do not have a brake bleeder available, connect a length of transparent plastic tubing to the bleed valve as outlined in the draining procedure.





Open the bleed valve (4) or (5) by a 1/4 turn and operate the brake lever (or pedal) several times until the fluid starts to emerge from the bleed valve.

Pull the lever or depress the pedal fully and loosen the bleed valve by at least a 1/4 turn.

Wait a few seconds, then release the lever or pedal gradually while simultaneously closing the bleed valve.



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 (4) or (5) to the specified torque (Sect. C 3, <u>Frame torque settings</u>). Replace the dust cap. Top up the fluid in the reservoir to the correct level and refit all removed parts.

#### Changing the clutch fluid



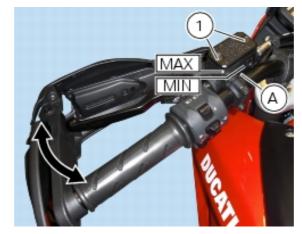
Clutch fluid will damage painted surfaces if spilled on them. In addition, it is very harmful in contact with the skin or with the eyes; in the event of accidental contact wash the affected area with abundant running water.

Undo the screws (1) and remove the cover 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.

Loosen the bleed valve (2) to allow fluid to escape.



Warning

While filling the circuit, keep the fluid level above the MIN mark at all times 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, <u>Frame torque settings</u>) 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.



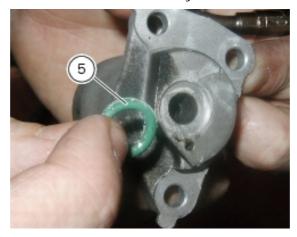
Unscrew the bleed valve by a 1/4 turn.
Undo the bolts (1) and remove the cover and membrane from the reservoir (A).
Operate the clutch lever until all the fluid has been expelled.

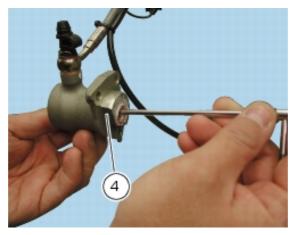


To help drain the circuit fully, unscrew the three retaining bolts (3) and remove the clutch slave cylinder from the engine.



Remove the clutch slave cylinder (4) taking care not to damage the internal O-ring (5). Push in the piston to force out all the fluid from inside the slave cylinder.





Refit the clutch slave cylinder and tighten the retaining bolts (3) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

Tighten the bleed valve to the specified torque (Sect. C 3, Frame torque settings). Replace the dust cap.

## Filling the clutch circuit



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, <u>Fuel, lubricants and other fluids</u>) from a previously unopened container.



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 several times 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 emerging from the plastic tube connected to the bleed valve (2) is 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 (2) 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 open 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).



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, <u>Frame torque settings</u>) and replace the dust cap.

Fill up to 3 mm above the MIN level mark on the reservoir.

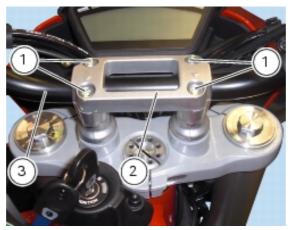
Replace the cap with the membrane and tighten down the screws (1).



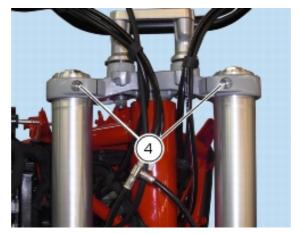
## Adjusting the steering head bearings

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.

Unscrew the four bolts (1), remove the single clamp (2) and withdraw the handlebar (3) from the top yoke, positioning it out of the way so it does not hinder subsequent operations.



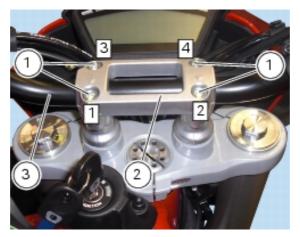
Slacken the clamp bolts (4) securing the top yoke to both fork legs.



Loosen the clamp bolt (5) that holds the steering tube to the top yoke.
Using service tool no. **88713.1058**, turn the nut (6) to the specified torque (Sect. C 3, Frame torque settings).



Tighten all previously loosened bolts to the specified torque (Sect. C 3, <u>Frame torque settings</u>). Reposition the handlebar, fit the clamp (2) and tighten the four clamp bolts (1) to the specified torque (Sect. C 3, <u>Frame torque settings</u>) in the sequence 1-2-3-4-1-2, as shown in the figure.



Turn the handlebar to full lock and check that the bearing play is correct.

Adjusting the clutch lever and front brake lever

The clutch lever (1) is fitted with a span adjuster (2) which serves to alter the distance of the lever from the handlebar.

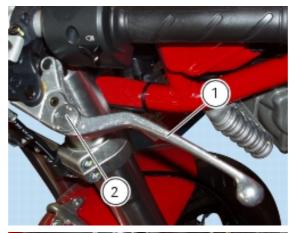
To adjust the span, hold the lever (1) fully forward away from the handlebar and turn the adjuster (2) to one of the four preset positions: position 1 corresponds to the maximum distance between lever and grip, while position 4 corresponds to the minimum distance.

The position of the front brake lever (3) can be adjusted in the same way.

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.



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

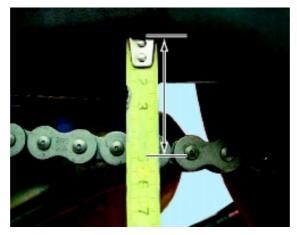




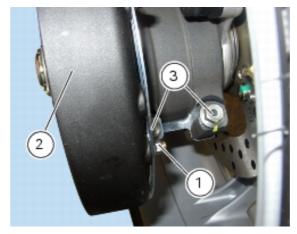
## Adjusting the chain tension

Slowly move the motorcycle to determine the position at which the chain is most taut.

Place the motorcycle on its sidestand and measure the freeplay on the bottom run of the chain in correspondence with the front end of the lower chain guard. Press down on the chain and release it, and check that the distance between the edge of the aluminium swingarm and the centre of the chain pin is **37** to **39** mm, as indicated on the label on the swingarm.



If not, adjust the chain tension as follows: loosen the nuts (1) that secure the chain guard (2) to the support bracket in order to access and loosen the bolts (3) securing the rear hub to the swingarm.

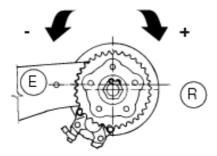


Apply an extension bar to the wrench supplied and insert the tooth of the wrench in the eccentric hub. Rotate the eccentric hub to obtain the correct chain tension. Rotate the hub clockwise to tighten the chain or anticlockwise to slacken it (as viewed from chain side of the bike).



Important

During this operation make sure that the axis of the wheel axle (R) remains at all times below the axis of the eccentric hub (E).



Lubricate the undersides of the heads and the threads of the bolts (3) with the recommended grease, then gradually tighten them to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>) in the sequence 1-2-1.

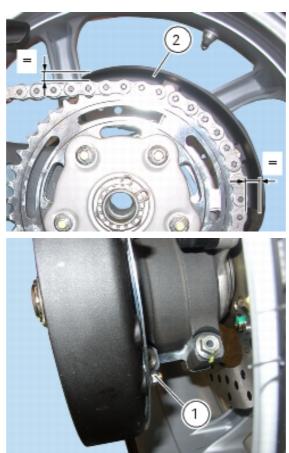




For the safety of the rider and passenger, it is essential that the eccentric hub bolts are correctly tightened.

After adjusting the chain tension, reposition the chain guard (2) making sure that its outer edges are equidistant from the chain.

Tighten the nuts (1) to the specified torque (Sect. C 3, <u>Frame torque settings</u>) and refit the rear wheel (Sect. G 4, <u>Refitting the rear wheel</u>).



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.

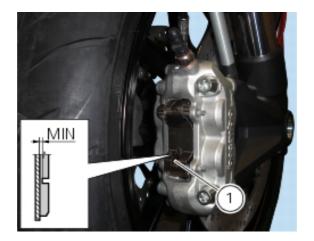


## **Important**

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

Check that the wear indicator groove in the friction material of the pads (1) is visible.





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

Change the brake pads as follows.

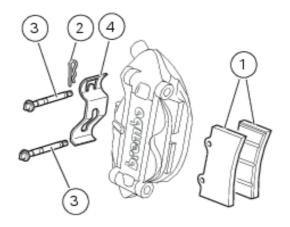
Remove the cotter pin (2) from the pad retaining pins.

Withdraw the pad retaining pins (3) from the outside.

Remove the clip (4) 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 (1) from the calipers.



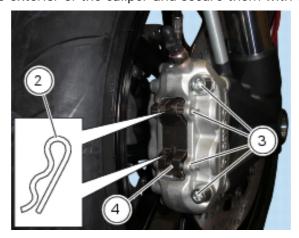


Change pads that have a shiny or "vitrified" appearance.

Refit the pads as follows.

Insert the new pads and clip (4).

Insert the retaining pins (3) from the exterior of the caliper and secure them with the cotter pins (2).

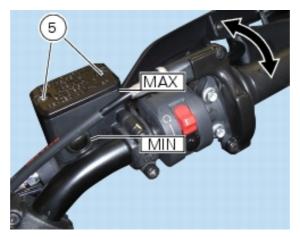


Operate the brake lever repeatedly so that the pads are firmly bedded in against the disc by the force of the brake fluid.

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 bolts (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

Remove the bolts (1) and remove the front brake calipers from the forks. Check that the wear indicator groove (A) in the friction material of the pads (4) is visible.



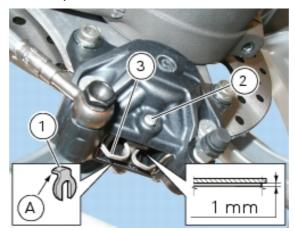
**Important** 

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 (1) (on the inner side of the caliper) from the pad retaining pin (2). Withdraw the pad retaining pin (2) towards the outside.

Remove the clip (3) from between the two caliper halves.



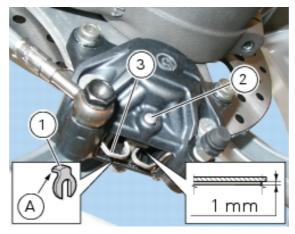
Force the caliper pistons back into their bores by forcing the brake pads apart. Remove the worn pads.



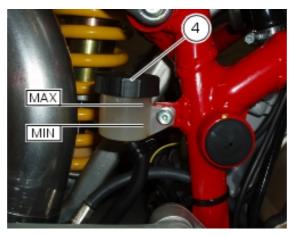
Notas

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

Insert the new pads and clip (3). Fit the retaining pin (2) from the outer side and secure it with the cotter pin (1), positioning the lip (A) so that it faces the wheel.



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.





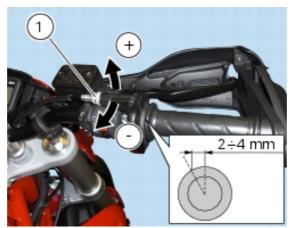
If it proves difficult to change the brake pads, first remove the caliper from the motorcycle (Sect. G 4, Removal of the rear wheel).



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

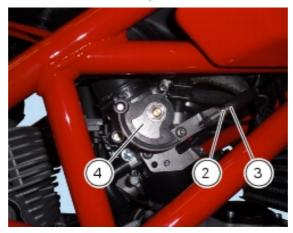
## Adjusting the throttle cables

The throttle cable should have freeplay of **2** to **4** mm (measured in terms of rotation of the twistgrip) in all steering positions.



For larger adjustments of the throttle cable, use the adjuster (2) located on the right-hand side of the throttle body. Remove the cap, loosen the lock nut (3) and turn the adjuster (2) to obtain the required free travel. Tighten the lock nut and replace the cap.

Adjust travel of the cold start control cable by turning the control lever on the handlebar to its maximum position and checking that plate (4) is located against the travel limit stop.

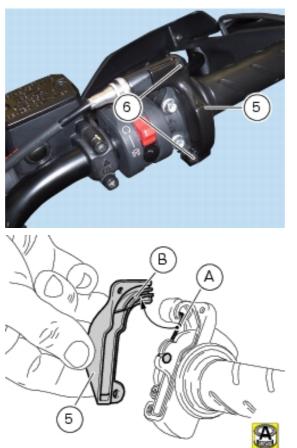


The condition of the outer throttle cables should be checked at regular intervals. The outer cables should show no signs of kinking or cracking.

Lubricate the ends of the throttle control cables with the prescribed grease periodically to ensure they run freely. Operate the control to check that the inner cable slides smoothly inside the outer cable: if you feel excessive resistance or stiffness, renew the cable.

To lubricate throttle cable, undo the two bolts (6) and remove the upper half of the twistgrip housing (5). Grease the end (A) of the cable and the race.

Replace the upper half of the twistgrip housing (5) very carefully, with the throttle cable correctly seated in slide (B). Tighten the bolts (6).



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.

#### Gearchange pedal

To adjust the position of the gearchange pedal, proceed as follows.

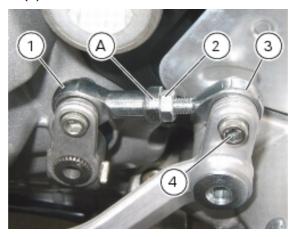
Use an open ended spanner to hold the rod (1) on flat (A) and slacken off lock nut (2).

Turn the screw (4) to detach the rod (3) from the gear change lever.

Turn the rod (3) to move the gear change pedal to the position.

Tighten the bolt (4) to secure the gear change lever to the rod (3).

Tighten the lock nut (2) against the rod (1).



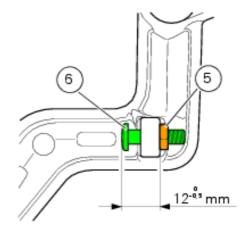
#### Rear brake pedal

Loosen the locknut (5).

Turn the pedal travel adjustment bolt (6) until the pedal is in the desired position: the standard position is shown in the above drawing.

Tighten the locknut (5) to the specified torque (Sect. C 3, Frame torque settings).

Operate the pedal by hand and check that there is approximately **1.5** to **2** mm of free travel before the brake begins to operate.

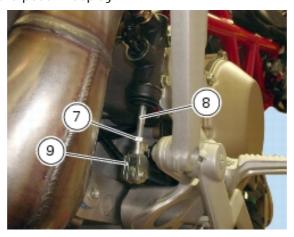


If not, adjust the length of the master cylinder pushrod as follows.

Slacken off the locknut (7) on the pushrod.

Screw the pushrod (8) into the clevis (9) to increase the freeplay, or screw it out to reduce it.

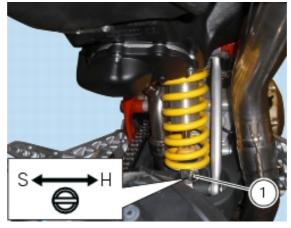
Tighten the locknut (7) and recheck the pedal freeplay.



## Adjusting the rear shock absorber

The shock absorber has external adjusters that enable you to adjust the suspension to suit the load on the motorcycle. The adjuster (1) located on the right-hand side, where the lower end of the shock absorber is attached to the swingarm, controls rebound damping.

Turn the adjuster (1) clockwise to stiffen the damping **H** and anti-clockwise to soften it **S**.



Adjuster nuts (2) and (3), located at the top end of the shock absorber, serve to adjust the preload of the outer spring. To adjust the spring preload, unscrew the upper adjuster nut (3) using a pin wrench. Screw the adjuster nut (3) in or out to respectively increase or reduce the pre-load.



STANDARD setting from the fully closed position (clockwise):

- unscrew the adjuster (1) by 12±2 clicks (rebound adjustment);
- spring preload: 23 mm.

# **A** Warning

To turn the preload adjuster nuts, use only a specific tool and take care, otherwise the wrench pins may slip off the nut. This could injure your hands. Never use a wrench with a too small pin or with a too short handle. Standard length of the preloaded spring on the shock absorber with the rear wheel raised off the ground: **166**  $\pm$  **1.5** mm.





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

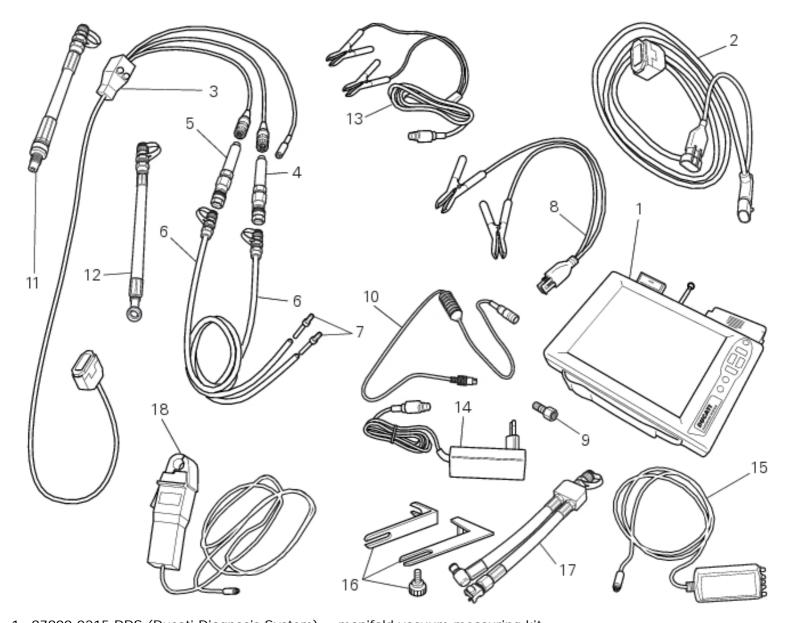


If the motorcycle is to be ridden with a pillion rider and luggage, we recommend setting the rear shock absorber spring preload to the maximum to ensure the best handling and proper ground clearance at all times. It may also be

Maintenance operations

necessary to adjust the rebound damping accordingly.

## 5 - Diagnostic instruments



- 1 97900.0215 DDS (Ducati Diagnosis System) + manifold vacuum measuring kit
- 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



DDS tester
Workshop service tools



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

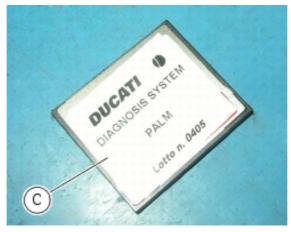
## Description of the Ducati Diagnostic System instrument

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) and a display memory card (C).







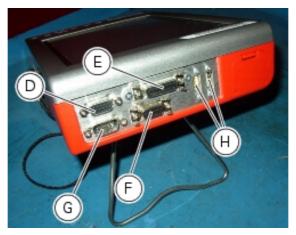
The touch-screen display unit (A) serves for both data display and input, using the stylus housed on the side of the unit

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 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:

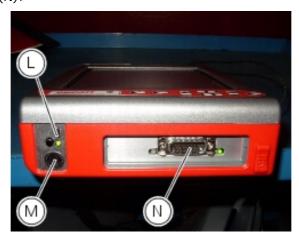
- one VGA output (D);
- one port for connection of the measurement module (E);

- one RS232 serial port for connection of peripheral devices (COM1) (F);
- a second RS232 serial port for connection of peripheral devices (COM2) (G);
- two generic USB ports (USB1 and USB2) (H).



The bottom connection panel has 3 connection sockets with the following functions:

- one USB port (L);
- one power connection socket (M);
- one diagnostics connection socket (N).



You can connect a printer to the DDS tester (1) to print test reports: connect the printer to the serial port (COM1) (F) 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

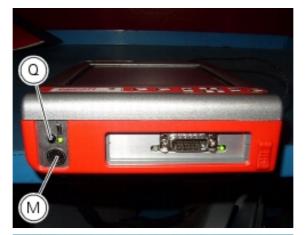
Belt tension sensor.

#### 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 (M); from the motorcycle: by connecting the specific cables (see paragraph "Connection to motorcycle");
- from the tester's internal battery: the battery (P) 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 (Q).



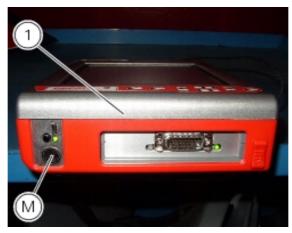




When using the tester, take care never to allow the power supply to fall below the minimum voltage: this situation could occur during engine starting and idling on motorcycles in which the battery is not in perfect working order. If the tester detects a power supply voltage of less than **9** Volts, 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:

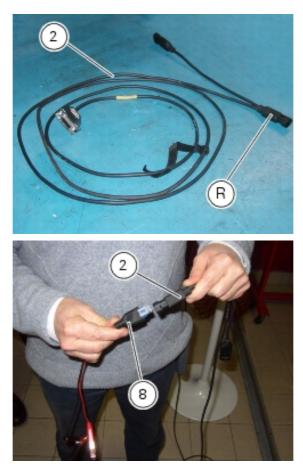
connect the battery power adapter (13) to the power connection socket (M) on the tester and to the motorcycle
battery;





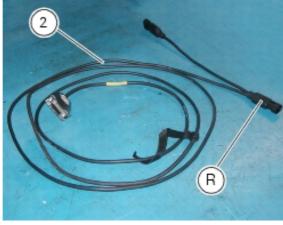
connect the power and diagnostic cable (2) to the diagnostic connection socket (N) on the tester; then connect the -battery socket adapter (8) to the connection socket (R) on the power and diagnostics cable (2) and to the motorcycle battery;





connect the power and diagnostic cable (2) to the diagnostic connection socket (N) on the tester; then connect the motorcycle power socket (S) to the connection socket (R) of the power and diagnostic cable (2).







#### 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.). From this function it is also possible to adjust the CO software and to enter the safety 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



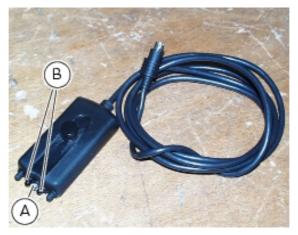
#### Notes

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.



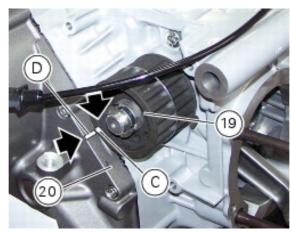
Operation	Section reference
Remove the right-hand side fairing	E 2, Removal of the side fairings
Remove the seat and the side panels	E 3, Removal of the seat/Removal of
	the rear side panels

Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
ı	N 4.2, Removal of the timing belt covers

Remove the spark plugs.

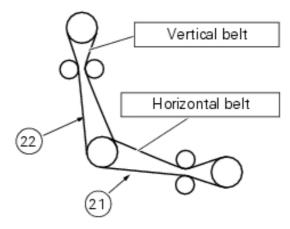
Position the crankshaft so that the piston of the horizontal cylinder is at TDC of its power stroke.

This is achieved by aligning the timing mark (C) on the driveshaft pulley (19) with reference mark (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 (22) 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 fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the seat and rear side panels	E 3, Refitting the seat/Refitting the rear side panels
Refit the right-hand side fairing	E 2, Removal of the side fairings

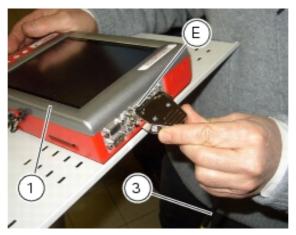
Measuring timing belt tension

Switch on the DDS tester (1); see paragraph entitled "Tester power supply".

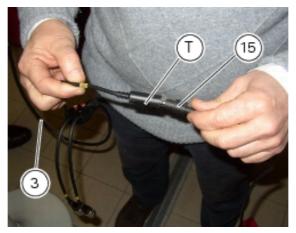
Connect the power and diagnostics cable (Measurement Module) (3) to the measurement module connector (E) on

Diagnostic instruments

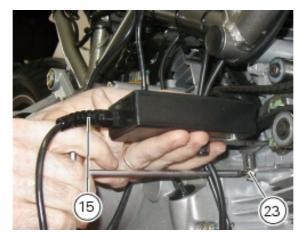
the DDS tester (1).



Connect the belt tension sensor (15) to the connector (T) 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 (23). 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 **1-1.5** 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.

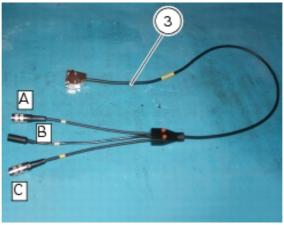




The socket to which the cable (Measurement Module) (3) is to be connected is indicated on the screen with a capital letter: A, B or C.

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







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, <u>Timing system/valves</u> 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, <u>Timing system/valves</u>).

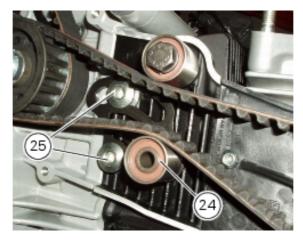
If the tension value is incorrect, tighten or slacken the belt by loosening the bolts (25) and moving the tensioner pulleys.

Manually raise the tensioner pulley (24) to increase belt tension or lower it to reduce belt tension.

Re-check the timing belt tension.

Repeat the above procedure until the correct belt tension is obtained.

Once the correct belt tension value has been obtained, tighten the bolts (25) to the specified torque (Sect. C 3, Engine torque settings).



## Self-learning throttle position sensor (TPS)

The linear throttle position sensor is mounted on the throttle body and cannot be adjusted. It is therefore necessary to teach the ECU the angle corresponding to the zero position of the position sensor itself, as follows.



#### Warning

This procedure must precede the first startup of the vehicle after replacement of the throttle body, potentiometer or ECU.

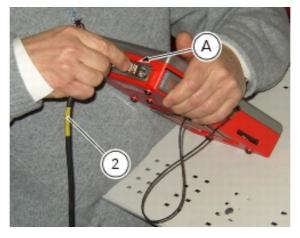
Remove the seat (Sect. E 3, Removal of the seat).

Make sure the throttle butterfly valves are seated against the stop screws (throttle twistgrip released).

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.

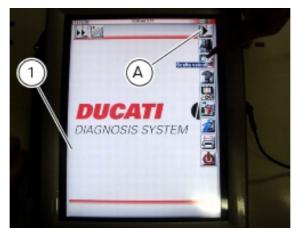
Switch on the DDS tester (1); see paragraph entitled "Tester power supply".

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



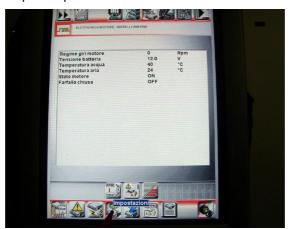


The DDS tester will interrogate the electronic control unit and display the parameters analysed with their relative values.

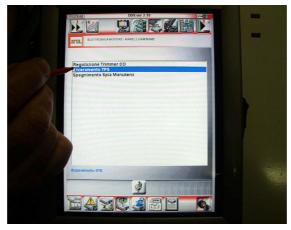


Make all connections with the motorcycle ignition key in the OFF position.

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" (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)).



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

Refit the seat (Sect. E 3, Refitting the seat).

## Adjusting the idle speed

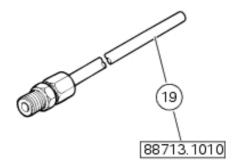


#### Notas

Check that the motorcycle is fitted with a genuine Ducati ECU, intake system and exhaust system; if not, fit genuine components.

#### Procedure

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



Connect the DDS and select HYPERMOTARD 796.

Make sure that the butterfly valve pulley is seated against the stop screw when the throttle twistgrip is fully closed. Make sure that the throttle cable freeplay is correctly adjusted.

#### Check:

- that the throttle angle values read by the DDS with the engine stopped is 0°.

Start the engine and wait for the engine temperature to reach 100 °C.

When the engine temperature reading reaches 100 °C, carry out the adjustment operations described below. The idle speed must be between  $1250\pm1350$  rpm  $(1300\pm50)$ :

if the idle speed is lower or higher than the specified range, open or close the bypass screws (20) of both cylinders

- by a 1/4 turn, and, once the correct idle speed has been obtained, check that the CO level in both cylinders is between 0.4% and 1.4%.





If the idle speed adjustment procedure is unsuccessful, proceed as follows:

- Overhaul the cylinders (clearances, timing, valve seats, etc.).
- Repeat the entire idle speed adjustment procedure.
- Check the vacuum pressures downstream of the butterfly valve (carry out this check only after completing the steps described above).



#### Warning

If the engine is shut off before proceeding with adjustment of the CO level, wait three minutes after restarting for the enrichment phase to finish and for the lambda sensors to start working.

If the idle speed is high and cannot be corrected by adjusting the air bypass screws, check the seals under the throttle body, in particular check for cracks or other damage in the intake manifolds and the latter are firmly secured to the engine, cuts in the pressure sensor pipes, etc.



#### Warning

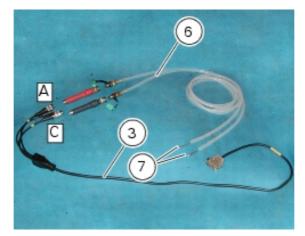
Idle speed adjustment takes priority over balancing the vacuum pressures downstream of the butterfly valve. Differences in pressure between the horizontal and vertical cylinder are therefore acceptable, provided that the idle speed is adjusted correctly.

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

#### Throttle body balancing

Connect the Measurement Module cable (3) to the Measurement Module connector on the DDS tester as described in the 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 "<u>Tester power supply</u>". 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 bolts (21) on the intake manifolds and install the fittings (7) in place of the bolts.



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

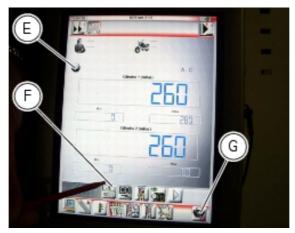


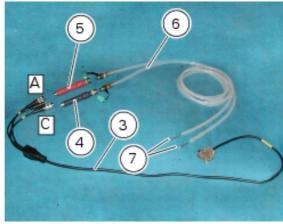
A Warning

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).

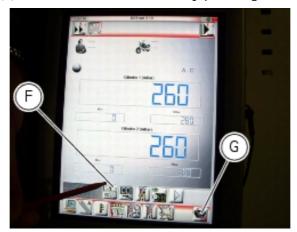
Press the "Start" icon to begin the cylinder pressure measurement procedure.

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).



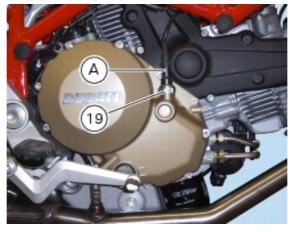
To adjust the balance (within the tolerance range of 260 mbar to 270 mbar), turn the bypass screws (20) until the two lines on the graph coincide, if in graphic mode, or until identical numerical values are displayed, if in numerical mode.

Correct balance is obtained when the two lines of the graph are very close together or when the two values are within the specified tolerance range.



## Checking the engine oil pressure

To measure the pressure of the lubrication circuit, use the engine oil pressure test point (19) as described below. Disconnect the wiring connector (A) and remove the pressure switch (19), taking care to recover the seal.

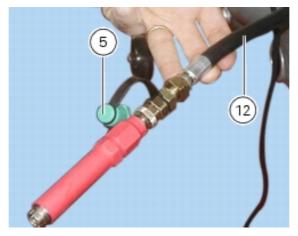


Insert the fitting (9) into the connection on the hose (12), interposing the two copper sealing washers (20). Insert the fitting (9) of the pipe (12) in the threaded hole (M10x1 mm) of the right crankcase cover and screw it fully home. Refit the pressure switch (19) on the fitting (9) along with its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



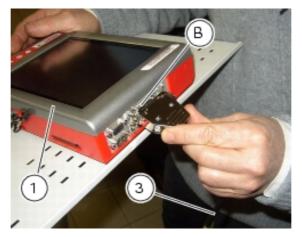


Connect the pressure sensor (5) to the pipe (12) to transform the pressure signal into an electrical signal.

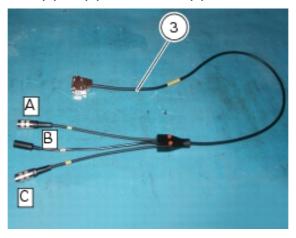


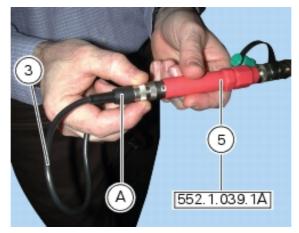
Switch on the DDS tester (1); see paragraph entitled "Tester power supply".

Connect the power and diagnostics cable (Measurement Module) (3) to the measurement module connector (B) on the DDS tester (1).

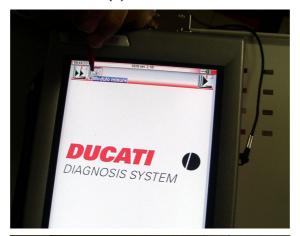


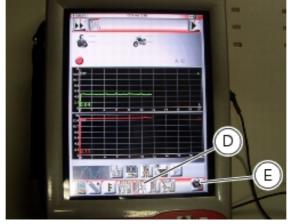
Connect the pressure sensor (5) to socket (A) or (C) of the cable (3).



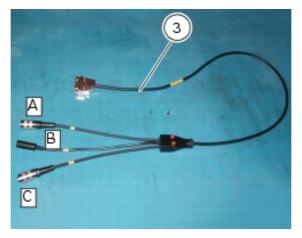


On the DDS tester (1), select the "Measurement module" function by pressing the corresponding icon; then press the "Pressure Test" icon (D) followed by the "Start" icon (E).





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: in one numeric form and in two graphic forms; to select the desired display type, press the "Value display" icon.

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 value measured will 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.



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, <a href="Engine torque settings">Engine torque settings</a>).

Reconnect the electrical system connector (A) to the pressure switch.



Disconnect the DDS tester.

### 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.

To test the cylinder compression you require a suitable compression gauge with a threaded adapter for the sparkplug hole.

Warm up the engine by allowing it to run for at least ten minutes.

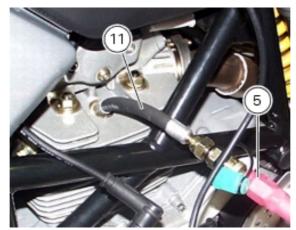
Open the throttles completely.

Pull the caps (F) off the spark plugs.

Remove the spark plugs.



Screw the cylinder compression fitting (11) into the spark plug bore. Connect the pressure sensor (5) to the cable (11).

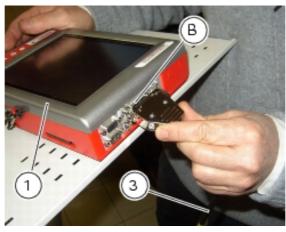


Switch on the DDS tester (1); see paragraph entitled "<u>Tester power supply</u>".

Connect the power and diagnostics cable (Measurement Module) (3) to the measurement module connector (B) on

Diagnostic instruments

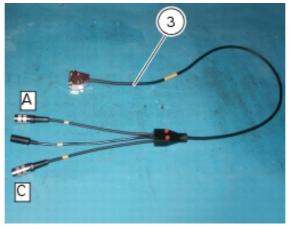
the DDS tester (1).



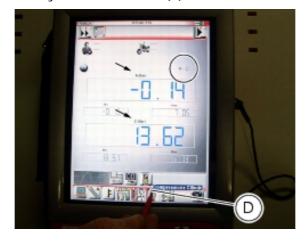
Connect the pressure sensor (5) to socket (A) or (C) of the cable (3).



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:
- 11 to 12 bar;
- minimum value:
- **10** 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.

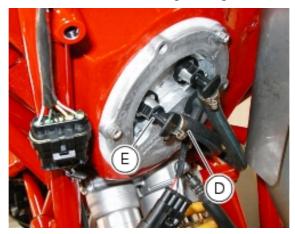
Refit the spark plugs and reconnect the HT leads (F)



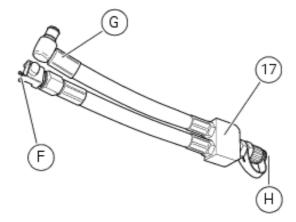


The on-screen icons used during this procedure are explained in a table at the end of this section.

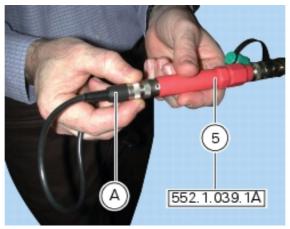
To test the fuel pressure, use the fuel pressure test pipe (17). Remove the fuel tank outlet pipe (D) on the left side of the flange along with the fitting (E).



Fit the fuel pressure test pipe (17), connecting one end (F) to the flange and the other (G) to the fitting (E): in this way, the fuel pressure can be measured at the test outlet (H).

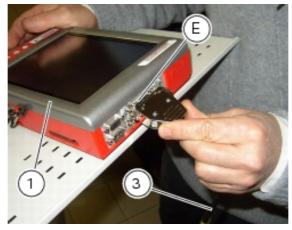


Connect the pressure sensor (5) to the test outlet (H) of pipe (17) to transform the pressure signal into an electrical signal.

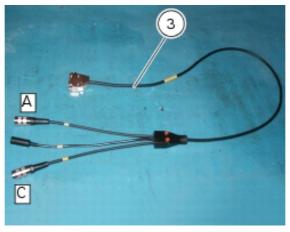


Switch on the DDS tester (1); see paragraph entitled "Tester power supply".

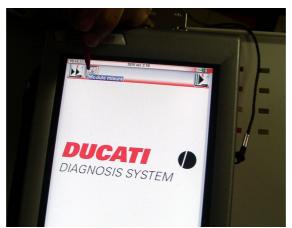
Connect the power and diagnostics cable (Measurement Module) (3) to the measurement module connector (E) on the DDS tester (1).



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 (L) followed by the "Start" icon (M).





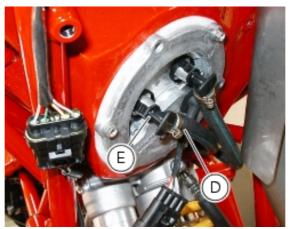
The socket to which the cable (Measurement Module) (3) is to be connected is indicated on the screen with a capital letter: A, B or C.

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 (N).



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 value measured will 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, refit the fuel tank outlet pipe (D) securing it with the clamp (E).



### Immobilizer override procedure



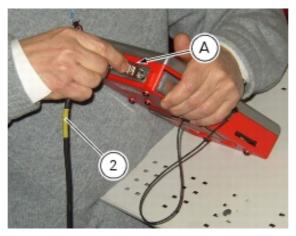
The on-screen icons used during this procedure are explained in a table at the end of this section.

In the event of a malfunction of the immobilizer system, it is possible to start the engine using the emergency procedure this procedure, which is described in full in Section P 7, <a href="Immobilizer override procedure">Immobilizer override procedure</a>, requires a secret code which may be entered using the DDS tester.

Remove the seat (Sect. E 3, Removal of the seat).

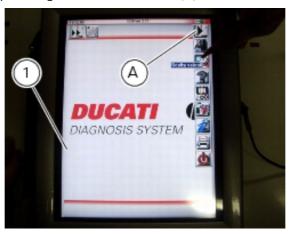
Switch on the DDS tester (1); see paragraph entitled "Tester power supply".

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" (A).

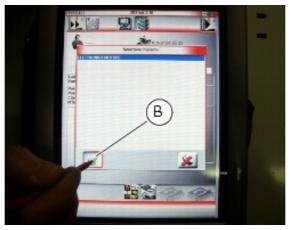


Press the "Select vehicle" icon and, on the next screen, press the "Select motorcycle" icon; select the motorcycle model and confirm, then select the version and confirm.





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.



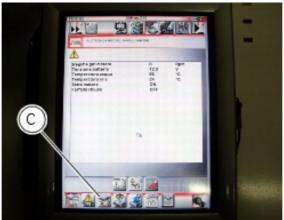


The DDS tester will interrogate the electronic control unit and display the parameters analysed with their relative values.

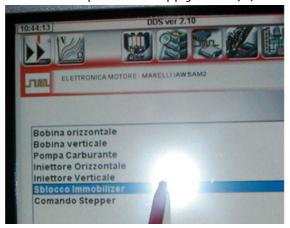


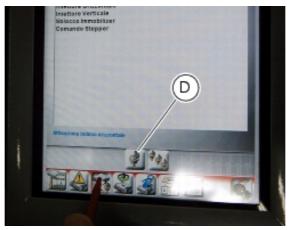
Make all connections with the motorcycle ignition key in the OFF position.

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



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



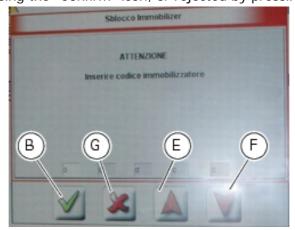


A screen will appear in which you can enter the 5 digit secret code. Use the red arrows (E) and (F) to enter each digit: after entering each digit, press the "Confirm" icon (B).

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.

Refit the seat (Sect. E 3, Refitting the seat).

#### Guided diagnosis



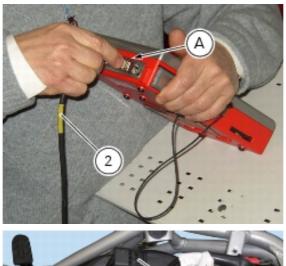
The on-screen icons used during this procedure are explained in a table at the end of this section.

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.

Remove the seat (Sect. E 3, Removal of the seat).

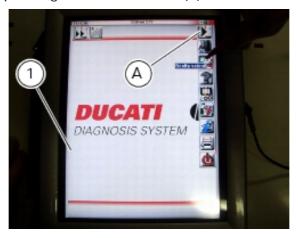
Switch on the DDS tester (1); see paragraph entitled "Tester power supply".

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" (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.





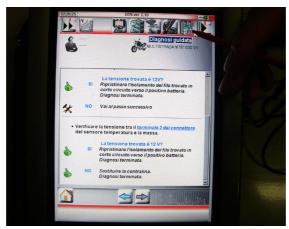
Press the icon "Select system" to display a list of the bike's systems that can be analysed. Select "Engine electronics" and press the "Confirm" icon (B).



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



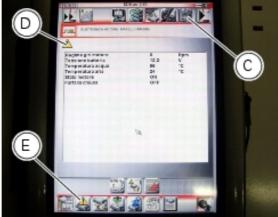
A series of screens are displayed indicating the operations required for correct diagnosis.



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" icon (C).





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

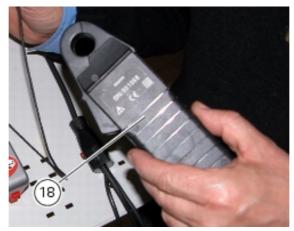
Testing the battery charging system



Notes

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

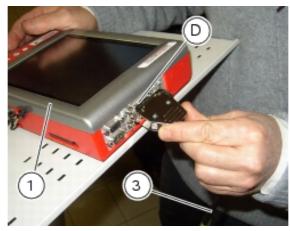
You can determine the engine rpm required for the alternator to produce sufficient current to charge the battery, power the injection/ignition system and all the electrical equipment on the motorcycle. When applied to a cable, the ammeter clamp (18) detects the magnetic field generated by the current passing through that cable.



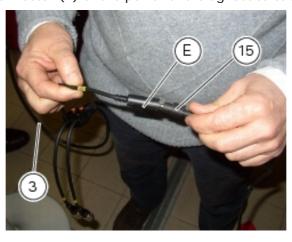
Remove the seat (Sect. E 3, Removal of the seat).

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 (D) on the DDS tester (1).



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





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 (+).

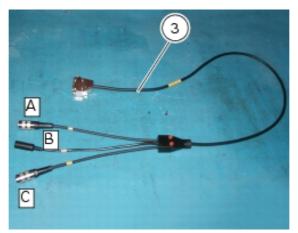


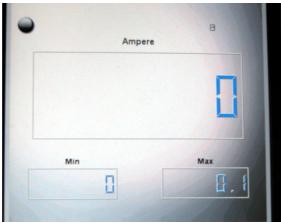
On the DDS tester (1), select the "Measurement module" function by pressing the corresponding icon; then press the "Ammeter" icon (F) followed by the "Start" icon.





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.



Refit the seat (Sect. E 3, Refitting the seat).

Deactivating the "service" indication on the instrument panel

The instrument panel multifunction display features a wrench symbol that signals the need for servicing in accordance with the programmed maintenance routine.

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



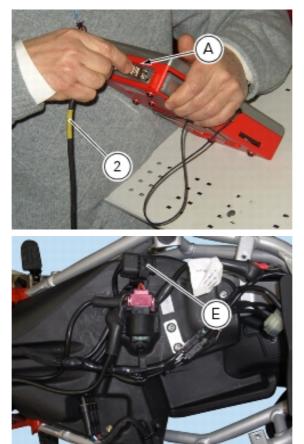
Notes

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

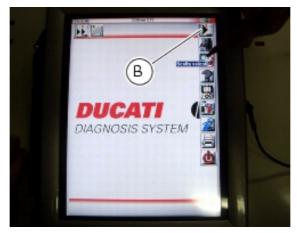
Remove the seat (Sect. E 3, Removal of the seat).

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 icon "Menu 1" (B).

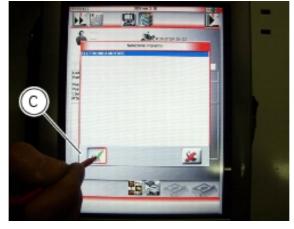


Press the "Select vehicle" icon and, on the next screen, press the "Select motorcycle" icon; select the motorcycle model and confirm, then select the version and confirm by pressing the "Select vehicle system" icon.





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.

Refit the seat (Sect. E 3, Refitting the seat).

### Icons table

Sumbol	Description
$\overline{\mathbf{V}}$	Confirm
	Exit
V Q	Measurement module
	Belt tension
	Start/Stop
	Menu 1
	Select vehicle
	Select motorcycle
	Self-diagnosis
	Settings
	Apply
	Cylinder synchronisation
RSCI23	Value display
	Reset
	Pressure test
	Cylinder compression

### Diagnostic instruments

	Actuators
	Guided diagnosis
	Select system
	Errors
A	Ammeter clamp

# OE - Impianto elettrico

## 1 - Headlight fairing - hand guards - rear-view mirrors 3

Removal of the hand guards - rearview mirrors 4

Refitting the hand guards - rearview mirrors 5

Removal of the headlight fairing 7

Refitting the headlight fairing 9

## 2 - Fairings 10

Removal of the side fairings 11

Refitting the side fairings 14

## 3 - Seat - side panels 15

Removal of the seat 16

Refitting the seat 16

Removal of the rear side panels 18

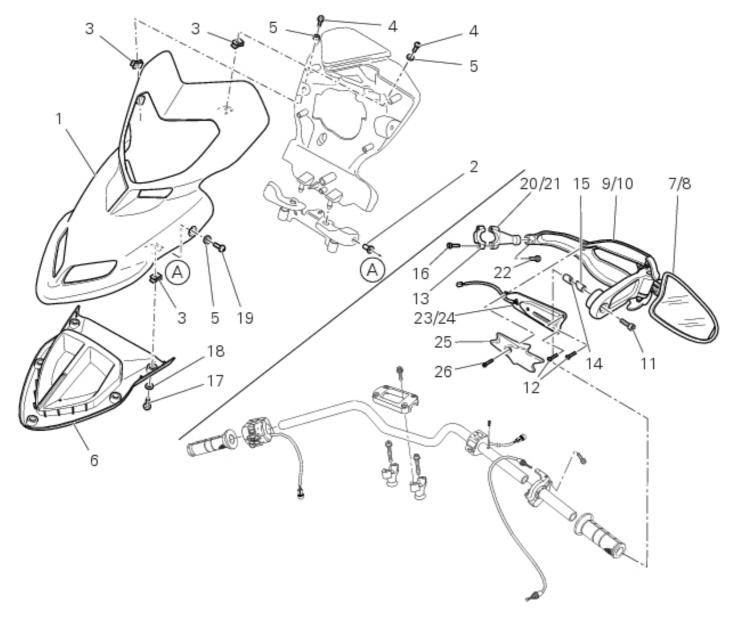
Refitting the rear side panels 19

## 4 - Front mudguard 20

Removal of the front mudguard 21

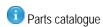
Refitting the front mudguard 22

## 1 - Headlight fairing - hand guards - rear-view mirrors



- I Headlight fairing
- 2 Spacer
- 3 Clip
- 4 Bolt
- 5 Washer
- 6 Lower support7 RH mirror
- 8 LH mirror
- 9 RH hand guard
- 10 LH hand guard
- 11 Bolt
- 12 Bolt
- 13 Upper clamp
- 14 Bush
- 15 Bush
- 16 Bolt
- 17 Bolt
- 18 Washer
- 19 Bolt
- 20 RH mirror support
- 21 LH mirror support
- 22 Bolt
- 23 Right turn signal
- 24 Left turn signal

25 Cover 26 Bolt



# HANDLEBARS AND CONTROLS

Headlight fairing

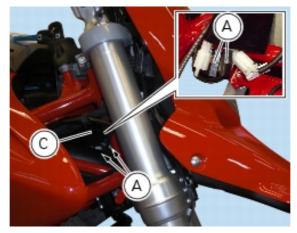


Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

Removal of the hand guards - rearview mirrors

Lift the rubber cover (C).

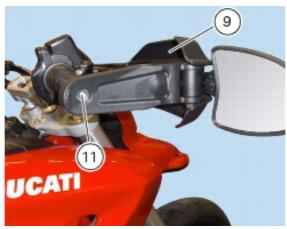
Disconnect the turn signal wiring connectors (A) from the main wiring loom.



Unscrew the bolts (16) and remove the clamps (13).



Loosen the bolts (11) and slide the hand guard-mirror assemblies (9) and (10) off the handlebars.





To disassemble the hand guard-mirror-turn signal assembly, refer to the exploded view at the beginning of this section.

Refitting the hand guards - rearview mirrors

If the hand guard-mirror-turn signal assembly has been disassembled, proceed with reassembly, fitting the right turn signal (23) to the hand guard (9), routing the wiring (A) behind clip (B) and fitting bolts (12). Tighten the bolts to the specified torque (Sect. C 3, Frame torque settings).



#### Notes

The right turn signal can be identified by the word "RIGHT" and its correct position is shown by the word "TOP".

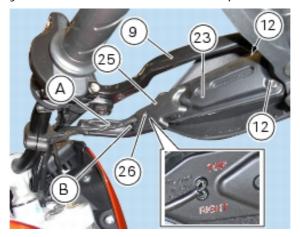
Locate the cover (25), fit the cover retaining bolts (26) and tighten to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

Proceed in the same way for the left-hand side.

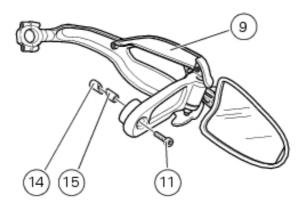


#### Notes

The left turn signal can be identified by the word "LEFT" and its correct position is shown by the word "TOP".



Insert the bolt (11) in the hand guard-mirror assembly (9) with bush (14) and bush (15).



Locate the hand guard-mirror assemblies (9) and (10) on the handlebar and tighten the bolts (11).

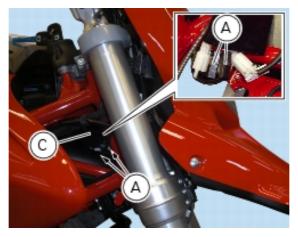




Refit the clamp (13) on the handlebar and tighten the bolts (16) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).



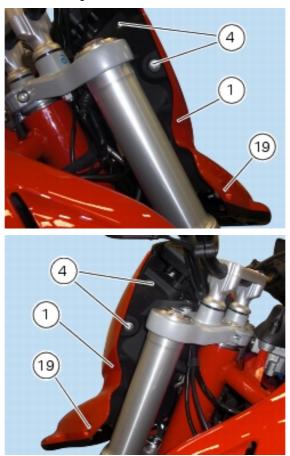
Reconnect the turn signal wiring connectors (A) to the main wiring loom. Replace the rubber cover (C).



Unscrew and remove the bolts (4) securing the bottom of headlight fairing (1) to the headlight support and recover the washers (5).

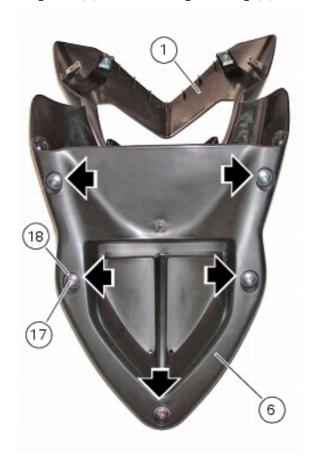
Unscrew and remove the bolts (19) securing the headlight fairing (1) to the lower headlight bracket and recover the washers (5).

Remove the headlight fairing (1) from the motorcycle.



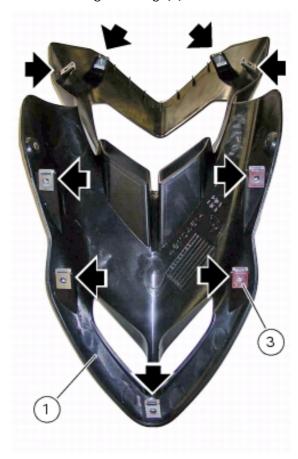
Disassembly of the headlight fairing

Unscrew the bolts (17) securing the mudguard (6) to the headlight fairing (1) and recover the washers (18).



Reassembly of the headlight fairing

Make sure that the clips (3) are fitted to the headlight fairing (1).

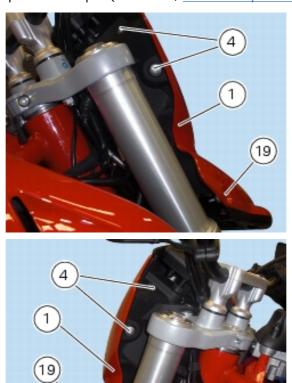


Insert the bolts (17) complete with the washers (18) in the mudguard (6). Fit the mudguard (6) to the headlight shell (1) and tighten the bolts (17) to the specified torque (Sect. C 3, <a href="Frame">Frame</a> torque settings).

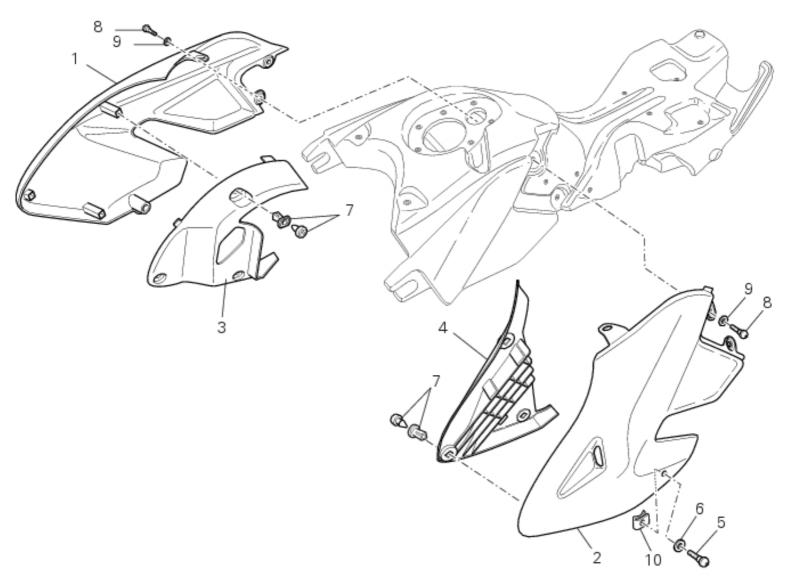


### Refitting the headlight fairing

Locate the headlight fairing (1) on the headlight support; fit the bolts (4) and (19) with their respective washers (5). Tighten the bolts (4) and (19) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



# 2 - Fairings



- 1 RH side fairing
- 2 LH side fairing
- 3 RH panel
- 4 LH panel
- 5 Bolt
- 6 Washer
- 7 Quick-release fastener
- 8 Bolt
- 9 Washer
- 10 Quick-release fastener



### **Fairing**



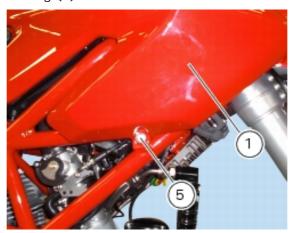
Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

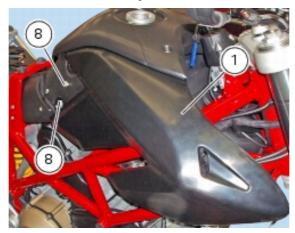
Removal of the side fairings

Operation	Section reference
Remove the seat	E 3, Removal of the seat

Unscrew the bolt (5) securing RH side fairing (1) to the frame and recover the washer (6).



Unscrew the bolts (8) securing RH side fairing (1) to the fuel tank and recover the washers (9). Remove the RH side fairing assembly (1) from the motorcycle.

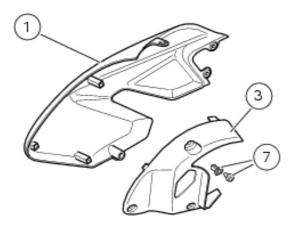




Repeat the above steps to refit the LH side fairing (2).

Disassembly of the fairing

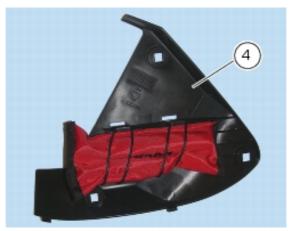
Unscrew the quick-release fasteners (7) and remove the RH panel (3).



Repeat the above steps to disassemble the LH side fairing (2).



Removal of the LH panel (4) gives access to the document compartment.



### Reassembly of the fairing

To reassemble the fairing, carry out the steps of the disassembly procedure in reverse order; in particular, prepare the quick-release fasteners (7) by putting them in the "open" position, as shown in the photos. Locate the inner panel (3) on the RH fairing (1). Insert the "open" fasteners in their corresponding locations on the panel. Secure the inner panel by closing the quick-release fasteners as shown in the photo.

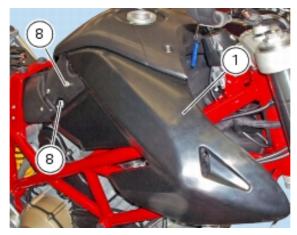


### Refitting the side fairings

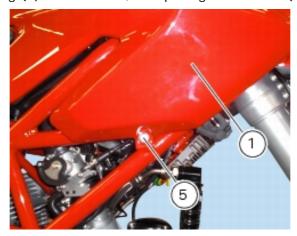


If parts that have been removed are not refitted correctly, they may become loose suddenly while riding and cause you to lose control of your motorcycle.

Fit the bolts (8) securing RH side fairing (1) to the fuel tank, interposing the washers (9).



Fit the bolt (5) securing RH side fairing (1) to the frame, interposing the washer (6).

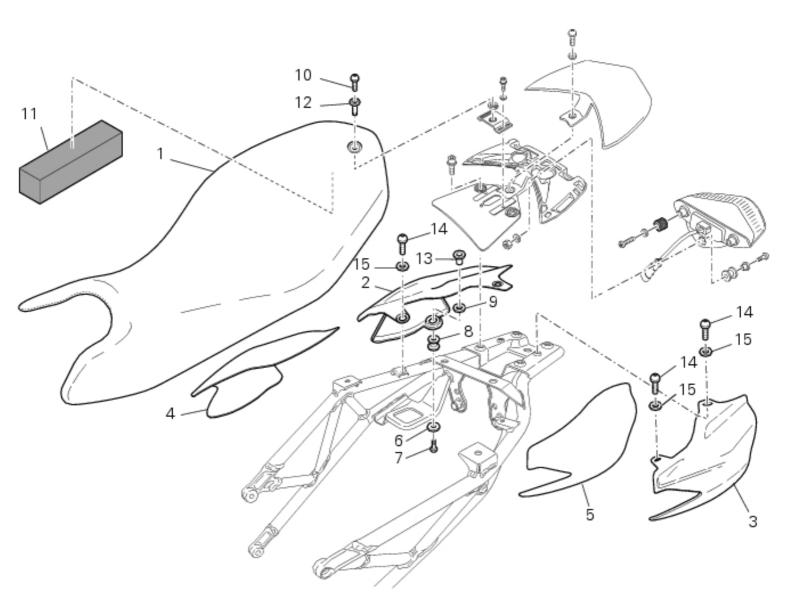


Tighten all the fairing bolts to the specified torque (Sect. C 3, <u>Frame torque settings</u>). Repeat the above steps to refit the LH side fairing (2).



Operation	Section reference
Refit the seat	E 3, Refitting the seat

# 3 - Seat - side panels



- 1 Seat
- 2 RH side panel
- 3 LH side panel
- 4 RH heat shield
- 5 LH heat shield
- 6 Washer
- 7 Bolt
- 8 Rubber
- 9 Washer
- 10 Bolt
- 11 Rubber mounting
- 12 Spacer
- 13 Spacer
- 14 Bolt
- 15 Washer



SEAT - Tail light

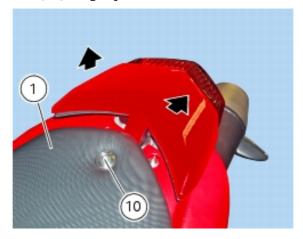


Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be

found in the exploded view diagram.

### Removal of the seat

To remove the seat (1), unscrew the bolt (10), slightly raise the rear of the seat and pull backwards.



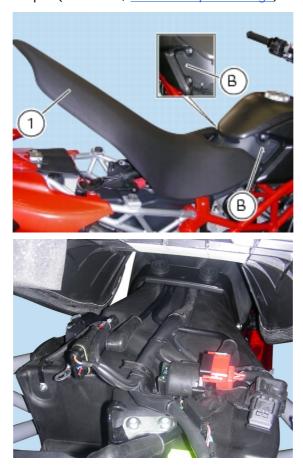
### Refitting the seat

To fit the seat (1), fully engage the slots (A) on the pins (B) of the fuel tank. Secure the seat with the bolt (10).



When refitting the seat, make sure that the wiring is held securely in the correct locations on the fuel tank to avoid the risk of wires being pinched.

Tighten the bolt (10) to the specified torque (Sect. C 3, Frame torque settings).

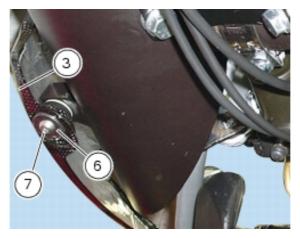


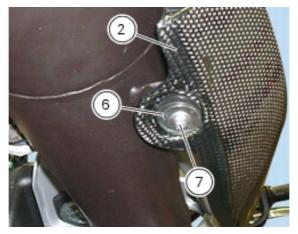


### Removal of the rear side panels

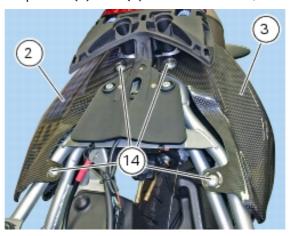
Remove the pillion seat, as described in the paragraph "Removal of the seat".

Unscrew the bolts (7) securing the side panels (2) and (3) to the silencer, and recover the washers (6) and (9) and spacer (13).





Unscrew the bolts (14) securing the side panels (2) and (3) to the subframe, and recover the washers (15).



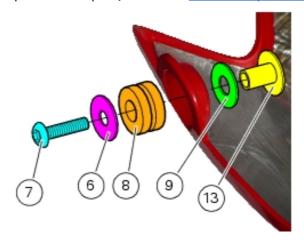
### Refitting the rear side panels

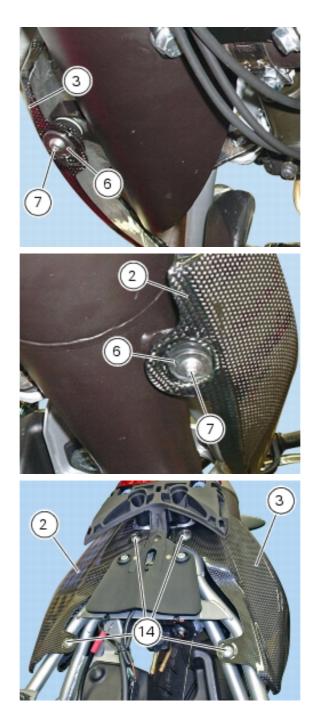
Refit the side panels following the steps of the removal procedure in reverse order.

In particular, check that the rubber dampers (8) are installed on the side panels; fit washers (9) on bushes (13), insert the bushes in the rubber dampers from the inside of the side panel and fit washers (6) on bolts (7). Fit the washers (15) on the bolts (14).

Locate the side panels and fit bolts (7) and (14).

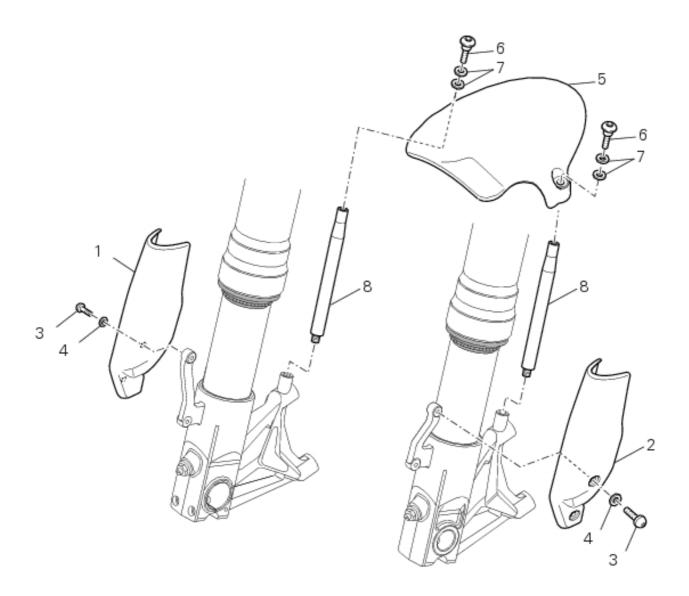
Tighten the bolts (7) and (14) to the specified torque (Sect. C 3, Frame torque settings).





Refit the pillion seat, as described in the paragraph "Refitting the seat".

# 4 - Front mudguard



- Right heel plate
- 2 Left heel plate
- 3 Bolt
- 4 Washer
- 5 Mudguard
- 6 Bolt
- 7 Washer
- 8 Stay



#### **FAIRING**

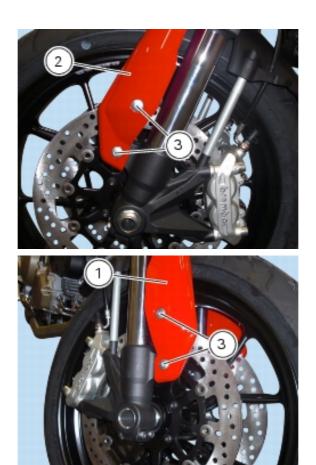


#### Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

#### Removal of the front mudguard

Remove the fork guards (1) and (2) by unscrewing the bolts (3) and recovering the washers (4).



Release the front brake hose (A) from the mudguard (5). Unscrew the bolts (6) securing the mudguard to the fork and recover the washers (7). Remove the mudguard.

Unscrew the stays (8) and remove them from the fork legs.





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.

Apply the recommended threadlocker to the threads of the stays (8).

Screw the supports (8) onto the fork legs.

Locate the mudguard (5) on the suppports (8), insert the bolts (6) complete with washers (7) and tighten to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

Locate the front brake hoses (A) in their respective clips on the mudguard.





Refit the fork guards (1) and (2) using the bolts (3) with washers (4) tightened to the specified torque (Sect. C 3, Frame torque settings).





# 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

Removal of the clutch master cylinder assembly 8
Refitting the clutch master cylinder assembly 9
Removal of the clutch slave cylinder 11
Refitting the clutch slave cylinder 12

## 3 - Front brake control 17

Removal of the front brake master cylinder 18
Refitting the front brake master cylinder 19

# 4 - Rear brake control 23

Removal of the rear brake master cylinder 24
Refitting the rear brake master cylinder 26

# 5 - Gearchange control 31

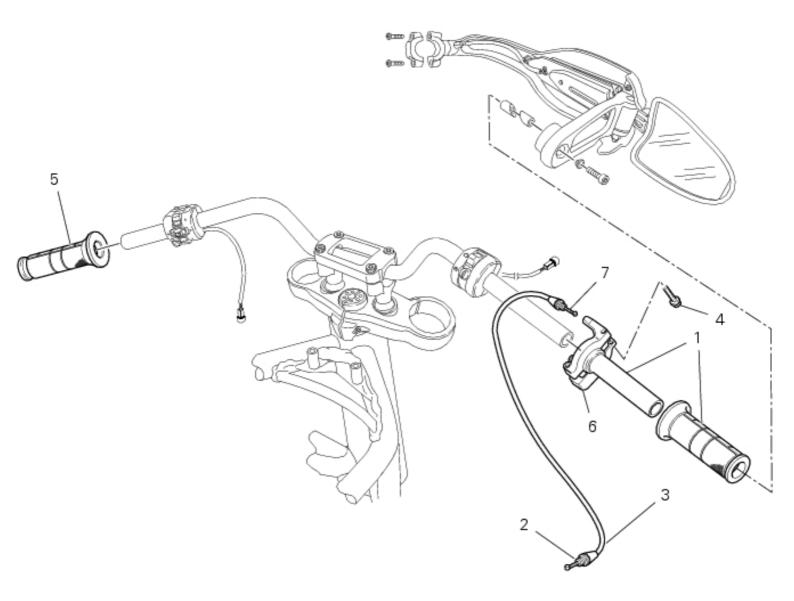
Removal of the gearchange control 32

Disassembly of the gearchange control 33

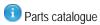
Refitting the gearchange control 33

# OF - Impianto elettrico

# 1 - Throttle twistgrip



- 1 Throttle twistgrip
- 2 Cable adjuster on throttle body
- 3 Throttle cable
- 4 Bolt
- 5 Left grip
- 6 Cover
- 7 Cable adjuster on handlebar



### **HANDLEBAR AND CONTROLS**



## Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

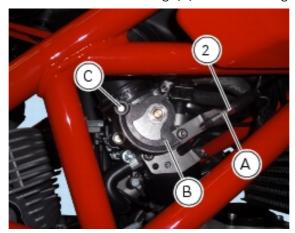
### Adjusting the throttle cable

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

Removal of the throttle twistgrip

Operation	Section reference
Remove the RH hand guard-mirror	E 1, Removal of the hand guards -
assembly	rearview mirrors

Loosen locknut (A) and fully unscrew the adjuster (2) from the throttle body pulley (B). Rotate the throttle body pulley (B) so that the cable end fitting (C) can be disengaged from the pulley.

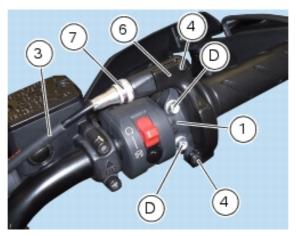


Remove the bolts (4) and the cover (6) and disconnect the throttle cable from the twistgrip, freeing the cable end from the race and fully unscrewing the adjuster (7).

Remove the throttle cable (3) from the motorcycle.

Loosen the two bolts (D) securing the throttle twistgrip to the handlebar.

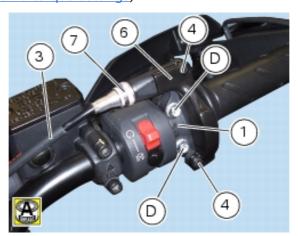
Remove the throttle twistgrip (1) from the handlebar.



#### Refitting the throttle twistgrip

Lubricate the end of the throttle cable (3) with the recommended grease.

To refit the throttle twistgrip components, reverse the steps of the removal procedure. Tighten the bolts (4) and (D) to the specified torque (Sect. C 3, Frame torque settings).



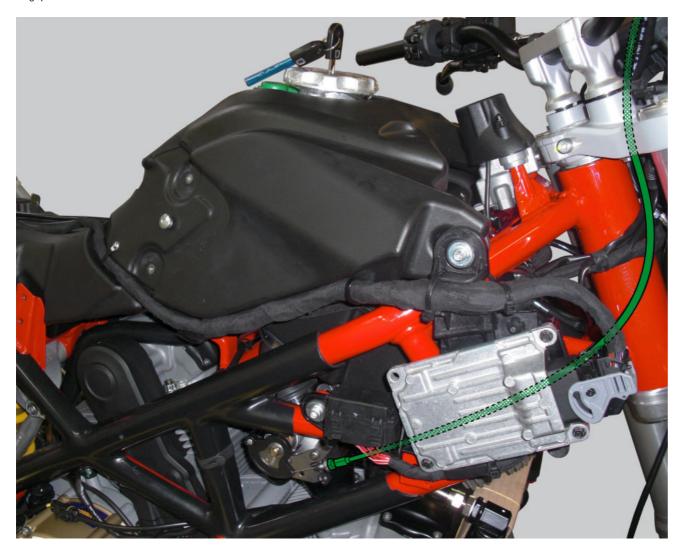
### Throttle twistgrip

Refer to the photos on the following pages for correct routing of the throttle cable.

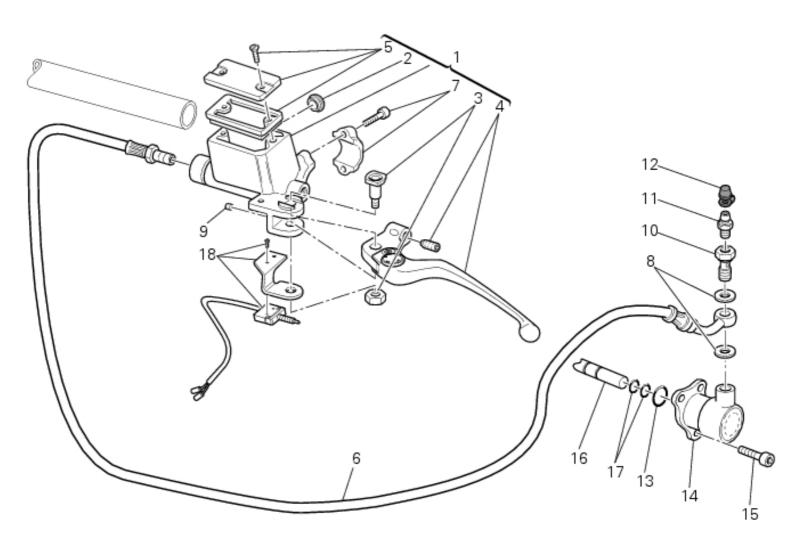
Operation	Section reference
Refit the RH hand guard-mirror	E 1, Refitting the hand guards -
assembly	rearview mirrors

## Throttle cable positioning





# 2 - Hydraulic clutch control



- 1 Clutch master cylinder
- 2 Inspection plug (replacement part)
- 3 Lever pivot pin
- 4 Lever with grub screw
- 5 Fluid reservoir cover
- 6 Clutch hose
- 7 Mounting clamp
- 8 Sealing washer
- 9 Rubber mounting
- 10 Banjo bolt
- 11 Bleed valve
- 12 Dust cap
- 13 O-ring
- 14 Clutch slave cylinder
- 15 Bolt
- 16 Clutch pushrod
- 17 O-ring
- 18 Microswitch



**CLUTCH CONTROL** 



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in 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 this component could endanger rider safety.

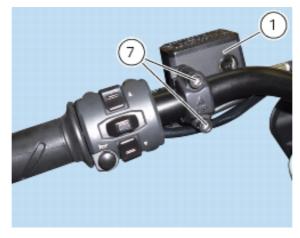
Maintenance operations of the master cylinder are limited to replacing the following parts: control lever, reservoir unit, and master cylinder fasteners.

Operation	Section reference
,	D 4, <u>Draining the clutch hydraulic</u> <u>circuit</u>
	E 1, Removal of the hand guards - rearview mirrors

Remove the dust cap (12) and the bleed valve (11) and unscrew the banjo bolt (10) and remove the hose (6), taking care to recover the sealing washers (8).

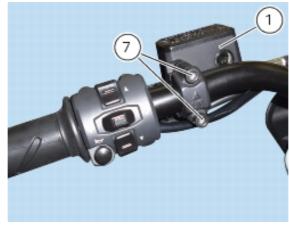


Unscrew the two clamp bolts (7) securing the clutch master cylinder assembly to the handlebar. Remove the clutch master cylinder assembly (1). to dismantle the assembly, refer to the exploded view diagram at the beginning of the chapter.



Refitting the clutch master cylinder assembly

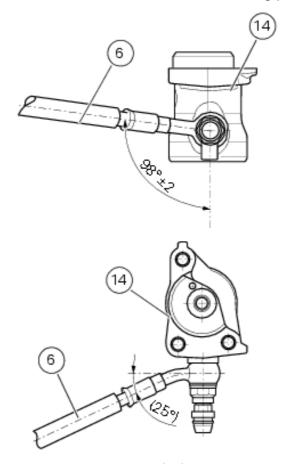
Tighten the retaining screws (7) to the specified torque (Sect. C 3, <u>Frame torque settings</u>), in the sequence 1-2-1, starting with the uppermost screw.



Locate the hose (6) on the slave cylinder (14), ensuring that the hose end fitting is correctly positioned relative to the slave cylinder (14).

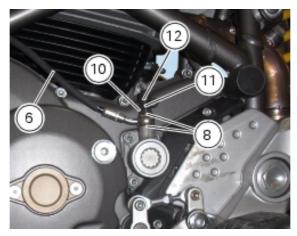


An incorrectly positioned hose can cause clutch faults and interfere with moving parts.



Locate the two sealing washers (8) and tighten the banjo bolt (10) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

Refit the bleed valve (11) and the dust cap (12).



For the positioning of the clutch hose (6) and retaining clips, see the illustration at the end of this section.

Operation	Section reference
Fill the clutch circuit	D 4, Filling the clutch circuit
1	E 1, Refitting the hand guards - rearview mirrors

#### Removal of the clutch slave cylinder



#### Warning

The clutch slave cylinder manufacturer advises against servicing of internal components of clutch slave cylinder (23). Incorrect overhaul of this component could endanger rider safety.

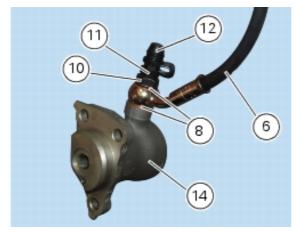
Only the following parts may be replaced: the bleed valve, the seal and the complete pushrod assembly.

Operation	Section reference
Drain the clutch system	D 4, Draining the clutch hydraulic
	<u>circuit</u>

Undo the three bolts (15) securing the clutch slave cylinder (14) to the engine and withdraw the unit from the crankcase.



Remove the dust cap (12) and the bleed valve (11) and unscrew the banjo bolt (10), taking care to recover the sealing washers (8): the unit (14) is now disconnected from hose (6). Push in the piston to force out all the fluid from inside the cap.

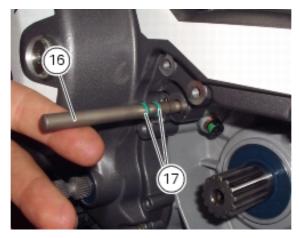


At this point the clutch pushrod (16) may also be withdrawn. Check the state of wear of the two O-rings (17) and renew them if necessary.



Notes

If the two O-rings (17) are renewed, it will also be necessary to renew the O-ring (13) of the clutch slave cylinder (14).



#### Refitting the clutch slave cylinder



If the clutch pushrod (16) is renewed, it will also be necessary to renew the O-rings (17) and (13) of the clutch slave cylinder (14).

Grease and refit the clutch pushrod (16) with the two O-rings (17).



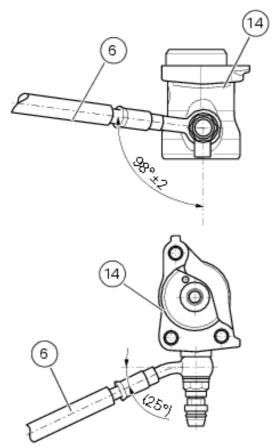


If the slave cylinder unit (14) is renewed, it will also be necessary to renew the O-ring (13) and the two O-rings (17) of the clutch pushrod (16).

Locate the slave cylinder unit (14) in the crankcase and tighten the bolts (15) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



Locate the hose (6) on the slave cylinder (14), ensuring that the hose end fitting is correctly positioned relative to the slave cylinder (14).



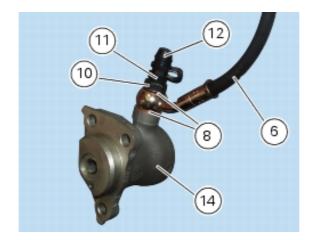


An incorrectly positioned hose can cause clutch faults and interfere with moving parts.

Locate the two sealing washers (8) and tighten the banjo bolt (10) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

Refit the bleed valve (11) and the dust cap (12).

Refer to the diagram on the following page for correct positioning of the retaining clips for the hose (6).

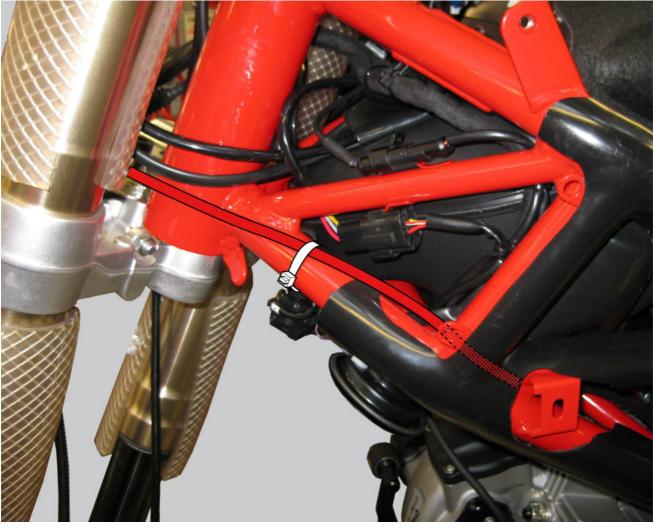


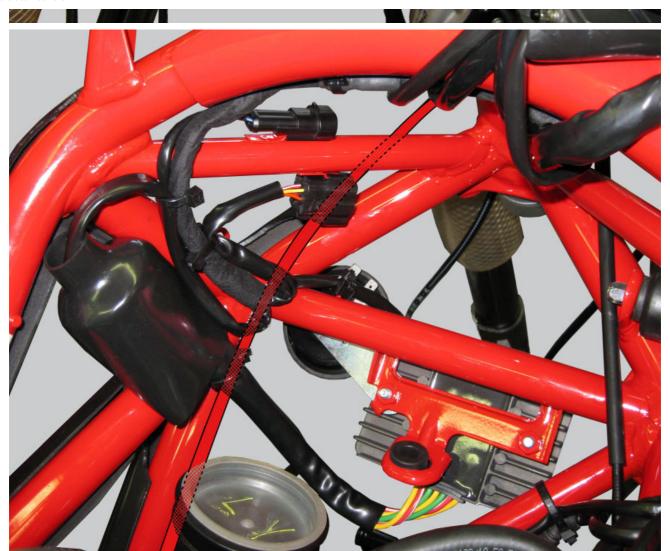
Operation	Section reference
Fill the clutch circuit	D 4, Filling the clutch circuit

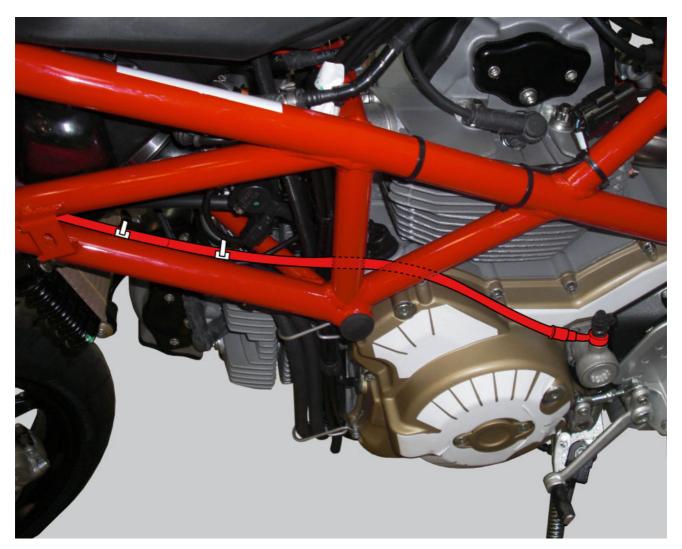
## Positioning of the clutch hose



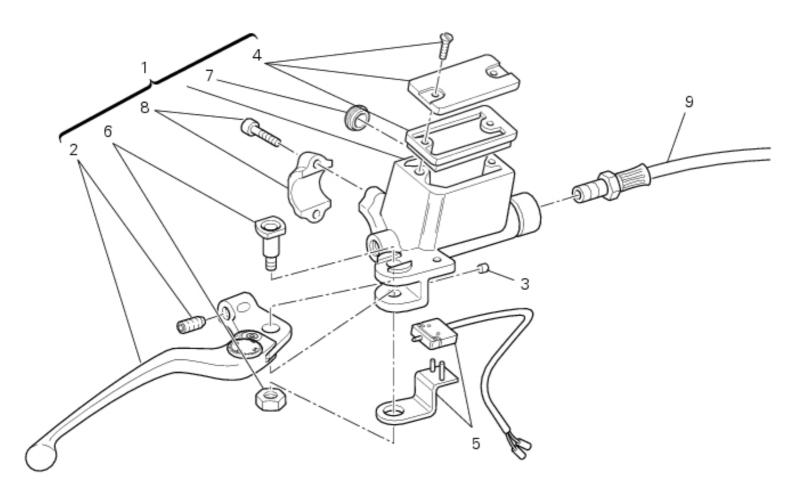








## 3 - Front brake control



- 1 Front brake master cylinder
- 2 Brake lever pedal
- 3 Rubber mounting
- 4 Fluid reservoir cover
- 5 Microswitch
- 6 Lever pivot pin
- 7 Inspection plug (replacement part)
- 8 Mounting clamp
- 9 Calipers-master cylinder hose



#### **FRONT BRAKE**



## Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

Removal of the front brake master cylinder



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.

If the hose connecting the master cylinder to the brake caliper is changed, ensure that the hose end fittings are positioned correctly.



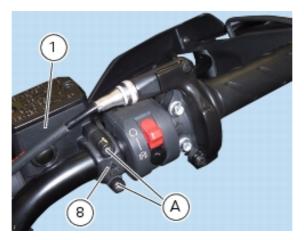
### Warning

If incorrectly positioned, the hose can affect brake operation and foul moving parts. Position the hose as shown in the figure.

Operation	Section reference
Drain the braking system	D 4, <u>Draining the clutch hydraulic</u> <u>circuit</u>
Disconnect the brake hose from the master cylinder unit	G 3, Removal of the front brake system
Remove the RH hand guard-mirror assembly	E 1, Removal of the hand guards - rearview mirrors

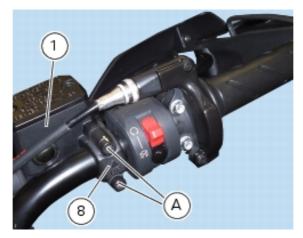
Unscrew the bolts (A) securing the mounting clamp (8) and then remove the front brake master cylinder assembly (1) from the handlebar.

For disassembly of components of the master cylinder unit (1), refer to the exploded view at the beginning of this chapter.



#### Refitting the front brake master cylinder

Locate the clamp (8) of the master cylinder (1) using the grub screw to secure it in the correct position. Tighten the bolts (A) of the mounting clamp (8) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>), in the sequence 1-2-1.



If any work has been carried out on the hose (9), follow the instructions given in Section G 3, Refitting the front

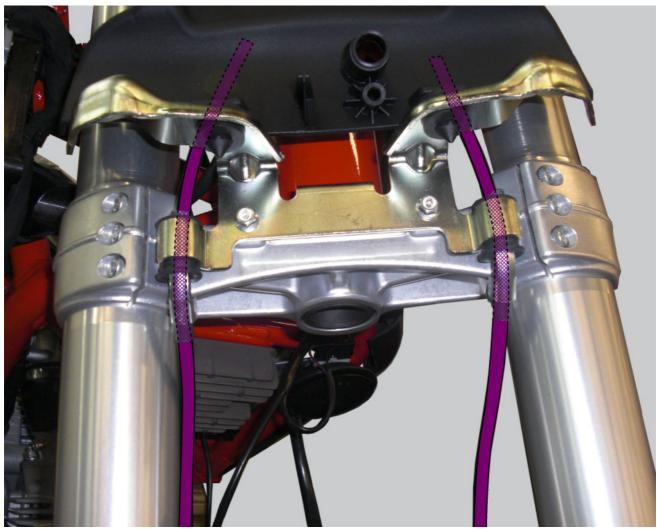
### brake system.

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
Refit the RH hand guard-mirror assembly	E 1, Refitting the hand guards - rearview mirrors

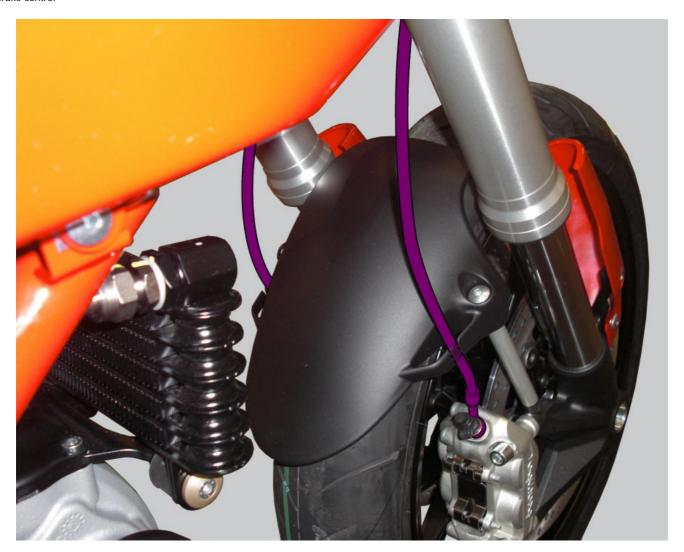
# Positioning of front brake hose



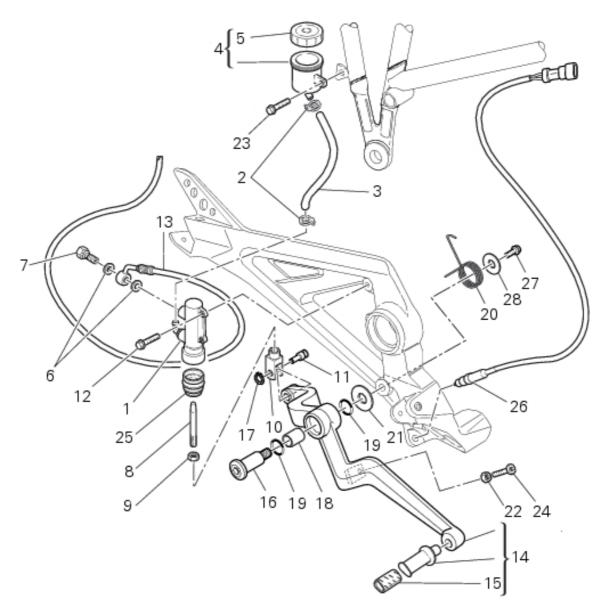








## 4 - Rear brake control



- 1 Rear brake master cylinder
- 2 Clamp
- 3 Reservoir master cylinder hose
- 4 Fluid reservoir
- 5 Filler cap
- 6 Sealing washer
- 7 Banjo bolt
- 8 Pushrod
- 9 Nut
- 10 Clevis
- 11 Pin 12 Bolt
- 13 Rear brake hose
- 14 Brake pedal
- 15 Rubber
- 16 Pin
- 17 Circlip
- 18 Bush
- 19 O-ring
- 20 Spring
- 21 Washer
- 22 Nut
- 23 Bolt
- 24 Adjuster screw

Rear brake control

25 Dust boot

26 Switch

27 Bolt

28 Washer



#### **REAR BRAKE**



#### **Important**

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

Removal of the rear brake master cylinder



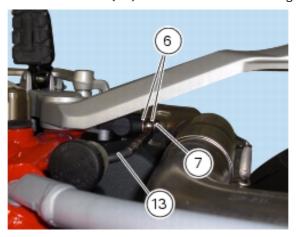
### Warning

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 the complete master cylinder assembly.

Operation	Section reference
Drain the braking system	D 4, <u>Draining the brake circuits</u>

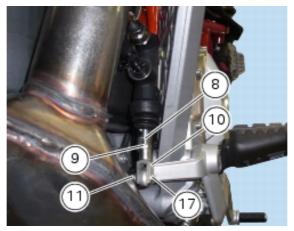
Undo the banjo bolt (7) securing the rear brake hose (13) and recover the sealing washers (6).



Unscrew and remove the bolts (12) securing the rear brake master cylinder (1). The master cylinder (1) is now free of the footrest bracket.

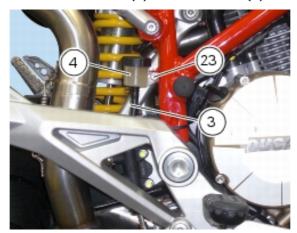


Release the pin (11) from the return spring (20) and remove the pin after having removed the circlip (17). Next unscrew the nut (9) and the pushrod (8) from the clevis (10).





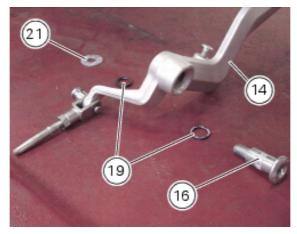
Remove the bolt (23) securing the reservoir (4). Remove the complete master cylinder and the reservoir (4) with the hose (3).



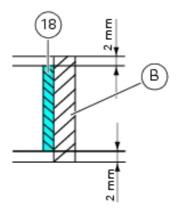
If necessary, remove the footrest bracket as described in Section H 4, <u>Removal of the footrest brackets</u>. Unscrew the pivot bolt (16).

Remove the pedal (14) and recover the washer (21) and O-rings (19).





If the bush (18) in the footrest bracket is to be renewed, install the new bush using a press so that it is recessed **2** mm relative to the outer surface of the footrest bracket (B).



#### Refitting the rear brake master cylinder



#### Warning

After working on the rear brake control, check the operation of the brake pedal following the instructions given in Section D 4, <u>Adjusting the position of the gearchange and rear brake pedals</u>.

Apply the recommended grease to the pivot bolt (16) and the seats of the O-rings (19).

Apply the recommended threadlocker to the thread of the hole for the pivot bolt (16) in the right-hand footrest bracket.

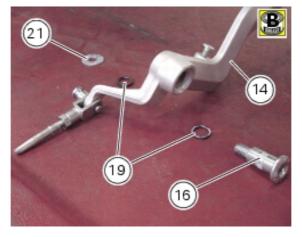
Fit the pivot bolt (16) on the lever (14) with O-rings (19) and washer (21).

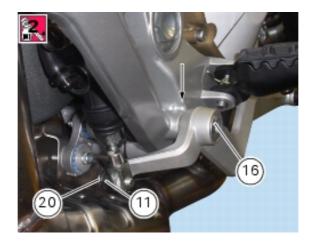
Fit the gearchange lever (14) to the footrest bracket and tighten the pivot bolt (16) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



When refitting the lever, make sure that the O-rings remain correctly seated.

Fit the spring (20), locating the end in the groove of in the clevis pivot pin (11).



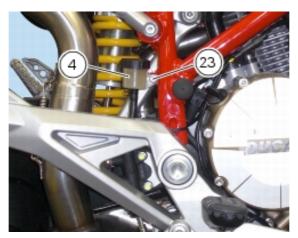


If removed, refit the right-hand footrest bracket as described in Section H 4, <u>Refitting the footrest brackets</u>. Locate the rear brake master cylinder (1) on the motorcycle and fit the retaining bolts (12), applying the recommended threadlocker.

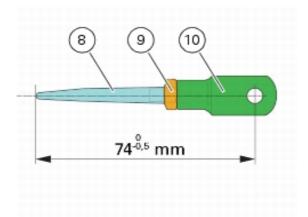
Tighten the bolts (12) to the specified torque (Sect. C 3, Frame torque settings).



Locate the reservoir (4) on its lug on the frame and secure it with the bolt (23) tightened to the specified torque (Sect. C 3, Frame torque settings).



If the rod (8) - clevis (10) assembly has been dismantled, reassemble by screwing nut (9) onto the rod (8), then screw the rod into the clevis (10) to obtain the measurement indicated in the figure. Restrain the pushrod and tighten the nut (9) against clevis (10) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).

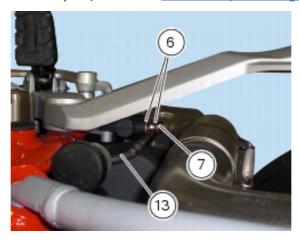


Lubricate the other end of the rod (8) with the recommended grease and insert it in the master cylinder (1).



Reconnect the hose (13), locating the sealing washers (6) on both sides of the hose end fitting, and secure it with the banjo bolt (7).

Orientate the brake hose end fitting (13) so that is pointing inwards at 90° to the axis of the master cylinder. Tighten the banjo bolt (7) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

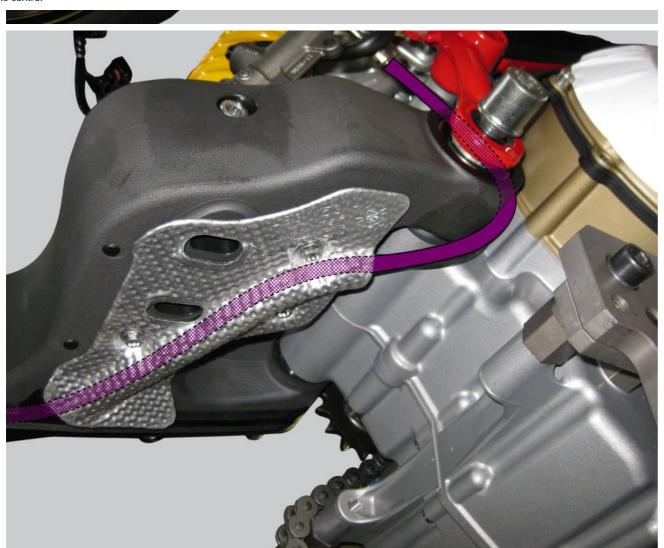


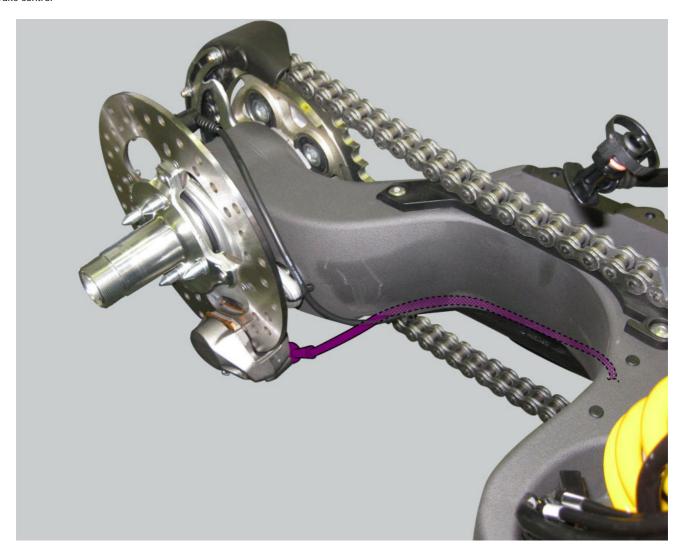
Operation	Section reference
Fill the brake circuit	D 4, Filling the brake circuits

Positioning of rear brake hose

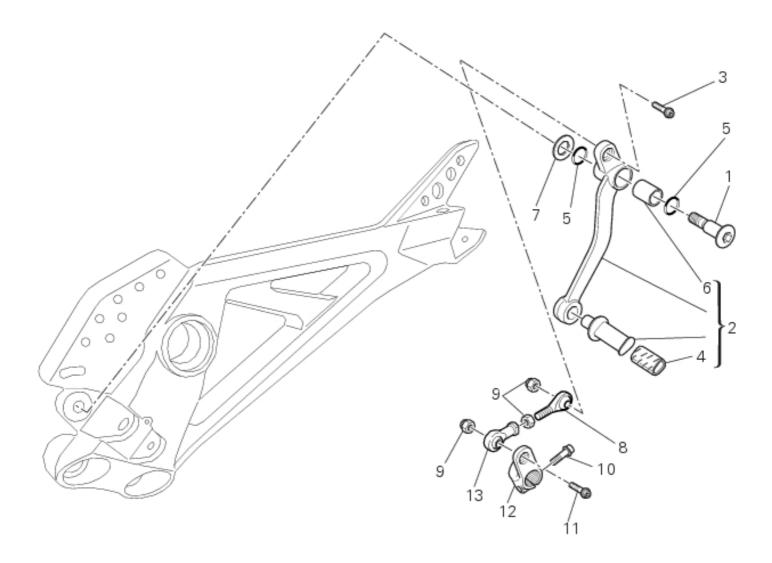




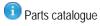




# 5 - Gearchange control



- Gearchange pedal pivot bolt
- 2 Gearchange pedal
- 3 Bolt
- 4 Pedal rubber
- 5 O-ring
- 6 Bush
- 7 Washer
- 8 Gearchange lever tie-rod
- 9 Nut
- 10 Bolt
- 11 Bolt
- 12 Lever
- 13 Pivot



### L.H. FOOTRESTS



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

### Removal of the gearchange control

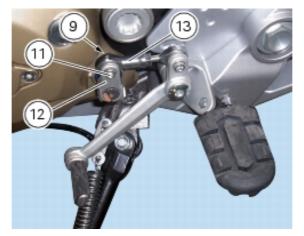
Unscrew and remove the pivot bolt (1) securing the gearchange pedal (2). Unscrew and remove the clamp bolt (10) securing the gearchange lever to the gear selector shaft. Withdraw the lever (12) complete with the gearchange control assembly.





Mark the position of lever (12) relative to the gear selector shaft.

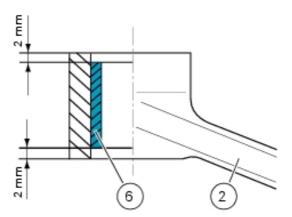
To remove the lever (12) from the gearchange control assembly, remove the bolt (11). Recover the nut (9) and slide the lever (12) off the pivot (13).



#### Disassembly of the gearchange control

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

If the bush (6) in the pedal (2) needs renewing, drive the replacement bush into place using a press. The bush must be seated **2** mm below the pedal outer face.





After working on the gearchange control, check the position of the gearchange pedal.

Gearchange control

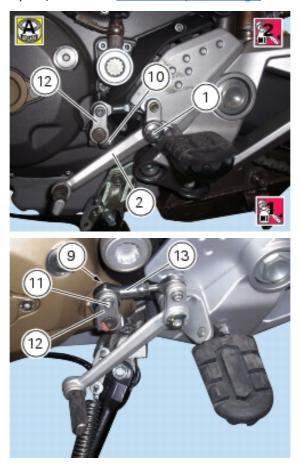
To adjust the position of the gear pedal, follow the instructions provided in Sect. D 4, <u>Adjusting the position of the gearchange and rear brake pedals</u>.

### Refitting the gearchange control

To refit the gearchange control, reverse the operations of the removal procedure.

In particular, grease the O-rings (5), apply threadlocker to the bolt (10), pivot bolt (1) and then tighten them to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

Tighten the nut (9) to the specified torque (Sect. C 3, Frame torque settings) while counterholding the bolt (11).



# 0G - Impianto elettrico

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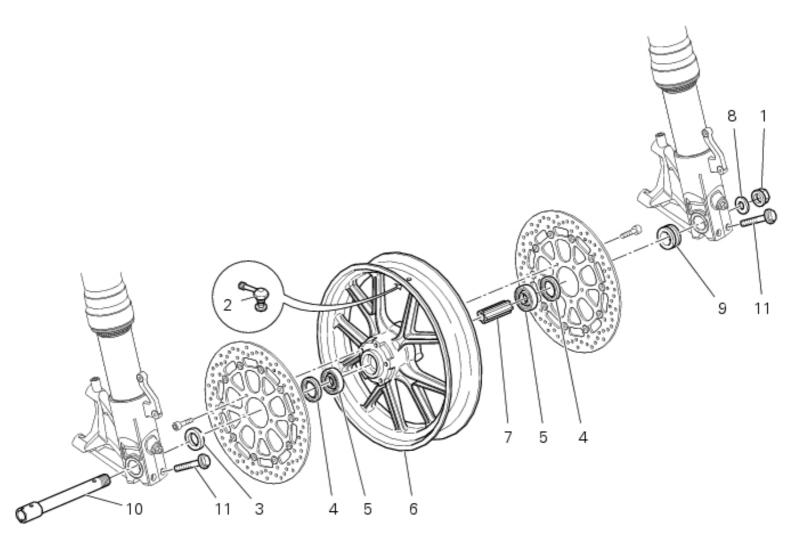
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## 1 - Front wheel



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



FRONT FORKS
FRONT AND REAR WHEELS



**Important** 

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

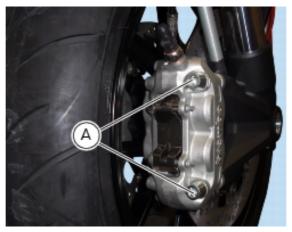
Front wheel

Removal of the front wheel

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



Do not operate the brake lever when the calipers are removed. This could cause fluid to leak out from the actuating pistons.

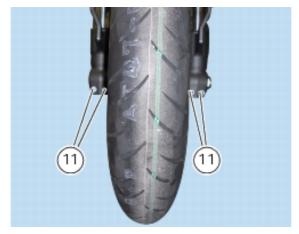




Support the bike so that the front wheel is raised from the ground. Loosen and remove the nut (1) on left side of the axle. Recover the washer (2).



Loosen the axle clamp bolts (11) 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).



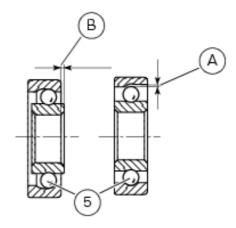
## Overhauling the front wheel

#### Wheel bearings

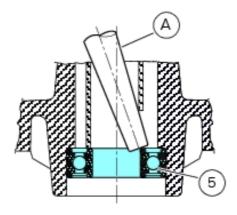
Before checking the dimensions, check the wear on wheel bearings (5). Check for wear by hand after cleaning and degreasing the bearings in their seats.

Turn the inner race.

Check the amount of radial (A) and axial (B) play. Excessive play will cause vibration and make the bike unstable and therefore the bearings must be renewed.



Position a drift (A) against the inner race of the bearing (5).



Tap the drift with a hammer to drive out the bearing. Apply the drift at different points to keep the bearing square during removal.



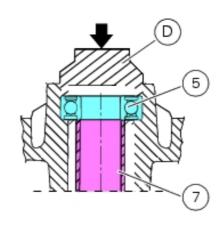
Once removed, the used bearings and seals must not be refitted.

Before fitting new bearings, check that the housing is clean and free from scoring and damage.

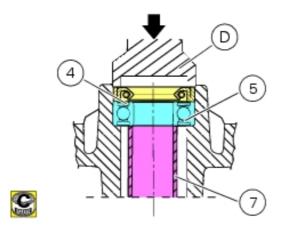
Grease the bearing seat and then push the new bearing (5) into its seat.

Using a tubular drift (D) which bears only on the outer ring of the bearing, drive the bearing fully into its seat. Use the same method to install the seals (4).

Ensure that spacer (7) is fitted between the two wheel bearings.







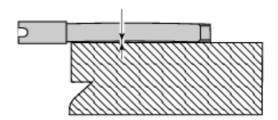


Wheels must be rebalanced after repair, maintenance and overhaul operations.

#### Front 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, <u>Front wheel</u>).



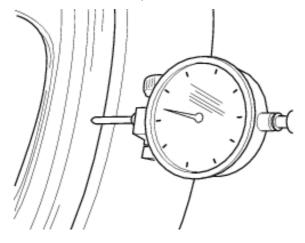
#### Overhauling the front wheel

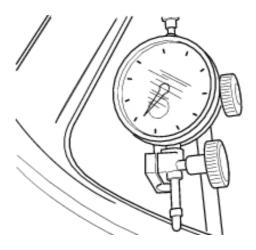
After you have checked the bearings, check the rims as follows.

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, <u>Front wheel</u>). 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 seal rings 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 complete with hoses securing them with the bolts (A).



Do not operate the brake lever when the calipers are removed. This could cause fluid to leak out from the actuating pistons.

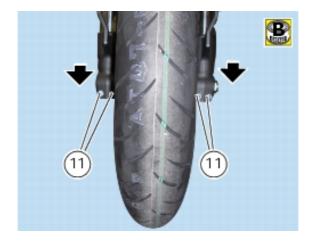




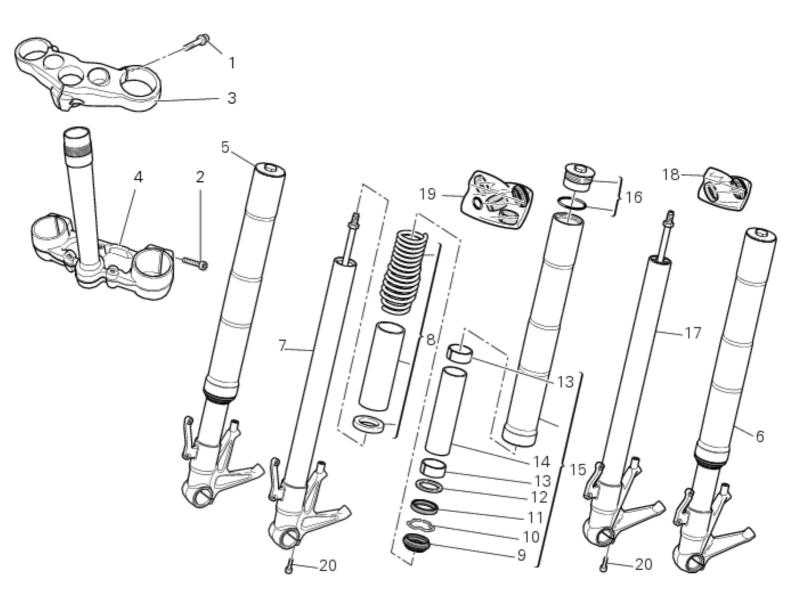
Check that the brake discs turn freely inside the calipers.

Before tightening the axle clamp bolts (11), lower the bike to the ground and push 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 (11).

Tighten the bolts (11) to the specified torque (Sect. C 3, Frame torque settings), in the sequence 1-2-1.



# 2 - Front fork



- 1 Bolt
- 2 Bolt
- Top yoke
- 4 Bottom yoke
- 5 Right fork leg assembly
- 6 Left fork leg assembly
- 7 Right inner tube assembly
- 8 Spring kit
- 9 Dust seal
- 10 Circlip
- 11 Seal
- 12 Collar
- 13 Top bush
- 14 Spacer
- 15 Outer tube
- 16 Top cap assembly
- 17 Left inner tube assembly
- 18 Seals kit
- 19 Overhaul kit
- 20 Bolt



#### **FRONT FORKS**

handlebar and controls



#### **Important**

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.



#### Notes

Not all parts shown are available separately as spares: however they are indicated for clearer explanation of the procedure.

#### Removal of the front forks

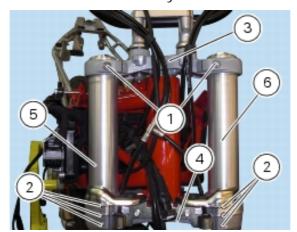
Before removing the front forks, it is first necessary to remove the following parts:

Operation	Section reference
Remove the front brake calipers	G 3, Removal of the front brake
	<u>system</u>
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 fairing	E 1, Removal of the headlight fairing

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).

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 (16) when the fork is still fitted to the motorcycle.



#### Notes

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

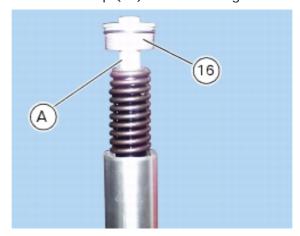
Unscrew the top cap (16).



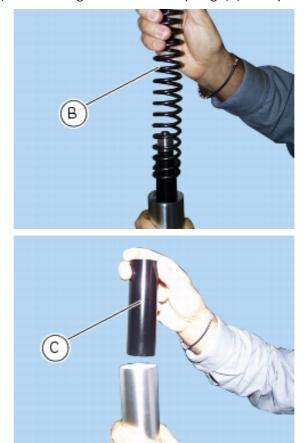
Disassembly of the front fork

Restrain the lock nut (A) with a hex wrench.

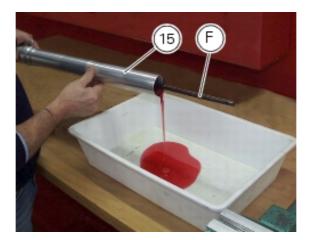
Using a second wrench, unscrew and remove the cap (16) with its O-ring seal from the damper.



Withdraw the complete spring kit (8), recovering, in order, the spring (B), the preload tube (C) and the bush.



Drain the oil from inside the leg by pumping with the outer tube (15) and the damper (F).



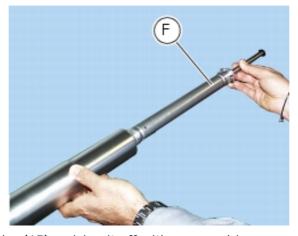


This movement generates pressure so that the oil will be rapidly expelled from the fork. Aim the jet of oil into a previously prepared container and avoid contact with fork oil.

Clamp the inner tube (7) in a vice with soft-faced jaws.



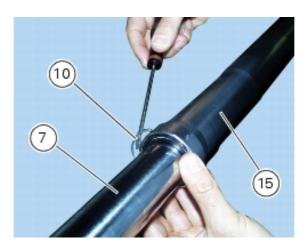
Withdraw the damper assembly (F).



Slip the dust seal (9) off the outer tube (15), prising it off with a screwdriver.



Remove the circlip (10).

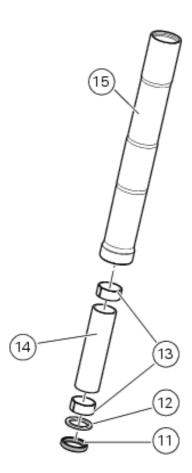


# Important

Take care not to damage the inner tube (7) and the seat of circlip (10) in the outer tube (15). Slide the outer tube (15) off the inner tube (7).

From the outer tube, remove:

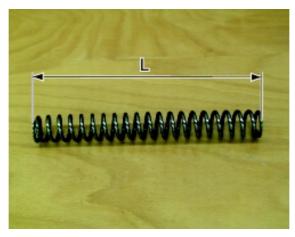
- oil seal (11);
- collar (12); lower bush (13);
- preload tube (14); top bush (13).



Inspection of the front fork

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

- **270** mm.



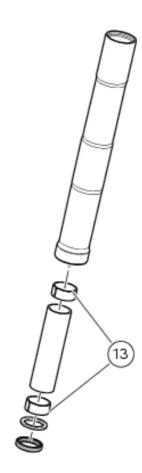
Renew the spring if the length is not within the specified limit.

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.

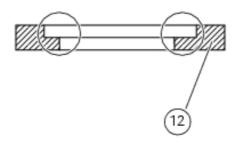
Check that the outer tubes are straight:

- maximum permissible error **0.10** mm.

Whenever the inner tube is removed from the outer tube it is good practice to renew the bushes (13).



Check the collar (12) for distortion in the area indicated. Renew if distorted.



Reassembly of the front fork

Clamp the inner tube in a vice.

Protect the end of the inner tube (7) with tape.

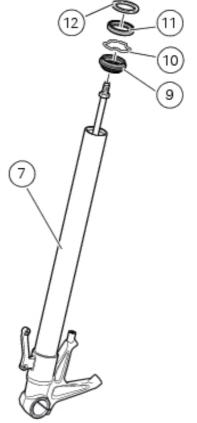


Before installation, smear the sliding edges of oil seal (11) with fork oil or oil seal grease. Install the oil seal (11) with the marked surface facing the dust seal (9).

Fit the following components to the inner tube (7):

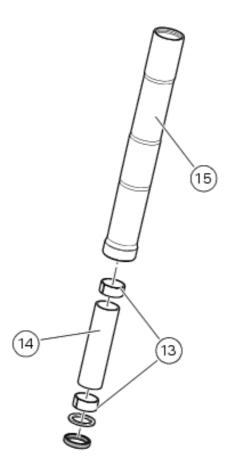
- dust seal (9);
- circlip (10);
- oil seal (11);
- collar (12).





Install the following components in the outer tube (15) using the oil seal installer no. 88713.3204:

- bush (13); preload tube (14); bush (13).





Before assembling the inner and outer fork tube (15), lubricate the sliding surfaces of the bushes (13) with fork oil.

Assemble the inner tube (7) with the outer tube (15).

Push the collar (12) and the oil seal (11) using the oil seal installer no. 88713.3204.

Fit the circlip (10) and the dust seal (9).





The outer tube must slide freely on the inner tube. Handle the inner and outer tubes with your hands only. The use of tools might damage the oil seals and bushes.

Pour half the specified quantity of oil in each fork leg (Sect. C 2, Fuel, lubricants and other fluids).

Pump with tool 88713.3203 to force the oil to fill internal volume completely.

Slide both the damper and outer tube fully down the inner tube.

Pour the remaining oil into the fork leg and measure the oil level.



Keep the fork leg vertical when measuring the oil level. Make sure the oil level is the same in both fork legs. Recommended oil:

SHELL ADVANCE FORK 7.5 or DONAX TA

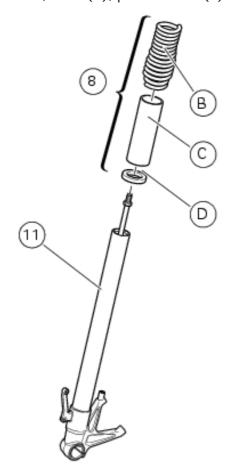
Standard capacity:

450 cc (right fork).

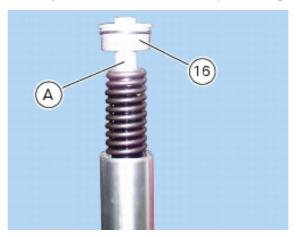
470 cc (left fork).

The quantity of oil affects fork response during the final part of the compression stroke. High oil level increases compression loading, low oil level will decrease it. Before reassembly, remove any oil from the spring kit (8).

Install the spring kit (8) comprised of, in order, bush (D), preload tube (C) and spring (B), on the inner tube (7).

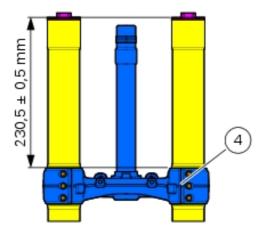


Restrain lock nut (A) and screw the top cap (16) complete with its O-ring on to the damper rod (8). Tighten the top cap (16) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).



#### 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.





The difference in height between the two fork legs must be no greater than 0.1 mm.

Locate the fork legs (5) and (6) in the bottom yoke (4).

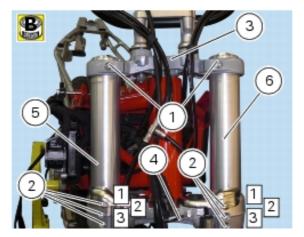
Locate the fork legs (5) and (6) in the top yoke (3).

Grease the threads and the undersides of the heads of bolts (1) and (2).

Tighten to the specified torque (Sect. C 3, <u>Frame torque settings</u>) the clamp bolts (1) and (2) securing the legs to the bottom yoke (4) and to the top yoke (3): tighten the bolts (2) in the sequence 1-2-3-1-2.



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



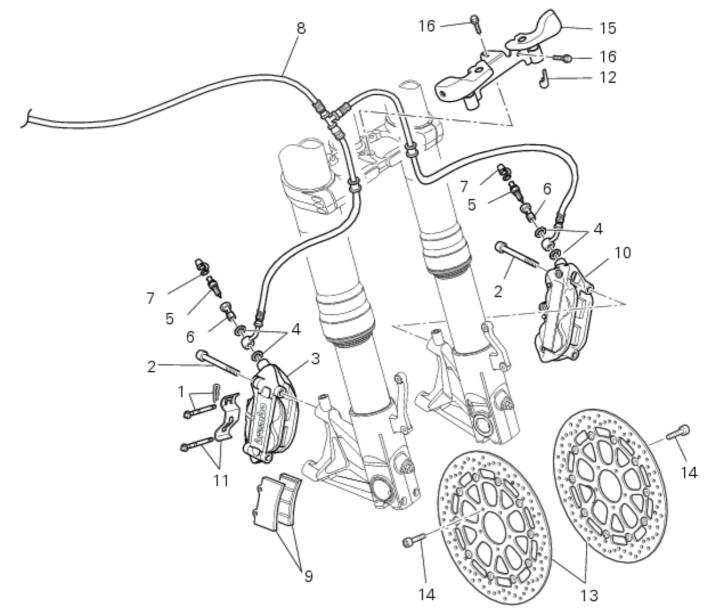
Refit any parts removed from the frame:

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



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

# 3 - Hydraulic front brake



- 1 Pad retaining pin and clip
- 3 Right brake caliper4 Sealing washer
- 5 Bleed valve
- 6 Banjo bolt
- 7 Dust cap
- 8 Calipers-master cylinder hose9 Pair of brake pads
- 10 Left brake caliper
- 11 Spring
- 12 Hose guide
- 13 Brake disc
- 14 Bolt
- 15 Support
- 16 Bolt
- Parts catalogue

**FRONT AND REAR WHEELS FRONT BRAKE** 



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

Maintenance operations



## Warning

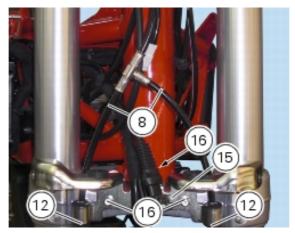
Brake fluid is corrosive and will damage paintwork. Avoid contact with eyes and skin. In case of accidental contact, wash the affected area with abundant running water and consult a doctor if necessary.

For maintenance instructions (brake pad wear check and renewal, brake fluid change, etc.) refer to Section D 4, <u>Maintenance operations</u>.

Removal of the front brake system

Operation	Section reference
Drain the braking system	D 4, <u>Draining the brake circuits</u>

Loosen the bolts (16) securing support (15) and withdraw hose (8) from the support. Remove the hose guides (12) from the hoses.

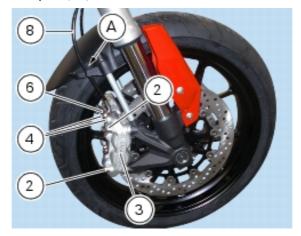


Unscrew the banjo bolts (6) on both brake calipers and disconnect the calipers from the hoses (8), recovering the sealing washers (4).

Free the hose (8) from the guide (A) on the mudguard.

Unscrew the two bolts (2) securing the right-hand front caliper (3) to the fork leg.

Repeat the operation for the left-hand caliper (10).



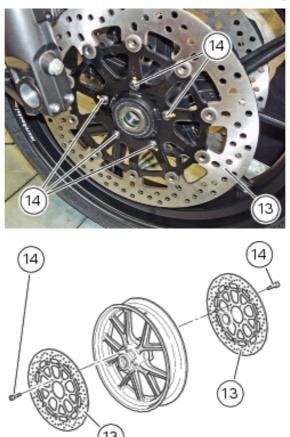


#### Removal of the brake discs

Operation	Section reference
Remove the front wheel	G 1, Removal of the front wheel

The front discs are comprised of a rotor.

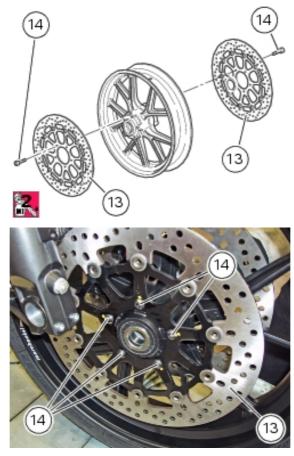
Undo the bolts (14) securing the brake discs to the wheel and remove the discs (13) from both sides of the wheel.



### Refitting the brake discs

Before refitting the brake disc to the wheel, clean all contact surfaces thoroughly and apply threadlocker to the threads of retaining bolts (14).

Screw in the bolts (14) securing the front brake disc (13) to the front wheel in the sequence: 1-3-5-2-4-6.



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

Operation	Section reference
Refit the front wheel	G 1, Refitting the front wheel

### Overhauling the front brake components



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. To check brake disc wear, refer to the service limits given in the paragraph "Hydraulic brakes" (Sect. C 1.1).

#### Refitting the front brake system



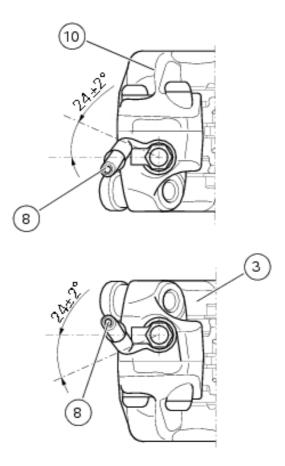
#### Warning

When refitting the brake system, take care to position correctly the end fittings of the hose (8) connecting the master cylinder and calipers (3) and (10).



#### Warning

If incorrectly positioned, the hose can affect brake operation and foul moving parts.



Fit the sealing washers (4) to either side of the connection fitting when connecting the brake hose to the brake caliper. Reconnect the hose (8) to the front brake calipers (10) and (3) and tighten the bolts (6) to their specified torque (Sect. C 3, Frame torque settings).

Fit the calipers (3) and (10) over the disc.

Grease the threads and undersides of the heads of the bolts (2).

Fit the two bolts (2) securing the caliper to the fork leg.

Tighten the bolts (2) to the specified torque (Sect. C 3, Frame torque settings).

Locate the brake master cylinder-lever assembly (Sect. F 3, Refitting the front brake master cylinder).





If removed, insert the clips (12) in the front brake hose grommets (B), positioning them so that the tabs (C) lie flush with the tops of the grommets, without however altering their position relative to the brake hoses.



Notes

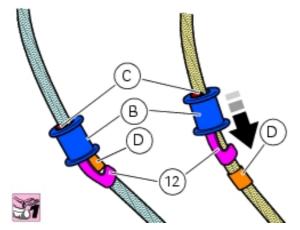
Apply the recommended lubricant to facilitate insertion of the clips.

Position the grommets so they seat against the sleeves (D), orienting the clips so that they are positioned on the front sides of the hoses, as shown in the figure.



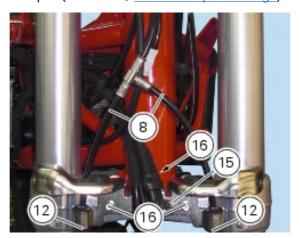
Notes

The purpose of the sleeves (D) and (C) is to provide positioning reference points for the brake hose guides; it is therefore important not to alter their positions on the brake hoses.



Insert the hose (8) in the headlight support (15), making sure that the guide (12) is positioned correctly. The special shape of the guide restrains the movement of hose (8) during braking. Position the hose as shown in the figure.

Tighten the bolts (16) to the specified torque (Sect. C 3, Frame torque settings).

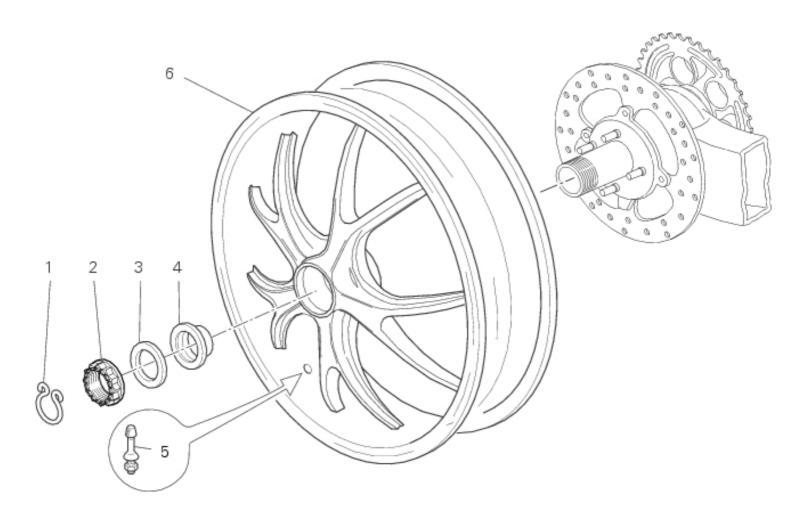


Operation Section reference

Hydraulic front brake

Fill the brake circuit D 4, Filling the brake circuits

## 4 - Rear wheel



- 1 Circlip
- 2 Nut
- 3 Washer
- 4 Bush
- 5 Valve
- 6 Wheel



## **FRONT AND REAR WHEELS**

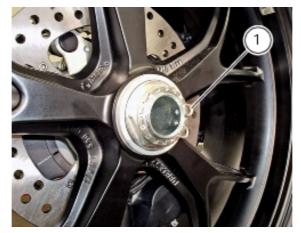


## Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

### Removal of the rear wheel

Place the motorcycle on the rear service stand and engage  $1^{\rm St}$  gear. Remove the circlip (1) securing the wheel nut.



Using a suitable socket, loosen the wheel nut (2). Fully unscrew the wheel nut (2), then slide of the washer (3) and the bush (4). Remove the rear wheel (6) from the motorcycle.



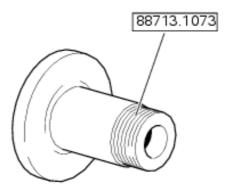
### Overhauling the rear wheel

Inspect the condition of the rear wheel.

As the rear wheel has no bearings, it should be supported on the service tool part no. 88713.1073.



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



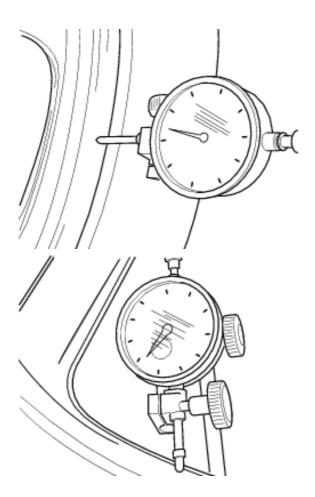
#### Overhauling the rear wheel

Inspect the wheel as described below.

Visually inspect the rim for cracks, scoring and deformation: change the wheel if damaged.

Fit the wheel on service tool no. **88713.1073** 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, <u>Rear wheel</u>). If the values measured are not within the tolerance limits, renew the wheel.



## Refitting the rear wheel

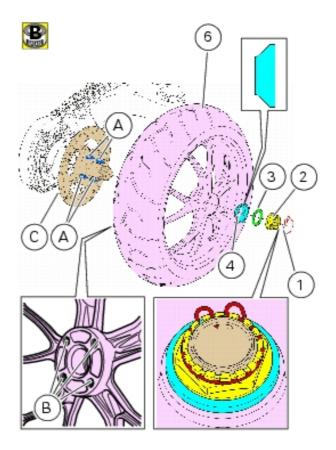
Clean the mating surfaces. Fit the rear wheel (6) on the axle (C), inserting the pins (A) in the corresponding holes (B) in the wheel.

Install the tapered spacer (4) on the axle, with the tapered side facing the wheel, as shown in the figure. Fit the washer (3).

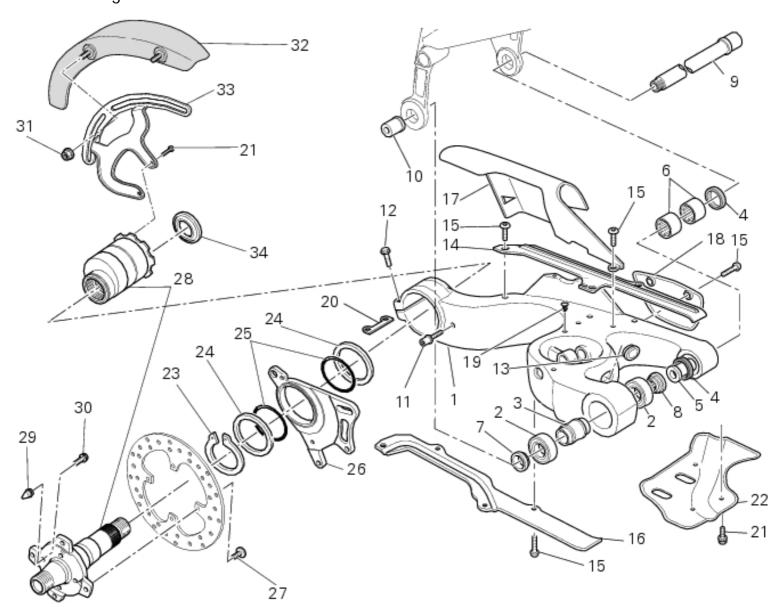
Apply grease to the axle thread and to the contact face of the nut (2).

Fit the nut and tighten it to the specified torque (Sect. C 3, Frame torque settings).

Install the safety clip (1), positioning it as shown in the figure.



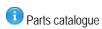
# 5 - Rear swingarm



- 1 Rear swingarm
- 2 Bearing
- 3 Spacer
- 4 Seal
- 5 Bush
- 6 Roller bearing
- 7 RH spacer
- 8 LH spacer
- 9 Swingarm pivot shaft
- 10 Special nut
- 11 Pin
- 12 Bolt
- 13 Plug
- 14 Upper drive chain slider
- 15 Bolt
- 16 Lower drive chain slider
- 17 Upper chain guard
- 18 Lower chain guard
- 19 Plug
- 20 Plate
- 21 Bolt
- 22 Heat shield
- 23 Circlip
- 24 Shim

Rear swingarm

- 25 O-ring
- 26 Caliper mounting bracket
- 27 Bolt
- 28 Hub assembly
- 29 Pin
- 30 Bolt
- 31 Nut
- 32 Splashguard
- 33 Bracket
- 34 Bush



# REAR WHEEL AXLE SWINGARM



## **Important**

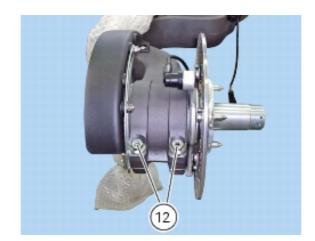
Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

#### Removal of the rear eccentric hub

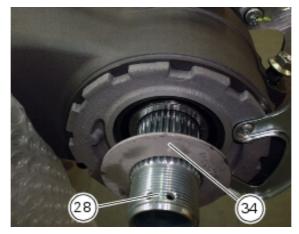
Before removing the rear brake disc, you must first remove the following parts.

Operation	Section reference
Remove the rear wheel	G 4, Removal of the rear wheel
Slacken off the drive chain	D 4, Adjusting the chain tension
Remove the rear sprocket	G 8, Removal of the rear sprocket
Remove the rear brake caliper	G 6, Removal of the rear brake system

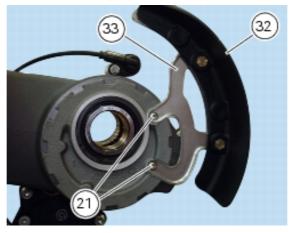
Slacken off the bolts (12).



Remove the spacer (34) on the chain side and withdraw the stub axle (28) complete with brake disc from the opposite side.



Remove the splashguard (32) by unscrewing the bolts (21) securing it to the bracket (33).



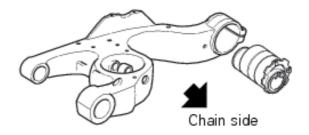
Remove the circlip (23) on the wheel side of the eccentric hub.



Remove the washer (24), the caliper mounting bracket (26) with the O-rings (25) and the other washer (24).



Withdraw the eccentric hub (28) from the chain side of the swingarm.





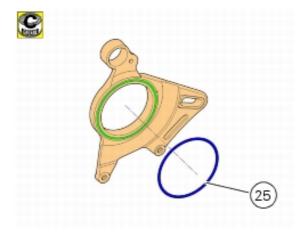
The rear hub is a component particularly critical to the dynamic safety of the motorcycle. For this reason, any overhaul of the internal components of the hub is strictly forbidden. The hub is available as complete assembly, part no. **756.2.006.2A**.

## Refitting the rear eccentric hub

Refitting is the reverse of removal, with attention to the following points.

Before refitting, apply the recommended grease to the seat on the eccentric hub (28) of the caliper mounting bracket (26) on which the rings (25), also greased, will be located.





If the caliper bracket locating pin (11) was removed, apply the recommended threadlocker on reassembly.

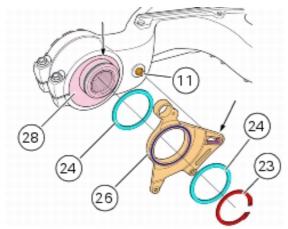


Fit the washer (24) on the hub (28).

Fit the caliper mounting bracket (with the 2 O-rings) on the hub, inserting the locating pin (11) on the swingarm in the slot on the bracket (26) as shown.

Fit another washer (24).

Secure the caliper bracket in place by fiting the circlip (23) in the groove in the hub (28).



Apply the prescribed threadlocker to the bolts (12) and tighten to the specified torque (Sect. C 3, <u>Frame torque settings</u>).



Operation	Section reference
Refit the rear brake caliper	G 6, Refitting the rear brake system
Refit the rear sprocket	G 8, Removal of the rear sprocket
Adjust the drive chain tension	D 4, Adjusting the chain tension
Refit the rear wheel	G 4, Refitting the rear wheel

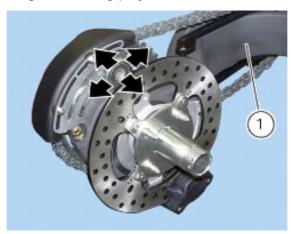
Tension the drive chain as indicated in the paragraph "Adjusting the chain tension" in Section D 4.

### Removal of the swingarm

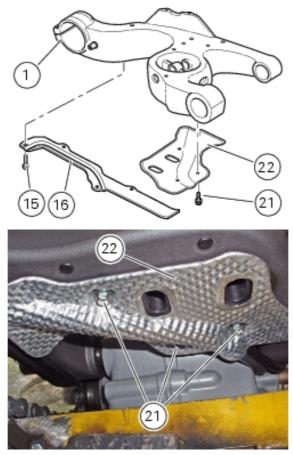
Before removing the parts in question, you must first remove the following parts:

Operation	Section reference
Remove the footrest brackets	H 4, Removal of the footrest brackets
Remove the rear wheel	G 4, Removal of the rear wheel
Slacken off the drive chain	D 4, Adjusting the chain tension
Remove the rear sprocket	G 8, Final drive
Remove the rear brake caliper	G 6, Removal of the rear brake system
Remove the shock absorber and suspension tie-rod from the swingarm	G 7, Removal of the rear shock absorber

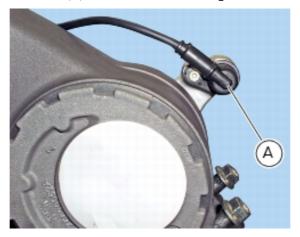
You can check the play in the swingarm bearings while the swingarm (1) is still installed on the motorcycle frame. Grasp the rear of the swingarm (1) and try to move it in the four directions shown by the arrows. Any abnormal movement is a sign of worn bearings that could cause instability when riding. Refer to the indications for checking swingarm bearing play in Section G 1, Wheel bearings.



Remove the eccentric rear hub as described in "Removal of the rear eccentric hub" in this section. Free the speed sensor wiring from the lower chain slider (16) and from the heat shield (22) by unscrewing the bolts (15) and (21).

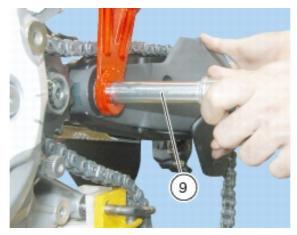


Disconnect the speed sensor wiring connector (A) from the main wiring loom.

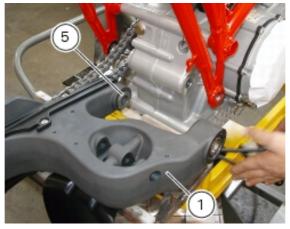


Unscrew the nut (10) and drive out the pivot bolt (9) using a suitable drift.

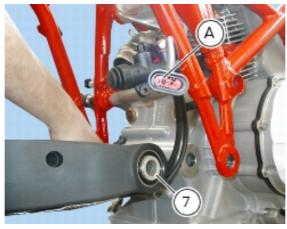


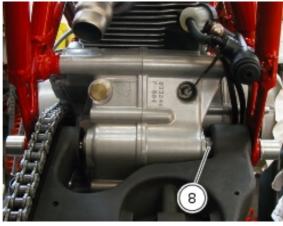


Withdraw the swingarm (1) from its seat sufficiently to recover the bush (5).

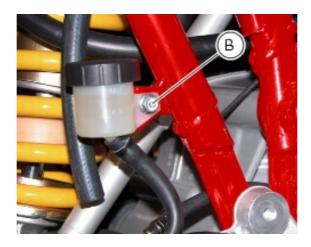


Where the right-hand side of the swingarm is attached to the frame, there are two internal spacers (8) and (7). Disconnect the wiring connector (A) from speed sensor.





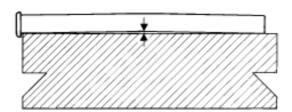
Remove the bolt (B) securing the rear brake fluid reservoir.



### Inspecting the swingarm pivot shaft

Before refitting the swingarm pivot shaft, check it carefully for distortion.

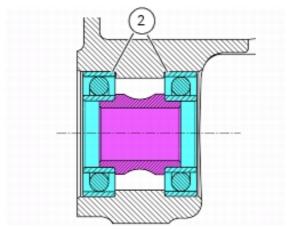
Roll the shaft on a reference surface and measure maximum distortion using a feeler gauge (see Sect. C 1.1, Rear wheel).

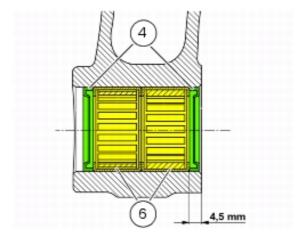


Renew the pivot shaft when distortion exceeds the specified limit or if cracked or otherwise damaged.

## Overhauling the rear swingarm

Inside the swingarm (1), at the point at which it pivots on the frame, there are a pair of ball bearing races (2) on the right-hand side and a pair of roller bearings (6) with seals (4) on the left-hand side.



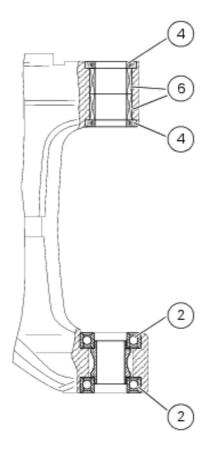


To change the bearings, proceed as follows. Remove the spacers (8) and (7) from the right-hand side of the swingarm and remove the bush (5) from the left-hand side.



Remove the bearings (2), the seals (4) and the roller bearings (6) using a suitable punch and a press. Support the swingarm and take care not to damage the bearing bores.

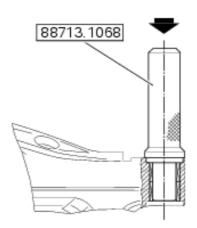
Once removed, the bearings (2), seal rings (4) and roller bearings (6) must not be reinstalled.



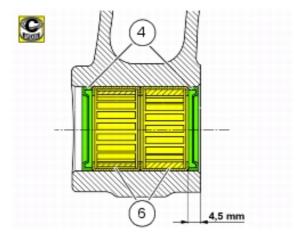
Heat the entire swingarm up to 150 °C and support it.

Insert the new roller bearings (6) 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.



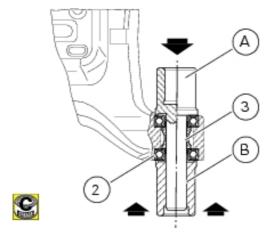
Use the same tool to fit the new seals (4), positioned as shown in the sectional view, so that they seat against the newly installed roller bearings.



To install the ball bearing races (2) 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 (2) with the internal spacer (3) onto the drift (A) and position it on the interior of the right-hand side support of the swingarm.



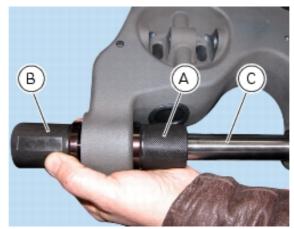
Insert the guide pin (C) into the previously mounted roller bearings and insert the other end in the bore in the tool (A).

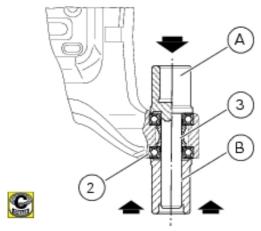


Drive the bearing (2) fully into the swingarm.

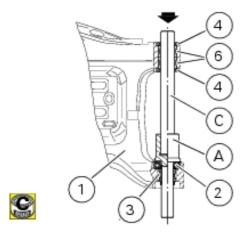
Fit the other new bearing (2) at the outer end of tool (A).

Using tool (A) as a stop, use tool (B) to drive the external bearing up against spacer (3): remove the tools.





Before refitting the swingarm (1), grease the ball bearings (2), roller bearings (6) and seals (4) with the recommended grease.

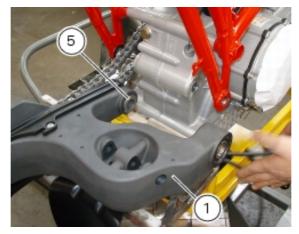


## Refitting the swingarm

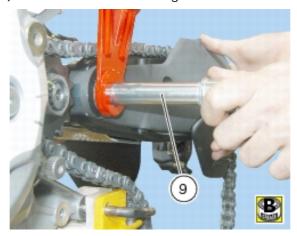
If the swingarm has been disassembled, reassemble it referring to the exploded view at the beginning of this chapter. Locate the swingarm assembly (1), making sure that spacers (7) and (8) are present on the RH side and that the bush (5) is present on the LH side.







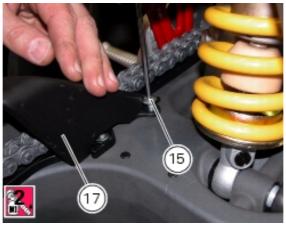
Lubricate the swingarm pivot shaft (9) with the recommended grease and insert it fully into the frame.



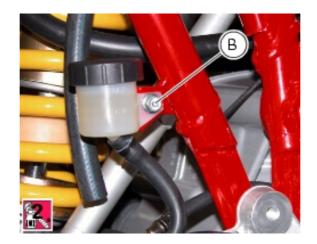
Lubricate the nut (10) with the recommended grease and screw it on the opposite end of the pivot shaft. Tighten the nut (10) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).



Fit the upper chain guard (17), feeding the drive chain through it; apply threadlocker to the bolts (15) and tighten them to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).

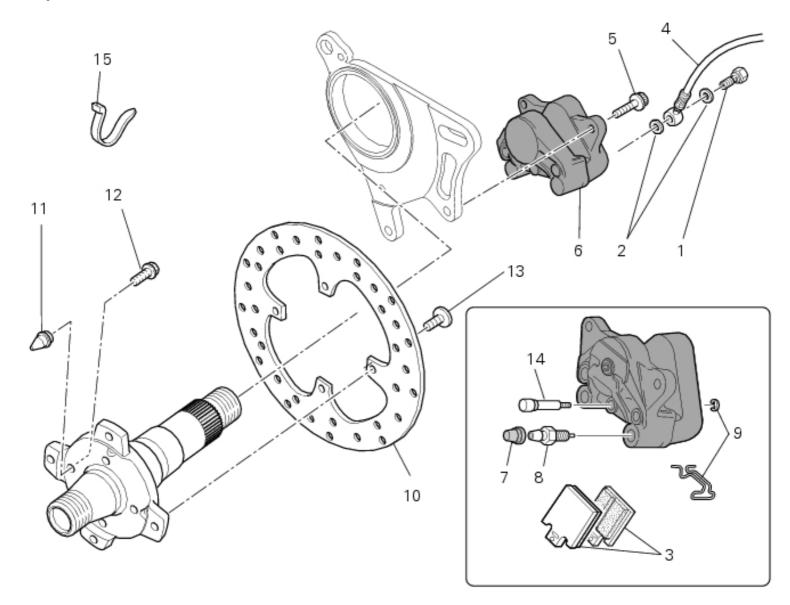


Reconnect the wiring connector (A) of the speed sensor and secure the rear brake fluid reservoir with the bolt (B) using the prescribed threadlocker.

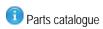


Operation	Section reference
Refit the shock absorber and tie-rod to the swingarm	G 7, Refitting the rear suspension
Refit the rear wheel	G 4, Refitting the rear wheel
Refit the rear brake caliper	G 6, Refitting the rear brake system
Refit the final drive assembly	G 8, Final drive
Adjust the drive chain tension	D 4, Adjusting the chain tension
Refit the footrest brackets	H 4, Refitting the footrest brackets

## 6 - Hydraulic rear brake



- 1 Banjo bolt
- 2 Sealing washer
- Pair of brake pads
- Rear brake hose
- 5 Bolt
- 6 Rear brake caliper
- 7 Dust cap
- 8 Bleed valve
- 9 Clip
- 10 Rear brake disc
- 11 Locating dowel
- 12 Bolt
- 13 Bolt
- 14 Pad retaining pin
- 15 Clamp



REAR WHEEL AXLE
REAR BRAKE



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

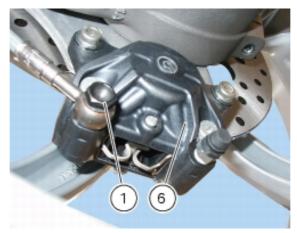
## Removal of the rear brake system

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

Operation	Section reference
j	F 4, Removal of the rear brake master cylinder
Remove the exhaust catalyser	L 8, Removal of the exhaust system

Rear brake caliper and master cylinder

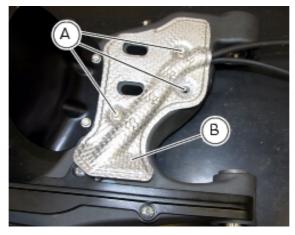
Unscrew and remove the banjo bolt (1) securing the hose (4) to the rear brake caliper and recover the sealing washers (2).



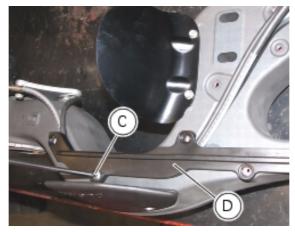


For the sake of clarity the following photos show the swingarm removed from the motorcycle, however all the operations described can also be carried out with the swingarm installed on the frame.

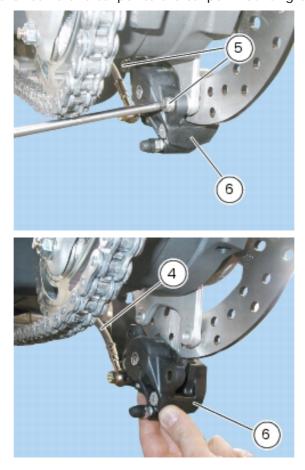
For the relative removal operations, refer to the exploded view in Sect. G 5, Rear swingarm. Unscrew the bolts (A) and remove the heat shield (B).



Unscrew the bolts (C) and remove the lower chain slider (D).



Remove the hose (4).
Unscrew the two bolts (5) securing the rear brake caliper to the caliper mounting bracket and remove the caliper (6).





Notes

See "Checking brake pad wear and changing brake pads" (Sect. D 4) for instructions on how to change the brake pads.



**Important** 

Critical safety components. The brake caliper manufacturer advises against servicing the internal components of calipers or the master cylinder. Incorrect overhaul of this component could endanger rider safety.

Only the following parts should be renewed:

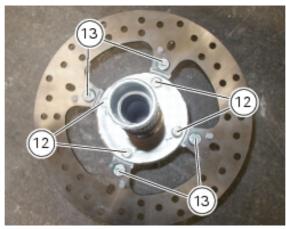
- brake caliper: pads, fasteners and bleed valve assembly;
- brake master cylinder: pedal, bleed valve assembly, reservoir and its parts (Sect. F 4, Rear brake control). Refer to the exploded view at the beginning of this section for indications on renewal of the above components.

Removal of the rear brake disc

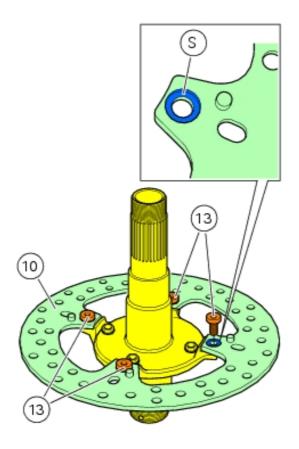
Operation Section reference

Remove the rear wheel	G 4, Removal of the rear wheel
Slacken off the drive chain	D 4, Adjusting the chain tension
Remove the rear sprocket	G 8, Removal of the rear sprocket
Remove the rear brake caliper	G 6, Removal of the rear brake system

Unscrew and remove the four bolts (13) securing the brake disc to the stub axle and remove the rear brake disc (10). If they are to be renewed, unscrew the bolts (12) from the hub and remove the locating pins (11). 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 Section C 1.1, Rear wheel for the brake disc wear tolerance limits.



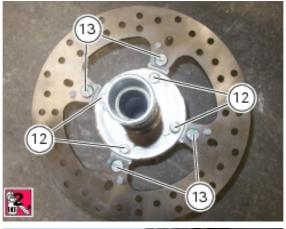


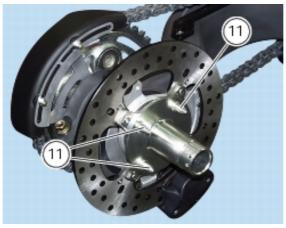


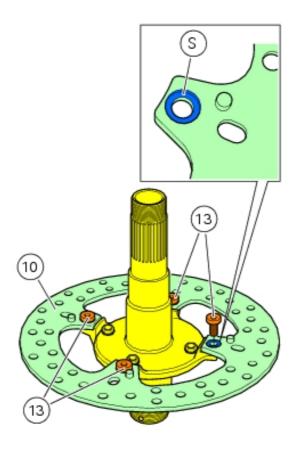
## Refitting the rear brake disc

Proceed with refitting of the rear brake disc (10). Install the brake disc (10), positioning it so that the countersinks (S) for the bolt heads are facing upwards.

Apply the recommended threadlocker and tighten the bolts (13) to the specified torque (Sect. C 3, <u>Frame torque settings</u>) in the sequence 1-2-3-4.







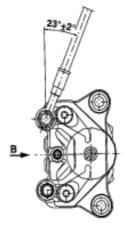
Operation	Section reference
Refit the rear brake caliper	G 6, Refitting the rear brake system
Refit the rear sprocket	G 8, Refitting the rear sprocket
Adjust the drive chain tension	D 4, Adjusting the chain tension
Refit the rear wheel	G 4, Refitting the rear wheel

### Refitting the rear brake system

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.

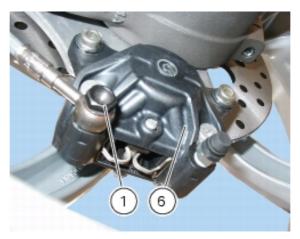


If incorrectly positioned, the hose can affect brake operation and foul moving parts. Position the hose as shown in the figure.



Fit the copper sealing washers (2) to either side of the hose end fittings when attaching the hose to the calipers and master cylinder.

After positioning the end fittings correctly, tighten the banjo bolts (1) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

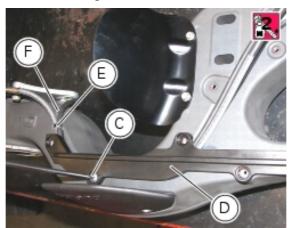




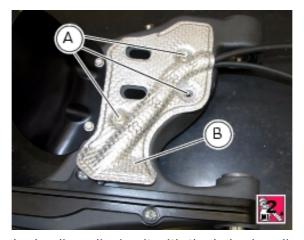
For the sake of clarity the following photos show the swingarm removed from the motorcycle, however all the operations described can also be carried out with the swingarm installed on the frame.

Position the rear brake hose (4) under the swingarm, securing it with the clip (E) to the speed sensor cable (F). Route the hose (4) and cable (F) through the slot in the swingarm.

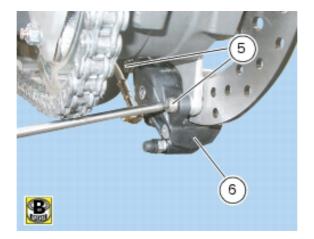
Fit the lower chain slider (D) with the bolts (C) using the recommended threadlocker.



Fit the heat shield (B) with the bolts (A), applying the recommended threadlocker, and tighten bolts (C) and (A) to the specified torque (Sect. C 3, Frame torque settings).

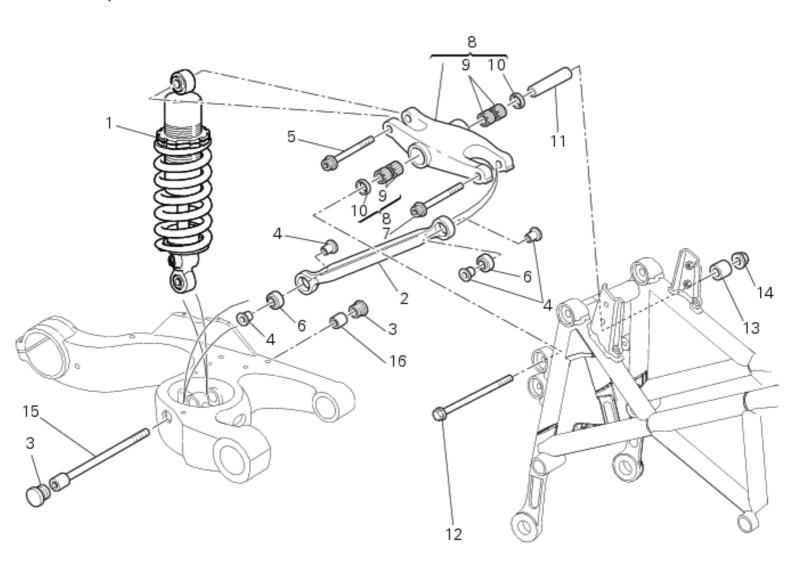


Fit the rear brake caliper (6) over the brake disc, aligning it with the holes in caliper mounting bracket. Apply grease to the bolts (5) and tighten to the specified torque (Sect. C 3, <u>Frame torque settings</u>).



Operation	Section reference
1, 7,	F 4, <u>Refitting the rear brake master</u> <u>cylinder</u>
Refit the catalyser	L 8, Refitting the exhaust system

## 7 - Rear suspension



- Shock absorber
- 2 Tie rod
- 3 Plug
- 4 Bush
- 5 Bolt
- 6 Ball joint
- 7 Bolt
- 8 Rocker arm
- 9 Roller bearing
- 10 Seal
- 11 Spacer
- 12 Bolt
- 13 Spacer
- 14 Nut
- 15 Bolt
- 16 Special nut



**REAR SUSPENSION** 



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

#### Rear suspension system

The rear suspension uses a fully adjustable progressive hydraulic monoshock (1). The system consists of an upper rocker arm (8) and a non-adjustable tie-rod (19), which is fixed to the single-sided swingarm.

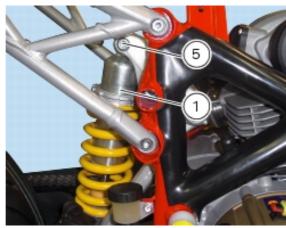
The swingarm pivots on the frame and the engine to achieve maximum rigidity; the rear end of the swingarm supports the eccentric wheel hub which allows chain tension adjustment.

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

#### Removal of the rear shock absorber

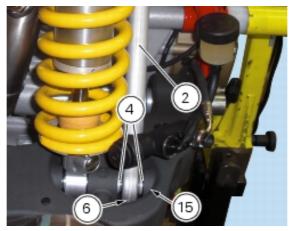
Operation	Section reference
Remove the presilencer	L 8, Removal of the exhaust system

To remove the rear shock absorber (1) from the swingarm and from the upper rocker arm, remove the rubber plug (3) and remove the upper bolt (5) and lower bolt (15).



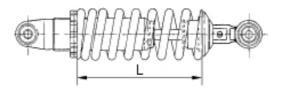


On removing the lower bolt (15), the lower ball-joint end fitting (6) of the tie-rod (2) is also released from the swingarm. Recover the threaded bush (16) and the bushes (4) located either side of the lower ball joint of the tie-rod.



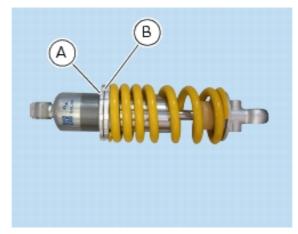
#### Overhauling the rear shock absorber

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 the locknut (A) and the 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

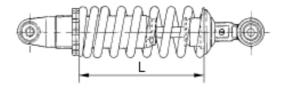
Fit the spring into its seat in the shock absorber with the tapered end towards the lower mounting. Refit the retaining ring (C).

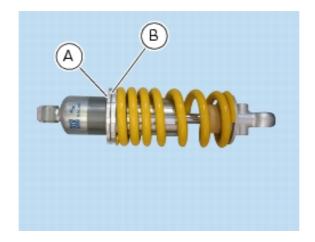
Screw in the spring adjuster nut (B) to obtain the previously measured length (L).



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).

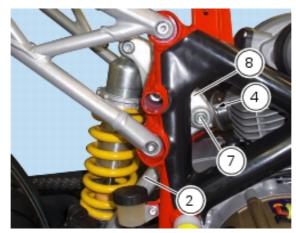




#### Removal of the rear suspension rocker arm

Disconnect the top of the rear shock absorber from the rocker arm as described in "Removal of the rear shock absorber" in this chapter.

Separate the linkage assembly (2) from the rocker arm (8) by undoing the bolt (7) and recover the bushings (6) at the sides of the ball joint (4).

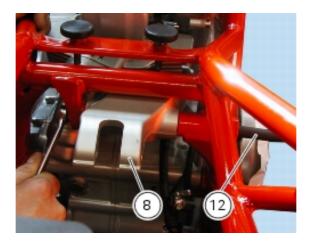


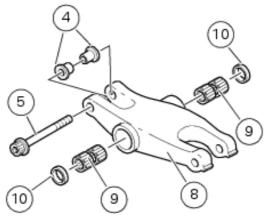
Before removing the rocker arm (8) from the frame, check the play of its internal needle roller bearings (9). Grasp the rear end of the rocker arm and push and pull it in all directions.

If excessive play is encountered, the bearings need to be renewed.

To remove the rocker arm (8) from the frame, unscrew the nut (14) and withdraw the spacer (13). Slide out the pivot bolt (12) and remove the rocker arm assembly (8) from the frame.







## Overhauling the rear suspension rocker arm

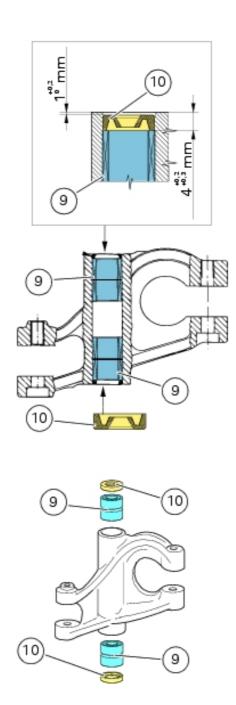
Disassembly of the rear suspension rocker arm

The rocker arm's movement is obtained by needle roller bearings (9) rotating on an inner spacer (13). Two seals (10) keep the lubricant inside the roller cages.

Remove the inner spacer (13) and remove the seals and the roller bearings using a drift with outside diameter  $\emptyset$  21.6 mm.

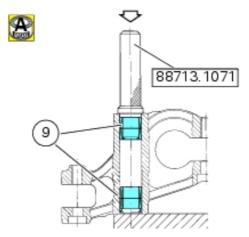


Take care not to damage the bearing housings on the rocker arm while driving out the bearings. Once disturbed, the seals (10) and needle roller bearings (9) may not be refitted.



Reassembly of the rear suspension rocker arm

Insert a new roller cage (9) on the service tool no. **88713.1071** and lubricate the rocker arm bore with the recommended grease.

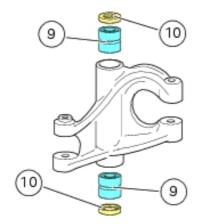


Support the rocker arm and drive the needle roller bearing into the rocker arm bore until the tool seats against rocker arm.



Make sure to drive the bearings perfectly square into the bore without jamming. Use a press, if necessary.

Fit a new seal (10) onto the drift with its metal side outermost. Seat it against the previously installed bearing (9). Repeat the above procedure for the other roller bearing (9) and the other seal (10).



Lubricate the bearings and seals with the recommended grease and insert the inner spacer (13).

#### Refitting the rear suspension

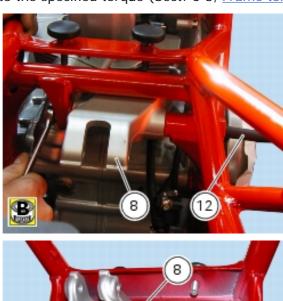
Lubricate the shank and thread of the bolt (12) and the underside of the head of the nut (14) with the recommended grease.

Insert the complete rocker arm assembly between the frame supports, as shown in the figure.

Drive the bolt (12) fully home against the frame.

Fit the washer (13) and the nut (14).

Restrain the nut and tighten the bolt to the specified torque (Sect. C 3, Frame torque settings).





Apply grease to the thread and under the head of the bolts (5) and (7) that secure the upper part of the shock absorber to the tie-rod and insert them in the rocker arm.

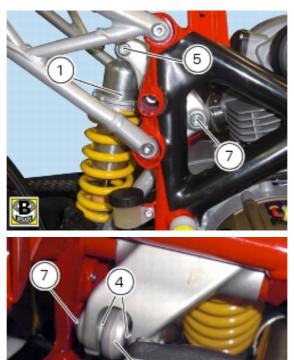
Position the shock absorber (1) with the reservoir at the top, on the left-hand side of the frame.

Insert the upper ball joint of the shock absorber, aligning it with the rear hole in the rocker arm.

Tighten the bolt (5) to the specified torque (Sect. C 3, Frame torque settings).

Install the bushes (4) on both the ball joint end fittings of the tie-rod (2).

Insert the upper end of the tie-rod in the rocker arm and tighten the bolt (7) to its specified torque (Sect. C 3, <u>Frame torque settings</u>).



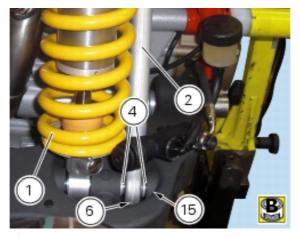
Insert the lower end of the shock absorber (1) and the tie-rod (2) in the swingarm.

Grease the sliding surface of the threaded bush (16) and insert it in the bore on the swingarm.

Grease the thread, underside and sliding surface of the lower retaining bolt (15) and insert it in the swingarm from the right-hand side.

2

Tighten the bolt (15) to the specified torque (Sect. C 3, Frame torque settings).

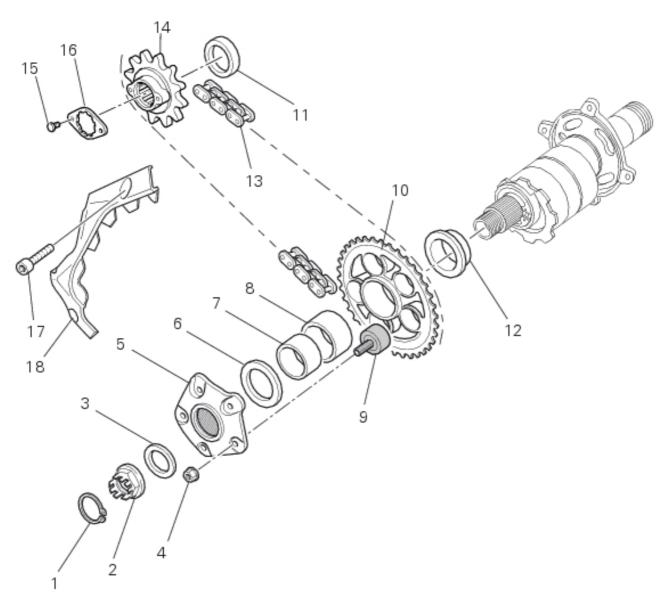


Refit the plug (3) in the bore on the swingarm.

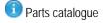


Operation	Section reference
Refit the presilencer	L 8, Refitting the exhaust system

## 8 - Final drive



- 1 Circlip
- 2 Nut with left-hand thread
- 3 Washer
- 1 Nut
- 5 Rear sprocket flange
- 6 Washer
- 7 Bush
- 8 Bush
- 9 Cush drive bush
- 10 Rear sprocket
- 11 Seal
- 12 Collar
- 13 Chain
- 14 Front sprocket
- 15 Bolt
- 16 Front sprocket retaining plate
- 17 Bolt
- 18 Front sprocket cover



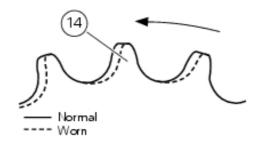
GEARBOX REAR WHEEL AXLE

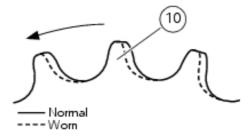


Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

#### Inspecting the final drive

To check wear of the final drive, carry out a visual inspection of the front sprocket (14) and the rear sprocket (10). If the teeth are found to worn as shown in the figure (dotted line), the sprocket must be renewed.

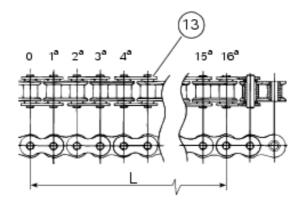




To check the amount of wear on the chain (13), keep the chain taut and measure 16 links. If the length (L) is greater than 254 mm, the chain should be renewed.



The rear sprocket (10), front sprocket (14) and chain (13) must all be renewed together.



#### Removal of the front sprocket

Remove the LH footrest bracket assembly as described in Section H 4, Removal of the footrest brackets. Undo the bolts (17) and remove the sprocket cover (18).

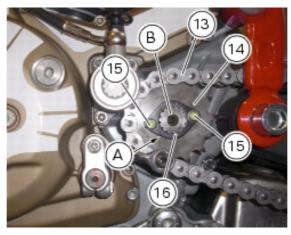


Slacken the chain (Sect. D 4, Adjusting the chain tension).

Engage a low gear and unscrew the two screws (15) on the sprocket retaining plate (16).

Remove the retaining plate (16) from the gearbox output shaft.

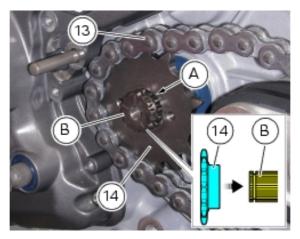
Slide the front sprocket (14) with the chain (9) off the gearbox output shaft and take the chain (13) off the sprocket.



#### Refitting the front sprocket

Check that the splines of the gearbox output shaft and the sprocket are in perfect condition. Hook the chain (13) onto the sprocket (14).

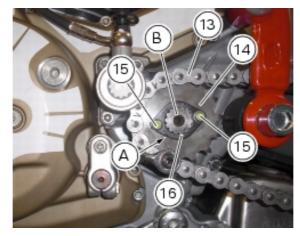
Install the front sprocket on gearbox output shaft (B) as shown in the figure. Push the sprocket beyond the groove (A).



Fit the sprocket retaining plate (16) to the gearbox output shaft (B) and turn it in the groove (A) until the holes in the plate (16) are aligned with the threaded holes in the sprocket (14): position the retaining plate with the rounded edge facing the sprocket.

Apply threadlocker to the threads of the screws (15).

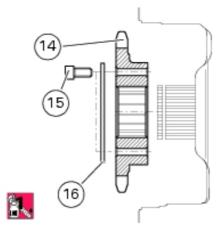
Engage first gear.



Tighten the screws (15) to the specified torque (Sect. C 3, Frame torque settings).



Adjust the chain tension as described in Section D 4, Adjusting the chain tension.



Fit the sprocket cover (18) and tighten the bolts (17) to the specified torque (Sect. C 3, Frame torque settings).



Renewal of the oil seal on the gearbox output shaft



For clarity, the figures show the engine removed from the frame. The procedure can also be carried out with the engine installed in the frame.

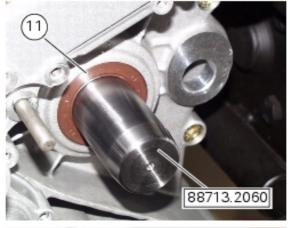
After removing the front sprocket as described previously, prise the oil seal (11) out of the crankcase with the aid of screwdriver.



The old oil seal and O-ring must be discarded and new ones fitted on reassembly.

Install the bush of service tool no. **88713.2060** on the output shaft. Lubricate the new oil seal (11) and press it into position.

Using the drift of the tool, drive the oil seal home so that seats against the crankcase bearing.





Refit the front sprocket as described in the previous paragraph.

## Removal 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 (1) from the nut (2).

Restrain the stub axle against rotation and, using a socket wrench, loosen the nut (2).





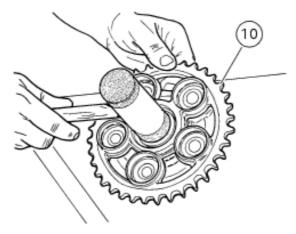
Fully unscrew the nut (2) and remove the washer (3) and the flange (5) complete with the rear sprocket.



Recover the collar (12).



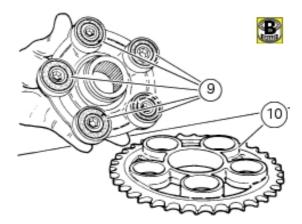
Using a mallet, tap the sprocket flange (5) with the cush drive bushes (9) off the sprocket (10).



Check the cush drive bushes (9) for signs of wear and, if necessary, remove from the sprocket flange and renew them.

## Refitting the rear sprocket

Refitting is the reverse of removal; ensure that all mating surfaces and the undersides of the retaining nuts (4) of the cush drive bushes (9) are lubricated with the recommended grease.



Check for wear following the instructions given at the beginning of this section.

Insert the rear wheel stub axle (C) in the hub (D).

Install the tapered spacer (6) on the axle (C), with the tapered side facing the axle, as shown in the figure.

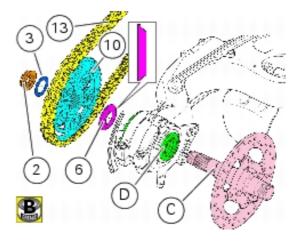
Fit the chain (13) to the rear sprocket (10), inserting the sprocket teeth in the chain links.

Fit the sprocket (10) on the axle.

Fit the washer (3) on the axle.

Apply grease to the axle thread and to the contact face of the nut (2).

Fit the nut and tighten it to the specified torque (Sect. C 3, Frame torque settings).





Install the safety clip (1), positioning it on the nut (2) as shown in the figure.



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 engine oil along the entire length of the chain both inside and outside (see specifications in Sect. C 2, Fuel, lubricants and other fluids).

# 0H - Impianto elettrico

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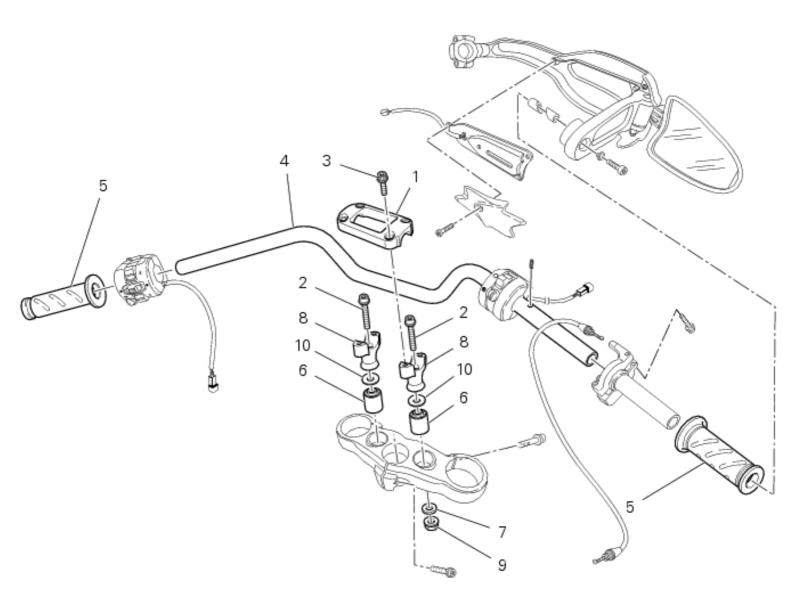
Removal of the number plate holder 47

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Refitting the rear turn signals 50

## 1 - Handlebar



- I Upper clamp
- 2 Bolt
- 3 Bolt
- 4 Handlebar
- 5 Grips
- 6 Spacer
- 7 Washer
- 8 Lower clamp
- 9 Nut
- 10 Washer



## **HANDLEBAR AND CONTROLS**



## Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

Removal of the handlebar

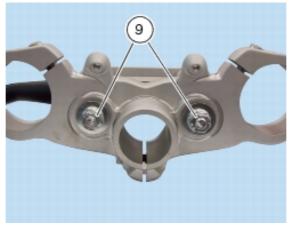
Operation	Section reference
Remove the LH and RH hand guards	E 1, Removal of the hand guards - rearview mirrors
Remove the throttle twistgrip	F 1, Removal of the throttle twistgrip
Remove the right-hand and left- hand handlebar switches	P 5, Checking the indicating devices
Remove the front brake lever	F 3, Removal of the front brake master cylinder
Remove the clutch lever	F 2, Removal of the clutch master cylinder assembly

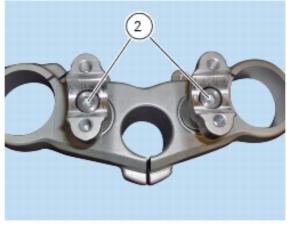
Unscrew and remove the bolts (3) securing the upper clamp (1). Remove the upper clamp (1).

Remove the handlebar (4) from its seat on the top yoke.

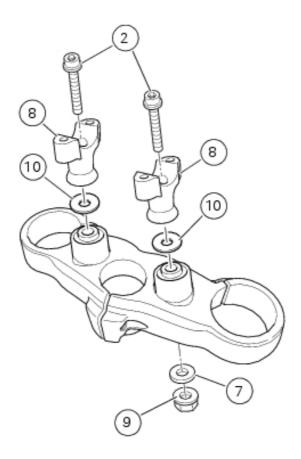


Slide the grips (5) off the handlebar (4). While counterholding the nuts (9), unscrew the bolts (2) and remove the lower clamps (8) from the top yoke.





Remove the bolts (2), the lower clamps (8) and the washers (7) and (10).

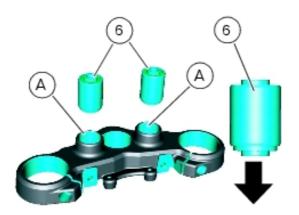


## Refitting the handlebar

Refit the grips (5) to the handlebar (4).

If the spacers (6) were removed from the top yoke, lubricate with silicone spray.

Seat the spacers (6) in the bores (A) in the top yoke, orienting them as shown in the figure.





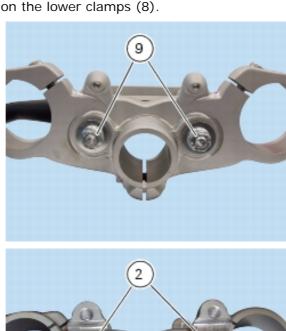
To drive in the spacers (6), use a drift that bears only on the outer ring (B) while applying a counterforce on zone (C) on the underside of the top yoke.

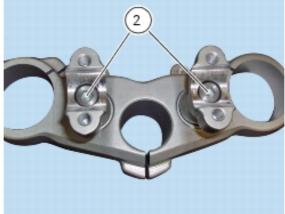
On completion of the operation, clean all excess lubricant from the components.

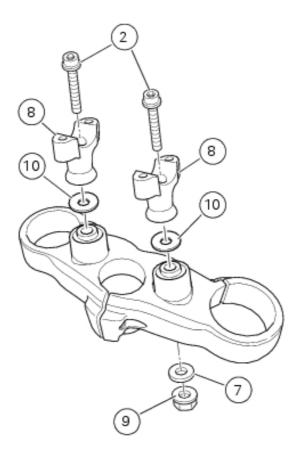
Handlebar



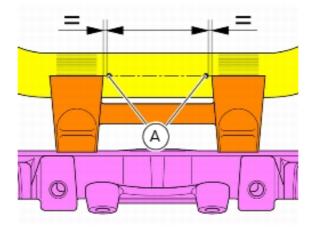
Locate the lower clamps (8) on the top yoke. Fit the bolts (2) in the clamps (8), screw on the nuts (9) complete with washers (7) and (10). Tighten the bolts (2) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>) while counterholding the nuts (9). Position the handlebar (4) in its seat on the lower clamps (8).







Position and orientate the handlebar so that the punch marks (A) are equidistant from the lower clamps and aligned with the faces of the clamps.

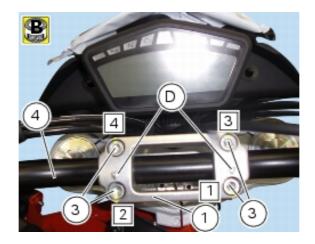


Apply the recommended grease to the threads and undersides of the heads of the bolts (3). Refit the upper clamp (1) and insert the bolts (3).



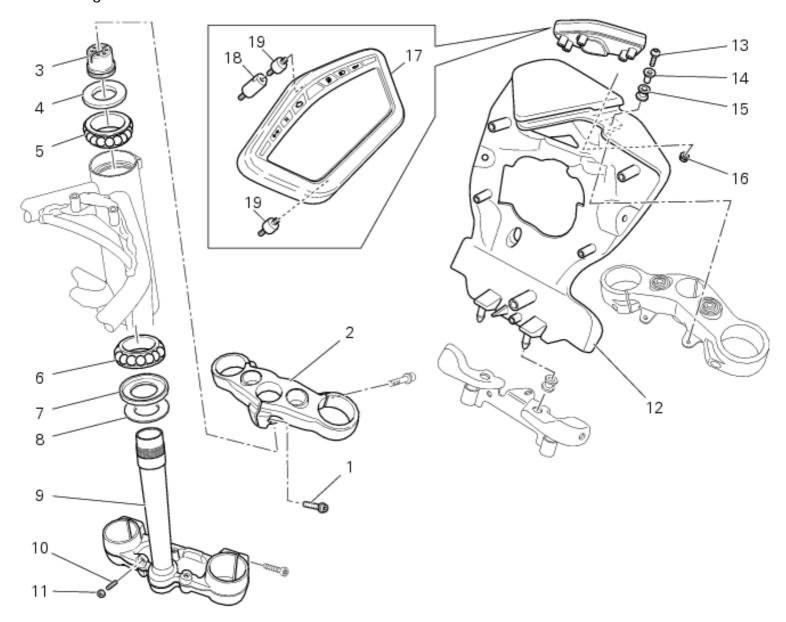
Position the upper clamp so that arrows (D) are pointing to the rear.

Tighten the bolts (3) to the specified torque (Sect. C 3, <u>Frame torque settings</u>) in the sequence 1-2-3-4-1-2, as shown in the figure.



Operation	Section reference
Refit the front brake lever	F 3, Refitting the front brake master cylinder
Refit the right-hand and left-hand handlebar switches	P 5, Checking the indicating devices
Refit the throttle twistgrip	F 1, Refitting the throttle twistgrip
Refit the clutch lever	F 2, Refitting the clutch master cylinder assembly
Refit the LH and RH hand guards	E 1, Refitting the hand guards - rearview mirrors

# 2 - Steering



- 1 Bolt
- 2 Top yoke
- 3 Nut
- 4 Seal
- 5 Bearing
- 6 Bearing
- 7 Seal
- 8 Washer
- 9 Bottom yoke
- 10 Adjuster screw
- 11 Nut
- 12 Headlight support
- 13 Bolt
- 14 Spacer
- 15 Rubber
- 16 Nut
- 17 Instrument panel
- 18 Bush
- 19 Rubber mounting



#### **HANDLEBAR AND CONTROLS**



**Important** 

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

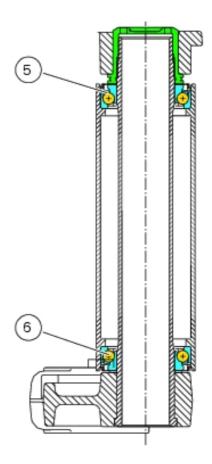
Adjusting the steering head bearings



Notes

See Section D 4, Adjusting the steering head bearings for adjustment of steering head bearing play.

If the steering head bearings cannot be adjusted correctly, check the bearings (5) and (6) for wear and, if necessary, renew them as described in "Removal of the steering head components" in this section.



Steering angle adjustment

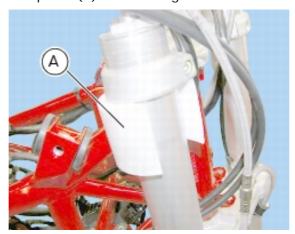
Loosen the nuts (11).

Loosen the adjuster screws (10) on both sides of the bottom yoke.



yoke, 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 (10) on the opposite side to bring it into contact with the stop on the steering head. Apply threadlocker to the thread of nut (11).

Hold the adjuster screw (10) firm and tighten the nut (11).

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 headlight fairing	E 1, Removal of the headlight fairing
Disconnect the instrument panel from the wiring loom	P 1, Routing of wiring on frame
Remove the fork legs	G 2, Removal of the front forks

Unscrew and remove the bolts (G) securing the upper clamp (H). Remove the upper clamp (H).

Remove the handlebar (L) from its seat on the top yoke.

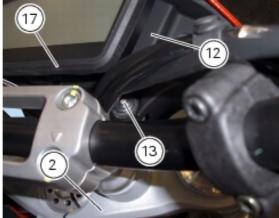




All parts fitted to the top and bottom yokes, including the wiring and control cables, can remain on the motorcycle provided they do not hinder the following operations.

It is possible to remove the instrument panel (17) by unscrewing the nuts (16). Remove the headlight support (12), unscrewing the bolts (13) securing it to the top yoke (2).



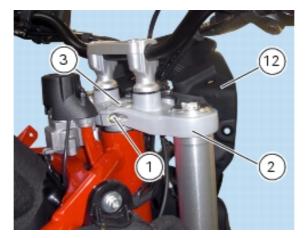




Withdraw the headlight support (12) towards the front and disconnect the headlight wiring (Sect. P 1, Routing of wiring on frame).

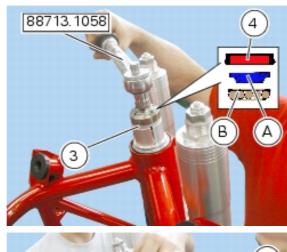
Remove the headlight support (12).

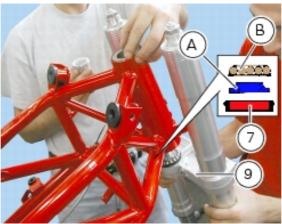
Loosen the bolt (1) securing the top yoke (2) to the steering stem nut (3). Remove the top yoke (2).



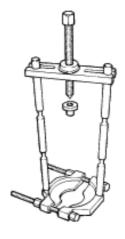
With the service tool no. **88713.1058** loosen the nut (3) and unscrew it from the steering stem. Slide the oil seal (4), the inner race (A) and the ball race (B) of the upper bearing (5) off the steering stem. Remove the bottom yoke (9) complete with the steering stem from the frame tube. Remove the ball race (B) of the lower bearing (6).

The inner race (A) of the lower bearing (6) and the relative oil seal (7) will remain on the steering stem.





Using a universal puller (see figure) remove the inner race (A) and the spacer (8) from the steering stem, taking care not to damage the seat.

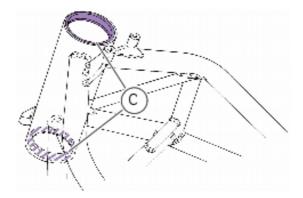


Steering



Once disturbed, the oil seals (4) and (7) and the bearings (4) and (6) 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

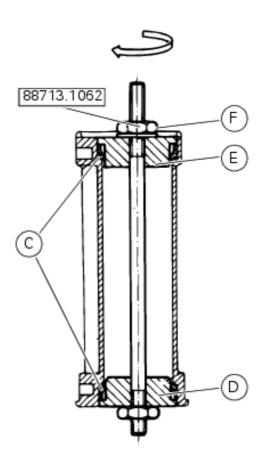
The steering head bearings (5) and (6) are identical but in no case may their components be swapped around during reassembly.

Clean all contact surfaces and lubricate with the recommended grease.



To fit the outer races (C) of the bearings (5) and (6) 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 (D, with threaded hole) of the tool into the lower race;
- fit the other movable bush (E) into the upper end of the tool and drive it fully home against the upper bearing race;
- tighten the nut (F) and use a wrench to seat the outer rings (C) in position in frame tube;
- leave the tool assembled until the steering head has cooled down to ensure that bearings are properly seated.



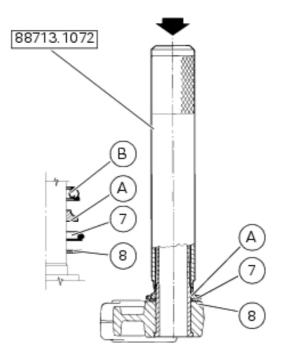
Insert the washer (8), oil seal (7) (with the rim facing upwards) and inner race (A) of bottom bearing (6) onto the steering stem after heating it for about 10 minutes to **120** °C.

Fit tool no. **88713.1072** into the steering stem. Keep the inner race (A) pressed against the dust seal (7) by hand for at least 15 seconds.

Lubricate the inner bearing race (A) with the recommended grease.

Fit the ball race (B) on the stem 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.

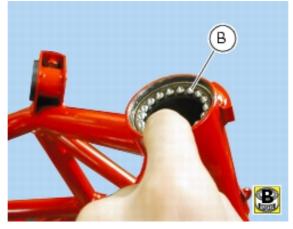




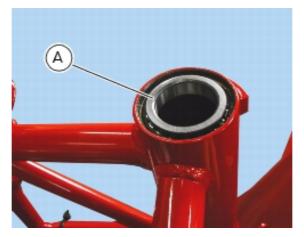
Fit the bottom yoke assembly (9) to the frame.



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 (5) to the steering head, with the larger diameter side of the race facing upwards.



Install the dust seal (4) with the flat side facing upwards.



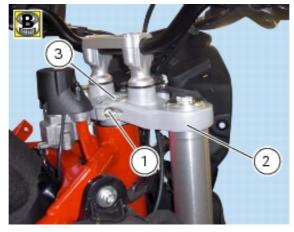
Grease adjusting ring nut (3) and tighten it by hand up against the oil seal (4). Fit service bush no. **88713.1058** to the steering stem nut (3) and fit the torque wrench to the bush. Tighten the steering stem nut (3) to the specified torque (Sect. C 3, Frame torque settings).



Fit the top yoke (2) on the steering stem nut (3), aligning the fork leg bores with the corresponding bores on the bottom yoke. Relocate the fork legs as described in Section G 2, <u>Refitting the front forks</u>.

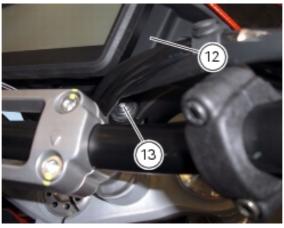
Grease the bolt (1).

Tighten the bolt (1) on the top yoke to the specified torque (Sect. C 3, Frame torque settings).



Reconnect the headlight wiring (Sect. P 1, Routing of wiring on frame).

Refit the headlight support (12) and tighten the bolts (13) to the specified torque (Sect. C 3, Frame torque settings).





with the shorter thread should be facing the instrument panel. Fit the bush (18) to the centre rubber, screwing it on by hand.

Locate the instrument panel (12) on the support and tighten the nuts (16).





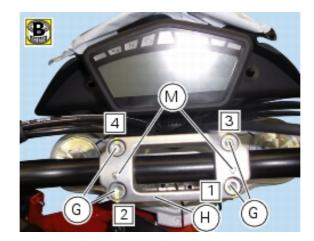
Apply the recommended grease to the threads and undersides of the heads of the bolts (G). Refit the clamp (H) and insert the bolts (G).



Notes

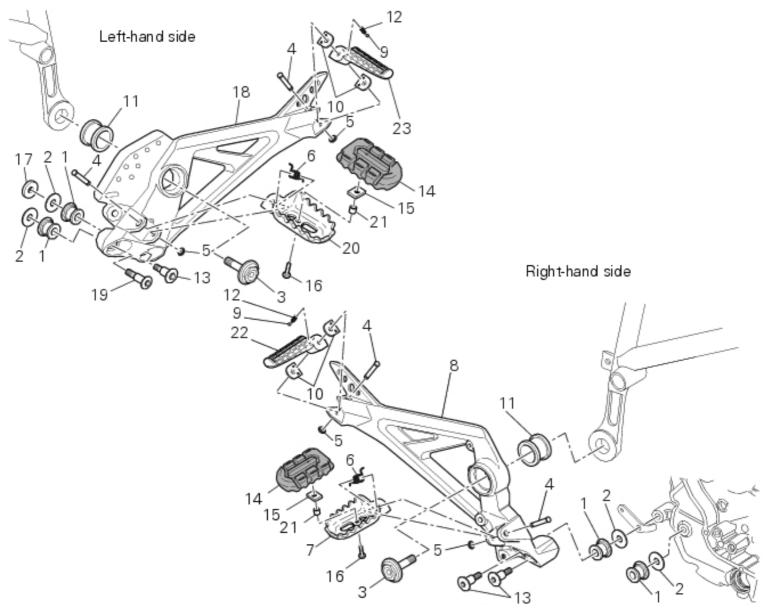
Position the upper clamp so that arrows (M) are pointing to the rear.

Tighten the bolts (G) to the specified torque (Sect. C 3, <u>Frame torque settings</u>) in the sequence 1-2-3-4-1-2, as shown in the figure.



Operation	Section reference
Refit the headlight fairing	E 1, Refitting the headlight fairing
Connect the instrument panel to the main wiring loom	P 1, Routing of wiring on frame
Refit the fork legs	G 2, Refitting the front forks

# 4 - Footrest brackets



- 1 Rubber mounting
- 2 Washer
- 3 Bolt
- 4 Pin
- 5 Ring6 Spring
- 7 Right front footrest
- 8 Right footrest bracket
- 9 Ball
- 10 Plate
- 11 Rubber mounting
- 12 Spring
- 13 Bolt
- 14 Footrest rubber
- 15 Plate
- 16 Bolt
- 17 Washer
- 18 Left footrest bracket
- 19 Bolt
- 20 Left front footrest
- 21 Bush
- 22 Right rear footrest
- 23 Left rear footrest

Footrest brackets



# R.H. FOOTRESTS L.H. FOOTRESTS



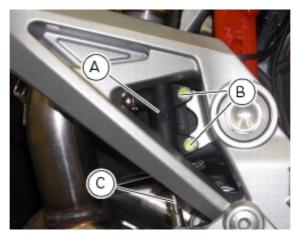
## **Important**

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

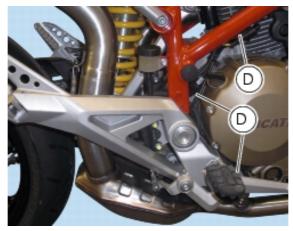
#### Removal of the footrest brackets

The following removal operations apply to both left and right footrest brackets.

Remove the rear brake master cylinder (A) by unscrewing the bolts (B): slide the master cylinder (A) off the pushrod (C).

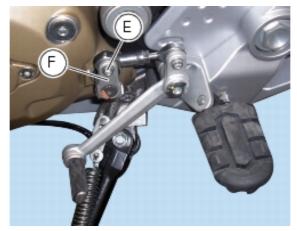


Disconnect the rear brake sensor (D) from the main wiring harness.





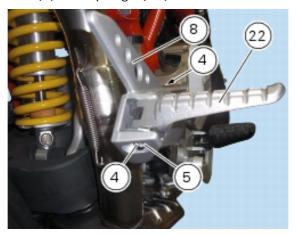
To remove the left-hand footrest brackets, unscrew the bolt (E) securing the gearchange control (F) to the engine and leave the gearchange assembly attached to the bracket.

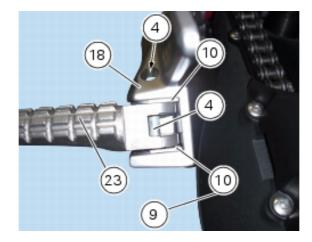


Unscrew the bolts (13), bolt (19) securing the brackets to the engine block. Recover the washers (2) and (17). Unscrew the two bolts (3) securing the bracket to the frame.

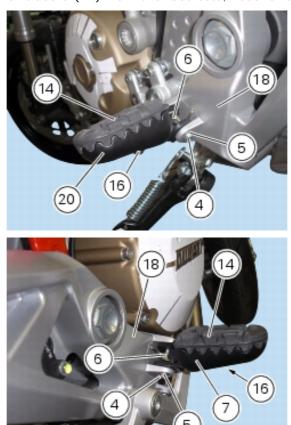


To detach the rear footrests (22) and (23) from the footrest brackets (8) and (18), remove the circlip (5) and pin (4) to release the footrests, plates (10), balls (9) and springs (12).





To disassemble the front footrests (20) and (7), separate them from the brackets (18) and (8). Remove the clip (5) and withdraw the pivot pin (4) to release the footrests and the spring (6). Unscrew the bolts (16) an separate the rubbers (14) from the footrests; recover the plates (15) and the bushes (21).





The footrests may also be removed with the footrest brackets installed on the motorcycle.

#### Refitting the footrest brackets

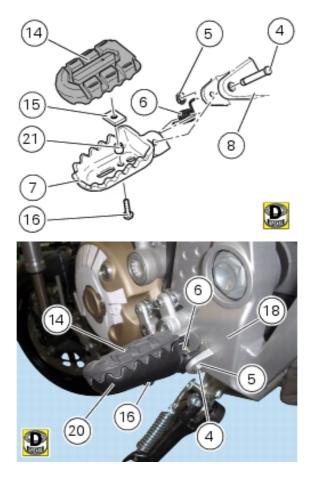
The refitting procedure described below applies to the footrest brackets on both sides of the motorcycle. For the front footrests (20) and (7), locate the bushes (21) and the plates (15), fit the rubbers (14) to the footrests and tighten the bolts (16) to the specified torque (Sect. C 3, Frame torque settings).

Position the springs (6) on the footrests as shown in the figure.

Insert the end of the springs in the holes in the brackets.

Grease the pin (4).

Insert the pin (4) from the top, securing it on the other side with the circlip (5).



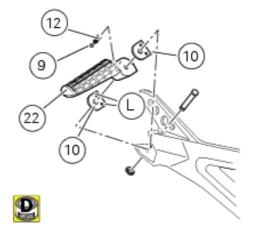
For the rear footrests (22) and (23), insert the springs (12) in the brackets as shown in the figure. Locate the balls (9) on the spring. Position the plates (10) on the footrest brackets as shown in the figure.

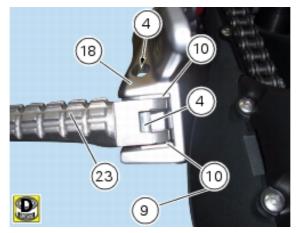


The side of the plate with the countersinking to the holes (L) must face the footrest bracket.

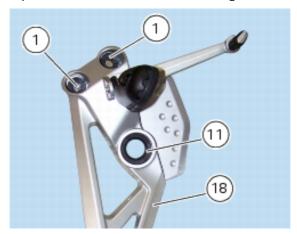
Push against the plates to allow insertion of the footrest with the spring and ball in the footrest brackets (8) and (18). Grease the pin (4).

Insert the pin and secure it with the circlip (5).





Check the condition of rubber mountings (1) and (11) in the footrest brackets (8) and (18). If new rubber mountings (1) are fitted, position them as shown in the figure.



Locate the right footrest bracket (8) in correspondence with the fixing points on the engine crankcase using washers (2).

Apply the recommended rubber assembly lubricant to bolts (13).

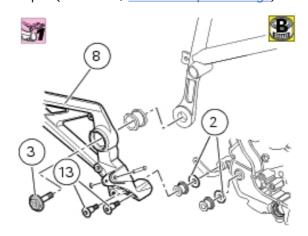
Insert the bolts (13).

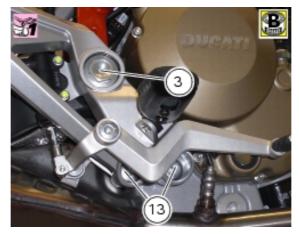
Apply the recommended grease to the bolt (3).

Insert the bolts (3).

Tighten the bolts (13) to the specified torque (Sect. C 3, Frame torque settings).

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





Locate the right footrest bracket (18) in correspondence with the fixing points on the engine crankcase using washers (2) and (17).

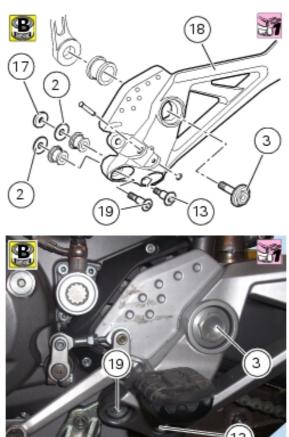
Apply the recommended rubber assembly lubricant to bolts (13) and (19).

Insert the bolts (13) and (19).

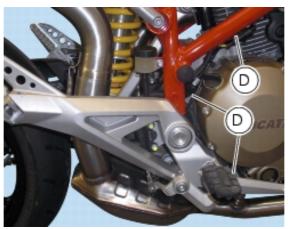
Apply the recommended grease to the bolt (3).

Tighten the screws (13) and (19) to the specified torque (Sect. C 3, Frame torque settings).

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



Reconnect the rear brake sensor (D) to the main wiring harness.

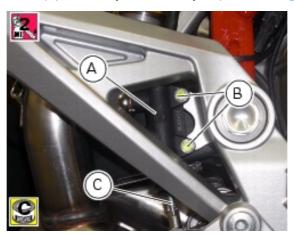




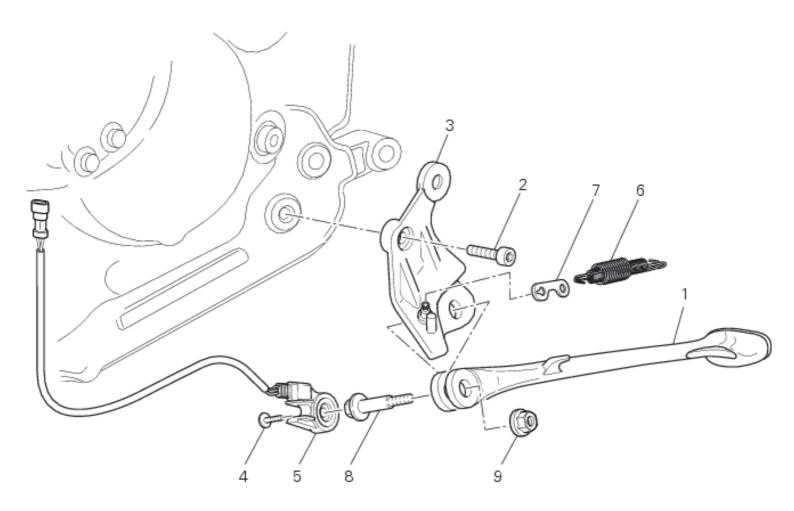
Fix the gearchange control to the engine crankcase, applying threadlocker to the bolt (E) and tightening it to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



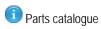
Grease the end of pushrod (C) and insert it in rear brake master cylinder (A). Apply the recommended threadlocker to the bolts (B). Tighten the master cylinder retaining bolts (B) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



# 5 - Sidestands



- 1 Sidestand
- 2 Bolt
- 3 Bracket
- 4 Bolt
- 5 Switch
- 6 Spring
- 7 Plate
- 8 Pivot bolt
- 9 Nut



## **STANDS**



## Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

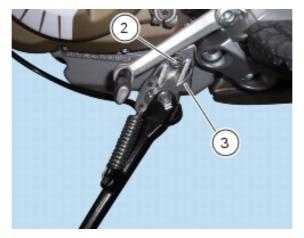
Removal of the sidestand

Operation	Section reference
Remove the left-hand footrest	H 4, Removal of the footrest brackets
bracket assembly	

Disconnect the wiring connector of sidestand switch (5) from the main wiring loom (refer to Sect. P 1, Routing of wiring on frame).

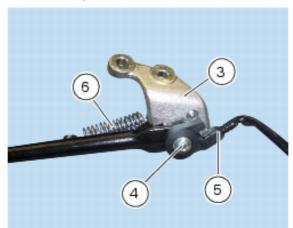


Unscrew the bolt (2) securing the sidestand bracket (3) to the engine and remove the complete sidestand assembly, recovering the washers (11).

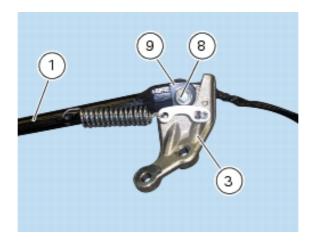


#### Disassembly of the sidestand

Unscrew the retaining bolt (4) and remove the sidestand switch (5). Detach the sidestand return springs (6) from the pivot bolt located on the bracket (3) and remove them.



Unscrew the pivot bolt (8) securing the sidestand to the bracket and remove the sidestand (1) and the nut (9).



#### Inspecting the sidestand

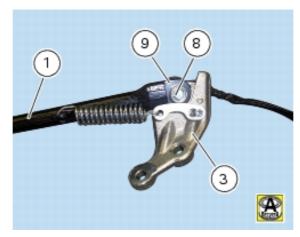
Fit the sidestand leg to the bracket and check that there is no excessive play. Ensure that the ends of the sidestand are not bent with respect to the shank.

A stand which shows signs of cracking must be renewed immediately.

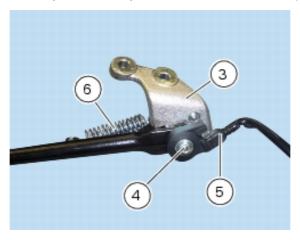
For details of how to test the switch (5), see Section P 6, Checking protection and safety device components.

#### Reassembly of the sidestand

Grease the sidestand leg (1) and fit it to the bracket (3). Secure it with pivot bolt (8) and the nut (9). Tighten the pivot bolt (8) to the specified torque (Sect. C 3, Frame torque settings).

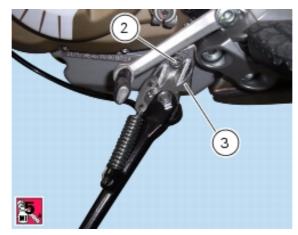


Position the sidestand return springs (6) and attach them to bracket (3) and stand leg (1). Locate the switch (5) on the bracket so that is seats against the pivot bolt (8). Fit the retaining bolt (4) and tighten to the specified torque (Sect. C 3, Frame torque settings).

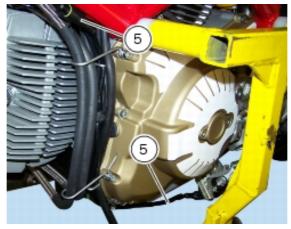


#### Refitting the sidestand

Apply the recommended threadlocker to the bolt (2). Locate the sidestand bracket (3) on the frame and insert the bolt (2). The bolt (2) must be tightened after refitting the left-hand footrest bracket.

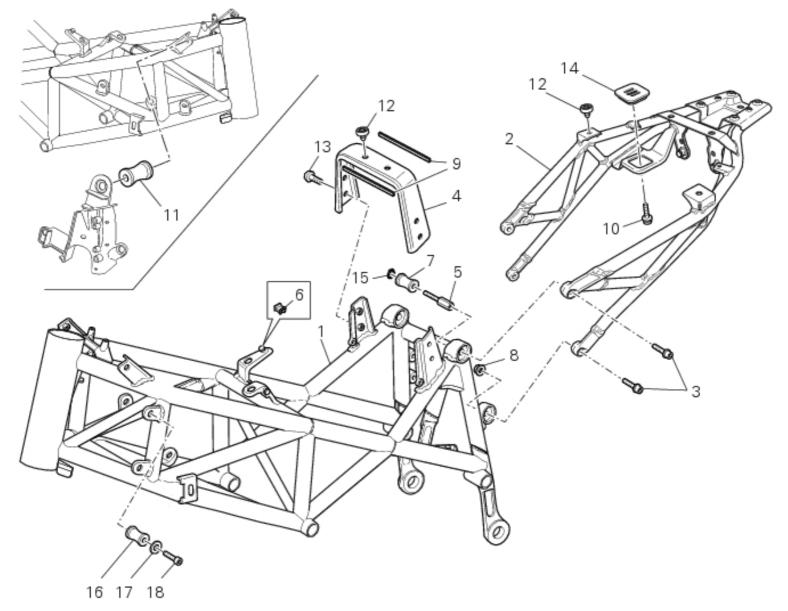


Refit the left-hand footrest bracket (Sect. H 4, <u>Refitting the footrest brackets</u>). Connect the sidestand switch wiring connector (5) to the main wiring loom.

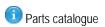


For correct routing of the sidestand switch wiring, refer to the diagrams in Section P 1, Routing of wiring on frame.

# 6 - Frame inspection



- Frame
- 2 Rear subframe
- 3 Bolt
- 4 Bracket
- 5 Pin
- 6 Clamp
- 7 Spacer
- 8 Nut 9 Rubber
- 10 Bolt
- 11 Rubber mounting
- 12 Rubber
- 13 Bolt
- 14 Rubber
- 15 Circlip
- 16 Rubber mounting
- 17 Washer
- 18 Bolt



**FRAME** 



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in 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.

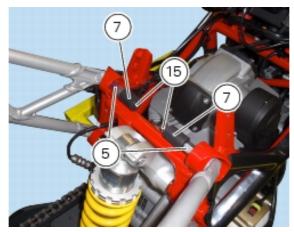
The structural component of the frame (1) is the subframe (2).

The subframe (2) serves to support motorcycle superstructures and must therefore be in perfect condition.

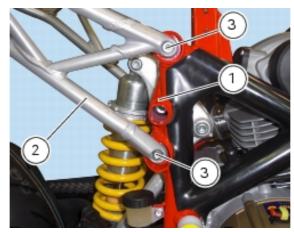
#### Removal of the rear subframe

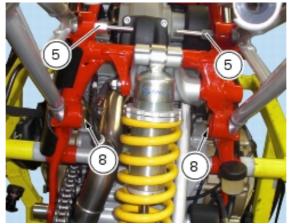
Disconnect all the wiring connections (Sect. P 1, Routing of wiring on frame) and remove the silencer (Sect. L 8, Removal of the exhaust system).

Remove the circlips (15) and the rubber spacers (7) from the pins (5).



Unscrew the bolts (3) and (5) securing the rear subframe (2) to the frame (1). Separate the rear subframe (3) from the main frame. Recover nuts (8) and pins (5).





Frame inspection

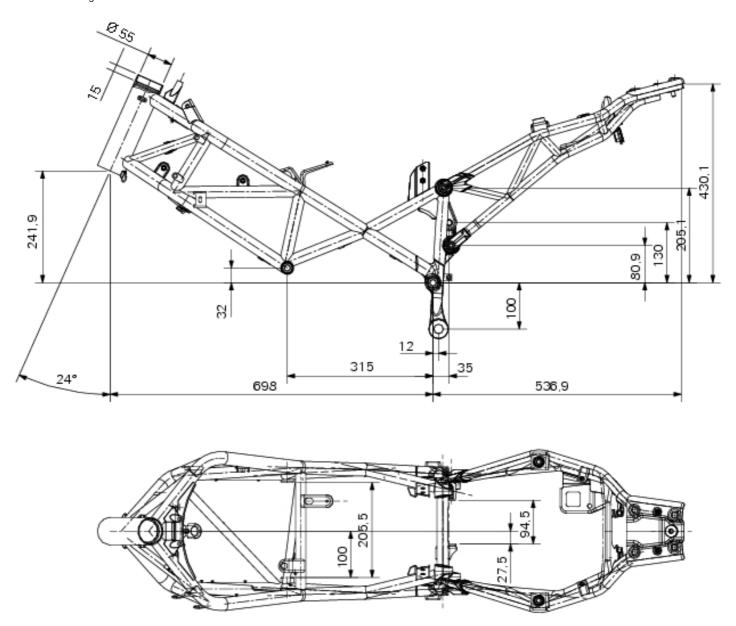
Check the dimensions of the frame against the dimensions shown here to determine whether it needs to be realigned or renewed.



## Important

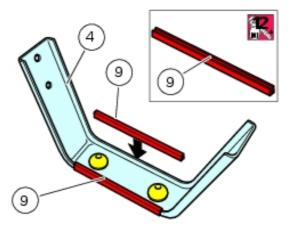
Badly damaged frames must be renewed and not repaired. Any work carried out on the frame can give rise to potential danger, infringing the requirements of EC directives concerning manufacturers' liability and general product safety.

Frame dimensional diagram

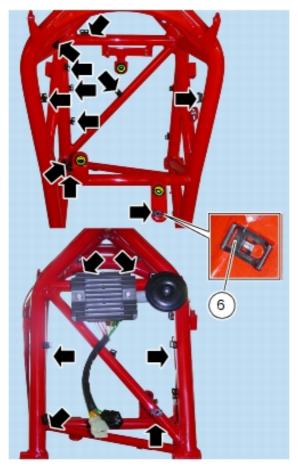


Reassembly of structural components and the frame

If the two rubber strips (9) have been removed from the bracket (4), apply the recommended threadlocker to the grooves in the rubber strips (9) and fit them to the seat support brcket as shown in the figure.

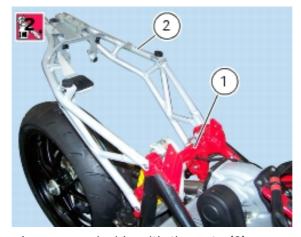


Check that the clips (6) are installed on the frame.

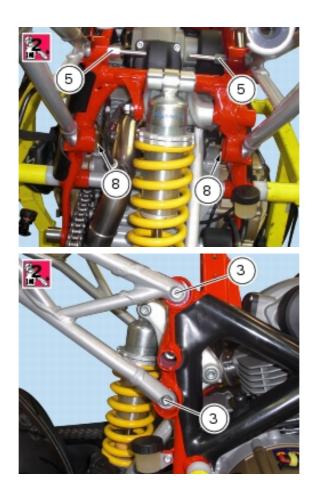


Refitting the rear subframe

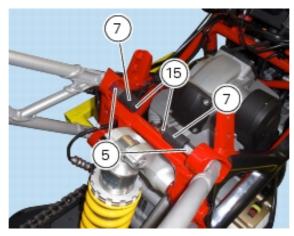
Locate the rear subframe (2) on the mountings on the frame (1).



Insert the pins (5) from the outside and secure on inside with the nuts (8).

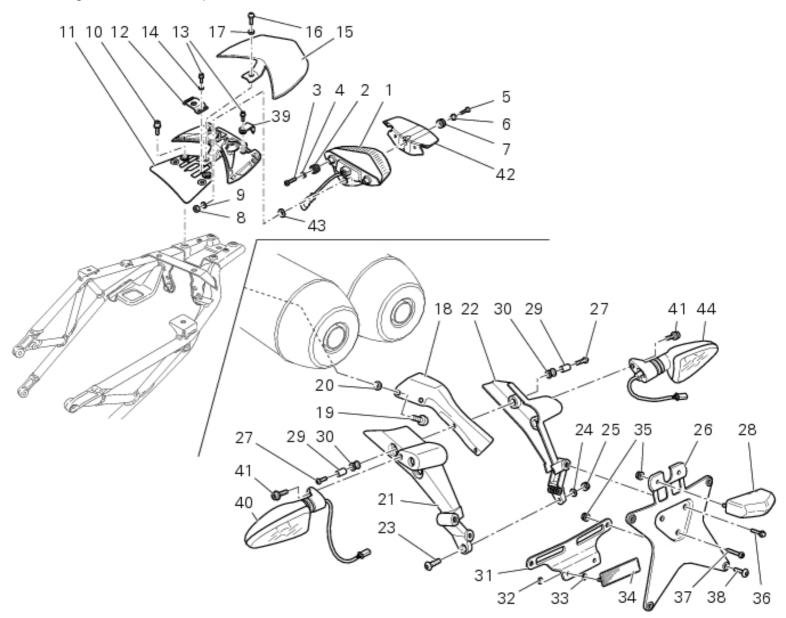


Fit the rubber spacers (7) to the pins (5) and secure then with the circlips (15). Tighten the bolts (3) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



Reconnect the wiring connections (Sect. P 1, <u>Routing of wiring on frame</u>) and refit the silencer (Sect. L 8, <u>Refitting the exhaust system</u>).

# 7 - Tail light and number plate holder



- 1 Tail light
- 2 Rubber mounting
- 3 Washer
- 4 Bolt
- 5 Bolt
- 6 Spacer
- 7 Rubber
- 8 Nut
- 9 Washer
- 10 Bolt
- 11 Tail light support
- 12 Plate
- 13 Bolt
- 14 Washer
- 15 Cover
- 16 Bolt
- 17 Washer
- 18 Bracket
- 19 Bolt
- 20 Washer
- 21 Left-hand support
- 22 Right-hand support
- 23 Bolt
- 24 Washer

- 25 Nut
- 26 Number plate holder
- 27 Bolt
- 28 Number plate light
- 29 Spacer
- 30 Rubber mounting
- 31 Plate
- 32 Quick-release fastener
- 33 O-ring
- 34 Reflector
- 35 Nut
- 36 Bolt
- 37 Bolt
- 38 Bolt
- 39 Plate
- 40 Left turn signal
- 41 Bolt
- 42 Heat shield
- 43 Washer
- 44 Right turn signal



## NUMBER PLATE HOLDER

Seat - Tail light



#### **Important**

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

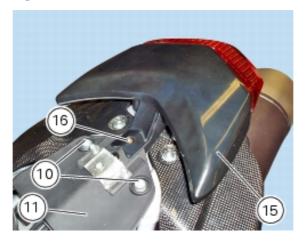
#### Removal of the tail light

Operation	Section reference
Remove the seat	E 3, Removal of the seat

Unscrew the bolt (16) and remove the cover (15).

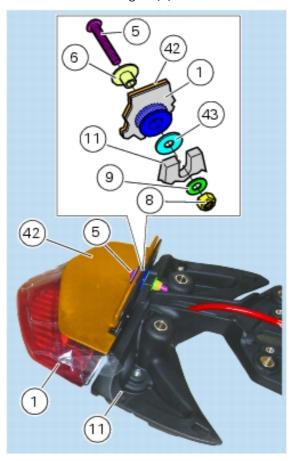
Recover the washer (17).

Unscrew the bolts (10) securing the tail light support (11) to the frame, slightly raise the support and disconnect the tail light (A) (Sect. P 1, Routing of wiring on frame).





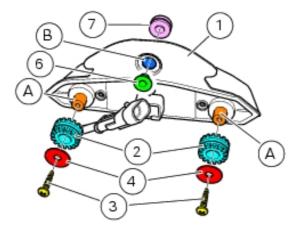
Unscrew the bolt (5) and the nut (8) o release the headlight (1) with the heat shield (42) from the support (11).



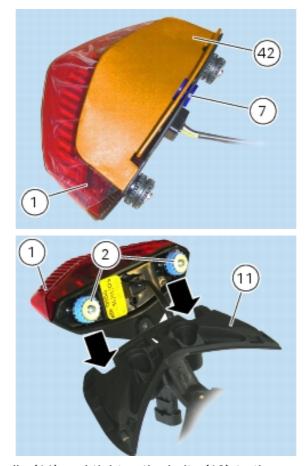
### Refitting the tail light

If removed, fit the silicone vibration dampers (2) on the bosses (A) on the tail light (1). Fit the washers (4) on the bolts (3), insert the bolts in the bosses, and tighten to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).

Insert a vibration damper (7) in hole (B). Insert a bush (6) in rubber bush (7), positioning it as shown.

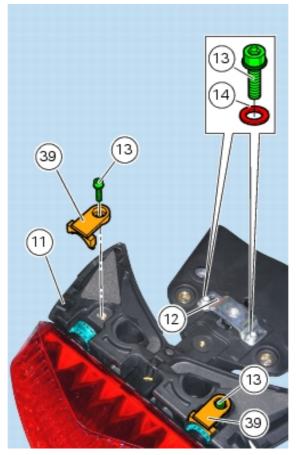


PLocate the heat shield (42) on the tail light (1), using the rubber bush (7) to connect the two parts. Fit the tail light (1) on the rear grab handle (11), locating the vibration dampers (2) in the slots in the grab handle indicated by the arrows.



Fit the brackets (39) to the grab handle (11) and tighten the bolts (13) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

Fit the washers (14) on the bolts (13). Fit the seat slide plate (12) and screw in the bolts (13), but do not tighten at this stage: the bolts will be tightened once the correct position of the slide relative to the seat has been identified.



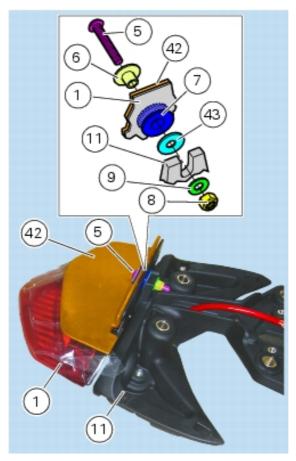
Fix the tail light (1) with the heat shield (42) to the grab handle (11), as described below. Insert a bush (6) in the rubber bush (7).

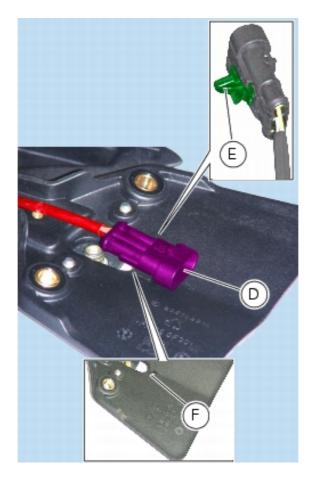
Insert a bolt (5) in the bush (6), interposing a washer (43) between the tail light and the grab handle.

Fit a washer (9) on the bolt (5).

Fit a nut (8) to bolt (5) and tighten bolt (5) to the specified torque (Sect. C 3, <u>Frame torque settings</u>) while counterholding the nut (8).

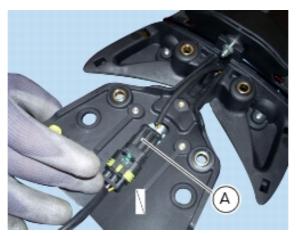
Position the wiring (C) as shown in the figure, and fit the connector (D) inserting clip (E) in hole (F) of the rear grab handle (11).





Connect the tail wiring (A), fix the tail light support (11) to the frame with bolts (10) and tighten the bolts to the specified torque (Sect. C 3, Frame torque settings).

Fix the cover (15) with the bolt (16) and washer (17) and tighten to the specified torque (Sect. C 3, <u>Frame torque settings</u>).



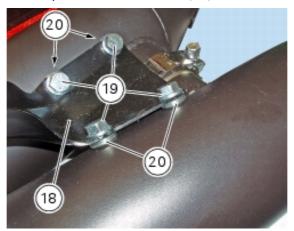




Operation	Section reference
Refit the seat	E 3, Refitting the seat

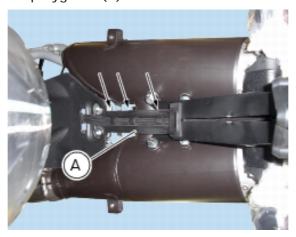
### Removal of the number plate holder

Unscrew the bolts (19) securing the number plate holder bracket (18) to the silencers, recovering washers (20).



Reconnect the turn signal and number plate light wiring connectors to the main wiring loom (Sect. P 1, Routing of wiring on frame).

Release the wiring from the clips on the sprayguard (A).

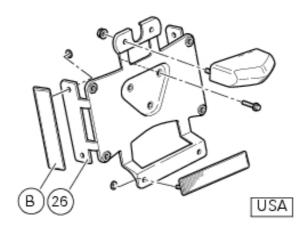


Remove the number plate holder assembly

For disassembly of the number plate holder, refer to the exploded view at the beginning of this section.



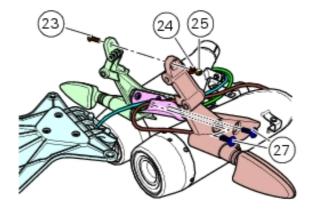
On the USA version, plate (26) has a different design and there is a bracket with side reflectors (B).



### Refitting the number plate holder

For reassembly of the number plate holder, refer to the exploded view at the beginning of this section, in particular: tighten the bolts (27) and bolt (23), while counterholding nut (25), to the specified torque (Sect. C 3, <u>Frame torque</u>

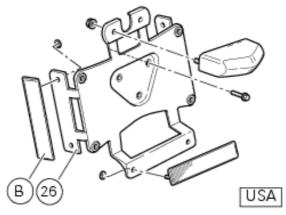
- settings);
- make sure that the wiring is correctly positioned inside the number plate holder bracket;
- tighten the bolts (36) and (37) to the specified torque (Sect. C 3, Frame torque settings).







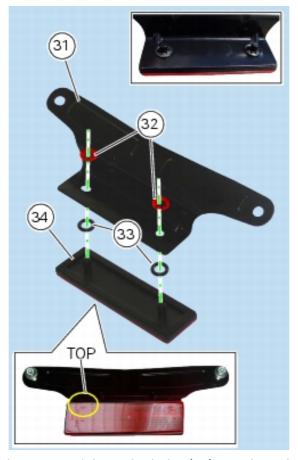
On the USA version, plate (26) has a different design and there is a bracket with side reflectors (B).



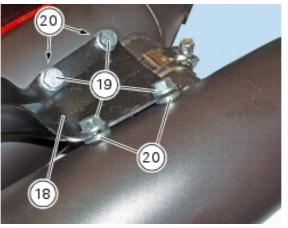
If the reflectors were removed, fit the O-rings (33) on the reflector (34). Fit the reflector on the bracket (31), with the word TOP towards the top. Secure the reflector oth quick-rlease fasteners (32), orienting them as show in the figure.

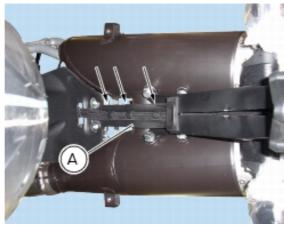


The O-rings (33) are only present on the EUROPA version.



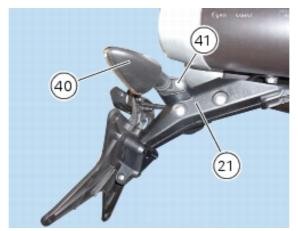
Refitting is the reverse of removal: take care to tighten the bolts (19) evenly and gradually, keeping the distances between the four fixing points on the plate and the silencers equal at all times. Tighten the bolts in a criss-coss sequence to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>). Locate the wiring in the clips on the sprayguard (A).

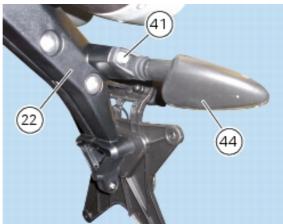




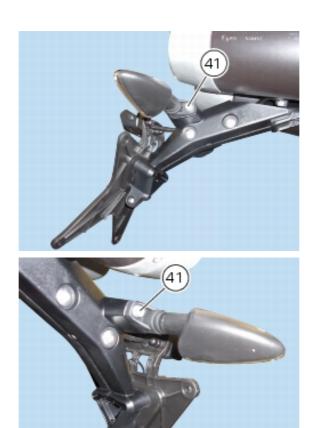
### Removal of the rear turn signals

To remove the rear turn signals (40) and (44), unscrew the bolts (41) and withdraw the wiring from supports (21) and (22).





### Refitting the rear turn signals



# OL - Impianto elettrico

# 2 - Fuel tank 3

Removal of the fuel tank 4
Removal of the fuel tank filler cap 8
Refitting the fuel tank filler cap 8
Removal of the fuel tank flange 10
Refitting the fuel tank flange 11
Refitting the fuel tank 12

# 6 - Throttle body 23

Removal of the throttle body 24
Refitting the throttle body 28

## 7 - Air intake 33

Removal of the airbox 34
Removal of the oil breather valve 39
Refitting the oil breather valve 39
Refitting the airbox 40

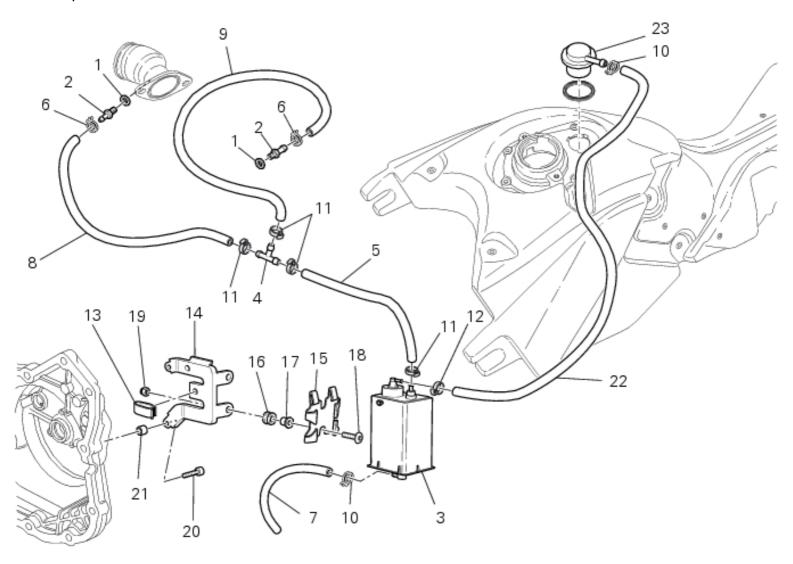
# 8 - Exhaust system 45

Removal of the exhaust system 46
Refitting the exhaust system 50

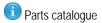
# 10 - Evaporative emissions canister 54

Evaporative emissions canister system (USA versions only) 55
Removal of the evaporative emissions canister 56
Refitting the evaporative emissions canister 57

# 10 -Evaporative emissions canister



- 1 Sealing washer
- 2 Union
- 3 Evaporative emissions canister
- 4 Union
- 5 Hose
- 6 Clamp
- 7 Hose
- 7 11030
- 8 Hose9 Hose
- 10 Clamp
- 11 Clamp
- 12 Clamp
- 13 Support
- 14 Bracket
- 15 Canister plate
- 16 Rubber
- 17 Spacer
- 18 Bolt
- 19 Nut
- 20 Bolt
- 21 Spacer
- 22 Hose
- 23 Breather valve



Fuel tank

#### Evaporative emissions canister



### Important

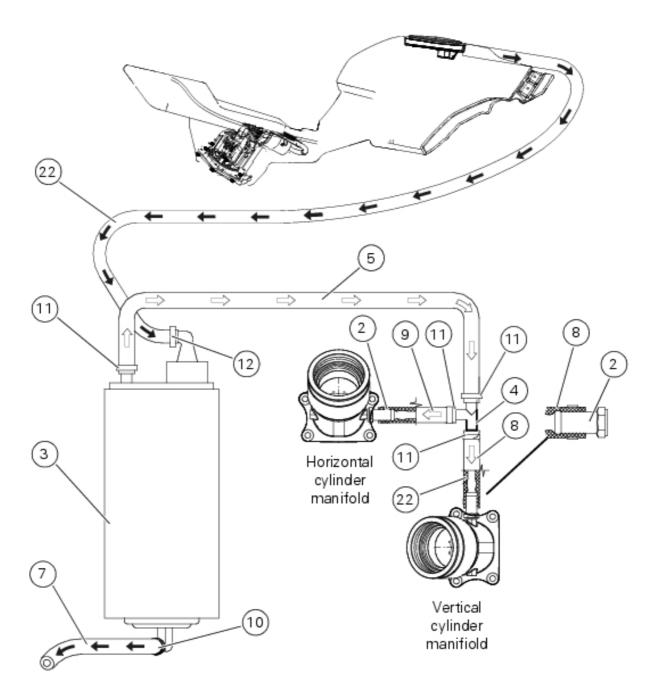
Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

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 (22) is connected to the canister (3); when the fuel has been filtered, it is returned to the intake manifolds via hose (5) and hoses (8) and (9). The hose (7) drains to the ground.

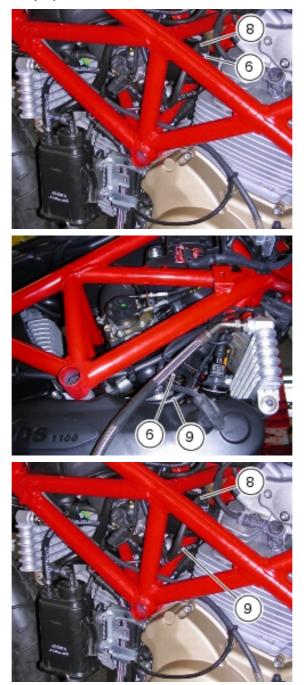
For correct positioning of the connection hoses consult the indications given below.



### Removal of the evaporative emissions canister

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the LH side fairing	E 2, Removal of the side fairings

Loosen the clamps (6) securing the hoses connecting the canister (3) to the intake manifolds of the horizontal and vertical cylinders and the breather valve (23).



Disconnect the hoses (8) and (9) connecting the canister (3) to the cylinders and the connection hose (22) to the breather valve (23).



Unscrew the nuts (19) and remove the canister (3) from plate (14).

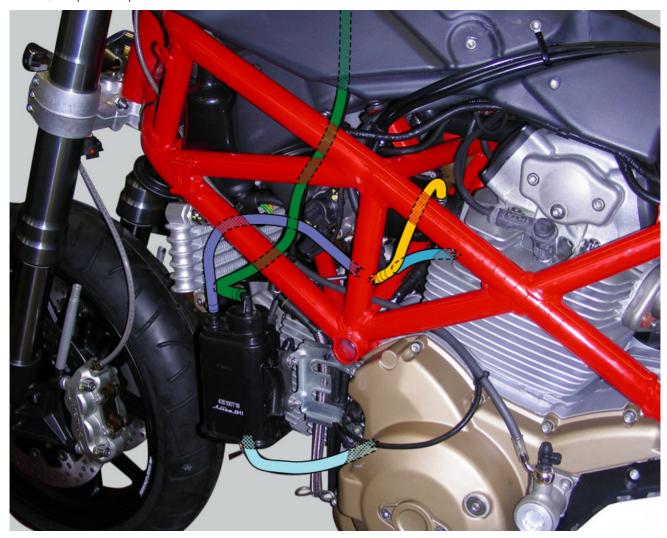


### Refitting the evaporative emissions canister

Refitting is the reverse of removal.

Operation	Section reference
Refit the LH side fairing	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

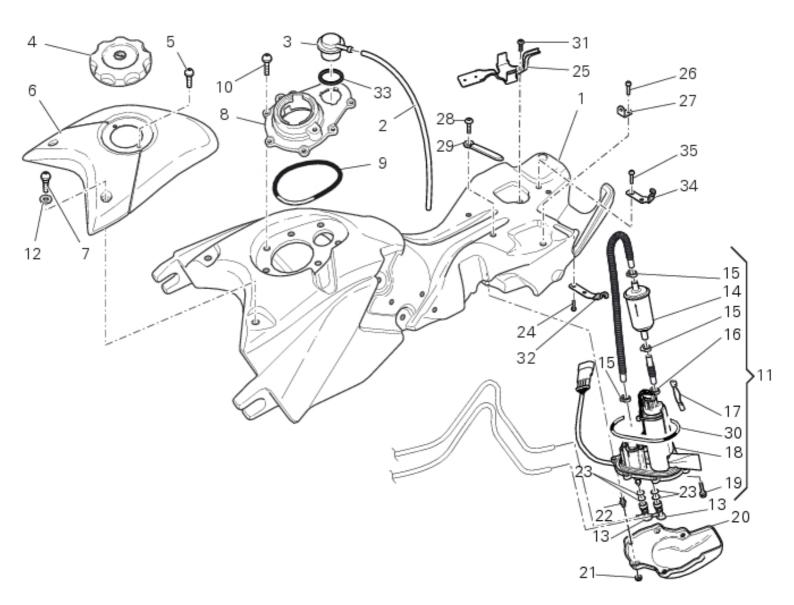
Positioning the hoses, clamps and evaporative emissions canister  $% \left( 1\right) =\left( 1\right) \left( 1\right) \left($ 







### 2 - Fuel tank



- 1 Fuel tank
- 2 Breather hose
- 3 Breather valve
- 4 Filler cap
- 5 Bolt
- 6 Fuel tank cover
- 7 Bolt
- 8 Filler
- 9 O-ring
- 10 Bolt
- 11 Flange assembly
- 12 Washer
- 13 Quick-release fitting
- 14 Filter
- 15 Collar
- 16 Collar
- 17 Thermistor
- 18 Flange
- 19 Bolt
- 20 Flange cover
- 21 Nut
- 22 Banjo bolt
- 23 O-ring
- 24 Bolt

- 25 Plate
- 26 Bolt
- 27 Plate
- 28 Bolt
- 29 Key
- 30 O-ring
- 31 Bolt
- 32 Plate
- 33 O-ring
- 34 Plate
- 35 Bolt



# FUEL SYSTEM



### Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

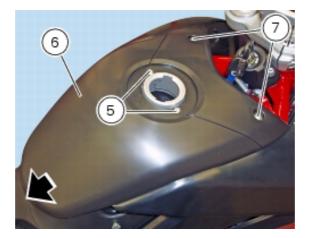
#### Removal of the fuel tank

Operation	Section reference
Remove the seat and the side panels	<b>   </b>
	the rear side panels
Remove the battery	P 2, <u>Battery</u>
Remove the contactor	P 3, Starter contactor

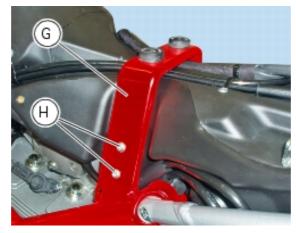
Unscrew and remove the fuel tank filler cap (4).



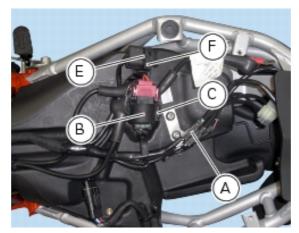
Unscrew the bolts (5) and (7) and remove the fuel tank cover (6), withdrawing it towards the seat. Recover the washers (12).



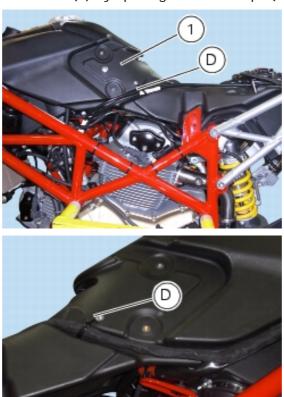
Remove the bracket (G) by unscrewing the bolts (H).



Disconnect the turn signal and number plate light wiring connectors (A) (Sect. P 1, Routing of wiring on frame). Withdraw the regulator fures assembly (B) from the support (C) and the self-diagnosis connector (E) from the strap (F) on the fuel tank.



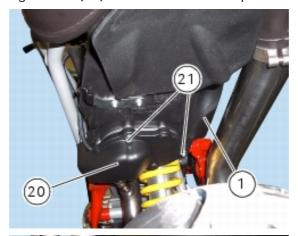
Release the main wiring loom from the fuel tank (1) by opening the metal clips (D).





Before removing the flange cover (20), check that the fuel tank (1) is empty.

Unscrew the nuts (21), remove the flange cover (20) and disconnect the quick-release fittings (13) from the flange.





Unscrew the bolts (M) securing the fuel hoses (N) to the fuel tank.



**A** Warning

Unscrew the special bolt (L) while counterholding with a size 5 Allen key the threaded insert located on the top of the tank.





Remove the fuel tank (1) from the motorcycle.



Removal of the fuel tank filler cap

Remove the hose (2) from the breather valve (3).

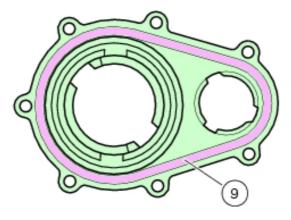


Release the breather valve (3) by turnig it anti-clockwiseand remove it from the fuel filler (8). Remove the fuel filler flange (8) by unscrewing the bolts (10) and recover the O-ring (9).



Refitting the fuel tank filler cap

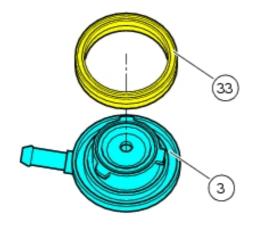
Fit a new O-ring (9).



Refit the fuel filler flange assembly (8) in its housing in the tank and tighten the bolts (10) to their specified torque (Sect. C 3, Frame torque settings) in the sequence 1-2-3-4-5-6-7.



Fit a new O-ring (33) on breather valve (3).



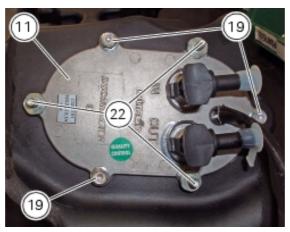
Insert the breather valve (3) in its seating on the fuel filler flange (8), applying the recommended lubricant to the surface in contact with the flange to facilitate assembly. Turn the the vlave clockwise to secure in place.

Fit the hose (2).

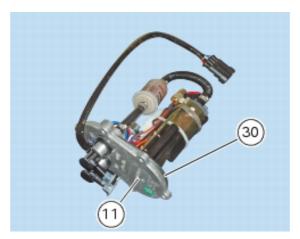


#### Removal of the fuel tank flange

Unscrew the bolts (19) and (22) securing the fuel tank flange (11). Remove the flange (11) from the fuel tank.



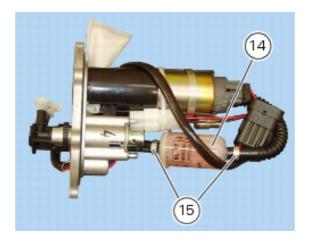
Recover the O-ring (30).



Using the appropriate tool, undo the clips (15) next to the fuel filter (14). Remove the old filter from the connecting hoses and fit a new filter. Before reassembly, carefully remove any deposits or scale from all parts.



When installing the new filter, position it so that the arrow stamped on the outer casing points towards the flange.



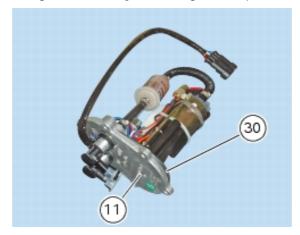


Notes

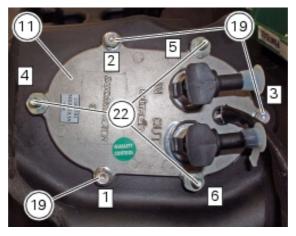
The flange is supplied as a spare part complete with the fuel pump and pressure regulator: the entire flange assembly must be replaced in the event of malfunction.

### Refitting the fuel tank flange

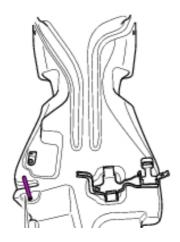
Grease the O-ring (30) and locate the flange and refit by reversing the steps of the removal procedure.



Tighten the bolts (19) and (22) to the specified torque (Sect. C 3, <u>Frame torque settings</u>), in the sequence 1 -2 -3 -4 - 5 -6.

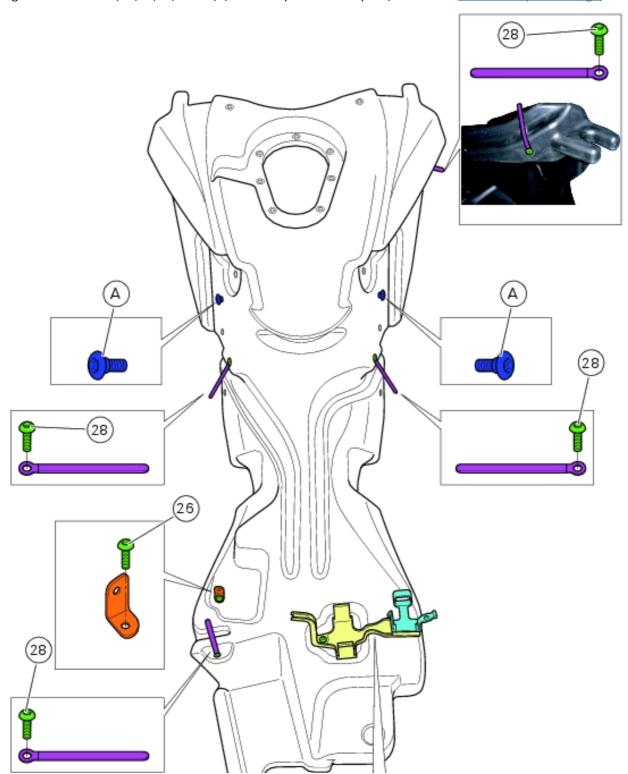


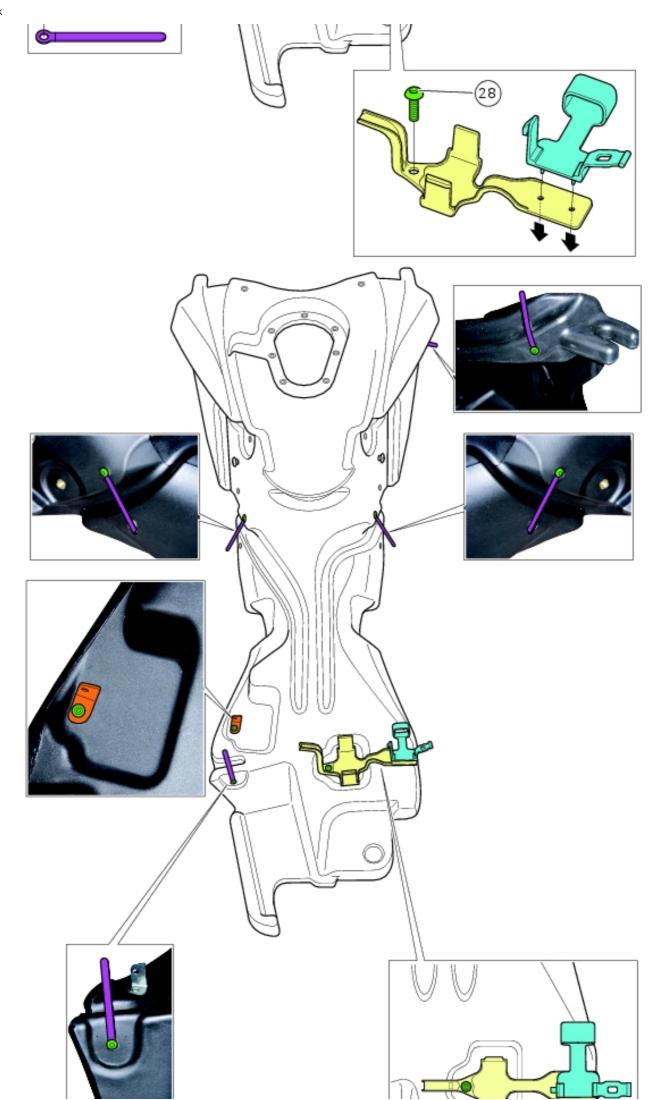
Locate the flange wiring, securing it as shown.



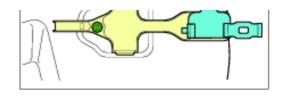
### Refitting the fuel tank

If the fuel tank has been disassembled into its component parts, reposition all the parts as shown in the figure. In particular: tighten the bolts (26), (28) and (A) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).





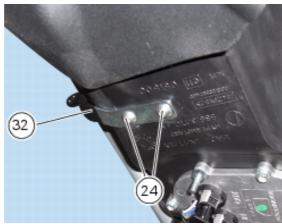




If the battery retaining plate (34) was removed, refit positioning it as shown; insert the bolts (35) and tighten them to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).

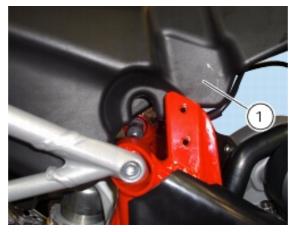
Fit the battery retaining plate (32), positioning it as shown; insert the bolts (24) and tighten them to the specified torque (Sect. C 3, Frame torque settings).





Reposition the fuel tank (1), engaging the front and central catches on the rubber bushes located on the frame.



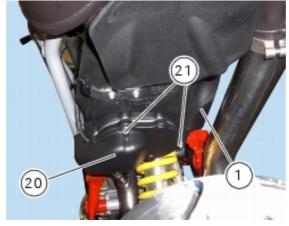


Locate the fuel hoses (N) on the tank and tighten the bolts (M).

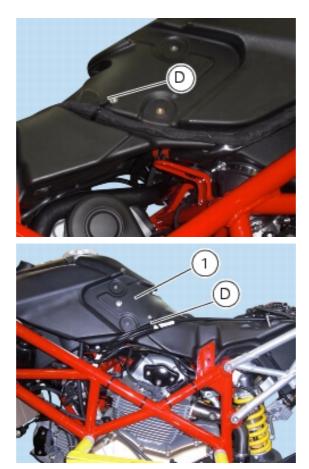


Connect the quick-release fasteners (13) o the flange, refit the flange cover (20) and tighten the nuts (21) to the specifie torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).

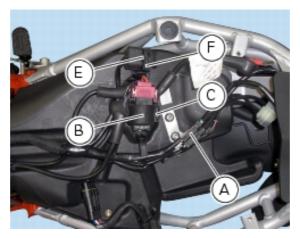




Secure the main wiring loom to the fuel tank (1) by closing the metal clips (D).



Disconnect the turn signal and number plate light wiring connectors (A) (Sect. P 1, Routing of wiring on frame). Reposition the regulator fures assembly (B) on the support (C) and the self-diagnosis connector (E) by closing the strap (F) on the fuel tank.



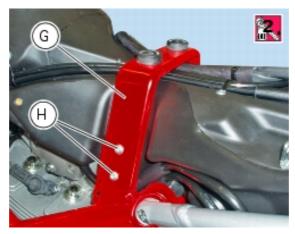
Marning

Screw in the special bolt (L) while counterholding with a size 5 Allen key the threaded insert located on the top of the tank.



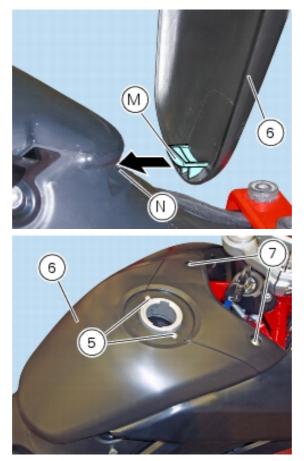


Refit the bracket (G), apply the recommended threadlocker and tighten the bolts (H) to the specified torque (Sect. C 3, Frame torque settings).



Fit the cover (6) by first inserting the tab (M) in the recess (N) on the tank and then locating the cover on the tank. Fix the tank cover (6) with bolts (5) and (7) and washers (12).

Tighten the bolts (5) and (7) to the specified torque (Sect. C 3, Frame torque settings).

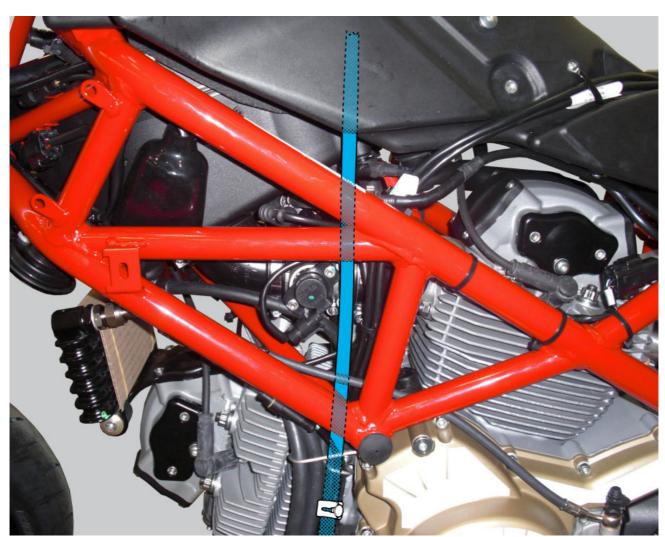


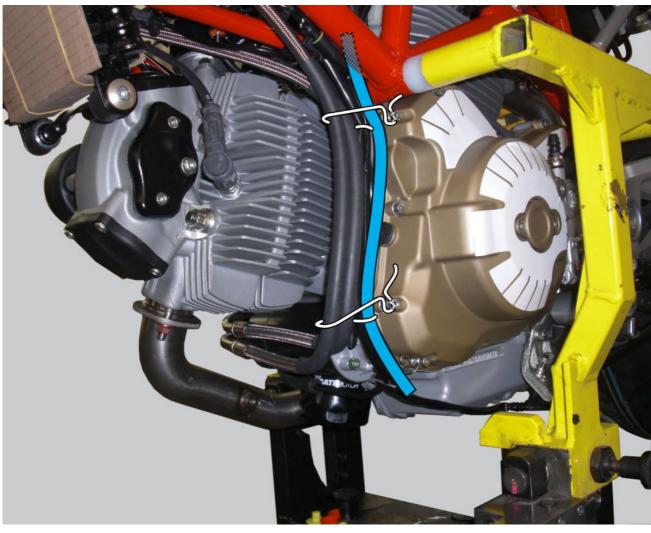


Operation	Section reference
Refit the contactor	P 3, Starter contactor
Refit the battery	P 2, Battery
· · · · · · · · · · · · · · · · · · ·	E 3, Refitting the seat/Refitting the rear side panels

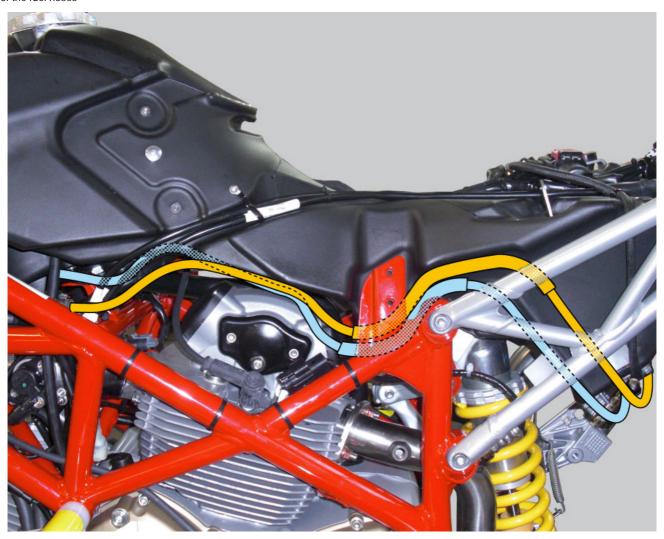
### Positioning of the fuel tank breather and drain hoses

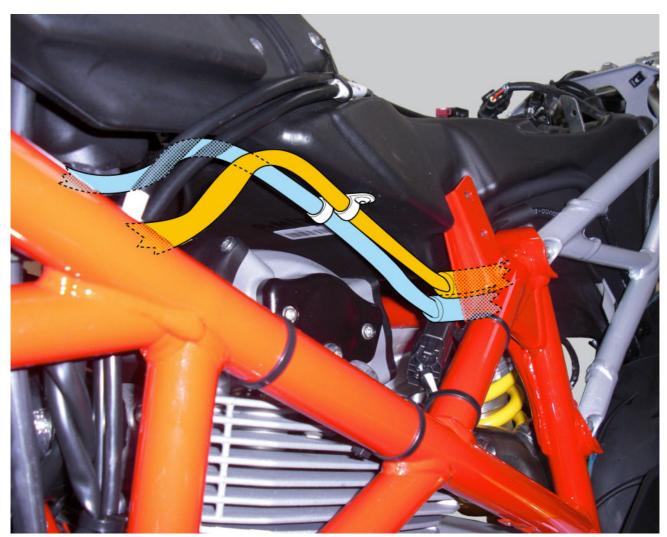


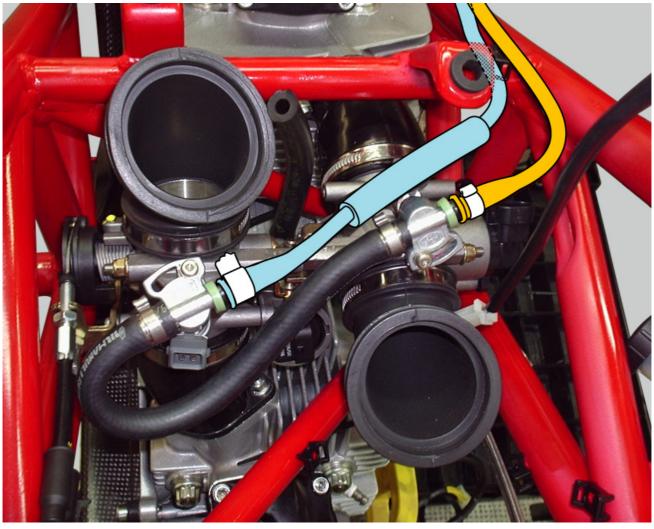




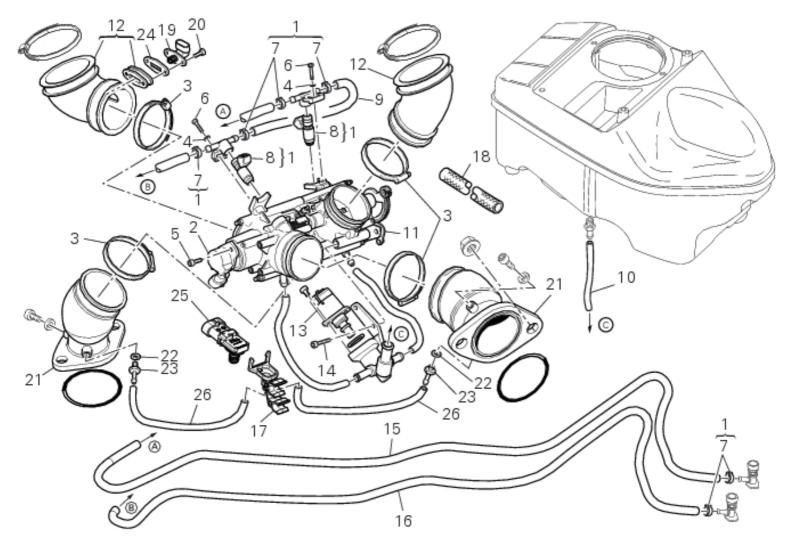
### Positioning of the fuel hoses







# 6 - Throttle body



- 1 Fuel system assembly
- 2 Throttle position sensor
- 3 Clamp
- 4 Washer
- 5 Bolt
- 6 Bolt
- 7 Clamp
- 8 Injector
- 9 Hose
- 10 Hose
- 11 Throttle body assembly
- 12 Hose
- 13 Stepper motor
- 14 Bolt
- 15 Fuel feed hose
- 16 Fuel return hose
- 17 Sensor support
- 18 Sleeve
- 19 Air temperature sensor
- 20 Bolt
- 21 Intake manifold
- 22 Aluminium gasket
- 23 Union
- 24 Sealing washer
- 25 Pressure sensor
- 26 Hose



### **INTAKE MANIFOLDS**



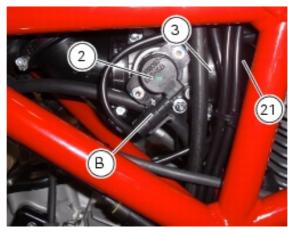
## Important

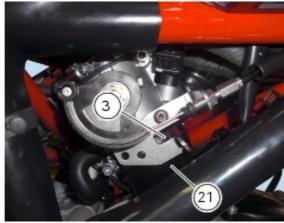
Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

### Removal of the throttle body

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the airbox	L 7, Removal of the airbox
Disconnect the throttle cable from the throttle body	F 1, Removal of the throttle twistgrip

Loosen the clips (3) securing the throttle body to the intake manifolds (21). Disconnect the connector (B) connecting the main wiring loom to the throttle position sensor (2).





Disconnect the wiring connectors (C) connecting the main wiring loom to the injectors (8).



Disconnect the connector (D) connecting the main wiring loom to the stepper motor (13).



Disconnect the wiring connector (E) connecting the main wiring harness to the air temperature sensor (19). Detach the air pressure sensor (25) from the throttle body and disconnect the wiring connector (F) from the main wiring harness.



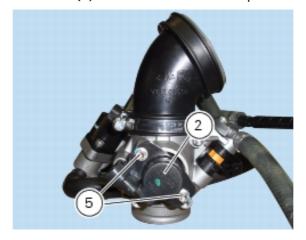
Remove the throttle body assembly (11) from the motorcycle.





This operation can be performed also with the throttle body installed on the motorcycle.

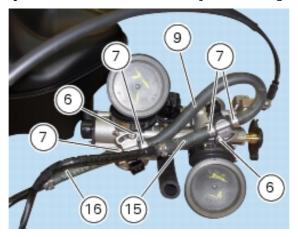
The throttle position sensor (2) is installed on the right-hand side of the throttle body, in the position of the vertical cylinder (MASTER) throttle. Undo the two bolts (5) to remove the throttle position sensor from the throttle body.



#### Removal of the fuel injectors

Undo the injector retaining clamps (7) with the fuel feed hose (15), fuel return hose (16) and injector connection hose (9).

Unscrew the bolts (6) to remove the injectors from the throttle body, recovering the washers (4).



#### Refitting the injectors

Lubricate the injector O-rings. Locate the washers (4) and tighten the bolts (6). Unscrew the clamps (7).



### Removal of the stepper motor

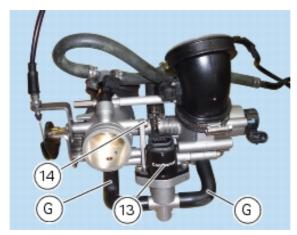
The stepper motor (13) is installed in the central part of the throttle body: to remove it, unscrew the bolts (14) and disconnect the hoses (G) from the throttle body. Refer to Section M 3, <u>Stepper motor</u> for details of stepper motor operation.



#### Refitting the stepper motor

Connect the hoses (G) to the throttle body.

Locate the motor (13) with its support on the throttle body, fitting the bolts (14). Tighten the bolts (14).



### Refitting the throttle body

If the hoses (12) were removed, reconnect them to the throttle body with the clamps (3), positioning the hoses and clamps as shown in the figure.



The air temperature sensor (19) is installed on the intake manifold of the vertical cylinder (12); to refit, refer to Section M 3, <u>Air pressure sensor</u>.





#### Warning

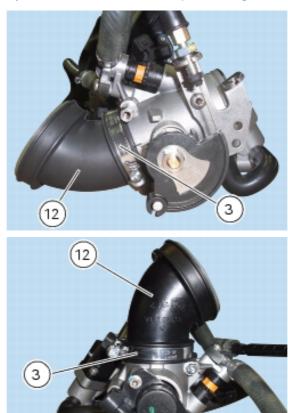
The hose which mounts the air temperature sensor (19) should be installed on the same side of the throttle body as the position sensor (2).



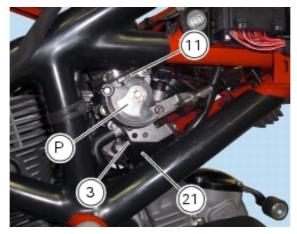


The end of the hose with the smaller diameter is to be connected to the throttle body.

Ensure the hoses are fully seated and cirrectly oriented on the throttle body. Tighten the clamps to the specified torque (Sect. C 3, Frame torque settings).



Fit the clips (3) on the intake manifolds (21) and orient them as shown in the photo. Orient the throttle body (11) with the pulley (P) facing the right-hand side (relative to the direction of travel) and insert it fully home in the intake manifolds.



Tighten the clamps (3) to the specified torque (Sect. C 3, Frame torque settings), making sure that they do not protrude beyond the locating edges of the manifolds.



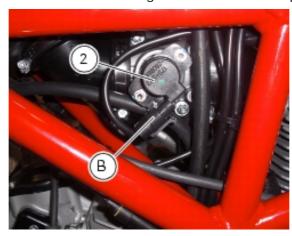
Connect the wiring connector (F) of the air pressure sensor to the main wiring harness and locate the air pressure sensor (25) on the throttle body.
Connect the wiring connector (E) connecting the main wiring harness to the air temperature sensor (19).



Reconnect the wiring connectors (C) to connect the main wiring loom to the injectors (8).



Connect the wiring connector (B) to connect the main wiring loom to the throttle position sensor (2).



Connect the wiring connector (D) to connect the main wiring loom to the stepper motor (13).



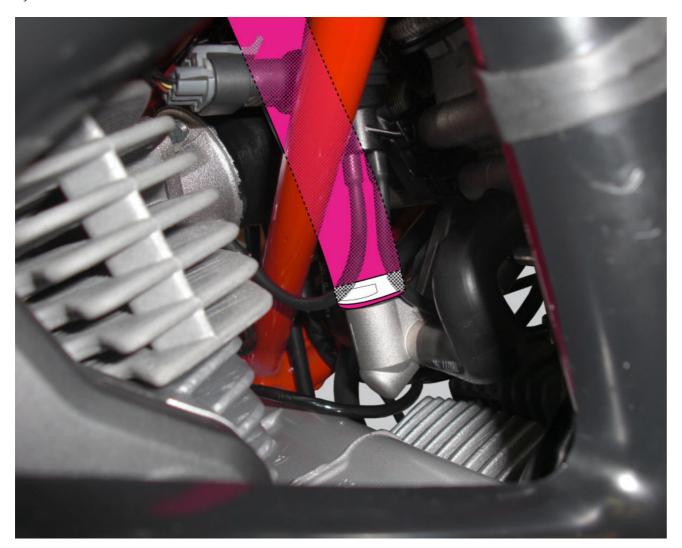
# Important

In the case of throttle body renewal, carry out the operation "Self-learning throttle position sensor (TPS)" as indicated in Section D 5.

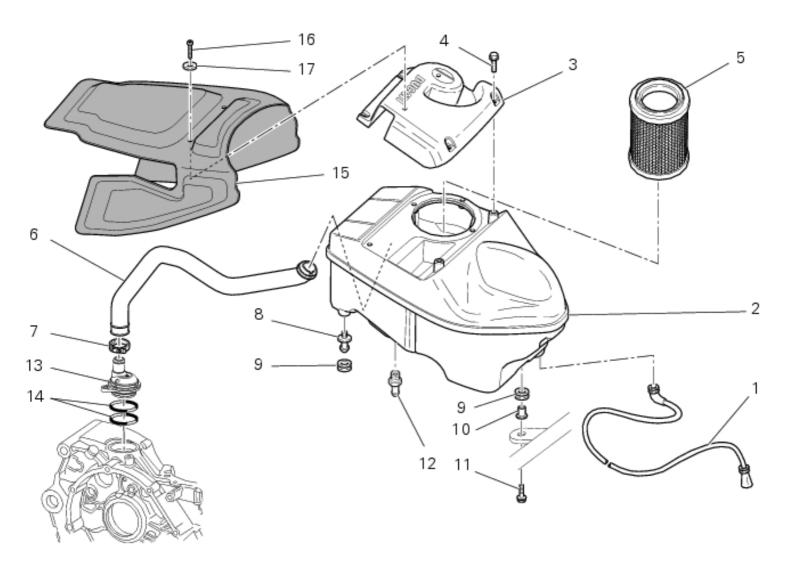
Operation	Section reference
Reconnect the throttle cable to the throttle body	F 1, Refitting the throttle twistgrip
Refit the airbox	L 7, Refitting the airbox
Refit the fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the seat	E 3, Refitting the seat

## Positioning of the stepper motor

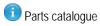




## 7 - Air intake



- 1 Hose
- 2 Airbox
- 3 Airbox cover
- 4 Bolt
- 5 Air filter element
- 6 Breather hose
- 7 Hose clip
- 8 Pin
- 9 Rubber
- 10 Spacer
- 11 Bolt
- 12 Pressure test fitting
- 13 Breather valve
- 14 O-ring
- 15 Soundproofing panel
- 16 Bolt
- 17 Washer



### **AIR INTAKE - OIL BREATHER**



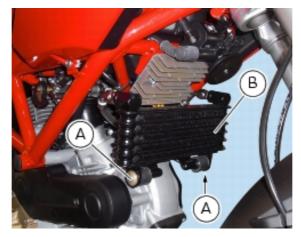
Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be

found in the exploded view diagram.

### Removal of the airbox

Operation	Section reference
	E 3, Removal of the seat/Removal of the rear side panels
	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank

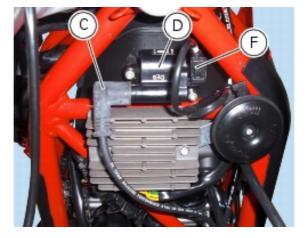
Undo the bolts (A) securing horizontal header of the oil cooler (B) and remove the oil cooler, leaving it connected to its hoses.

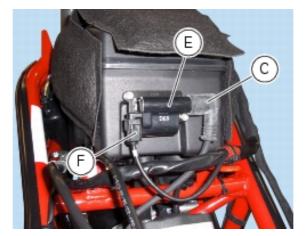


Loosen the clamp (7) and detach the hose (6) from the valve (13).

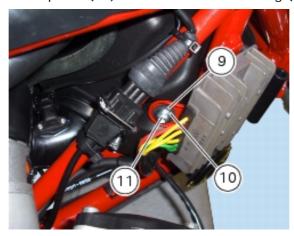


Disconnect the HT leads (C) of horizontal cylinder coil (D) and the vertical cylinder coil (E) from the respective spark plugs. Disconnect the main wiring loom connectors (F) from the coils.

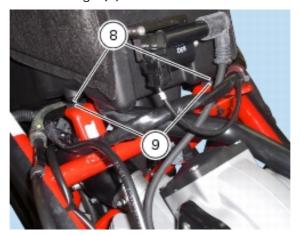




Loosen the front bolt (11) and recover the spacer (10) and the rubber mounting (9).



Detach the two pins (8) from the rubber mountings (9).



Loosen the clamps (L) of the intake manifolds (G).





Remove the hose (H) from pressure test fitting (12).

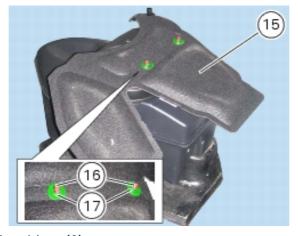


Lift the airbox (2) complete with the coils and leads.



Disassembly of the airbox

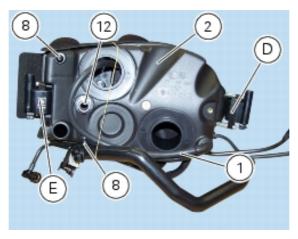
Unscrew the bolts (16) recovering the washers (17) and raise the soundproofing panel (15) from the airbox.



Disconnect the drain hose (1) from the airbox (2). Unscrew the pressure test fitting (12).

Unscrew the studs (8).

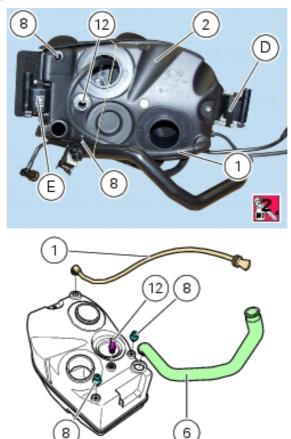
To remove the coils (D) and (E) refer to Section M 3, Coil.



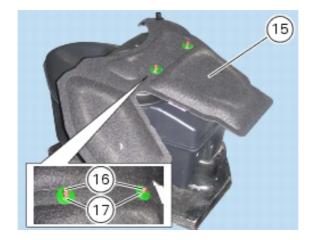
#### Reassembly of the airbox

To refit the coils (D) and (E) on the airbox, refer to Section M 3, <u>Coil</u>. Apply threadlocker to the two studs (8), screw them into the airbox (2) and tighten them to the specified torque (Sect. C 3, <u>Frame torque settings</u>). Apply threadlocker to the threads of pressure test fitting (12) and tighten the fitting to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

Insert the drain hose (1) in airbox (2).



Locate the soundprofing panel (15) on the airbox, fit the bolts (16) with washers (17) and tighten the bolts (Sect. C 3, <u>Frame torque settings</u>).



#### Removal of the oil breather valve

Unscrew the bolt (V) and remove the oil breather valve (13) from the crankcase half. Check the condition of O-rings (14) and renew them if necessary.



## Refitting the oil breather valve

Lubricate the O-rings (14) with the recommended grease. Tighten the bolt (V) of the valve (13) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).



### Refitting the airbox

Reposition the airbox (2) complete with coils and hoses on top of the throttle body.



Fit the stepper motor hose (H) on the pressure test point (12).



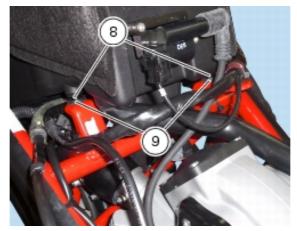
Check that clamps (L) are correctly positioned on intake manifolds (G), with the fixing bolts oriented towards the exterior of the motorcycle.

Connect the intake manifolds (G) to the airbox and tighten the clamps (L) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

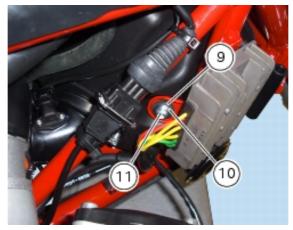




Insert the pins (8) in the rubber mountings (9) on the frame.

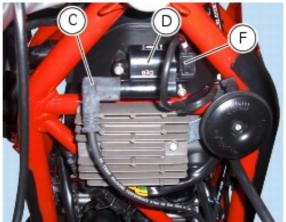


Reposition rubber mounting (9) and the spacer (10) and tighten the bolt (11) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



Reconnect the main wiring loom connectors (F) to the coils. Reconnect the HT leads (C) of horizontal cylinder coil (D) and the vertical cylinder coil (E) to the respective spark plugs.

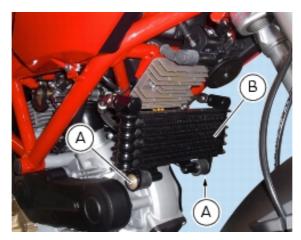




Refit the hose (6) with the clamp (7) on the valve (13) and tighten the clamp (7) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



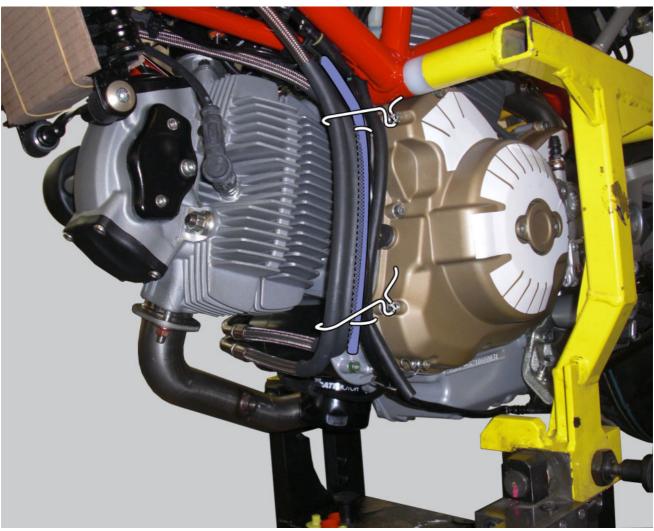
Position the oil cooler (B) on the horizontal cylinder head, tightening the bolts (A) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



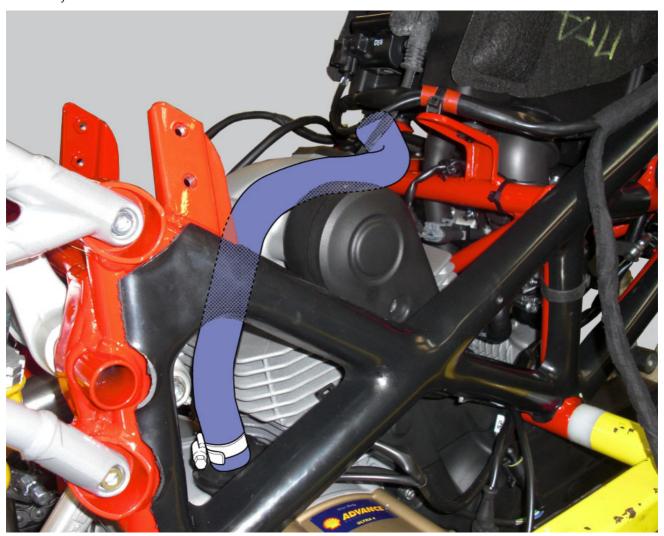
Operation	Section reference
Refit the fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the seat and rear side panels	E 3, Refitting the seat/Refitting the rear side panels

Positioning of the airbox drain hose

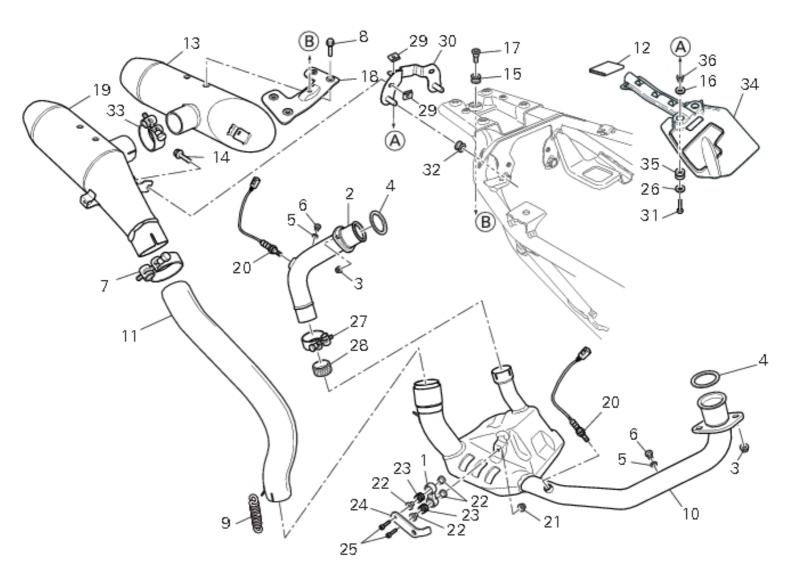




## Positioning of the blow-by hose



# 8 - Exhaust system



- 1 Support
- 2 Vertical cylinder head exhaust pipe
- 3 Nut
- 4 Exhaust gasket
- 5 Sealing washer, thickness 1
- 6 Plug
- 7 Clamp
- 8 Bolt
- 9 Spring (short)
- 10 Balance pipe
- 11 Presilencer exhaust pipe
- 12 Rubber mounting
- 13 Left-hand silencer
- 14 Bolt
- 15 Rubber mounting
- 16 Washer
- 17 Special bolt
- 18 Bracket
- 19 Right-hand silencer
- 20 Lambda sensor
- 21 Nut
- 22 Spacer
- 23 Rubber mounting
- 24 Bracket

#### Exhaust system

- 25 Bolt
- 26 Washer
- 27 Strap
- 28 Sealing washer
- 29 Quick-release fastener
- 30 Bracket
- 31 Bolt
- 32 Rubber
- 33 Strap
- 34 Splashguard
- 35 Rubber
- 36 Spacer



#### **EXHAUST SYSTEM**



### Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

#### Removal of the exhaust system

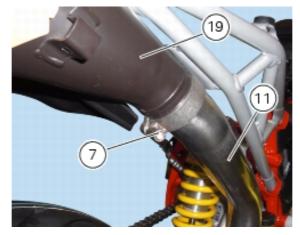
Operation	Section reference
Remove the seat and the side panels	E 3, Removal of the seat/Removal of the rear side panels
Remove the rear grab handle	H 7, Removal of the tail light
Remove the number plate holder	H 7, Removal of the number plate holder
Remove the RH footrest	H 4, Removal of the footrest brackets



### Important

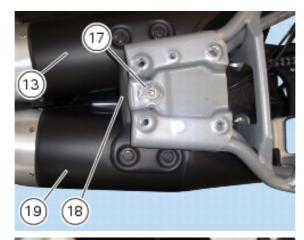
Before starting any work on the exhaust system, make sure that the engine has cooled down sufficiently.

Disconnect the turn signal and number plate light wiring connectors (Sect. P 1, Routing of wiring on frame). Unscrew the hose clamp (7) to separate the silencers (19) from the exhaust pipe (11).



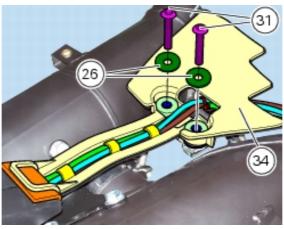
Unscrew the special bolt (17).

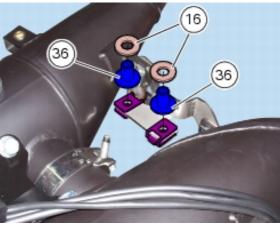
Withdraw the silencers (13) and (19), complete with undertail heat shield (18) and number plate holder assembly from the rubber mountings (32) on the frame.



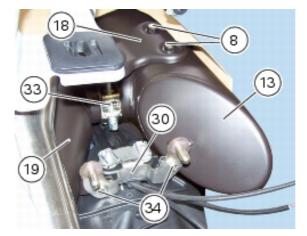


Remove the splashguard (34), unscrewing the bolts (31) and recovering washers (26), (16) and bushes (36).



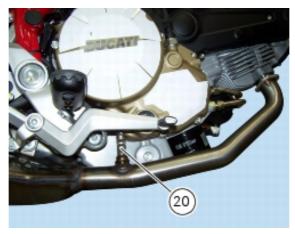


To separate the silencers (13) and (19) unscrew the bolts (34) and remove the bracket (30). Unscrew the bolts (8) and remove the bracket (18). Undo the clamp (33) and separate the two silencers.

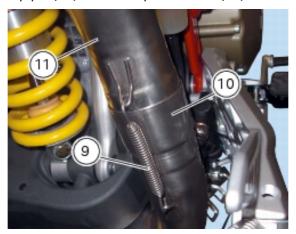


Disconnect the lambda sensors (20) from the main wiring harness (Sect. P 1, Routing of wiring on frame).

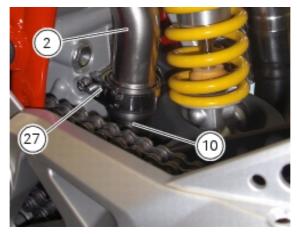




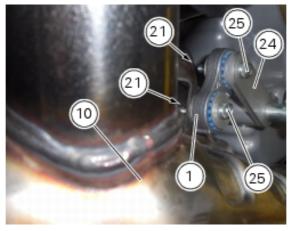
For the "Lambda sensor" refer to Section M 3.
Remove the spring (9) and remove the pipe (11) from the presilencer (10).



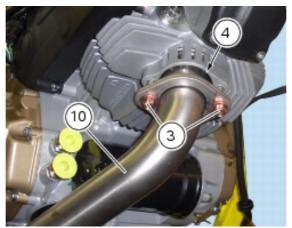
Unscrew the clamp (27) to separate the presilencer (10) from the vertical cylinder exhaust pipe (2): recover the gasket (28).

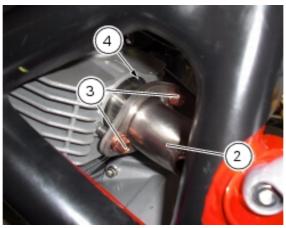


Unscrew the bolts (25) and the nuts (21) securing the presilencer (10) to the frame. Recover the bracket (24) and the support (1).



Unscrew the nuts (3) and remove the exhaust manifold (2) from the vertical cylinder head and the balance pipe (10) from the horizontal cylinder head, recovering the gaskets (4).



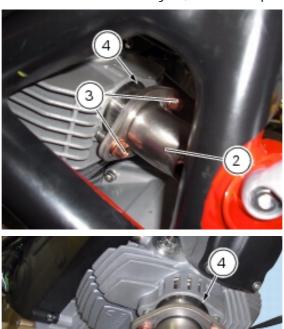


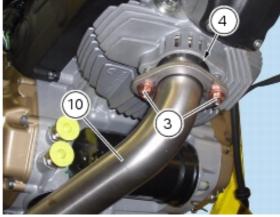
Refitting the exhaust system

Renew the gaskets (4).

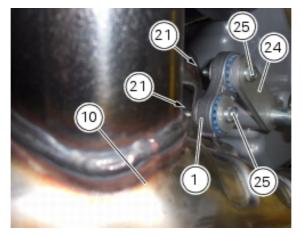
Position the balance pipe (10) and vertical head exhaust pipe (2) with the gaskets (4) on their respective cylinder heads and tighten the nuts (3) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).

Position the presilencer (10) from the underside of the motorcycle; insert the presilencer pipe in the swingarm.

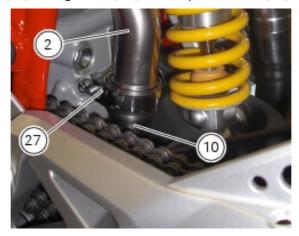




Fit the bolts (25), the spacers (22), the support (1) and the nuts (21) to fix the presilencer (10) to the bracket (24). Tighten the nuts (21) and (25) to the specified torque (Sect. C 3, Frame torque settings).



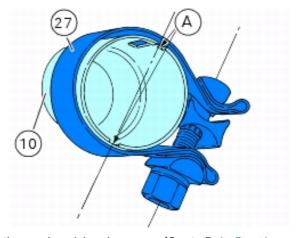
Connect the pipe (2) with the clamp (27) and gasket (28) to the presilencer (10).



Position the clamp (27) securing the pipe (2) to presilencer (10) so that the screw lies parallel to the line through the

notches (A) in the end of the pipe. Position the clamp (27) so that it is flush with the end of the pipe, or at least so that the notches (A) are not completely uncovered.

Tighten the clamp (27) to the specified torque (Sect. C 3, Frame torque settings).

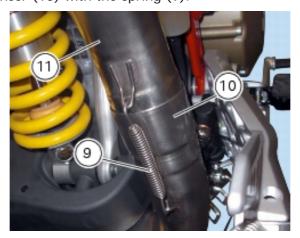


Connect the lambda sensors (20) to the main wiring harness (Sect. P 1, Routing of wiring on frame).





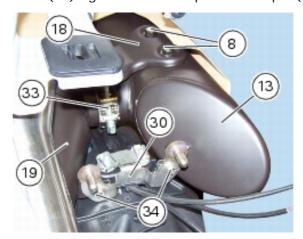
Position the hose (11) on the presilencer (10) with the spring (9).



Join the two silencers (13) and (19) tightening the clamp (33) ato the specified torque (Sect. C 3, <u>Frame torque settings</u>), securing the bracket (18) with the bolts (8) and tightening the bolts (8) to the specified torque (Sect. C 3,

#### Frame torque settings).

Secure the silencer bracket (39) with bolts (34) tightened to the specified torque (Sect. C 3, Frame torque settings).

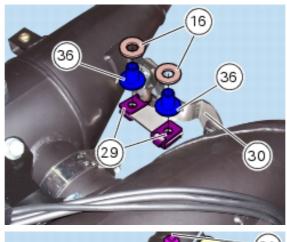


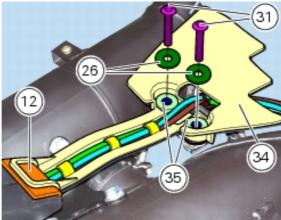
Fit the washers (16) on the bushes (36). Insert the rear end of the splashguard in the vibration damper (12), routing the wiring through the apertures in the spashguard.

Locate the bushes (36) so they rest against the clips (29). Insert the rubber vibration dampers (35) in the bushes (36). Fit the washers (26) on the bolts (31) and insert the bolts in the clips (29).

Tighten the bolts (31) to the specified torque (Sect. C 3, Frame torque settings).

Secure the wiring in the clips on the splashguard and bind them together with small tie.

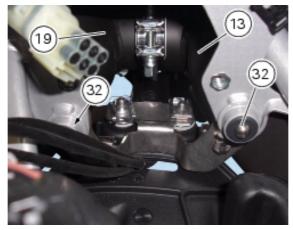


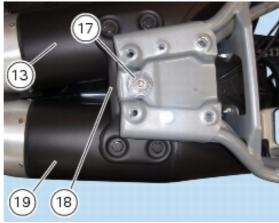


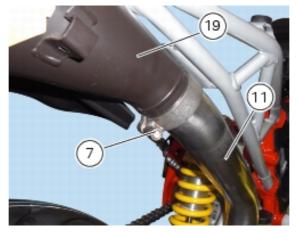
Fit the silencers (13) and (19), inserting them from the rear of the motorcycle, connecting them to pipe (11) and inserting the pins of the silencer in rubber mountings (32) on the frame.

Tighten the bolt (17) to the specified torque (Sect. C 3, Frame torque settings).

Tighten the clamp (7) to the specified torque (Sect. C 3, Frame torque settings).







Reconnect the rear turn signal and number plate light wiring (Sect. P 1, Routing of wiring on frame).

Operation	Section reference
Refit the right-hand footrest	H 4, Refitting the footrest brackets
Refit the number plate holder	H 7, Refitting the number plate holder
Refit the rear grab handle	H 7, Refitting the tail light
Refit the seat and rear side panels	E 3, Refitting the seat/Refitting the rear side panels

# 0M - Impianto elettrico

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Spark plug 22

Coil 23

Injection relay 24

CAN Line 25

## 1 - Description of the system

General information on the fuel injection-ignition system

The integrated electronic control system, with ignition and injection both controlled by the same control unit, ensures optimal engine performance and output, thus reducing fuel consumption and harmful exhaust emissions. This system ensures an accurately metered air-fuel ratio and optimal management of ignition advance.

The system consists of three different circuits:

Fuel circuit

Air circuit

Electrical circuit (with control unit, sensors and actuators).

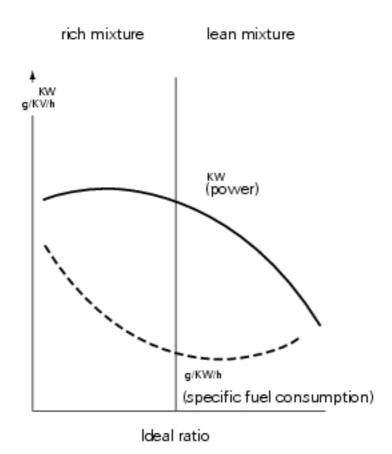
Importance of the air-fuel mixture and the ignition advance.

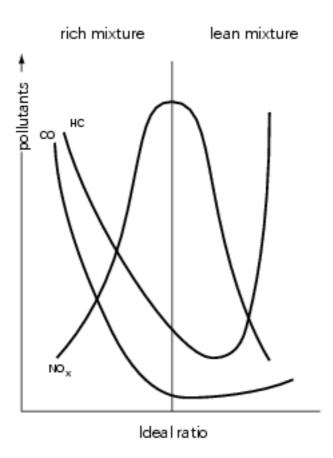
Correct management of the air-fuel ratio and the ignition advance are fundamental requirements for optimal engine operation.

The air-fuel mixture is given by the ratio, in weight, of air to fuel taken in by the engine: the ideal or stoichiometric ratio is that which determines complete combustion. Excessive or insufficient air give rise to, respectively, a lean (or weak) mixture or a rich mixture, which affect power and consumption, as well as emissions of exhaust gases.

Electronic control of the ignition advance makes it possible to optimise engine performance, maximum power, fuel consumption, and concentration of exhaust pollutants.

Electronic ignition timing control combined with fuel supply control allows for optimal engine operation in all conditions of use (low temperature start, warm-up stage, transitory acceleration/deceleration stages, engine under partial load, full load, idle).





#### Siemens M3C fuel injection-ignition system

The Marelli injection-ignition system is the Alfa/N type, in which the engine speed and throttle position are used as the main parameters for measuring the quantity of intake air. If the quantity of air is known, the quantity of fuel can be dosed accordingly to obtain the required ratio. Additional sensors in the system (engine rpm, aspirated air pressure, air temperature, engine oil temperature and lambda sensor to control CO level) are used to adjust the basic engine control strategy in accordance with the operating conditions. The engine speed and the throttle angle also make it possible to calculate the optimal advance for all types of operating conditions. The quantity of air taken in by each cylinder during each cycle depends on the density of the air in the intake manifold, the cylinder capacity and the volumetric efficiency.

The volumetric efficiency of the engine is determined experimentally throughout the entire range of operating conditions (rotation speed and engine load conditions). The values obtained in this way are then used for the generation of a map which is stored in the **Flash EPROM** of the **Siemens M3C** ECU for injection control. The **Flash Eprom** can be programmed via CAN line. Fuel injection control is of the phased sequential type, i.e. the injectors are not operated in parallel. Fuel delivery to each cylinder may start during the expansion stroke and may extend up to after the beginning of the induction stroke. Fuel cut-off timing (the time when the injectors are closed), is saved onto a special map, which is stored in the ECU **Flash Eprom**. Ignition is of the static inductive discharge type, featuring dwell time control so as to ensure coil charging at steady power Power modules for coil power supply are included in the ECU hardware. Advance curves are stored in the ECU **Flash Eprom**. Both coils and power modules are controlled by the ECU, which calculates the ignition advance.



To test the components and wiring of the injection - ignition system, use the "DDS" tester, following the indications given in the paragraph "Guided diagnosis" (Sect. D 5).

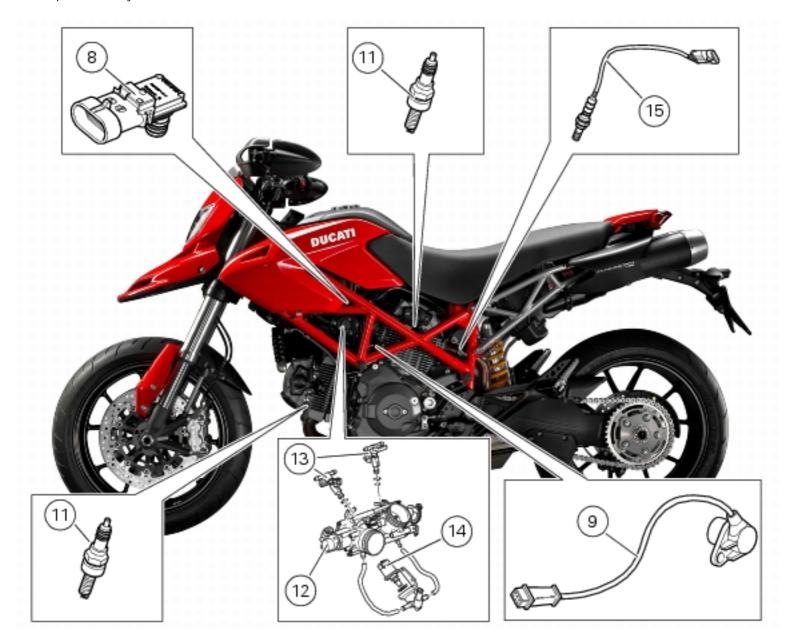
Key to the sensor position diagram

1 Injection ECU

### Description of the system

- Injection relay
- 3 Fuel pump
- 4 Lambda sensor (horizontal cylinder)
- 5 Engine temperature sensor
- 6 Air temperature sensor7 Horizontal cylinder coil
- 8 Pressure sensor
- 9 Engine speed sensor
- 10 Vertical cylinder coil
- 11 Sparkplug
- 12 Throttle position sensor
- 13 Injectors
- 14 Stepper motor
- 15 Lambda sensor (vertical cylinder)

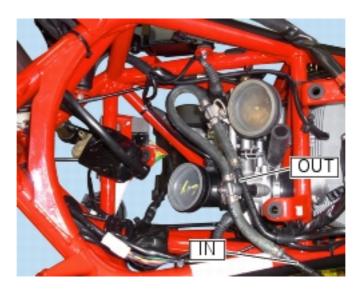




## Fuel circuit

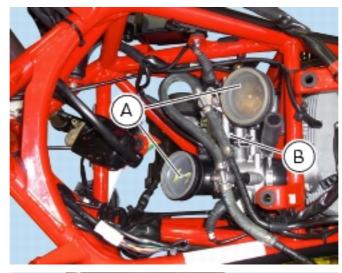
Fuel from the tank is pumped into the delivery line (OUT) and then to the injectors, by means of a pump located on a flange installed at the bottom of the fuel tank. The flange also incorporates the pressure regulator that controls the fuel feed pressure and keeps it constant at a higher value than the negative pressure generated by the engine. Fuel that is not injected in the intake hoses returns to the flange and then to the tank by way of a return hose (IN).





### Air circuit

The air circuit is composed of two intake manifolds (A), the throttle body (B) and an airbox (C) located over the throttle body.

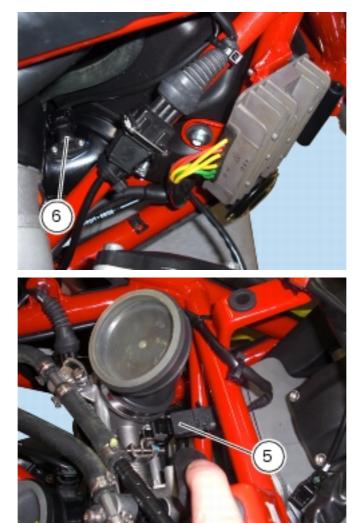




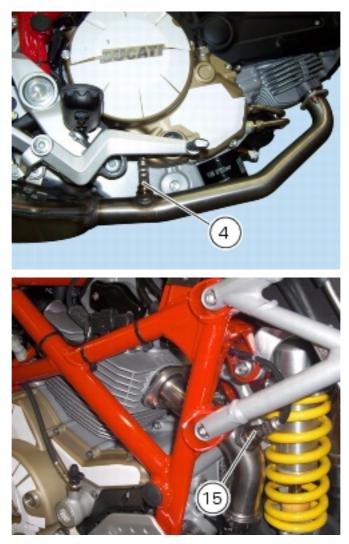
This motorcycle is equipped with a stepper motor (14) that determines the supplementary air flow downstream of the butterfly valves during the engine starting phase (see "Operating phases" in this section).



The engine control system (ignition and injection) relies on several sensors which adjust the mixture according to the air pressure and temperature and the engine load. An air temperature sensor (6) located on the intake manifold of the vertical cylinder and an air pressure sensor (5) located between the "V" of the engine block, connected to the air intakes, measures the atmospheric pressure and transmits this information to the ECU where it used to make essential adjustments to the quantity of fuel injected when the motorcycle is ridden at varying altitudes (e.g. a route that starts at sea level and ends at a high altitude); they also allow the ECU to make mixture corrections in relation to air density. Assuming that the volume of air is constant, if the temperature rises, oxygen content will decrease, whereas it will increase as the temperature falls. If the temperature rises, the mixture should be leaner, while if it falls, the mixture should be made richer to maintain the best air-fuel ratio.



The two lambda sensors (4) and (15), installed respectively in the horizontal and vertical cylinder exhaust pipes, provide information that is used by the ECU to control the air-fuel mixture.



There is a throttle position sensor (12) fitted on the spindle of the rear cylinder throttle. This device sends the ECU a signal that is an indirect indication of the quantity of air aspirated by the engine (indirect measurement of engine load).



## Operating phases

### Normal operation

When the engine is warm, the unit calculates injection time and the ignition advance using the values stored in the respective maps, in accordance with the RPM and throttle position. The calculated quantity of fuel is fed to each cylinder through the injectors in one single sequential delivery.

Description of the system

### Starting

When the ignition switch is turned to ON, the control unit activates the fuel pump for a few moments to pressurise the fuel supply circuit. The throttle position and engine temperature signals are processed. When the engine is turned over by the starter motor, the unit receives the engine RPM and timing signals that allow it to proceed with injection and ignition. To facilitate start-up, the mixture is enriched in accordance with engine temperature During starting, the ignition advance angle is maintained at 0° until the engine starts. When the engine starts, the ECU controls the ignition advance in accordance with the values stored in the map and makes any necessary corrections according to the air and engine temperatures.

### Acceleration/deceleration

During acceleration, the ECU makes the mixture richer for improved engine performance. Acceleration is detected by monitoring the speed at which the rider turns the twistgrip to open the throttle. During a rapid deceleration, determined by the rider quickly turning the twistgrip to close the throttle, the ECU makes the mixture leaner to reduce emissions and fuel consumption.

# 2 - Fuel injection-ignition system

Key to fuel injection-ignition system diagram

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 "Wiring diagram", Section P 1:

- 4 Fusebox
- 5 Data acquisition/Diagnostics
- 6 Starter motor
- 7 Starter contactor with MASTER fuse
- 8 Battery
- 16 Fuel tank
- 17 Injection relay
- 19 Sidestand switch
- 20 Air temperature sensor
- 24 Horizontal cylinder coil
- 25 Horizontal cylinder spark plug RH
- 26 Vertical cylinder coil
- 27 Vertical cylinder spark plug RH
- 28 Horizontal cylinder injector
- 29 Vertical cylinder injector
- 30 Throttle position sensor
- 31 Rpm/timing sensor
- 33 Stepper motor
- 34 Neutral switch
- 35 Oil pressure switch
- 38 Clutch switch
- 41 Instrumentation (instrument panel)
- 46 Engine ECU

# 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 the barometric pressure and the engine load in Speed Density mode)
- Air temperature sensor (measures intake air temperature)
- Engine temperature sensor (measures the engine oil temperature)
- Timing/rpm sensor for engine rotation speed and the position of each cylinder 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.



## **I** 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.

Removal of the electronic control unit

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the right-hand fairing	E 2, Removal of the side fairings

Disconnect the wiring connector (1) from the ECU. Unscrew and remove the retaining bolts (2).

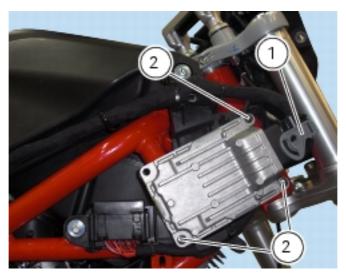
System components

Remove the ECU from the motorcycle.

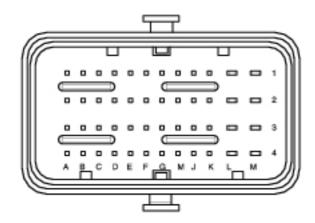


## Refitting the ECU

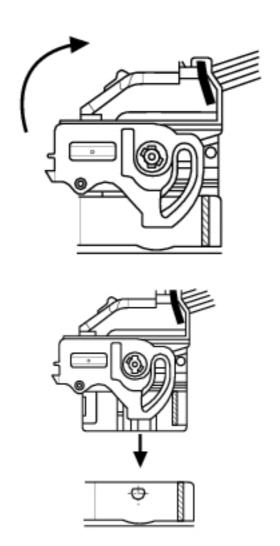
Fix the ECU to the frame with bolts (2) and reconnect the wiring connector (1). Tighten the bolts (2) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



Connector (1) is a 48 PIN connector.



Make sure that the clip (A) for the connector (1) is in its "open" position (as shown in the diagram). Rotate the clip (A) to secure the connector (clip in the "locked" position).



Operation	Section reference
Refit the right-hand fairing	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

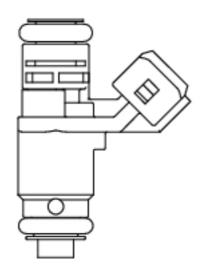
# Fuel injectors

The injectors (1) deliver the correct quantity of fuel required for optimal engine operation.



The control unit controls injector opening by feeding current to the coil of an electromagnet which

creates a magnetic field thereby attracting an armature and 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 Section L 6, <u>Removal of the fuel injectors</u>/<u>Refitting the injectors</u>.



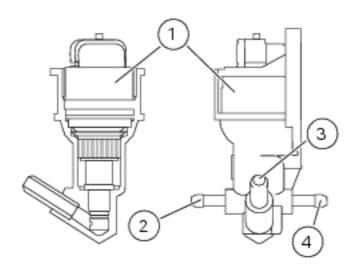
### Notes

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.

### 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.

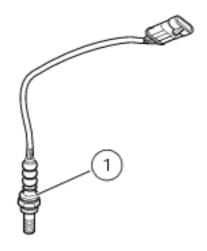
The opening of the stepper motor opening is controlled by 2 strategies:

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.

### Lambda sensor

The Lambda sensor (1), positioned on the exhaust pipe, transmits information to the ECU on the amount of oxygen in the exhaust fumes. With this information the ECU can maintain optimal control over the fuel-air mixture.







The outer surface of the sensor element in zirconium dioxide is in direct contact with the exhaust gas, while the inner surface is in contact with the atmosphere. Both surfaces are coated with a thin layer of platinum. Oxygen in ionic form travels through the ceramic layer and charges the platinum layer electrostatically so that the platinum acts as an electrode: the electrical signal generated is carried on the sensor output cable.

The zirconium dioxide element becomes permeable to oxygen ions at a temperature of around 300  $^{\circ}$ 

When the oxygen concentration is different on the two sensor surfaces, a voltage is generated thanks to the special physical properties of the zirconium dioxide. With a lean mixture the signal voltage is low, while with a rich mixture it is high.

Typically the change in signal intensity occurs when the air-fuel ratio is 14.7 to 1 (14.7 parts air to 1 part petrol), which is referred to as "Lambda 1". This ratio is considered to be an indication of complete combustion, hence the name "Lambda Sensor". therefore

lambda = 1 means mixture in stoichiometric (ideal) ratio

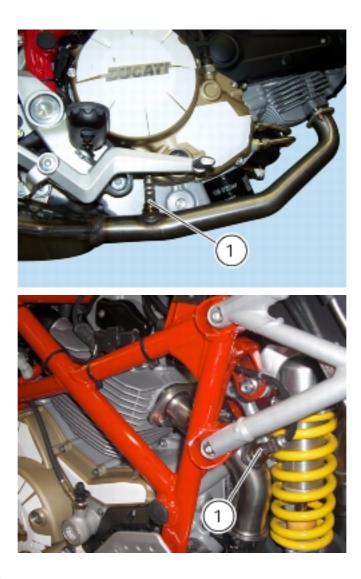
lambda >1 means a lean mixture

lambda < 1 means a rich mixture.

The air-fuel mixture control system is managed by the lambda sensor, which starts to operate at over **300** °C: the ceramic material starts conducting oxygen ions at around **300** °C. If the proportion of oxygen starts to differ between the two ends of the probe, this generates an electrical voltage between the two electrodes due to the particular nature of the material. This makes it possible to measure the difference in oxygen content between the exhaust gas and the ambient air. Combusted gas still contains a residual amount of oxygen when the air-fuel mixture delivered to the combustion chamber is incorrect. This makes it possible to adjust the injection control unit to ensure the engine always runs with the optimal air-fuel mixture.

To remove the lambda sensors (1) unscrew them from the horizontal and vertical cylinder exhaust pipes.

When refitting the sensors, tighten them to the specified torque (Sect. C 3, Frame torque settings).



## 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.



To check this component, use the DDS tester following the instructions given in the paragraph "Guided diagnosis" (Sect. D 5).

For renewal of the TPS, refer to Sect. L 6, Removal of the throttle body.

## Rpm/timing sensor

This sensor is of the inductive type: it faces the timing gear and is capable of "reading" the 48 teeth

System components

and the 2 gaps (each equivalent to 2 teeth) positioned 180° apart.

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).



### Air temperature sensor

This sensor is powered by the ECU and provides information regarding the temperature of the aspirated air. The electronic signals thus obtained are transmitted to the ECU, where they are used to make corrections in accordance with the temperature reading.



#### 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).

### Removal of the air temperature sensor

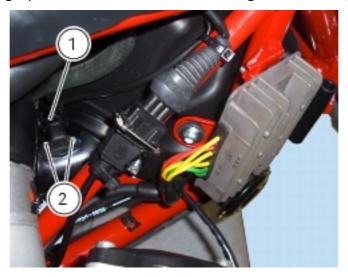
To remove the air temperature sensor, disconnect the main wiring harness connector (1) from the sensor, unscrew the retaining bolts (2) and remove the sensor from the intake manifold.



Refitting the air temperature/pressure sensor

Refitting is the reverse of removal: tighten the retaining screws (2) of the sensor to the specified torque (Sect. C 3, Frame torque settings.

On completion of the refitting operation, reconnect the wiring connector (1) to the sensor.



### Air pressure sensor

This sensor is powered by the ECU and it supplies information concerning the absolute air pressure in an area of the motorcycle that is not subject to turbulence. The electronic signals thus obtained are transmitted to the ECU, where they are used to make corrections in accordance with the pressure reading.



To test the operation of the injector, use the DDS tester and follow the instructions given in the paragraph "Guided diagnosis" (Sect. D 5).

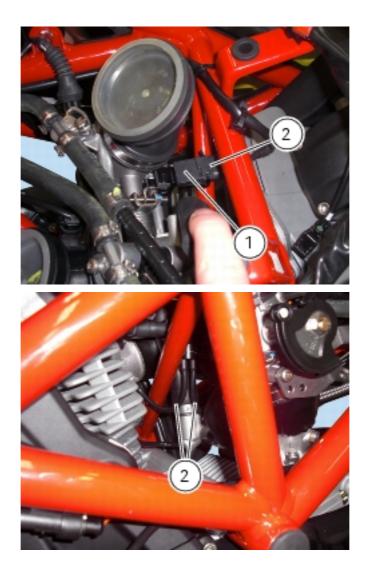
Removing the air pressure sensor

To remove the air pressure sensor (1), first remove the following components:

Operation	Section reference
Remove the seat and the side panels	E 3, Removal of the seat/Removal of the rear side panels
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the airbox	L 7, Removal of the airbox

Disconnect the main wiring harness connector (3) from the sensor, and detach the sensor from the throttle body.

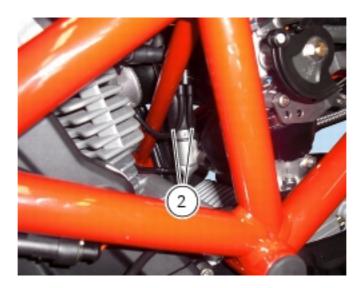
Remove the hoses (2) from the intake manifolds.



Refitting the air pressure sensor

Refitting is the reverse of removal. On completion of the refitting operation, reconnect the wiring connector (3) to the sensor. Refit the airbox (Sect. L 7, Refitting the airbox).

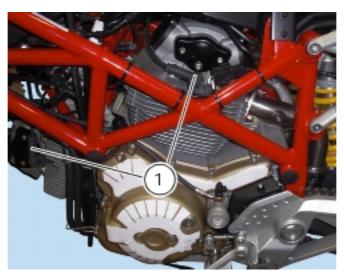




## Spark plug

Clean the area around the spark plug bores with a compressed air jet before removing the spark plugs themselves.

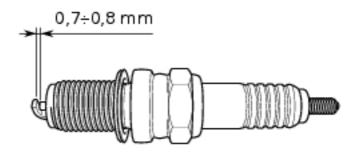
Remove the spark plug connectors (1) from the spark plugs in both heads and remove the four spark plugs, making sure that no debris falls into the combustion chamber.





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, <u>Engine torque settings</u>). Refit the spark plug caps (1).



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.

Make: NGK. Type: DCPR8E.

Alternative

Make:

CHAMPION.

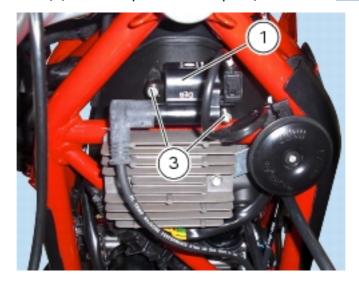
Type: RA4 HC.

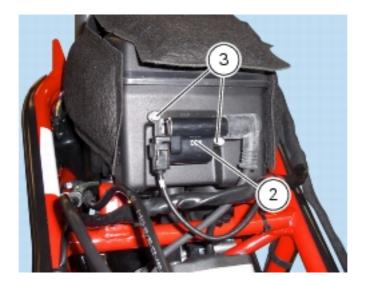
### Coil

An inductive discharge ignition system is used. Coil operation is governed by the M3C electronic control unit, which calculates the ignition advance. The power module (integrated in the electronic control unit) also guarantees constant energy coil charge, by adjusting the dwell time. The horizontal cylinder coil (1) and vertical cylinder coil (2) are mounted to the airbox. In order to access the coils, it is necessary to remove the following components:

Operation	Section reference
	E 3, Removal of the seat/Removal of the rear side panels
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the airbox	L 7, Removal of the airbox

Unscrew the retaining bolts (3) and recover the spacer located in correspondence with the coil (1). When refitting, tighten the bolts (3) to the specified torque (Sect. C 3, Frame torque settings).



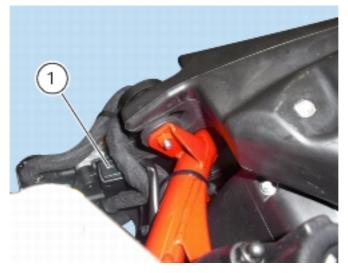




To check the coils for faults use the "DDS" tester (Sect. D 5, Guided diagnosis).

## Injection relay

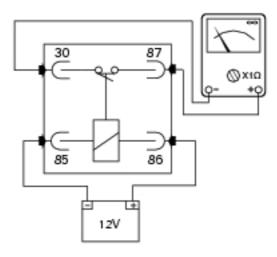
The relay (1) is located next to the ECU.



To access the relay, remove the seat (Sect. E 3, Removal of the seat) and remove the right-hand fairing (Sect. E 2, Removal of the side fairings).

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, <u>Diagnostic instruments</u> concerning operation of the multimeter). The resistance reading should be near zero and, if present, the audible continuity 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 lay-out of the electrical system and consequently reduce its overall weight.

The CAN line is connected to two nodes:

the instrument panel and the engine ECU (I.A.W. 5AM2).

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)
- 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)
- Overrev (gear change signal)
- Scheduled service limit (light on instrument panel illuminates)
- Intake air temperature (input to instrument panel)
- Battery voltage-Identification of motorcycle model
- EOBD LED control
- Immobilizer recovery
- Atmospheric pressure (sensor integrated in the instrument panel).

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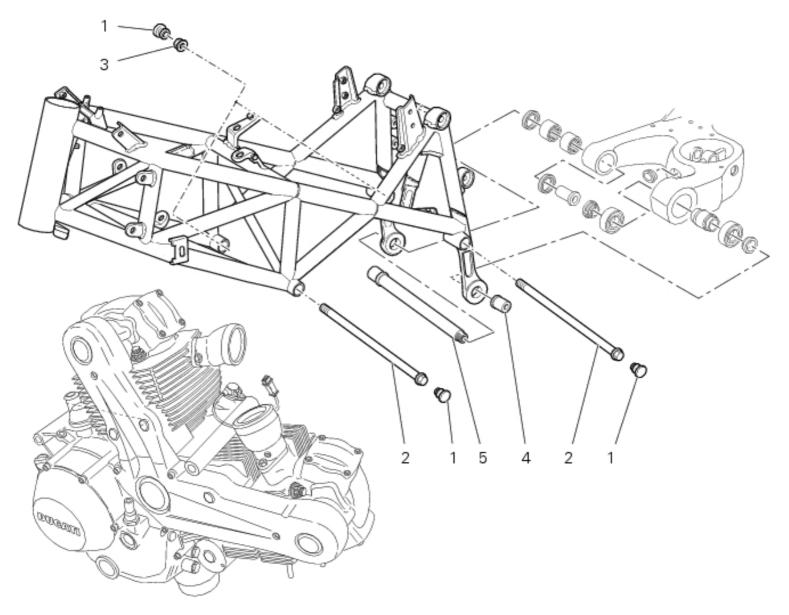
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# 1 - Removal - refitting of the engine assembly



- 1 Plug
- 2 Bolt
- 3 Nut 4 Special nut
- 5 Swingarm pivot shaft



FRAME SWINGARM



### **Important**

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in 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.

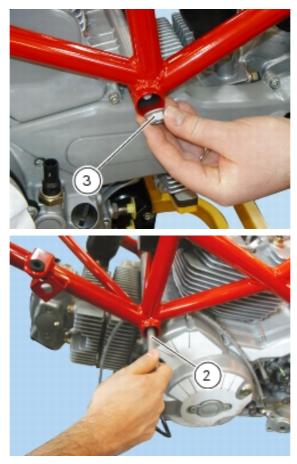
The following flow chart illustrates the logical sequence in which the parts are to be removed from the motorcycle and a reference to the section where the removal procedure is described. This section describes only the operations to be carried out after having removed all the parts listed in the flow chart.

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the side fairings	E 2, Removal of the side fairings
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Disconnect the HT leads	M 3, Spark plug
Remove the airbox	L 7, Removal of the airbox
Disconnect the throttle cables from the throttle body	F 1, Removal of the throttle twistgrip
Remove the throttle body	L 6, Removal of the throttle body
Drain the oil from the lubrication system	D 4, Changing the engine oil and filter cartridge
Remove the oil cooler hoses from the engine block	N 2.2, Removal of the oil cooler
	N 2.2, Removal of the oil cooler  F 5, Removal of the gearchange control
the engine block	F 5, Removal of the gearchange
the engine block  Remove the gearchange control	F 5, Removal of the gearchange control
the engine block  Remove the gearchange control  Remove the footrest brackets	F 5, Removal of the gearchange control  H 4, Removal of the footrest brackets
Remove the gearchange control  Remove the footrest brackets  Remove the sidestand  Disconnect the exhaust pipes from	F 5, Removal of the gearchange control  H 4, Removal of the footrest brackets  H 5, Removal of the sidestand
Remove the gearchange control  Remove the footrest brackets  Remove the sidestand  Disconnect the exhaust pipes from the cylinder heads	F 5, Removal of the gearchange control  H 4, Removal of the footrest brackets  H 5, Removal of the sidestand  L 8, Removal of the exhaust system  F 2, Removal of the clutch slave
Remove the gearchange control  Remove the footrest brackets  Remove the sidestand  Disconnect the exhaust pipes from the cylinder heads  Remove the clutch slave cylinder	F 5, Removal of the gearchange control  H 4, Removal of the footrest brackets  H 5, Removal of the sidestand  L 8, Removal of the exhaust system  F 2, Removal of the clutch slave cylinder

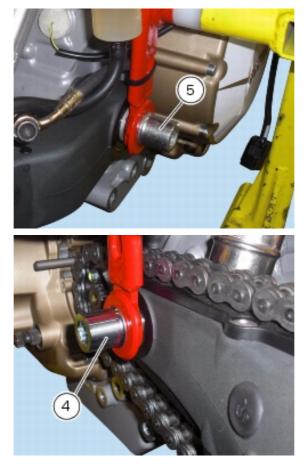
Place a service stand beneath the engine to support it during removal from the frame. Remove the plugs (1) from the frame tubes at the engine mounting points.



Unscrew the nuts (3) on the right-hand side of the frame, on the two upper engine mounting bolts (2).



Restrain the swingarm pivot shaft (5) on the right-hand side of the motorcycle while unscrewing the nut (4) on the left-hand 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 (2).

Withdraw the complete engine assembly from the frame by lowering it and pushing it forwards.

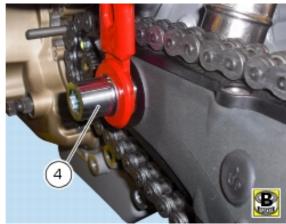
### Refitting the engine

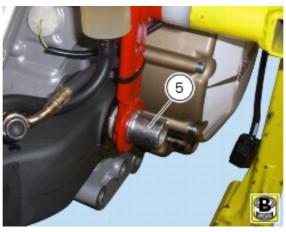
Refitting is the reverse of removal.

In particular, lubricate the nuts (3), nut (4) and the swingarm pivot shaft (5).

Tighten the nuts (3) and the nut (4) to the specified torque (Sect. C 3, Frame torque settings).

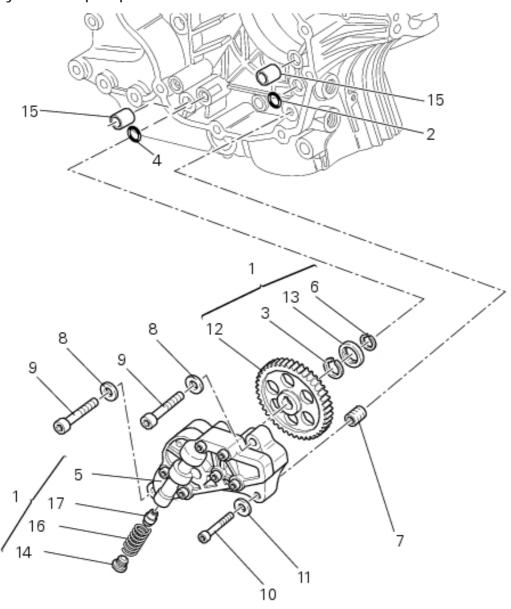




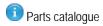


Operation	Section reference
Reconnect the wiring connectors on the engine block	P 1, Routing of wiring on frame
Refit the front sprocket	G 8, Refitting the front sprocket
Adjust the drive chain tension	D 4, Adjusting the chain tension
Refit the clutch slave cylinder	F 2, Refitting the clutch slave cylinder
Reconnect the exhaust pipes to the cylinder heads	L 8, Refitting the exhaust system
Refit the sidestand	H 5, Refitting the sidestand
Refit the footrest brackets	H 4, Refitting the footrest brackets
Refit the gearchange control	F 5, Refitting the gearchange control
Refit the oil cooler hoses to the engine block	N 2.2, Refitting the oil cooler
Fill the lubrication system	D 4, Changing the engine oil and filter cartridge
Refit the throttle body	L 6, Refitting the throttle body
Reconnect the throttle cables to the throttle body	F 1, Refitting the throttle twistgrip
Refit the airbox	L 7, Refitting the airbox
Reconnect the HT leads	M 3, Spark plug
Refit the fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the side fairings	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

# 2.1 - Lubrication system: oil pump



- Complete oil pump assembly
- O-ring 2
- 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 Bush
- 14 By-pass plug 15 Locating bush
- 16 By-pass spring 17 By-pass valve



Filters and oil pump

Lubrication system: oil pump



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

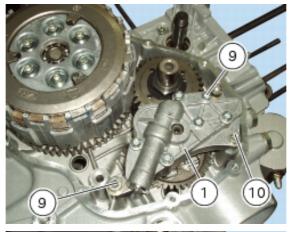
### Removal of the oil pump

Operation	Section reference
	D 4, Changing the engine oil and filter cartridge
Disconnect the oil pressure sensor	P 5, Checking the indicating devices
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).

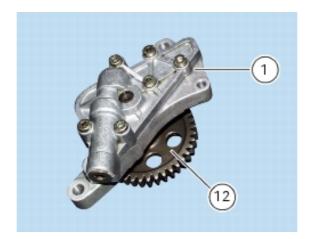




### Disassembly of the oil pump

Hold the oil pump (1) in a vice taking care not to damage the drive gear (12).

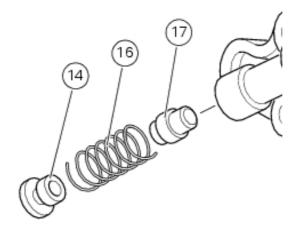
Lubrication system: oil pump



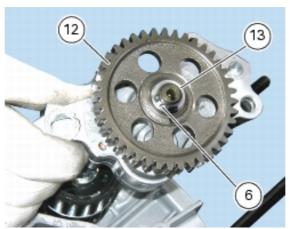


Make sure that vice jaws are faced with soft material.

Remove the plug (14) and extract the spring (16) and by-pass valve (17). Check the condition of the above components.



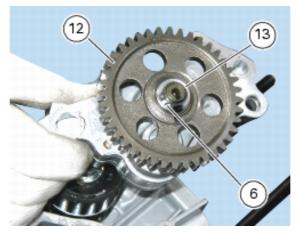
Check the condition of the above components. Remove the circlip (6), slide out the bush (13) and the circlip (3). Slide out the pump drive gear (12).



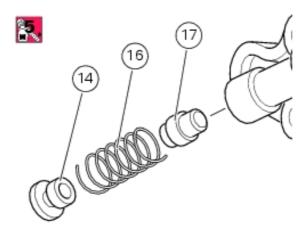
### Reassembly of the oil pump

Fit the pump drive gear (12), circlip (3) and bush (13) on the oil pump. Secure the components installed by inserting the circlip (6) in its groove.

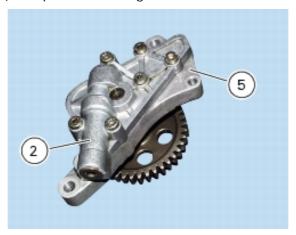
Lubrication system: oil pump



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, <a href="Engine torque settings">Engine torque settings</a>) after applying a medium strength threadlocker.



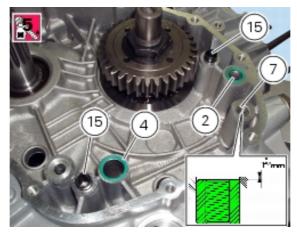
Fit the cover (2) to the pump body (5) complete with the gears.



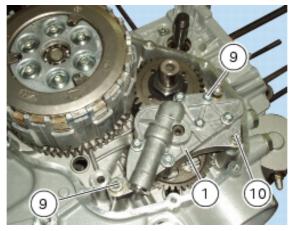
### Refitting the oil pump

If removed, apply the recommended threadocker to the bush (7) and screw it into the crankcase half by the specified amount.

Position the locating bushes (15) and the O-rings (2) and (4) in correspondence with the crankcase lubrication oilways.



Position the oil pump (1) on the crankcase and tighten the bolts (9) and (10) to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>).



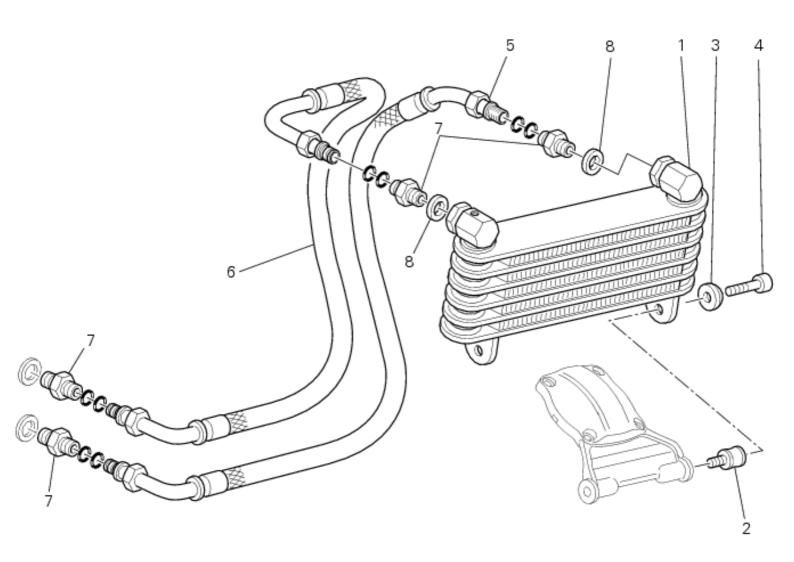
Check the gear backlash with the driving gear by fixing a dial gauge, equipped with the appropriate stylus, to the crankcase half.



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
	N 6.2, Reassembly of the clutch-side crankcase cover
Connect the oil pressure sensor	P 5, Checking the indicating devices
Top up the engine oil	D 4, Changing the engine oil and filter cartridge

# 2.2 - Lubrication system: oil cooler



- 1 Oil cooler
- 2 Rubber mounting
- 3 Spacer
- . I Bolt
- 5 Oil return hose
- 6 Oil supply hose
- 7 Connection fitting
- 8 Aluminium gasket



### **OIL COOLER**



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

Removal of the oil cooler

Operation	Section reference
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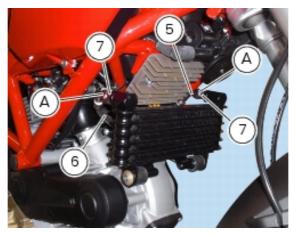
Drain the oil from the lubrication system

D 4, Changing the engine oil and filter cartridge

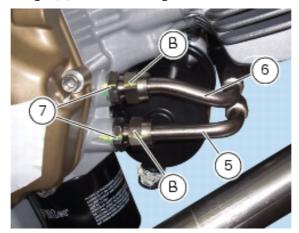
Loosen the nuts on the unions (A) and detach the oil cooler supply (6) and return (5) hoses from the connection

Rotate the oil cooler (1) forwards to prevent the oil from flowing out.

Check the condition of two O-rings at each hose connection.



Loosen the nuts on unions (B) and detach the delivery (6) and return (5) hoses from the engine. You can now remove the connection fittings (7) for connecting the hoses to the engine.



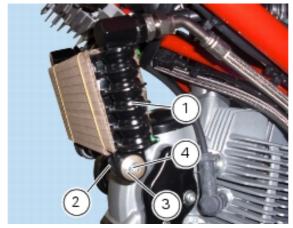
Check the condition of the aluminium sealing washers (8) and renew them if necessary.

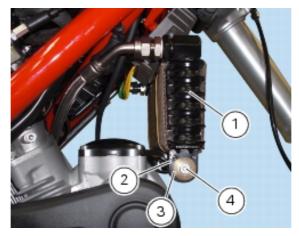
Loosen the bolt (4) and recover the spacer (3) and the rubber mounting (2).

Slide the oil cooler (1) off the pins of the front subframe, towards the left-hand side of the motorcycle.

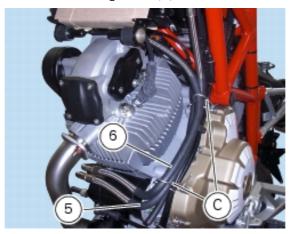
Remove the connection fittings (7) on the oil cooler, check the condition of the sealing washers (8) and renew if necessary.

Remove the rubber mountings (2); check their condition and renew if necessary.





To remove the hoses (5) and (6), free them from the guides (C).





The oil cooler can be removed complete with its hoses.

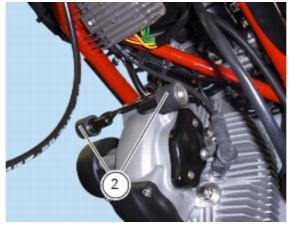
### Oil cooler inspection

Visually inspect the cooler.

Renew the cooler at any sign of damage or leaks.

### Refitting the oil cooler

Fit the rubber mountings (2) on the horizontal cylinder head and tighten to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

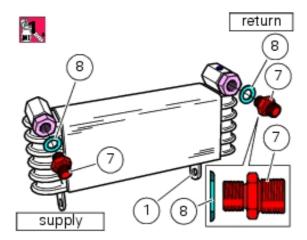


Fit the sealing washer (8) on the connection fitting (7).

The sealing washer must be installed on the side of the nipple with the smaller diameter thread with the square edge side facing the oil cooler.

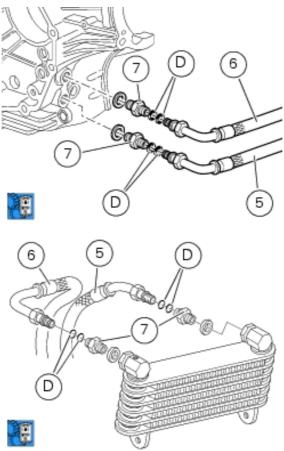
Apply threadlocker to the thread of the connection fitting (7) that is screwed into the oil cooler.

Insert the connection fitting (7) with the sealing washer (8) in the supply port or return port and tighten to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>) while restraining the hex nut of the oil cooler.





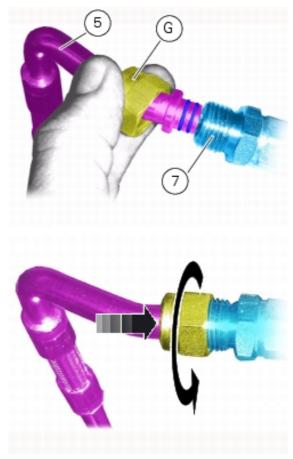
Lubricate the threads of the fittingss (5) and (6) and O-rings (D) with engine oil.



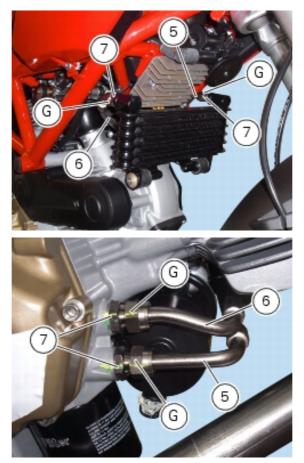
Fit the hoses (5) and (6) on the fittings (7) without inserting the O-rings. Screw the nuts (G) fully on to the connection fittings by hand.



To avoid pinching the O-rings, do not push the hose into the connection fitting. The O-rings should only be inserted in the connection fitting by tightening the nut (G).

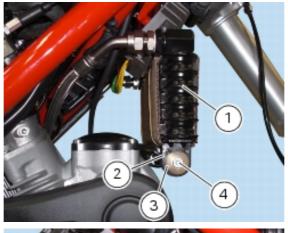


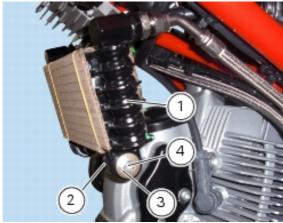
Tighten the nuts (G) to the specified torque (Sect. C 3, <u>Frame torque settings</u>) while counterholding the flats on the connection fittings (7).



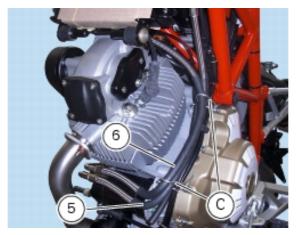
Position the oil cooler (1) in correspondence with the rubber mountings (2) fitted previously and secure it with the collars (3) and bolts (4).

Tighten the oil cooler retaining bolts (4) to the specified torque (Sect. C 3, Frame torque settings).



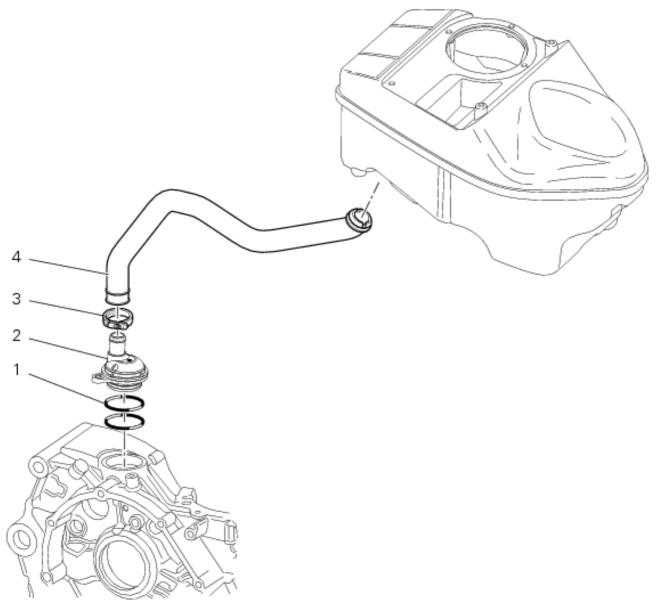


Locate the hoses (5) and (6) in the guides (C).



Operation	Section reference
	D 4, Changing the engine oil and filter
	<u>cartridge</u>

# 2.3 - Lubrication system: oil breather



- 1 O-ring
- 2 Oil breather valve
- 3 Clamp
- 4 Hose



## **AIR INTAKE - OIL BREATHER**



#### Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

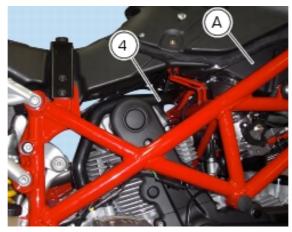
Removal of the oil breather valve

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the side fairings	E 2, Removal of the side fairings

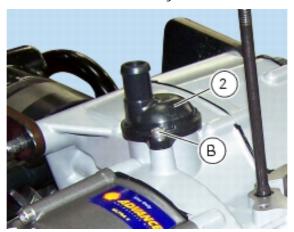
Loosen the clamp (3) securing the connection hose (4) of the oil breather valve (2).



Extract the hose (4) from the airbox (A).



Unscrew the bolt (B) and remove the oil breather valve (2) from the engine. Check the condition of O-rings (1) and renew them if necessary.



## Refitting the oil breather system

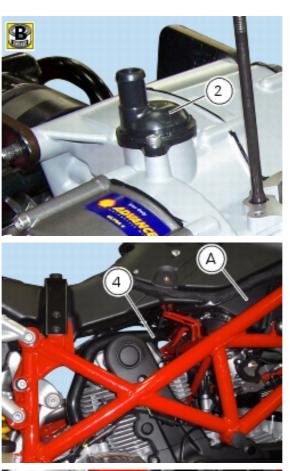
Refitting is the reverse of removal.

It is advisable to first position the hose (4) in the airbox (A) and then the hose clamp (3) on the breather valve (2).



Notes

On reassembly, lubricate the O-rings (1) with the recommended grease.



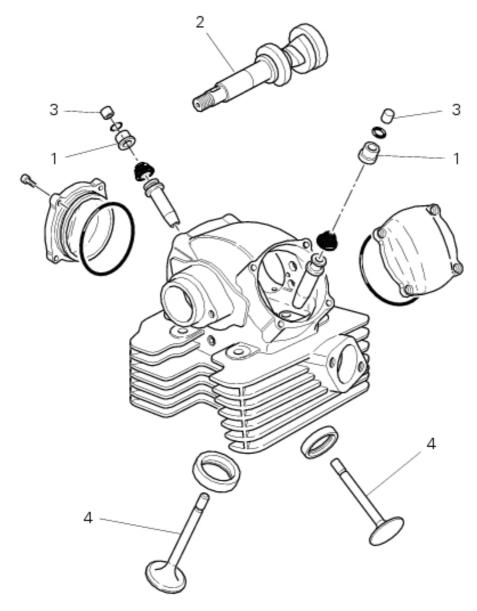




To facilitate subsequent removal and refitting operations, we recommend that the hose clamps are installed in their original positions.

Operation	Section reference
Refit the side fairings	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

# 4.1 - Cylinder head assemblies: checks and adjustments



- 1 Valve closing shim
- 2 Camshaft
- 3 Valve opening shim
- 4 Valve



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, but which can be found in the exploded view diagram.

Checking and adjusting valve clearances

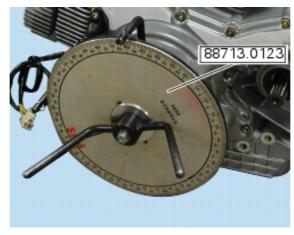
Operation	Section reference
Remove the seat	E 3, Removal of the seat

Remove the side fairings	E 2, Removal of the side fairings
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the oil cooler	N 2.2, Removal of the oil cooler
Remove the valve covers	N 4.3, Removal of the valve covers
Remove the timing belt covers	N 4.2, Removal of the timing belt
	covers



For clarity, the figures show the engine block removed from the frame.

Remove the inspection cover (A) and install service tool no. 88713.0123.



Turn the crankshaft until the mark on the timing belt driveshaft pulley is aligned with the mark on the crankcase cover.



Set the degree wheel of service tool no. **88713.0123** to zero the horizontal cylinder is at top dead centre of the expansion stroke, and therefore we can proceed to check the valve clearances on this cylinder.

To measure valve clearances in the vertical cylinder, rotate the crankshaft counterclockwise through 270° from this position. This will bring the vertical cylinder to top dead centre of the expansion stroke, and therefore we can proceed to check the valve clearances on this cylinder.

Checking the opening clearance (Sa) of the intake/exhaust valves

To check the valve opening clearance (Sa), insert the blade of a feeler gauge between the opening rocker (D) and the shim (3).

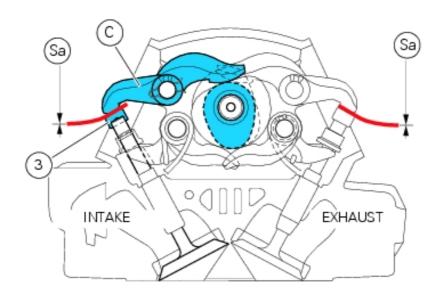


While inserting the blade of the feeler gauge to check the clearance, apply gentle leverage to overcome the force of the closing rocker spring and thus eliminate any play in the rocker mechanism: then check that the shim can rotate freely.

The clearance values must be within the specified limits (Sect. C 1.1, <u>Timing system/valves</u>). If they are not, remove the opening shim (3), as described in the paragraph "<u>Removal of the cylinder head</u> assembly", Sect. N 4.4, and replace it with a shim of appropriate thickness to obtain the specified clearance.



Opening rocker arm shims measuring 1.8 to 3.45 are available as replacement parts: each shim is marked with its size.



Checking the closing clearance (Sc) of the intake/exhaust valves

To check the valve closing clearance, insert the blade of a feeler gauge between the closing rocker (C) and the shim (1): the closing clearance (Sc) corresponds to the thickness of the feeler gauge and should allow the free rotation of the shim without any significant play.

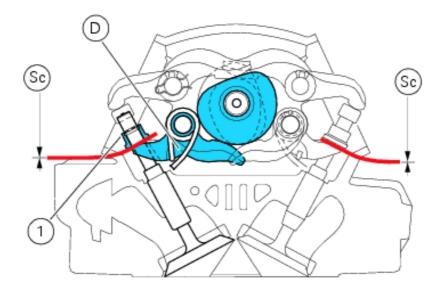
The clearance must be within the specified limits (Sect. C 1.1, <u>Timing system/valves</u>).

If it is not, remove the closing shim (1), as described in the paragraph "Removal of the rocker arms, shims and valves" Sect. N 4.4, and replace it with a shim of suitable thickness to obtain the specified clearance.



Closing rocker arm shims measuring 2.2 to 4.5 are available as replacement parts: each shim is marked with its size.

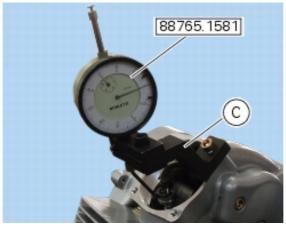
Refit the opening and closing shims as described in the paragraph "Refitting the rocker arms, shims and valves", Sect. N 4.4.

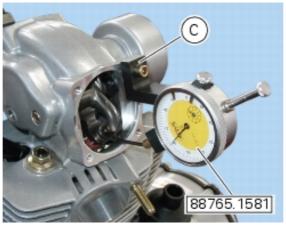


### Checking valve lift

Fit the gauge (C) **88765.1581** in correspondence with the fixing hole of the previously removed cylinder head valve cover, as shown in the photo.

Reset the valve opening clearance when the camshaft is in its rest position by fitting a feeler gauge between the upper rocker arm and opening shim.







This operation is best done using one dial gauge for the exhaust valve and another one for the intake valve. Make sure the dial gauge fork is centred relative to the valve axis and located against 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, <u>Timing system/valves</u>). Perform the same procedure for the exhaust valve, fixing the support to the opposite side of the cylinder head. Refit following the procedure indicated in the previous paragraph "<u>Checking and adjusting valve clearances</u>". Remove the tools **88765.1581**.

Operation	Section reference
Refit the timing belt covers	N 4.2, Refitting the timing belt covers
Refit the valve covers	N 4.3, Refitting the valve covers
Refit the oil cooler	N 2.2, Refitting the oil cooler
Refit the fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the side fairings	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

### Checking the engine timing

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the side fairings	E 2, Removal of the side fairings
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the oil cooler	N 2.2, Removal of the oil cooler
Remove the timing belt covers	N 4.2, Removal of the timing belt
	covers
Remove the valve covers	N 4.3, Removal of the valve covers



Engine timing should be checked after changing parts such as camshafts, valves or timing belt rollers or when overhauling badly worn engines.

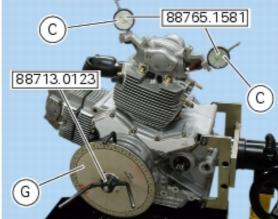
Remove the spark plugs and install the tool (E) **88765.1297** in the spark plug bore to determine the piston's TDC, along with gauges (C) **88765.1581** and the timing check tool with timing degree wheel (G) **88713.0123**). Reset the opening valve clearance when the camshaft is in rest position by inserting a feeler gauge between the opening rocker arm and the opening shim.

Check that in this condition the camshaft can rotate. If it moves stiffly, use a thinner feeler gauge.

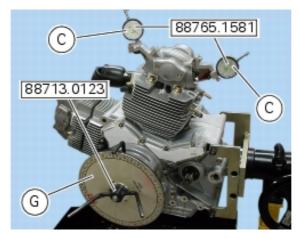
In this condition, with the piston of the horizontal cylinder is at TDC and the valves fully closed as confirmed by the reading on gauge (E), set gauges (C) to zero.

Adjust the timing belt tension as described in Section N 4.2, Refitting the timing belt tensioner pulleys.





Turn the degree wheel (G) counterclockwise until the dial gauge (C) on the exhaust side shows a lift of **1** mm. Check that the angular displacement reading on the degree wheel (G) is as specified (Sect. C 1.1, <u>Timing system/valves</u>).



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 to rotate until, in correspondence with the closure of the valve for the compression stroke, you obtain a lift of the intake valve of **1** mm on the gauge (C). Check that the angular displacement reading matches the specified value (Sect. C 1.1, <u>Timing system/valves</u>).

Rotate clockwise again until obtaining 1 mm lift of the exhaust valve, on both valve opening and closure.

Check the angular displacement value against the specified value.

Repeat the procedure for the vertical cylinder.

Permissible tolerance for measured values is ±3° with respect to specified values.

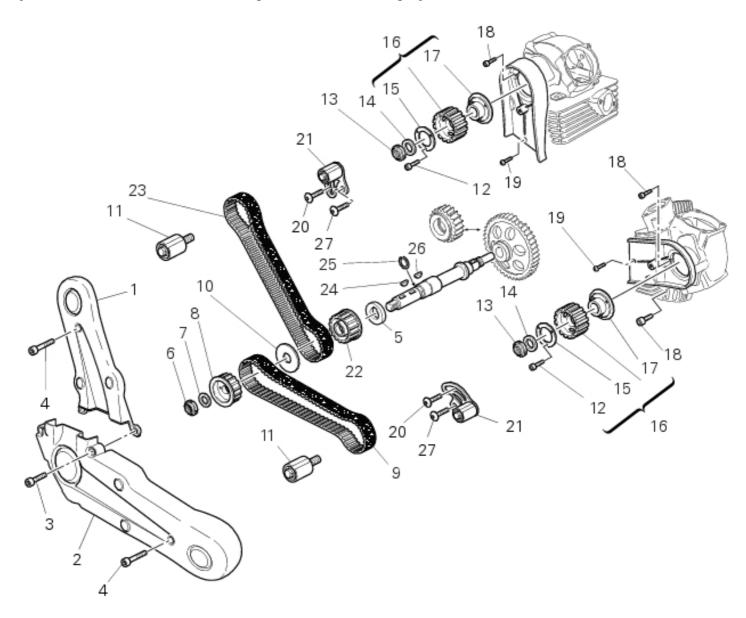
Remove the tools used to check engine timing.

Operation	Section reference
Refit the valve covers	N 4.3, Refitting the valve covers
Refit the timing belt covers	N 4.2, Refitting the timing belt covers
Refit the oil cooler	N 2.2, Refitting the oil cooler
Refit the fuel tank	L 2, Refitting the fuel tank

Cylinder head assemblies: checks and adjustments

Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the side fairings	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

# 4.2 - Cylinder head assemblies: timing belt covers/timing system



- Vertical cylinder timing belt cover
- 2 Horizontal cylinder timing belt cover
- 3 Bolt
- 4 Bolt
- 5 Spacer
- 6 Elastic stop ring
- 7 Washer
- 8 Outer timing belt driveshaft pulley
- 9 Horizontal cylinder timing belt
- 10 Intermediate spacer
- 11 Idler pulley assembly
- 12 Bolt
- 13 Elastic stop ring
- 14 Washer
- 15 Special washer
- 16 Camshaft pulley
- 17 Flange
- 18 Bolt
- 19 Bolt
- 20 Bolt
- 21 Tensioner pulley assembly
- 22 Inner timing belt driveshaft pulley
- 23 Vertical cylinder timing belt
- 24 Key

Cylinder head assemblies: timing belt covers/timing system

25 Circlip

26 Key 27 Bolt



timing system

Cylinder head: timing system



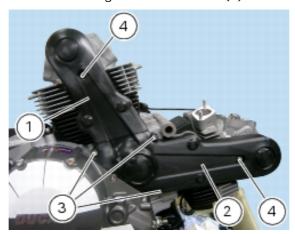
## **Important**

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

### Removal of the timing belt covers

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the side fairings	E 2, Removal of the side fairings
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank

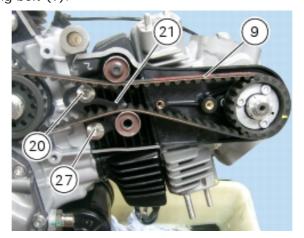
Unscrew the screw (4) and screws (3) and remove the horizontal timing belt cover (2). Unscrew the screw (4) and remove the vertical timing belt outer cover (1).



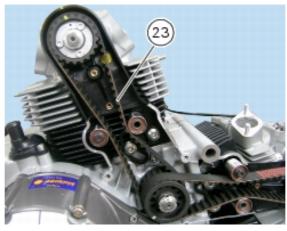
### Removal of the timing system assembly

Loosen the positioning screw (20) of the tensioner pulley (21) of the horizontal cylinder timing belt. Loosen the screw (27) securing the tensioner pulley of the horizontal cylinder timing belt and move the tensioner pulley (21) to the rest position.

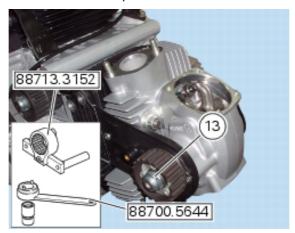
Remove the horizontal cylinder timing belt (9).



Repeat the above operations to remove the vertical cylinder timing belt (23).



To remove the camshaft pulleys, install the tool **88713.3152** on the pulley to be removed to prevent its rotation, and using service socket no. **88700.5644** inserted in a torque wrench or ratchet arm, loosen the pulley retaining nut (13).



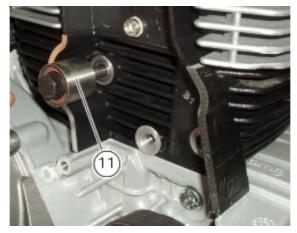
Remove the nut (13), washer (14) and pulley (16).



On reassembly, always fit new nuts.

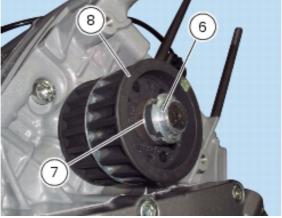


Unscrew and remove the idler pulleys (11).

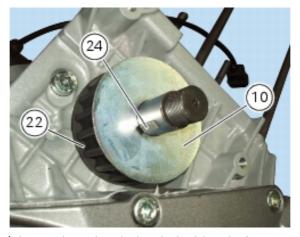


Use the wrench of tool no. **88700.5644** to lock rotation of the timing belt driveshaft pulley on the crankcase and, using the socket combined with the tool, loosen the nut (6). Remove the nut (6), the washer (7) and the outer pulley (8).



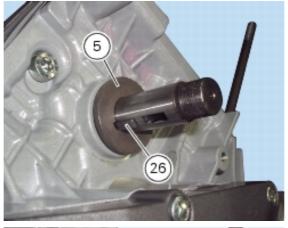


Remove the first Woodruff key (24) located on the timing belt driveshaft. Remove the intermediate spacer (10) and the inner pulley (22).



Remove the second Woodruff key (26) located on the timing belt driveshaft. Remove the spacer (5) and the circlip (25).

Cylinder head assemblies: timing belt covers/timing system





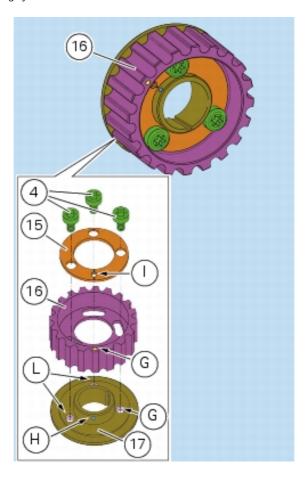
### Disassembly and reassembly of the timing belt pulleys

To disassemble the pulleys, loosen and remove the three screws (12), slide of the washer and (15) and remove the pulley (16) from the flange (17).

To reassemble, fit the pulley (16) on the hub (17), aligning the timing mark (G) on the pulley with the timing mark on the (H) on the hub.

Fit the washer (15) against the pulley, aligning the timing notch (I) with the timing marks (G) and (H) on the pulley and the hub respectively.

Insert the three screws (12) in the threaded holes (L) of the hub.



## Refitting the timing system assembly

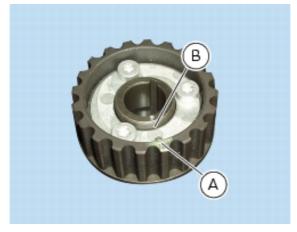
Refitting the camshaft timing pulleys

Check that the keyway on the end of camshaft is in good condition and without burrs. Fit one key (C) into the camshaft keyway.





During reassembly, take care that the timing mark "B" on the spacer flange is aligned with the mark "A" on the pulley and washer.



Fit the assembled pulley (16) onto the camshaft, so that is firmly seated.



Make sure that the Woodruff key is not dislodged.



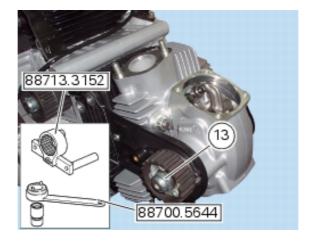
Fit the tool no. **88713.3152** onto the pulleys to prevent rotation. Apply a smear of grease to the thread and underside of the nut (13), and fit the washer (14) and the nut.



Always fit new nuts on reassembly.

Using the socket of service tool no. **88700.5644** in combination with a torque wrench, tighten the nuts (13) to their specified torque (Sect. C 3 Engine torque settings).



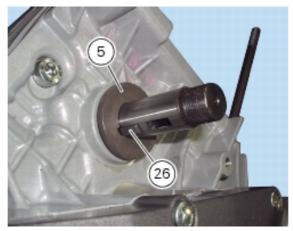


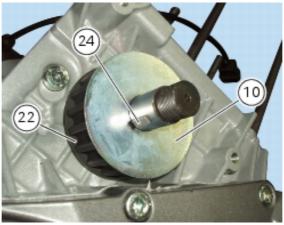
Refitting the timing belt driveshaft pulleys

Install the circlip (25) on the pulley side of the timing belt driveshaft. Drive it into its seat using the protective cap **88700.5749** and the relative drift.



Fit the spacer (5) with the slot facing the crankcase. Locate on the timing belt drievshaft, the first Woodruff key (26), the inner pulley (22) the intermediate spacer (10) and the second Woodruff key (24).



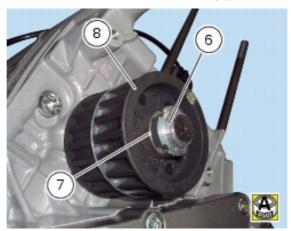




To prevent the nuts working loose and consequent serious engine damage, always use new self-locking nuts on all the timing belt pulleys on reassembly.



Apply a thin coating of grease to the thread and underside of the nut (6).

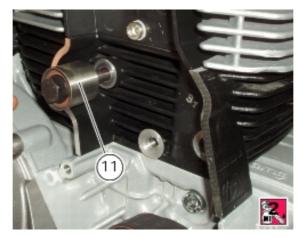


Use the wrench of tool **88700.5644** to restrain the pulleys against rotation and, using the bush of the tool in a torque wrench, tighten the self-locking nut to the specified torque (Sect. C 3, <u>Engine torque settings</u>).

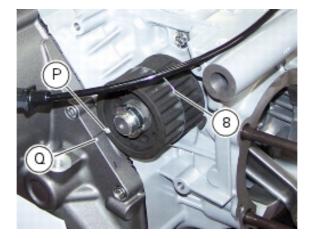


Refitting the timing belt tensioner pulleys

If removed, apply the recommended threadlocker to the idler pulley (11) and tighten to the specified torque (Sect. C 3, Engine torque settings).



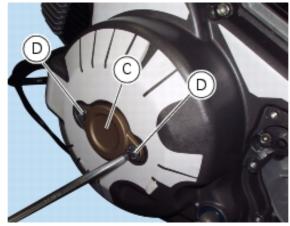
Position the crankshaft so that the piston of the horizontal cylinder is at TDC of its power stroke. This is achieved by aligning the timing mark (P) on the timing belt driveshaft pulley (8) with the reference notch (Q) on the crankcase cover.





Turn the timing belt driveshaft pulley with the spark plugs removed from the engine.

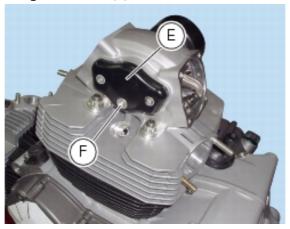
Remove the inspection cover (C) from alternator-side crankcase cover by unscrewing the two bolts (D).



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.



Remove the srew (F) from the inner timing belt cover (E) and recover the washer.



Restrain the camshafts of both cylinder heads by screwing tool no. 88713.2282 into the camshaft end caps (E).



Turn the pulleys by hand until the end of the tool engages the slot in the camshaft.

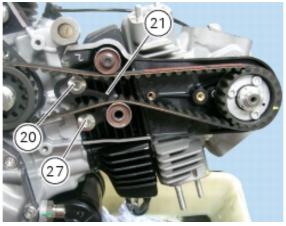


Fit the horizontal (9) and vertical (23) timing belts using your hands only and without altering the alignment of the pulleys.





Locate the tensioner pulleys (21) on the vertical and horizontal cylinders. Screw in, but do not tighten at this point, the screws (27) and (20), so that the tensioner pulleys can rotate.

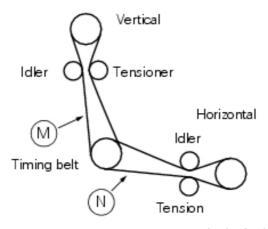




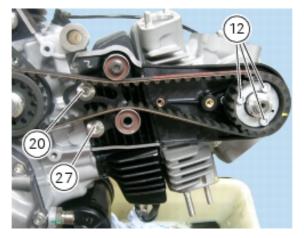
Check the timing belt tension and adjust if necessary as described in the paragraph "Measuring timing belt tension" (Sect. D 5).



Check the tension values on sections of belts (M) and (N) shown in the figure.



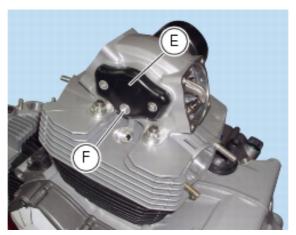
When the correct belt tensioning value is reached, ensure that bolts (20), (27) and (12) are tightened to the specified torque (Sect. C 3, Engine torque settings).





Whenever you renew any components of the timing system, it is good practice to also check the timing (Sect. N 4.1, Cylinder head assemblies: checks and adjustments).

Remove the service tools no. **88713.2282** from the camshaft end caps (E) and refit the screws (F) with the washers, tightening them to the specified torque (Sect. C 3, <u>Engine torque settings</u>).





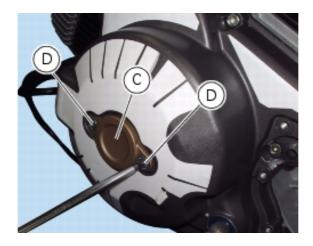
Remove the crankshaft locking tool 88713.2011 unscrewing first the pin and then the screw from the tool.



Refit the inspection cover (C) in the alternator-side crankcase cover, inserting the two bolts (D). Tighten the bolts to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>).



Before refitting the cover (C), check the condition of the O-ring and renew it if necessary.



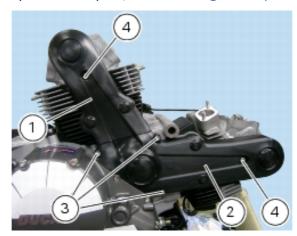
## Refitting the timing belt covers

Position the vertical timing belt cover (1) on the engine.

Fit the cover retaining screws (4) and tighten to the specified torque (Sect. C 3, Engine torque settings).

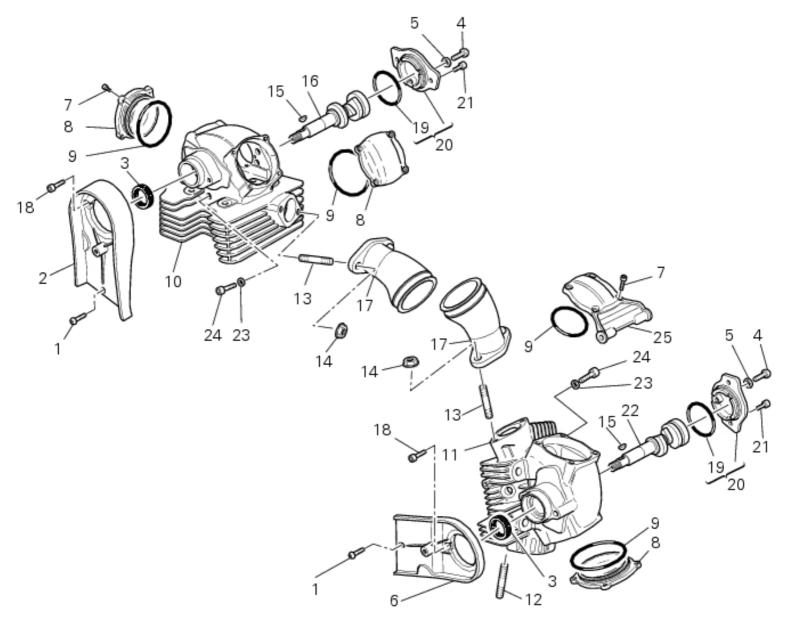
Locate the horizontal timing belt cover (2) on the engine.

Tighten the screws (4) and (3) to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>).



Operation	Section reference
Refit the fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the side fairings	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

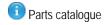
# 4.3 - Cylinder head assemblies: camshafts



- 1 Bolt
- 2 Vertical cylinder head inner timing belt cover
- 3 Seal
- 4 Bolt
- 5 Washer
- 6 Horizontal cylinder head inner timing belt cover
- 7 Bolt
- 8 Valve cover
- 9 O-ring
- 10 Vertical cylinder head
- 11 Horizontal cylinder head
- 12 Stud bolt
- 13 Stud bolt
- 14 Nut
- 15 Key
- 16 Camshaft-vertical cylinder head
- 17 Air intake funnel
- 18 Bolt
- 19 O-ring
- 20 Camshaft end cap
- 21 Bolt
- 22 Horizontal cylinder head camshaft
- 23 Copper gasket
- 24 Bolt

Cylinder head assemblies: camshafts

### 25 Valve cover



CYLINDER HEAD: TIMING SYSTEM

Vertical cylinder head

HORIZONTAL CYLINDER HEAD

**INTAKE MANIFOLDS** 



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

### Removal of the intake manifolds

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the side fairings	E 2, Removal of the side fairings
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the airbox	L 7, Removal of the airbox
Disconnect the throttle cables from the throttle body	F 1, Removal of the throttle twistgrip
Remove the throttle body	L 6, Removal of the throttle body



#### Notes

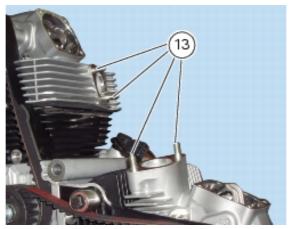
The procedure can also be carried out with the engine installed in the frame. For clarity, the photos show the engine removed from the frame.

Unscrew and remove the nuts (14) securing the intake manifolds of the vertical and horizontal cylinder heads from the studs (13).

Remove the manifolds (17).



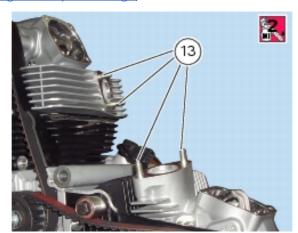
If necessary, remove the studs (12) and (13) from the cylinder heads.

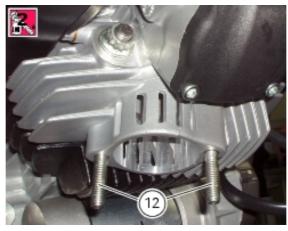




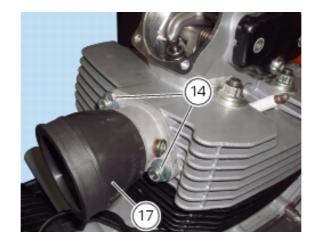
## Refitting the intake manifolds

Apply the recommended threadlocker to the studs (12) and (13), install them in the cylinder heads and tighten them to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>).





Locate the intake manifolds (17) and secure with the nuts (14). Tighten the nuts (14) to the specified torque (Sect. C 3, Engine torque settings).



Operation	Section reference
Refit the throttle body	L 6, Refitting the throttle body
Reconnect the throttle cables to the throttle body	F 1, Refitting the throttle twistgrip
Refit the airbox	L 7, Refitting the airbox
Refit the fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the side fairings	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

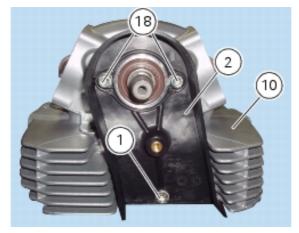
## Removal of the inner timing belt covers and camshaft end caps

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the side fairings	E 2, Removal of the side fairings
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the timing belt covers	N 4.2, Removal of the timing belt covers
Remove the camshaft pulleys	N 4.2, Removal of the timing system assembly

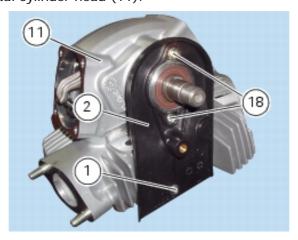


For clarity, the figures show the cylinder head removed from engine.

Remove the retaining screws (18) and (1) and remove the inner timing belt cover (2) from the vertical cylinder head (10).

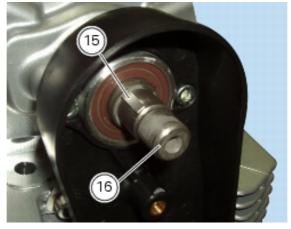


Repeat the operation for the horizontal cylinder head (11).

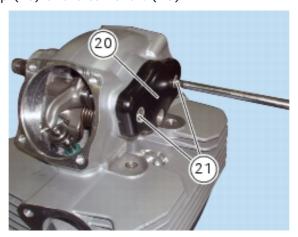




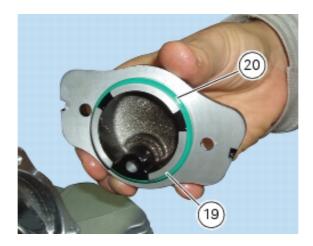
When removing the covers, take care not lose the Woodruff keys (15) located on camshafts (16) and (22).



Unscrew the bolts (21) of the end cap (20) of the camshaft (16).



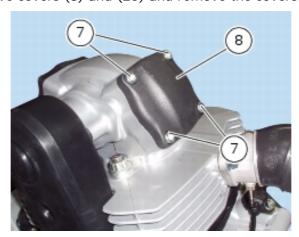
Remove the camshaft end cap (20) from the cylinder head and recover the O-ring (19).

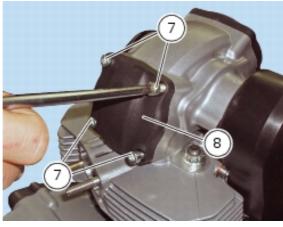


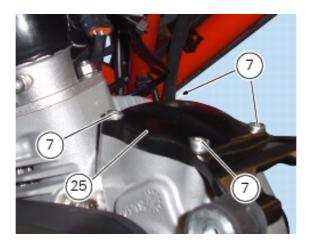
## Removal of the valve covers

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the side fairings	E 2, Removal of the side fairings
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the oil cooler	N 2.2, Removal of the oil cooler

Undo the retaining screws (7) of valve covers (8) and (25) and remove the covers with relative O-rings (9).

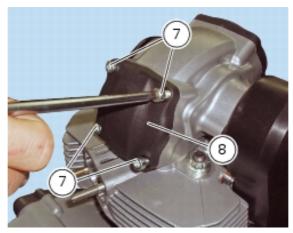


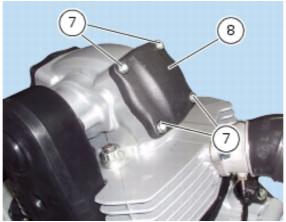


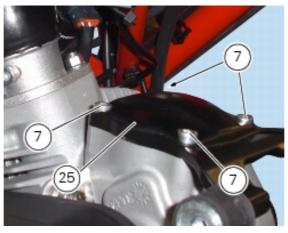


## Refitting the valve covers

Always fit new O-rings (9) when refitting the valve covers. Fix the valve covers (8) and (25) with the relative O-rings (9) to the cylinder head. Tighten the bolts (7) to the specified torque (Sect. C 3, Engine torque settings).







Operation	Section reference
Refit the oil cooler	N 2.2, Refitting the oil cooler
Refit the fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the side fairings	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

### Removal of the camshafts

Operation	Section reference
Remove the seat	E 3, Removal of the seat
Remove the side fairings	E 2, Removal of the side fairings
Remove the battery	P 2, Removal of the battery
Remove the starter contactor	P 3, Starter contactor
Remove the fuel tank	L 2, Removal of the fuel tank
Remove the timing belt covers	N 4.2, Removal of the timing belt covers
Remove the timing belts and camshaft timing belt pulleys	N 4.2, Removal of the timing system assembly



#### Notes

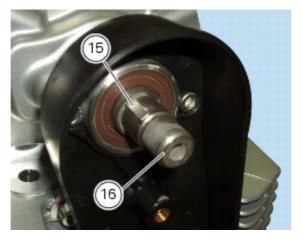
This operation can be carried out with the rocker arms installed in the cylinder head. For clarity, the photos show the cylinder head with the opening rocker arms removed.

Remove the camshaft end caps as described above. Remove the key (15) from the camshaft.



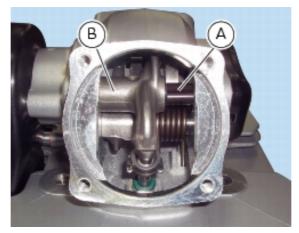
#### Notes

To prevent possible damage to components, turn the camshaft (16) through a series of rotations so that the cams do not foul the rockers.

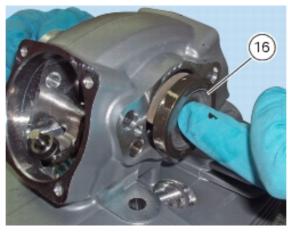


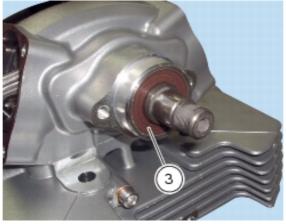


If the rocker arms are installed in the cylinder head, remove the spring (A) of the opening rocker arm (B) to facilitate operations.



Withdraw the camshaft (16) from its housing. Remove the oil seal (3) from the cylinder head.





## Inspecting the camshafts

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.

Install the camshaft between two centres and check for distortion using a dial gauge:

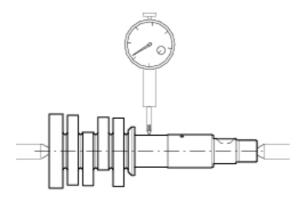
- service limit: **0.1** mm.



Notes 1

The effective distortion will be half the total reading obtained on the dial gauge.

Cylinder head assemblies: camshafts



Each camshaft is stamped with an identification letter:

O: horizontal; V: vertical.

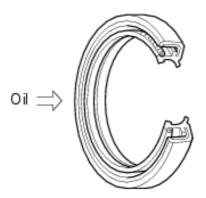


## Checking the oil seals

Fit new oil seals at each engine overhaul.

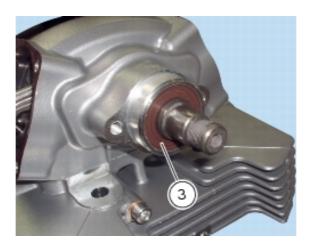
Insert the new oil seals squarely in their bores. Use suitable drifts.

Lubricate the lip of oil seals after assembly. This operation must be performed very carefully.



## Refitting the camshafts

If removed, install the oil seal (3) in the bore on the right-hand side of the cylinder head using a suitable drift.



# Important

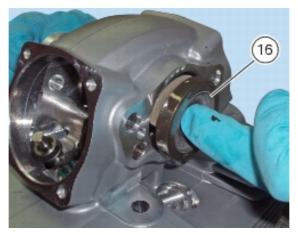
If the rockers arms are already installed in the cylinder head (Sect. N 4.4, <u>Refitting the rocker arms, shims and valves</u>), insert the camshaft (16), carefully rotating it as you go, so that the camshaft lobes do not foul the rocker arms.

Before fitting the camshaft, check the punch mark: "V" means vertical, "O" means horizontal.

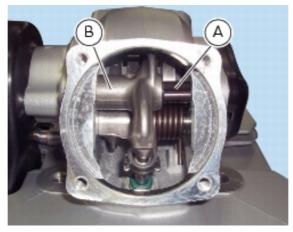


Apply graphite oil to the seats of the camshaft so that it is lubricated also during the initial revs of the engine. Insert the camshaft (16) from the left-hand side of the cylinder head.





If previously removed, relocate the spring (A) of the opening rocker arm (B).



Check the condition of the Woodruff key (15) and its groove, and install it.



Operation	Section reference
Refit the inner timing belt covers and camshaft end caps	N 4.3, Refitting the camshaft end caps
Refit the timing belts and camshaft timing belt pulleys	N 4.2, Refitting the timing system assembly
Refit the timing covers	N 4.2, Refitting the timing belt covers
Refit the fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the side fairings	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

Lubricate the new O-rings (19) with the recommended grease and fit on the end cap (20). Fit the end cap (20) on the left-hand side of the cylinder head.

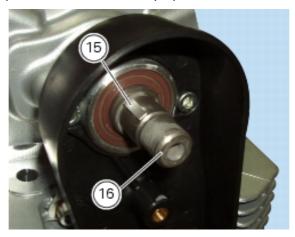


Secure the end cap (20) with the bolts (21). Tighten the bolts (21) to the specified torque (Sect. C 3, <u>Engine torque settings</u>).





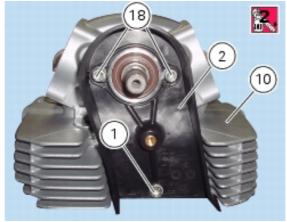
Take care not to dislodge the key (15) located on camshaft (16).

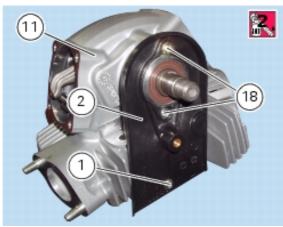


Locate the inner timing belt cover (2) of the vertical cylinder head on the left-hand side of the cylinder head and insert the retaining screws (1) and (18).

Tighten the bolts (18) and (1) to the specified torque (Sect. C 3, Engine torque settings).

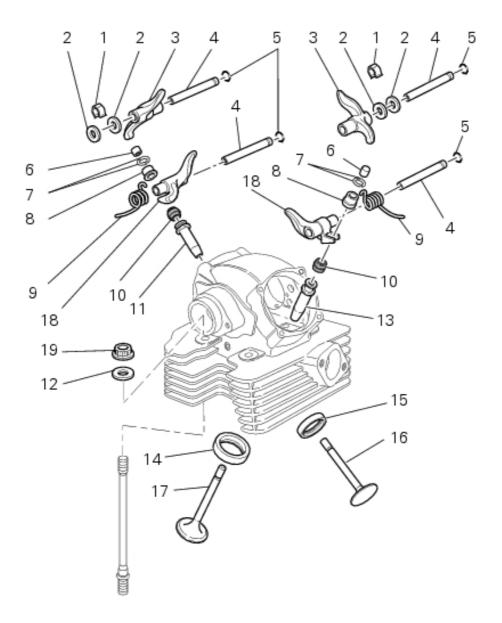
Repeat the above operations for the other cylinder head (11).



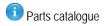


Operation	Section reference
Refit the camshaft timing pulleys to the cylinder heads	N 4.2, Refitting the timing system assembly
Refit the timing belt covers	N 4.2, Refitting the timing belt covers
Refit the fuel tank	L 2, Refitting the fuel tank
Refit the starter contactor	P 3, Starter contactor
Refit the battery	P 2, Refitting the battery
Refit the side fairings	E 2, Refitting the side fairings
Refit the seat	E 3, Refitting the seat

## 4.4 - Cylinder head assemblies: valves - rocker arms



- 1 Clip
- 2 Shim
- 3 Opening rocker arm
- Rocker arm shaft
- 5 O-ring
- 6 Valve opening shim
- 7 Half rings
- 8 Valve closing shim
- 9 Spring
- 10 Valve rubber
- 11 Exhaust valve guide
- 12 Washer
- 13 Intake valve guide
- 14 Intake valve seat
- 15 Exhaust valve seat
- 16 Exhaust valve
- 17 Intake valve
- 18 Closing rocker arm
- 19 Nut



Crankcase halves

## <u>Vertical cylinder head</u> <u>HORIZONTAL CYLINDER HEAD</u>



#### **Important**

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

## Removal of the cylinder head assembly

Operation	Section reference
Remove the engine from the frame	N 1, Removal of the engine
_	N 4.2, Removal of the timing belt covers
Remove the timing belts and the timing belt pulleys	N 4.2, Removal of the timing system assembly

#### Removal of the cylinder heads

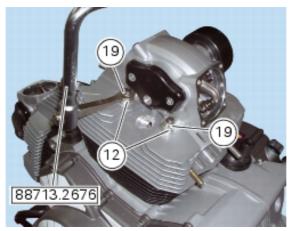


#### Notes

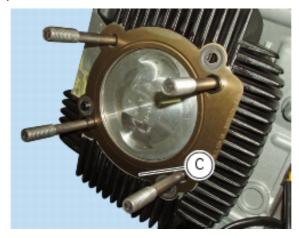
On disassembly of the components mounted on the cylinder head it is essential that they are laid out or marked in such a way that they can be refitted in exactly the same position they occupied before being removed.

Using tool 88713.2676, unscrew the nuts (19) on the cylinder head studs.

Remove the nuts (19) and recover the special washers (12) positioned between the nuts and the cylinder head.

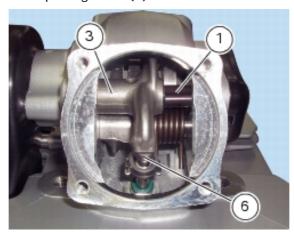


Remove the head assembly from the engine by lifting it off the engine stud bolts. Remove the cylinder head gaskets (C).

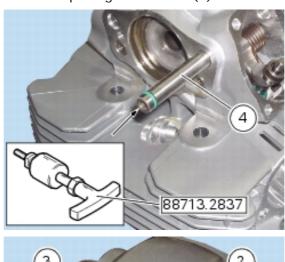


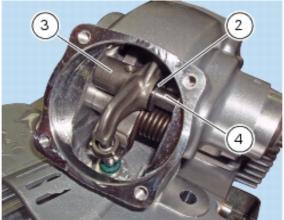
Operation	Section reference
Remove the valve covers	N 4.3, Removal of the valve covers
Remove the camshafts	N 4.3, Removal of the camshafts
	N 4.3, Removal of the inner timing belt covers and camshaft end caps

Remove the clip (1) securing the opening rocker (3). Move the rocker arm (3) to free the valve opening shim (6).



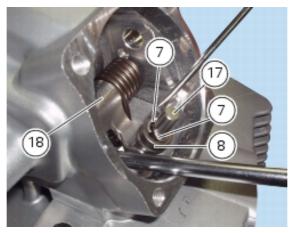
Screw service tool **88713.2837** to the threaded end of the opening rocker shaft (4). Withdraw the rocker shaft (4) and recover the opening rocker arm (3) and the two shims (2).





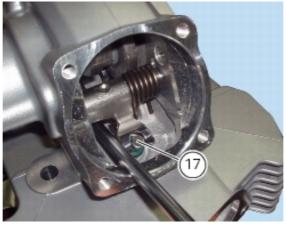
Using two screwdrivers, hold the closing rocker arm (18) in the "valve open" position. Slide the valve closing shim (8) along the intake valve stem (17) in such a way as to make it possible to remove the two half rings (7) securing the valve.

Use long nosed pliers or a magnetic screwdriver to remove the half rings (7) from the valve stem.



Slide the valve closing shim (8) off the valve (17). Withdraw the valve (17) from the underside of the cylinder head.



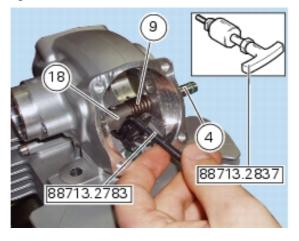


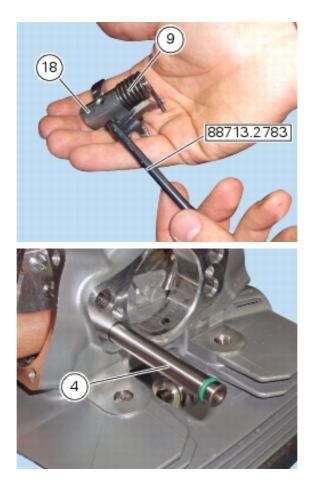
Repeat the above operations for the exhaust side.

Attach the end of the spring (9) of the closing rocker arm (18) to the tool 88713.2783.

Remove the closing rocker arm shaft (4) using service tool 88713.2837.

Remove the rocker arm (18), the spring (9) and service tool 88713.2783.





## Overhaul of cylinder head components

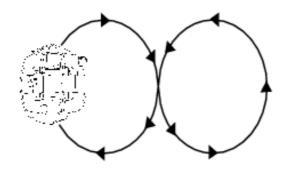
## Overhaul of the cylinder heads

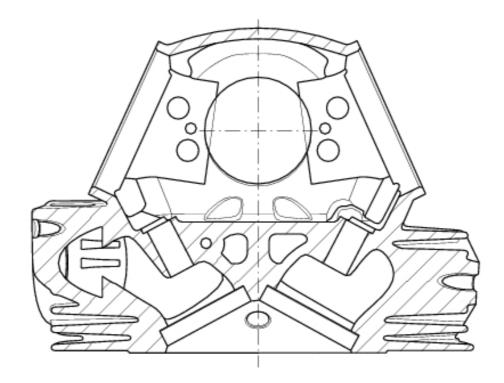
Remove any carbon deposits from the combustion chamber and its ducts. Check for cracking and inspect the sealing surfaces for scoring, ridges or other damage.





The cylinder barrel mating surface must be perfectly flat. If this is not the case, spread diamond dressing compound (6 to 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.





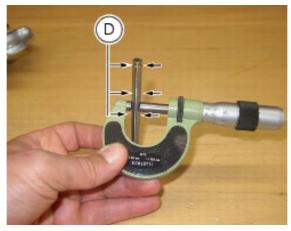
#### Checking the valves

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.

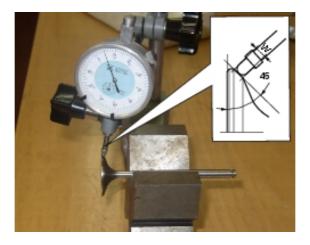


The valves cannot be ground.

Perform the following checks: measure the diameter of the valve stem (D) at various heights along the portion that runs in the valve guide.

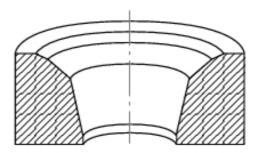


Check that valve head band (at **45**° to valve head top face) is concentric to the valve stem as follows: place the valve on a V block, set a dial gauge at right angles to the head and rotate the valve. Service limit: **0.03** mm.



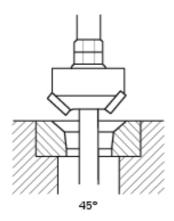
#### Checking the valve seats

Visually inspect the valve seats: there must no excessive hollowing and there must be no pitting or cracks.



If a valve seat is only slightly damaged, it may be lapped using the special  $45^{\circ}$  lapping tools, with subsequent grinding of the valve into its seats.

If the valve seats are excessively damaged, fit oversize seats. Replacement seats are available with **0.03** and **0.06** mm oversized outside diameters.

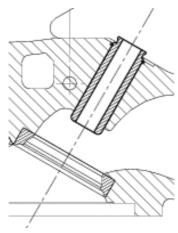




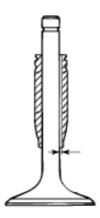
When you change the valve seats, change the valve guides as well.

Renewal of the valve seat

Remove the worn seats by grinding out the rings. Take great care not to damage the valve seat housing in the cylinder head.



Check the diameter of cylinder head bores and choose the oversized valve seat that will give an interference fit of **0.11** to **0.16** mm. Replacement valve seats are supplied in outside diameter oversizes of **0.03** and **0.06** mm.



Heat the cylinder head gradually and evenly up to **200** °C and chill the new valve seats in dry ice. Install the seats perfectly square into their bores using a suitable installer.



Allow to cool and then lap the valve seats, smooth the connections between the ducts and the new seats and grind the valves.

#### Valve-seat contact surfaces

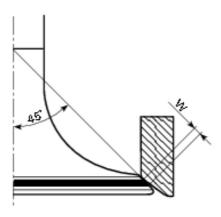
Use Prussian blue or a mixture of minium and oil to check that the contact surface (W) between valve and seat is **1.0** to **1.5** mm.

Maximum permissible limit:

- 2.0 mm.

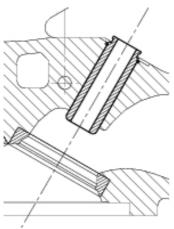
Grind the seat if the dimension measured is greater than above limit.

Fill the intake and exhaust ducts with fuel to check for leaks; if leaking occurs, check the sealing surfaces for burrs.



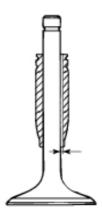
## Overhaul of the valve guides

Carefully examine the internal surface of the valve guide: for cracking or distortion. If the guide is excessively out-of-round, use a reaming tool to make the mating faces more uniform.





When you change the valve guide, you must also change the valve. The intake valve guides are made from cast iron, whereas the exhaust valve guides are bronze.



Valve-valve guide clearance

Assembly clearance:

-0.03 to 0.06 mm.

Maximum permissible wear limit:

- **0.08** mm.

Renewal of the valve guides

To renew the valve guides (11) and (13), proceed as follows.

Heat up the cylinder head gradually and evenly up to 200 °C.

Drive out the valve guide using a suitable drift (see drawing).

Allow the cylinder head to cool down and check the condition of the seat.

Select the most suitable replacement valve guide to obtain an interference fit in the cylinder head bore of **0.022**-

**0.051** mm; replacement valve guides are supplied in O.D. oversizes of **0.03**, **0.06** and **0.09** complete with lock rings. Heat up the cylinder head again and chill the new valve guide in dry ice.

Lubricate the seat and install the valve guide so that the stop ring is located against the head, using the drift previously used to remove the old guide.

Allow the cylinder head to cool, then ream out the inside of the new valve guide.



Overhauling the rocker arms

Check for signs of wear, grooves or chrome flaking off.

Check the condition of the rocker arm bore and shaft.

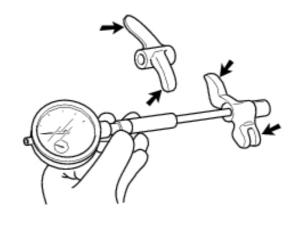
nominal diameter of rocker arm bore:

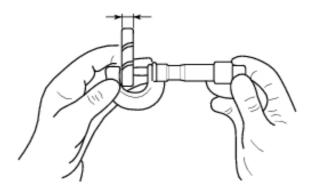
- 10.040 to 10.062 mm.

nominal diameter of rocker arm shaft:

- 10 to 0.005 mm.

Check the contact surfaces of the shims and the valve return collets are perfectly flat with no signs of wear.





Rocker shaft-rocker bore clearance

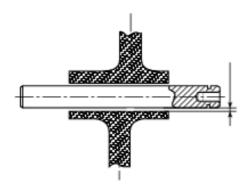
The assembly clearance must be **0.03** to **0.06** mm.

Maximum permissible wear limit:

#### - **0.08** mm.

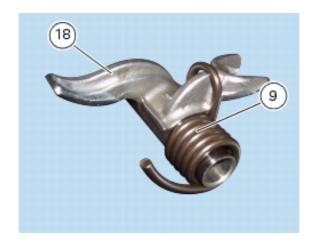
The rocker arm shafts should be a light force fit in the cylinder head.

In the event of excessive clearance, fit **0.02** mm oversize shafts (available from Parts Service).



## Checking the rocker arm springs

Carefully examine the springs (9) of the closing rocker arms (18). There must be no signs of cracking, distortion, or loss of elasticity.



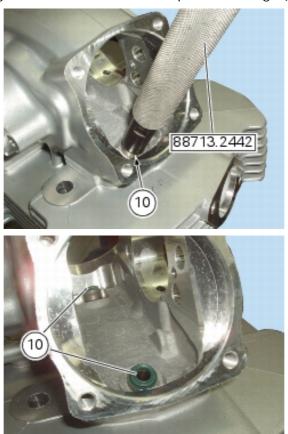
## Refitting the cylinder head assembly

To refit the cylinder head reverse the steps of the removal procedure; pay particular attention to those operations mentioned specifically.

It is very important that all the components are carefully cleaned.

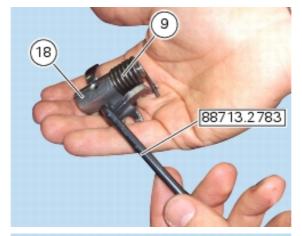
If removed, fit new valve guide seal rings (10), lubricate with engine oil and insert from the spring side with tool part no. **88713.2442**.

Fit the end of the tool into the valve guide and use a mallet to tap the seal rings (10) home into the valve guides.



Refitting the rocker arms, shims and valves

Fit the closing rocker arm (18) and relative spring (9) on service tool no. **88713.2783**. Insstall the service tool-rocker arm-spring assembly in the cylinder head and insert the shaft (4) with a new seal ring (5), suitably lubricated.



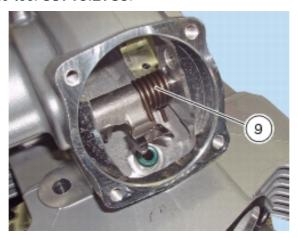


Important

When assembling the rocker arm shafts (4) make sure that threaded hole is on the external side of the cylinder head.



Detach the spring (9) and remove the tool 88713.2783.

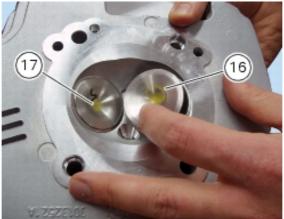


Proceed in the same way for the exhaust side.



Install the valve (17) and valves (16), first lubricating them with engine oil.

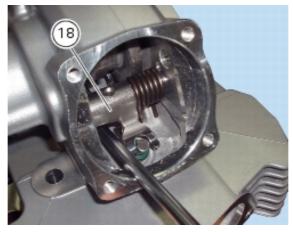




Provisionally install the camshaft (C).



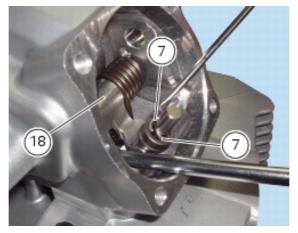
Using two screwdrivers, hold the closing rocker (18) in the "valve open" position.



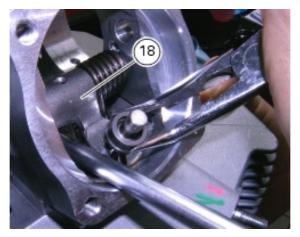
Fit the closing shim (8) on the valve stem (17) with the larger diameter side facing the rocker arm.



Position the two half rings (7) on the valve stem. Remove the screwdriver and position the closing rocker arm (18) in the rest position.



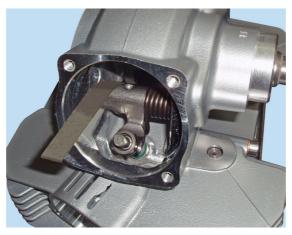
Reposition the screwdriver, and compress the spring as much as possible while holding the valve, the shim and the half rings in the "valve closed" position. Release the closing rocker (18) with a rapid motion, so that the half rings seat in the shim.



With the valve in rest position and while pushing on the rocker arm to oppose the force of the return spring, check

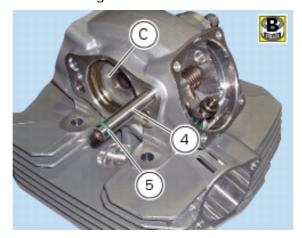
that the clearance between the rocker and the closing shim is within the specified tolerance limits (Sect. N 4.1, Checking the closing clearance (Sc) of the intake/exhaust valves).

If not, adjust the valve clearance (Sect. N 4.1, Checking and adjusting valve clearances).

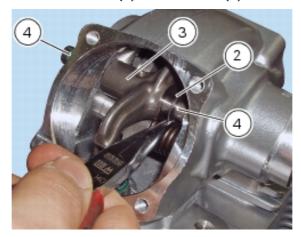


Once the specified clearance has been obtained, remove the camshaft (C), lubricate it with graphite oil and reinstall it in the cylinder head.

Insert the rocker arm shaft (4) with the threaded hole on the external side of the cylinder head: the seal (5) should be renewed on installation; lubricate it before fitting.



Locate the opening rocker arm (3) and the two shims (2) on the shaft (4).



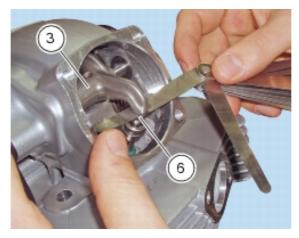
Refit the camshaft end cap (Sect. N 4.3, Refitting the camshaft end caps).

Refit the camshaft timing pulleys (Sect. N 4.2, Refitting the timing belt driveshaft pulleys).

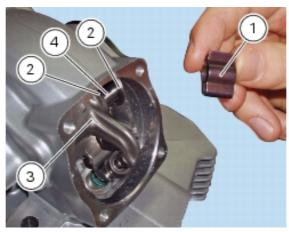
Locate the valve opening shim (6) on the valve stem.

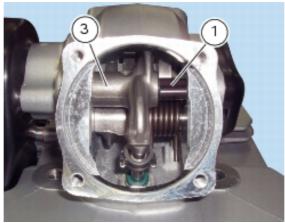
With the valve in rest position, check that clearance between the rocker arm (3) and the shim (6) is within the specified tolerance limits (Sect. N 4.1, Checking the opening clearance (Sa) of the intake/exhaust valves).

If not, adjust the valve clearance (Sect. N 4.1, Checking and adjusting valve clearances.



Fit the side clip (1) on the shaft (4) of the opening rocker arm (3) between the two spacers (2).





Operation	Section reference
Refit the camshaft end caps	N 4.3, Refitting the camshaft end
	<u>caps</u>
Refit the camshafts	N 4.3, Refitting the camshafts
Refit the valve covers	N 4.3, Refitting the valve covers

## Refitting the cylinder heads

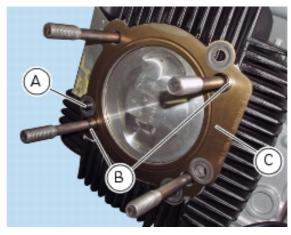


## Warning

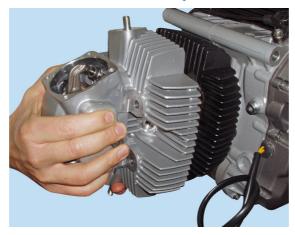
In order to prevent oil leaks developing between the cylinder barrel and the crankcase, every time the cylinder head is removed, it is essential to remove also the cylinder barrel/piston in order to be able to clean the crankcase and cylinder barrel, to renew, if necessary, damaged gaskets and O-rings and to apply new liquid gasket (Sect. N 5, Refitting the cylinder/piston assembly).

Before refitting the cylinder head assemblies, fit new head gaskets (C) and check that the locating dowels (A) and

bushes (B) are installed (Sect. N 5, Cylinder/piston assemblies).

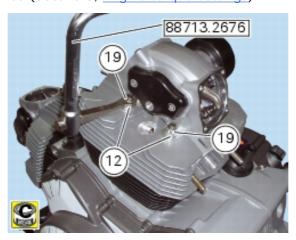


Fit the cylinder head onto the studs and lower it down onto the cylinder barrel.



Fit the special washers (12) over the stud bolts with the square edged face towards the cylinder head and the flat face towards the inside.

Grease the threads and undersides of the nuts (19) and the threads of the studs with the recommended grease. Using tool no. **88713.2676** in conjunction with a torque wrench, gradually tighten the cylinder head nuts to the specified torque in a crosswise sequence (Sect. C 3, Engine torque settings).



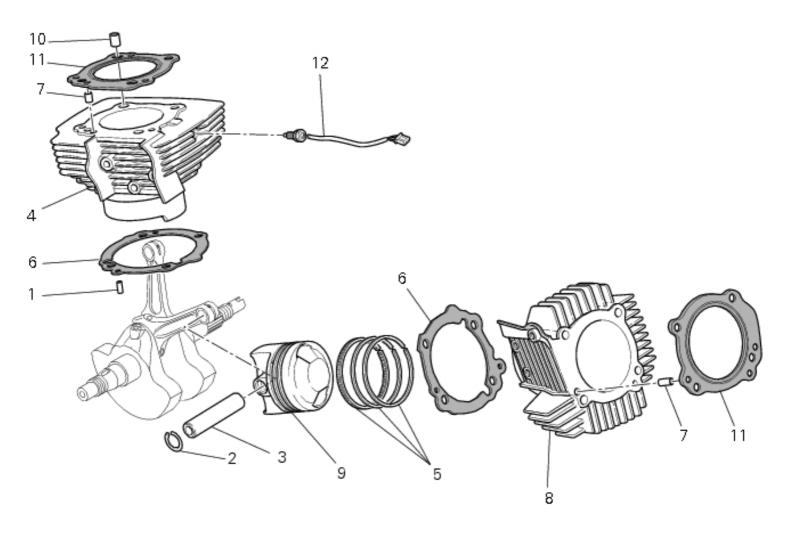


Incorrect tightening could cause abnormal elongation of the studs and serious damage to the engine.

Operation	Section reference
	N 4.2, Refitting the timing system assembly
Refit the timing belt covers	N 4.2, Refitting the timing belt covers
Refit the engine to the frame	N 1, Refitting the engine



## 5 - Cylinder/piston assemblies



- 1 Pin
- 2 Circlip
- 3 Gudgeon pin
- 4 Vertical cylinder
- 5 Piston rings
- 6 Cylinder-crankcase gasket
- 7 Pin
- 8 Horizontal cylinder
- 9 Piston
- 10 Locating bush
- 11 Cylinder head gasket 12 Cylinder temperature sensor



## **Cylinders - Pistons**



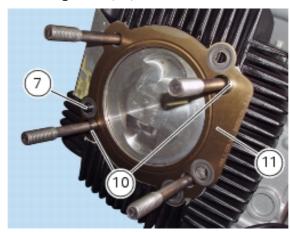
## Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

Removal of the cylinder/piston assembly

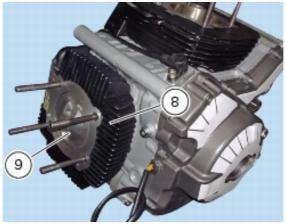
Operation	Section reference
Remove the engine from the frame	N 1, Removal of the engine
Remove the timing belt covers	N 4.2, Removal of the timing belt covers
Remove the timing belts and the timing belt pulleys	N 4.2, Removal of the timing system assembly
Remove the cylinder heads from the engine	N 4.4, Removal of the cylinder head assembly

Remove the dowel (7), bushes (10) and head gasket (11) from their seats on the cylinder barrel.

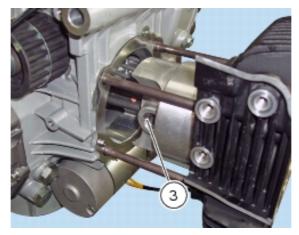


Use service tool no. **88700.5644** to bring the piston (9) of the horizontal cylinder (8) close to TDC. Carefully lift the cylinder barrel (8) off the crankcase, keeping it vertical.





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).



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 an assembly as described below.

Close the opening in the engine crankcase with a rag or soft paper to prevent foreign material or solid combustion residue from falling in.

Remove the circlip (2) of the gudgeon pin (3) from the clutch side.



Working from the opposite side, drive out the gudgeon pin (3) sufficiently to release the connecting rod. Lift the cylinder/piston assembly clear of the engine crankcase studs.



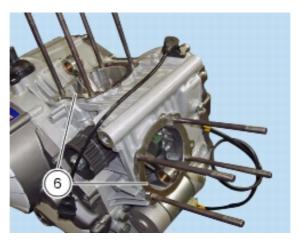
If work is to be carried out on the piston, carefully withdraw it from the cylinder.



To remove the vertical cylinder-piston assembly, proceed as described above for the horizontal cylinder. Remove the cylinder-crankcase gaskets (6) from the cylinder barrel.



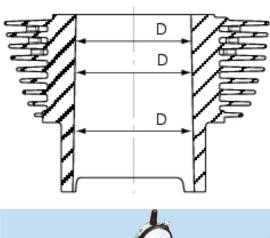
Mark the pistons to show from which cylinder they were removed: V = Vertical - H = Horizontal.



## 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 (D) at three different heights and in two directions offset by 90°, thereby determining the assembly clearance, taper, and ovality (see specified values in Section C 1.1, <a href="Cylinder/Piston">Cylinder/Piston</a>).





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 cylinders are marked by a letter (punched into the specific surface on the cylinder side) showing the class to which they belong.

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.

Check the piston diameter.



The pistons must always be renewed as a pair.

Cylinder/piston assemblies

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 Section 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.

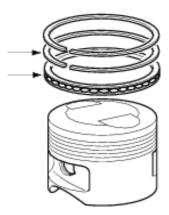
The assembly clearance with the piston at the time of installation must be **0.002** to **0.008** mm.

The maximum permissible wear limit is **0.035** mm.

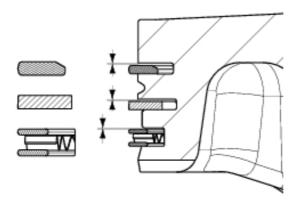
If a new gudgeon pin is fitted, you must also change the connecting rod small end bush.

#### 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.

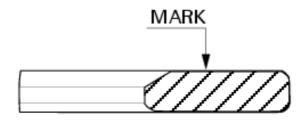


Piston ring-to-groove clearance

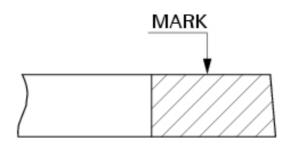


The maximum permissible wear limit is 0.15 mm for the top compression ring (1st) and 0.10 mm for the others (2nd and oil control ring).

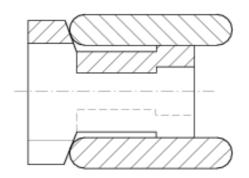
1<sup>st</sup> compression ring



2<sup>nd</sup> compression ring



Oil control ring





The piston rings must always be installed with markings facing upwards.

## Gudgeon pin-piston clearance

Measure the diameter of the gudgeon pin bore in the piston. Measure the diameter of the gudgeon pin.

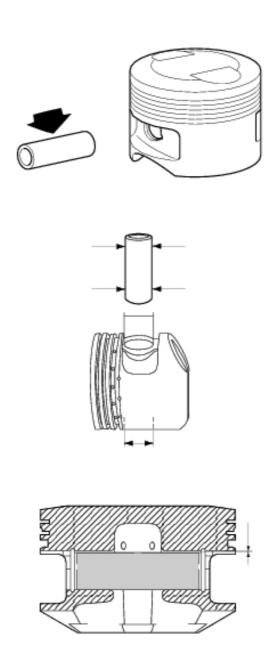
Cylinder/piston assemblies

Maximum wear limit:

- **0.025** mm.

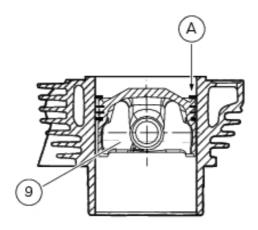


If you fit a new gudgeon pin, you must also change the connecting rod small end bush.



## Piston ring-to-bore clearance

It is essential that the measurement be performed with the piston ring (A) positioned perfectly square in the cylinder. For this reason, the piston (9) should be inserted in the cylinder without piston rings fitted and then place the piston ring to be checked on top of the piston.

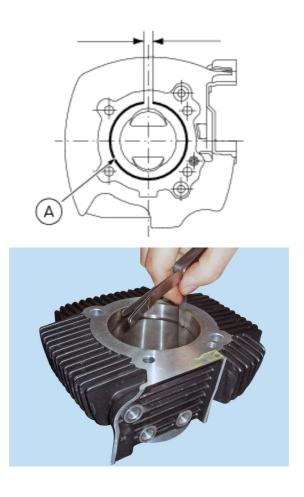


Measure the piston ring gap: Top and second piston ring (nominal): **0.20** to **0.40** mm.

Wear limit: **0.80** mm.

Oil control ring (nominal): 0.30 to 0.60 mm.

Wear limit: 1.0 mm.



## Refitting the cylinder/piston assembly

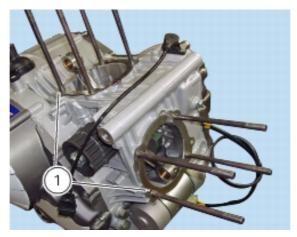
If a new cylinder/piston assembly is to be fitted, make sure that the piston and cylinder are of the same size class. The letter indicating the cylinder size class is stamped on the cylinder-head mating face; the piston size class letter is stamped on the crown in between the two recesses.



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). 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 pockets facing the exhaust port.



Remove any deposits and degrease the contact surfaces of the crankcase and the cylinders. Check that the dowel (1) is installed on the crankcase.

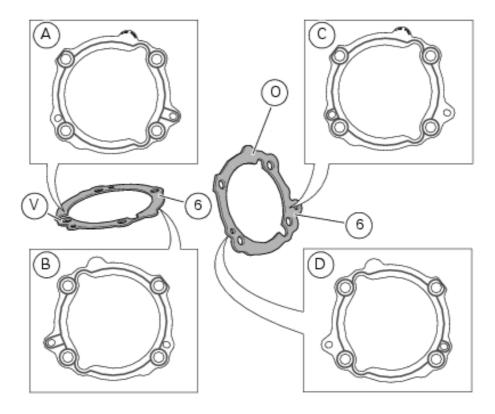


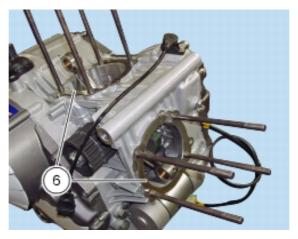
Apply a bead of liquid gasket to the contact faces of the gasket (6): the exact configuration of the bead of liquid gasket varies according to whether the gasket is for the (6) for the vertical cylinder (V) and the horizontal cylinder (O). The illustrations below the the various configurations:

- Face in contact with cylinder barrel vertical cylinder (A)
- Face in contact with crankcase vertical cylinder (B)
- Face in contact with cylinder barrel horizontal cylinder (C)
- Face in contact with crankcase horizontal cylinder (D)

Locate the gasket (6) on the crankcase with the word "TOP" facing upwards.







Using service tool no. **88700.5644**, bring the small end of the connecting rod up to near TDC. Fit the piston-cylinder assembly on 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 must slide smoothly in the connecting rod small end bush and in the piston (9).

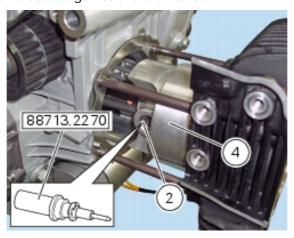


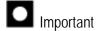
Stuff the crankcase opening with a cloth to prevent foreign objects from falling inside and then fit the circlip (2) using service tool **88713.2270**.



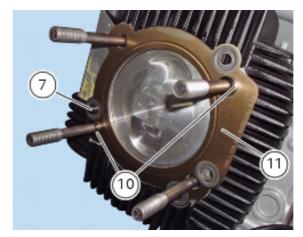
Always fit new circlips (2) on reassembly.

Push the cylinder barrel (4) down until it seats against the crankcase.



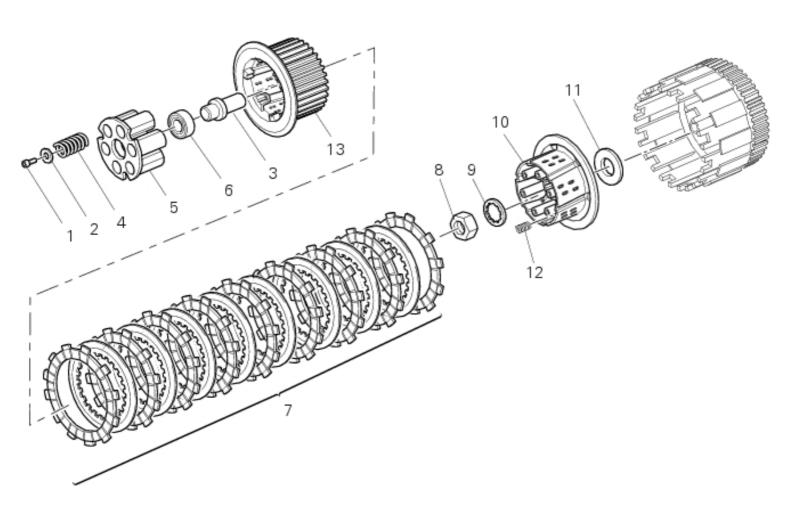


Locate the locating dowel (7), head gasket (11) and centring bushes (10).



Repeat the procedure for the other cylinder.

Operation	Section reference
Refit the cylinder heads	N 4.4, Refitting the cylinder heads
Refit the timing belt pulleys and the timing belts	N 4.2, Refitting the timing system assembly
Refit the timing belt covers	N 4.2, Refitting the timing belt covers
Refit the engine to the frame	N 1, Refitting the engine



- 1 Bolt
- 2 Collar
- 3 Clutch lifter
- 4 Clutch spring
- 5 Pressure plate
- 6 Bearing
- 7 Clutch plates
- 8 Nut
- 9 Lock washer
- 10 Clutch centre
- 11 Shim
- 12 Spring
- 13 Hub



#### Clutch



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

#### Description of the APTC clutch assembly

The APTC system with servo-assisted torque and anti-wheel slip on braking.

The advantages of this system are:

- prevents the unwelcome effects of excessive engine braking during hard downshifting, thus making for smoother, cleaner cornering (no rear wheel slip);
- reduces the amount of driver effort required to disengage the clutch. The clutch lever effort is significantly reduced, without compromising the feel of the lever to the rider (servo-assisted).

The APTC system consists essentially of a splined coupling between the two parts of the clutch drum.

This coupling exploits the axial component of driving torque (bike accelerating) or reverse-acting torque (clutch disengaged) to produce servo-assistance in the former case and prevent rear wheel slip in the latter.

In practice, this means that under acceleration (and thus with driving torque) the clutch pack will tend to be under a greater load (from springs initially more loaded), while during hard downshifting, the reverse-acting torque will tend to take load off the springs thus causing the plates to slip.

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 housing.

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.

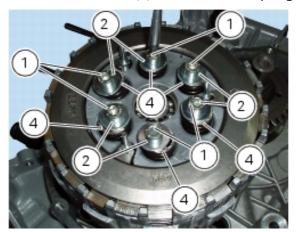
### Removal of the APTC clutch

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
Remove the clutch-side crankcase cover	N 6.2, Removal of the clutch-side crankcase cover

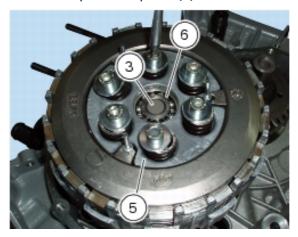
Screw the three tools **88713.2591** into the relative bores in the hub.



Unscrew the retaining screws (1) and remove the collars (2) and the clutch springs (4).



Remove the pressure plate (5) with the clutch control pin (3). If necessary, using a drift of suitable diameter, remove the bearing (6) installed on the inner side of the pressure plate (5).

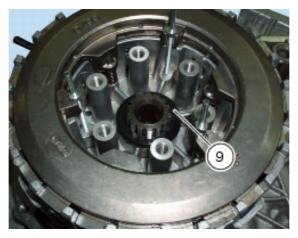


Hold the clutch drum with the service tool no. 88713.2556 and unscrew the nut (8).

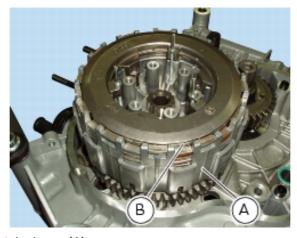




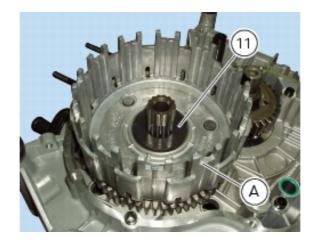
Remove the washer (9).



Withdraw the clutch hub-plates-centre assembly (B) from the clutch drum (A), marking the components so as to be able to install them in the same position.



Remove the spacer (11) from the clutch drum (A).



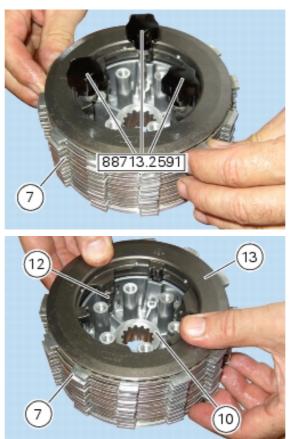
Disassembly of the clutch hub-plates-centre assembly

Unscrew the three tools 88713.2591.

Withdraw the hub (13) and the plates (7) from the clutch centre (10). Recover the three springs (12). Remove the clutch plates (7) from the hub (13).



When removing the plates, keep them in the same order as they were originally installed, tying them together if necessary.

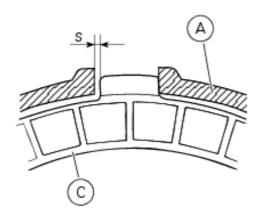


Overhaul and inspection of the APTC clutch components

Clearance between the clutch drum and friction plates

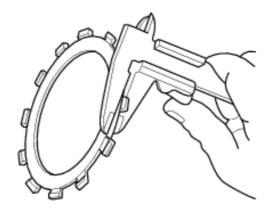
Insert a friction plate (C) in the clutch drum (A) and measure the clearance (S) with a feeler gauge. The clearance "S" must not exceed **0.6** mm.

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 **3.2** mm.



# Important

The total thickness of the clutch plate pack must not be less than **50.2** mm.

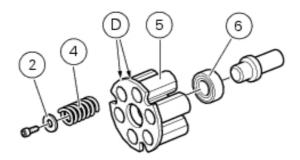
Place the plate on a flat surface and check the amount of deformation with a feeler gauge. Max flatness error: **0.2** mm.



#### Overhaul of the pressure plate

Check the condition of bearing (6): renew the bearing if the play is excessive.

Check the contact surfaces of the last friction plate; if it is excessively scored, use a reference plate and diamond lapping paste (6-12 microns thick) and rub the friction plate on it to obtain a smooth, uniform surface. Check the condition of the spring guide cups (D) of the pressure plate (5) and always replace the spring retainer caps (2) at each overhaul.

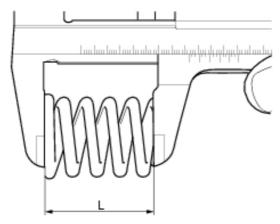


Overhauling the pressure plate springs

Measure the length "L" of each spring (4):

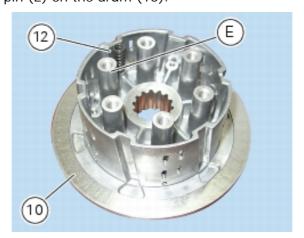
- minimum length: **41** mm.

Renew any springs that are shorter than the above limit value.

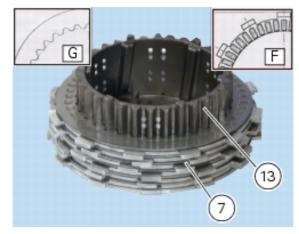


Reassembly of the clutch hub-plates-centre assembly

Install the three springs (12) on the pin (E) on the drum (10).



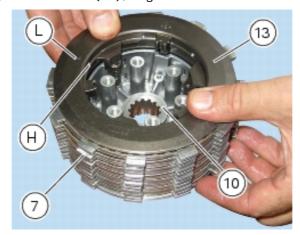
Install the clutch plates (7) in the hub (13) starting with one of the 11 friction plates (F) and alternate with the 10 driven plates (G).



Install the clutch plate assembly (7) with hub (13) in the drum (10).



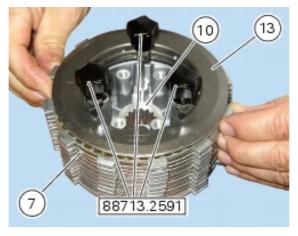
When refitting the clutch centre (10) with the hub (13), align the reference notches (H) and (L).



Insert the three tools **88713.2591** to fix the hub (13) to the clutch centre (10). Screw in the three tools **88713.2591** by hand, pressing down on the clutch plates with the hub (13), so as to overcome the resistance of the springs.

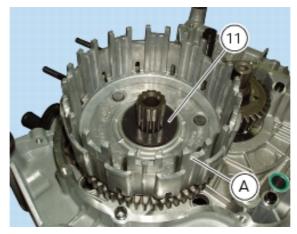


Screw in the three tools 88713.2591 to put the clutch plates under a light load.



Refitting the APTC clutch

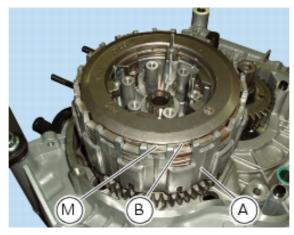
Locate the spacer (11) on the drum (A).



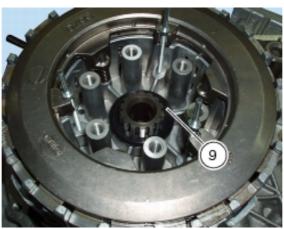
Position the hub-plates-drum assembly (B) inside the drum (A).



Position the last friction plate (M) so that it is offset relative to others.



Locate the lock washer (9) on the gearbox input shaft, seating it against the clutch assembly.



Apply the recommended grease to the contact face of the nut (8) and to thread of the gearbox input shaft, then fit the nut to the input shaft and tighten by hand.

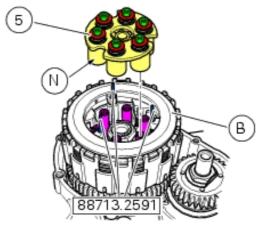
Restrain the clutch drum with tool part no. 88713.2556 when tightening nut (8).

Tighten the nut (8) to the specified torque (Sect. C 3, Engine torque settings).

Remove service tool no. 88713.2556.



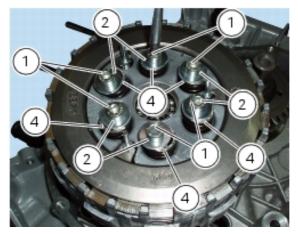
Install the pressure plate (5) in the clutch asembly (B) aligning the three tools **88713.2591** with the three indents (N) in the pressure plate.



Check that the two codes (P) stamped on the hub (13) and the pressure plate (5) are aligned.



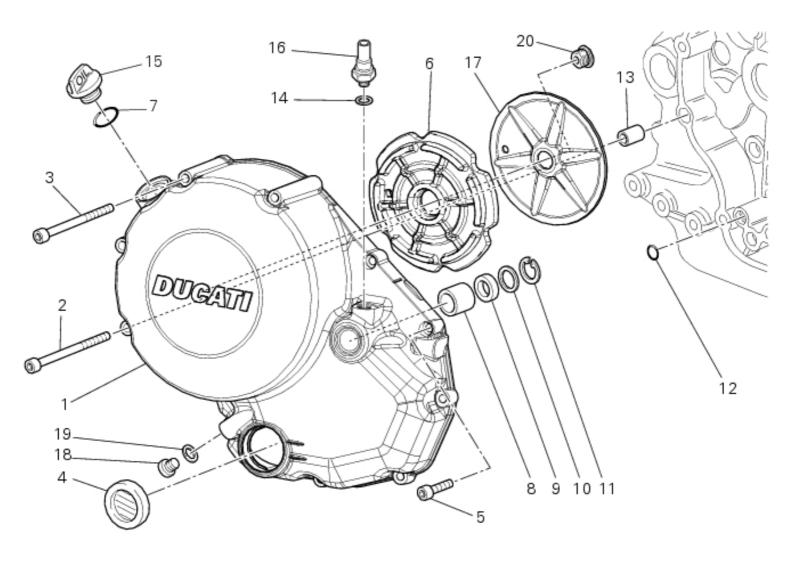
In each cavity, fit a spring (4) and a cap (2). Tighten the screws (1) to the specified torque (Sect. C 3, <u>Engine torque settings</u>), working in a crosswise pattern.



Unscrew and remove the service tools 88713.2591.

Operation	Section reference
Refit the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
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

## 6.2 - Clutch assembly: clutch-side crankcase cover



- Clutch-side crankcase cover
- 2 Bolt
- 3 Bolt
- 4 Oil level sight glass
- 5 Bolt
- 6 Panel (BLACK)
- 7 O-ring
- 8 Bush
- 9 Seal
- 10 Shim
- 11 Circlip
- 12 O-ring
- 13 Locating bush
- 14 Sealing washer, thickness 2
- 15 Plug
- 16 Pressure switch
- 17 Cover
- 18 Plug
- 19 Sealing washer
- 20 Bolt

#### Clutch-side crankcase cover

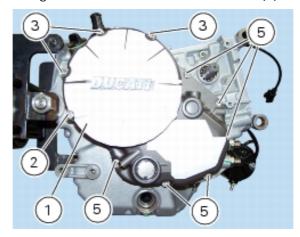


Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

#### Removal of the clutch-side crankcase cover

Operation	Section reference
_	D 4, <u>Changing the engine oil and filter</u> <u>cartridge</u>
	P 5, Checking the front and rear brake light switches, neutral light switch, oil pressure switch and clutch switch

Unscrew the bolts (2), (3) and (5) securing the clutch-side crankcase cover (1).

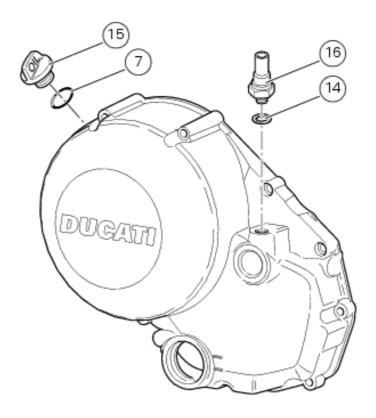


Tap around the edge of the cover with a plastic mallet to detach it from the crankcase. Remove the cover (1) taking care not to damage the locating bush (13). Check the condition of the locating bush (13) and replace if deformed.



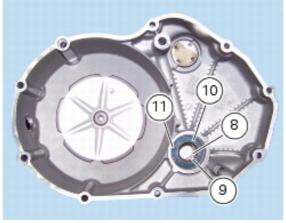
Disassembly of the clutch-side crankcase cover

Remove the plug (15) from the cover and the relative O-ring (7), the engine oil pressure switch (16) and its seal (14).



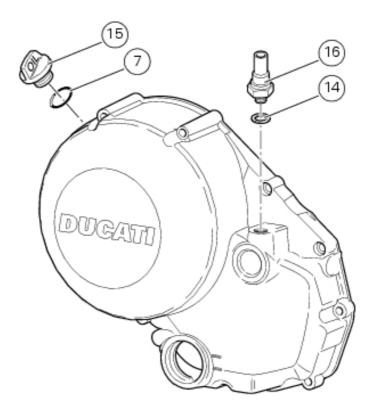
Unscrew the screw (20) securing the inner cover (17).
Remove the inner cover (17) and sound-proofing panel (6).
Remove the circlip (11) and slide off the shim (10) and the oil seal (9).
The drilled bush (8) is mounted to the cover by a forced interference fit. Remove it using a suitable puller.
Inspect the oil seal (9) and renew it if necessary.





Reassembly of the clutch-side crankcase cover

Fit the plug (15) and the seal (7). Fit the pressure switch (16) and the seal (14).



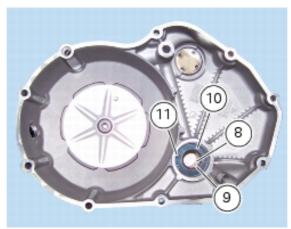
If the bush has been replaced, fully seat the new bush (8) in the slot in the cover using a suitable drift and a press. If the oil seal (9) needs to be renewed, fit the new seal into the crankcase cover, positioning it so the side without a spring is facing the circlip (13).

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).



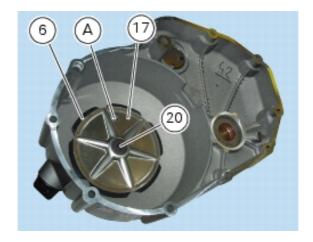
In order for the oil seal (9) to function correctly, it must have an assembly clearance that allows the circlip (11) to rotate.



Position the sound-proofing panel (6) inside the clutch-side crankcase cover (1), aligning it with the pin (A|) as shown in the figure.

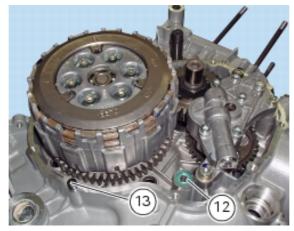
Position the inner cover (17) on the panel (6), aligning it with the pin (A).

Fit the screws (20) and tighten to the specified torque (Sect. C 3, Engine torque settings).

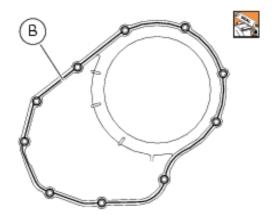


#### Refitting the clutch-side crankcase cover

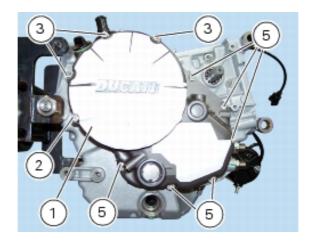
Clean and degrease mating surfaces on the clutch-side crankcase cover and crankcase and ensure that locating bush (13) and the O-ring (12), located in correspondence with the oil way, are installed in the crankcase.



Apply a uniform continuous bead of DUCATI liquid gasket (B) onto crankcase mating surfaces, working around all the holes.

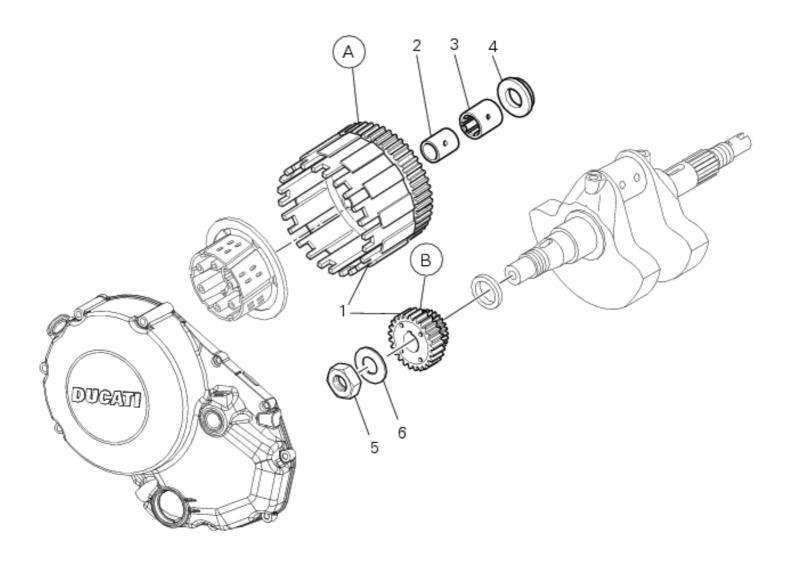


Fit the cover assembly (1) to the crankcase half and insert the retaining screws. Tighten the screws (2), (3) and (5) to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>) in a crosswise pattern.



Operation	Section reference
	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



- Clutch drum/Primary drive gears
- 2 Inner ring
- 3 Inner bearing
- 4 Spacer
- 5 Threaded ringnut
- 6 Lock washer



Clutch connecting rods



Important

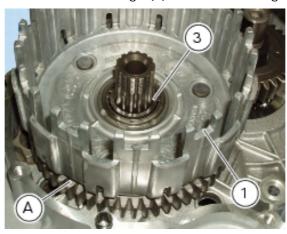
Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

Removal of the primary drive gears

0	Continuo of continuo
luberation	II Section reference
le beramen	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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
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 APTC clutch
Remove the oil pump	N 2.1, Removal of the oil pump

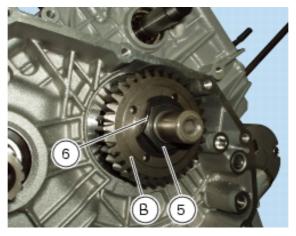
Withdraw the clutch drum (1) complete with roller bearings (3) and the driven gear of the primary gear pair (A).



Remove the circlip (2) and the internal spacer (4).



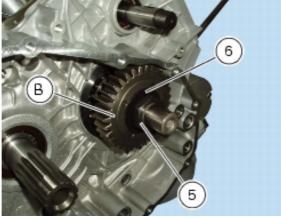
Straighten out the lock washer (6) on the nut (5) securing the primary drive driving gear (B).



Restrain the primary drive gear (B) using service wrench no. **88713.2423** and unscrew the threaded nut (5) securing the pinion.

Remove the nut (5) and lockwasher (6).





Remove the primary driving gear (B) using puller **88713.2092** and interposing a packing piece of aluminium or copper between the crankshaft and the screw of the puller.

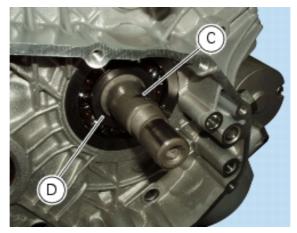


Take care to recover the key (C) from the crankshaft and the internal spacer.



Refitting the primary drive gears and checking backlash

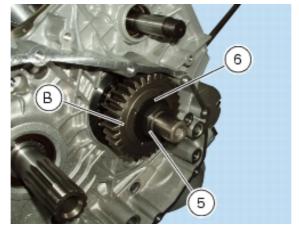
Fully degrease the crankshaft splined end and the corresponding spline on the primary drive gear. Check that the key (C) and internal spacer (D) are in position on the crankshaft.



Fit the driving gear (B) onto the crankshaft with the oil pump drive sprocket facing the crankcase. Temporarily secure the gear with the washer (6) and nut (5).



If fitting a new primary driving gear (B), check the backlash.

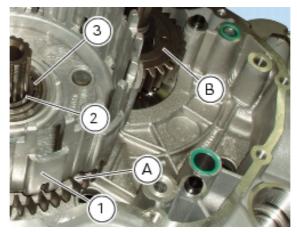


To check the gear backlash, temporarily fit the clutch drum (1) complete with internal spacer (4), driven gear (A), roller bearing (3) and internal bush (2) on the gearbox input shaft. Fix a dial gauge to the engine crankcase, positioning the stylus against a gear tooth.

Turn the driven gear (A) to mesh the teeth and check with the dial tool that backlash ranges between **0.05** and **0.07** mm.

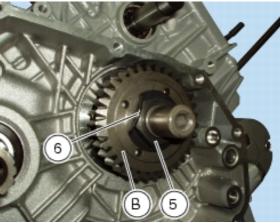
Repeat the check at 16 different points of the driven gear.

If the measured values are outside the permissible tolerance limits, try changing the position of driven gear (A) on the input shaft, leaving the driving gear (B) on the crankshaft. If the backlash is still outside the tolerance limits, renew the primary drive gear pair (1).



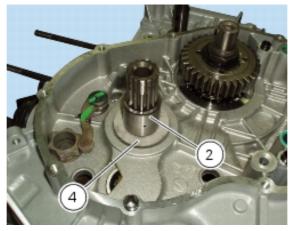
After checking the backlash, restrain the driving gear (B) with service wrench no. **88713.2423** and tighten the nut (5) to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>). Stake the lock washer (6) onto the nut (5).

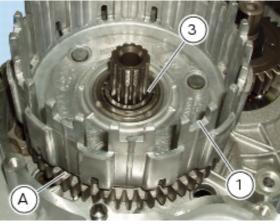




Refit the oil pump and check the backlash between the oil pump gear and primary drive gear on the crankshaft (Sect. N 2.1, <u>Refitting the oil pump</u>).

Thoroughly degrease the mating surfaces of the clutch drum (1), the internal bearing (3) and the bush (2). Fit the internal spacer (4) to the input shaft with its flat side facing outwards. Install the inner bush (2) and clutch drum (1) with driven gear (A) complete with roller bearing (3).





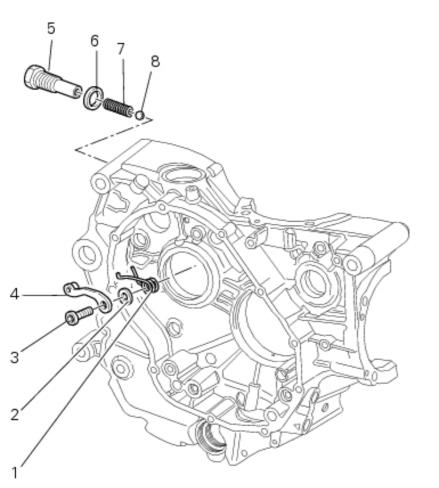
Operation

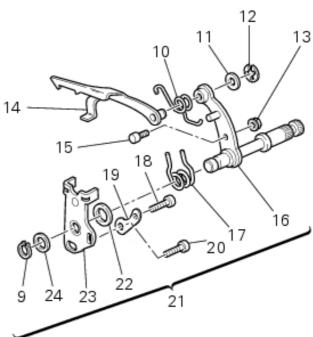
Section reference

## Clutch assembly: primary drive gears

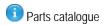
Refit the complete clutch assembly	N 6.1, Refitting the APTC clutch
Refit the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
Connect the oil pressure sensor	P 5, Checking the front and rear brake light switches, neutral light switch, oil pressure switch and clutch switch
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 Sealing washer
- 7 Detent ball spring
- 8 Ball
- 9 Circlip
- 10 Selector claw return spring
- 11 Shim
- 12 Circlip
- 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 Spacer
- 20 Bolt
- 21 Gearchange mechanism
- 22 Locating ring
- 23 Stop plate
- 24 Shim



## Gearchange control



### Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

### Removal of the gearchange mechanism

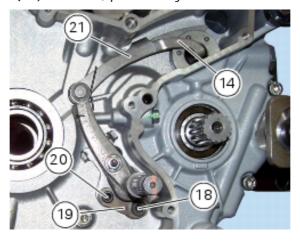
Operation	Section reference
Drain the engine oil	D 4, Changing the engine oil and filter
	<u>cartridge</u>
Remove the gearchange control	F 5, Removal of the gearchange control
Remove the clutch slave cylinder	F 2, Removal of the clutch slave cylinder
Remove the front sprocket	G 8, Removal of the front sprocket
Remove the alternator cover and flywheel/alternator assembly	N 8, Flywheel-alternator

Unscrew and remove the gear selector mechanism (21) retaining bolts (18) and (20). Remove the bolts (18) and (20), and the spacer (19) and withdraw the gear selector mechanism complete with the gear lever shaft, spring and stop plate.



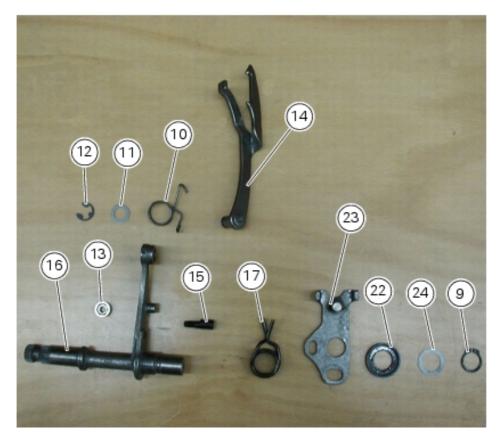
### **Important**

Visually inspect the gear selector claw (14) for wear, particularly around the area where it contacts the selector drum.



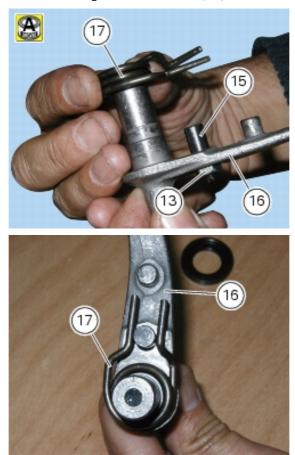
Disassembly of the gear selector mechanism

If it is necessary to renew any components, disassemble the gearchange mechanism as shown in the exploded view.

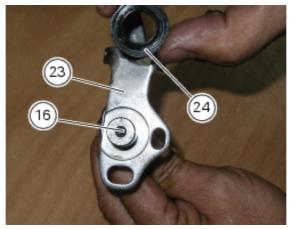


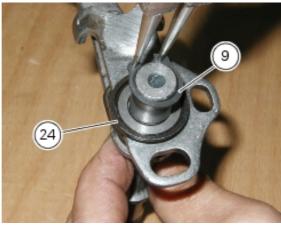
Reassembly of the gearchange mechanism

If the components of the gearchange mechanism were dismantled on removal, fit the spring (17) on the shaft (16) in the position indicated in the photo. Grease the threaded end of the eccentric gearchange lever pin (15) and install it on the upper part of the gearchange lever, securing it with the nut (13). Screw the nut on by hand (do not tighten).

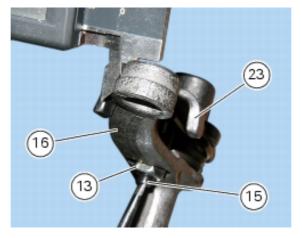


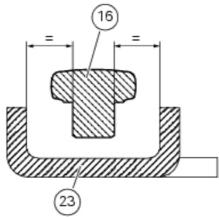
Insert the shaft (16) in stop plate (23) and washer (24) and secure with circlip (9).





Ensure that the shaft with lever (16) is positioned correctly relative to stop plate (23). The edges of the plate must be equidistant from the pin of the lever; to adjust the position, loosen the locknut (13) and turn eccentric pin (15).

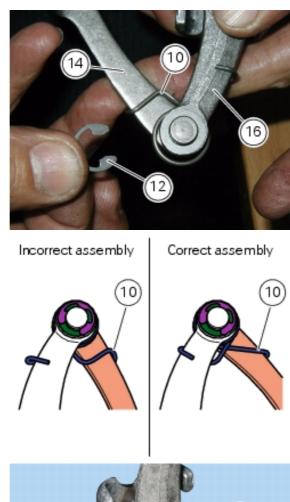


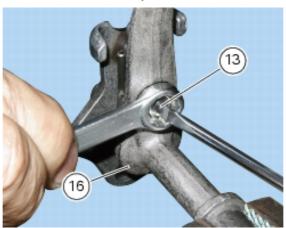


Position the spring (10) between the shaft (16) and the fork (14). Fit the ring (12) to secure the assembly.

Check that the spring (10) is installed correctly as shown in the figure.

Tighten the nut (13) to the specified torque (Sect. C 3, Engine torque settings).

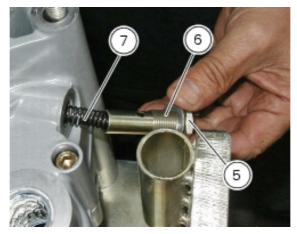




Disassembly of the gear interlock plunger and pawl assembly

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
Remove the clutch-side crankcase cover	N 6.2, Removal of the clutch-side crankcase cover
crankcase cover	cover

Unscrew the interlock plunger screw (5) and remove seal (6), spring (7) and detent ball (8).



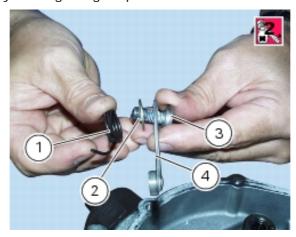
Unscrew the clutch-side crankcase screw (3) and remove the pawl (4), washer (2) and spring (1).

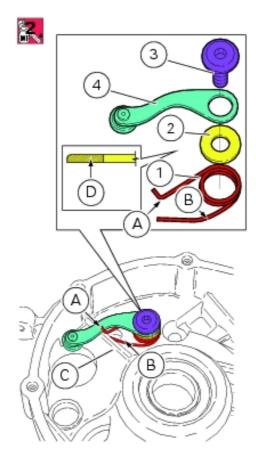


### Reassembly of the gear interlock plunger and pawl assembly

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.

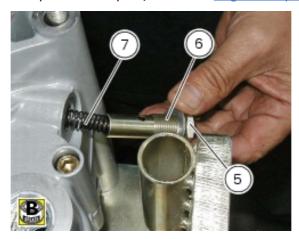
Start the bolt in the crankcase half. Position end (B) of the spring so that it rests against rib (C) of the crankcase half, as shown in the figure. Tighten the bolt (3) to the specified torque (Sect. C 3, Engine torque settings). Check that the spring functions correctly by manually moving the gear pawl lever.





Apply grease and then fit the ball (8), spring (7), and seal (6) into interlock plunger (5) and screw the interlock plunger assembly into the crankcase.

Tighten the gear interlock plunger to the specified torque (Sect. C 3, Engine torque settings).

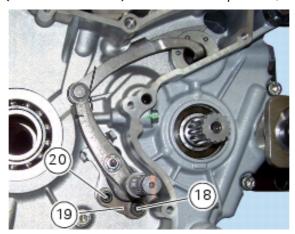


Operation	Section reference
Refit the clutch drum.	N 6.3, Refitting the primary drive gears and checking backlash
Refit the complete clutch assembly	N 6.1, Refitting the APTC clutch
Refit the clutch-side crankcase cover	N 6.2, Refitting the clutch-side crankcase cover
Connect the oil pressure sensor	P 5, Checking the front and rear brake light switches, neutral light switch, oil pressure switch and clutch switch
Refill the engine with oil	D 4, Changing the engine oil and filter cartridge

Locate the gearbox drum selector claw in the centre of the gearbox roller bearings. Position the gearchange mechanism (21) in the chain-side crankcase.

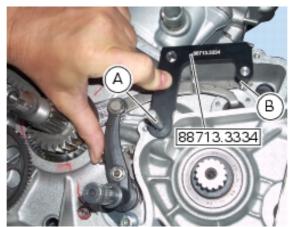


Fit the bolts (18) and (20) with the spacer (19). Temporarily fit the gearchange lever (or a service lever) and the front sprocket, and put the gearbox in neutral.

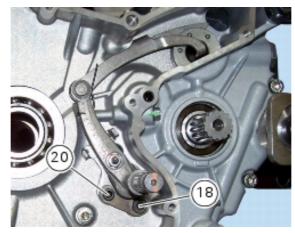


Fit the service tool no.  $\bf 88713.3334$  on the selector claw.

Position the service tool so that the locating dowel (A) engages the hole in the tool and pin (B) of the tool is engaged in the selector claw, applying hand pressure at point (C) and pressing to the right.



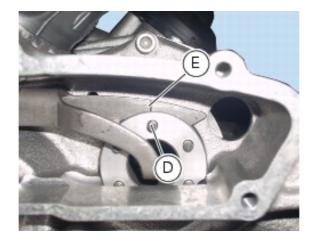
In this position, tighten first the gearchange mechanism retaining bolt (18) and then bolt (20) to the specified torque (Sect. C 3, Engine torque settings).



Remove the service tool and check that the pin (D) on the selector drum is aligned with mark (E) on the selector claw. 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.

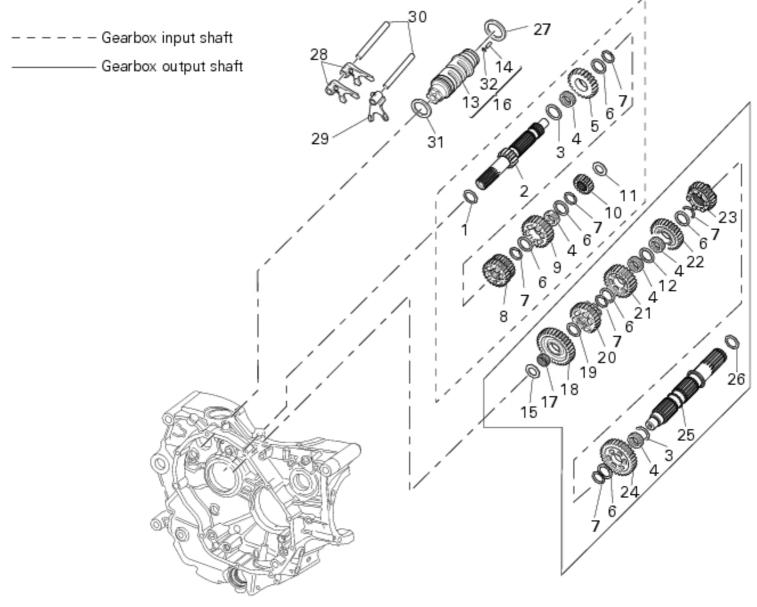
Operate the gearchange lever and turn the front sprocket at the same time to check that all the gears engage when shifting up and down.

Remove the gearbox lever.



Operation	Section reference
Refit the flywheel/alternator assembly and alternator-side crankcase cover	N 8, Refitting the flywheel-alternator assembly
Refit the front sprocket	G 8, Refitting the front sprocket
Refit the clutch slave cylinder	F 2, Refitting the clutch slave cylinder
Refit the gearchange control	F 5, Refitting the gearchange control
Fill the engine with oil	D 4, Changing the engine oil and filter cartridge

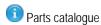
## 7.2 - Gearbox assembly: gearbox shafts



- Shim, thickness 1
- 2 Gearbox input shaft
- 3 Shim, thickness 0.5
- 4 Needle roller bearing
- 5 5<sup>th</sup> speed driving gear.
- 6 Splined washer, thickness 0.5
- 7 Circlin
- 3 3<sup>rd</sup>-4<sup>th</sup> speed driving gear.
- 9 6<sup>th</sup> speed driving gear.
- 10 2<sup>nd</sup> speed driving gear.
- 11 Shim, thickness 1.8
- 12 Splined washer, thickness 0.5
- 13 Selector drum
- 14 Special needle roller (square cross-section)
- 15 Shim
- 16 Selector drum assembly
- 17 Needle roller bearing
- 18 1<sup>St</sup> speed driven gear.
- 19 Shim, thickness 1
- 20 5<sup>th</sup> speed driven gear.
- 21 4<sup>th</sup> speed driven gear.
- 22 3<sup>rd</sup> speed driven gear.

Gearbox assembly: gearbox shafts

- 23 6<sup>th</sup> speed driven gear
- 24 2<sup>nd</sup> speed driven gear.
- 25 Gearbox output shaft
- 26 Shim
- 27 Shim, thickness 1
- 28 1st, 4th-2nd, 3rd speed selector fork.
- 29 5<sup>th</sup>, 6<sup>th</sup> speed selector fork.
- 30 Selector fork shaft
- 31 Shim, thickness 1
- 32 Roller retaining ring



Gearchange control
Gearbox



## Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

### Removal of the gearbox assembly

Operation	Section reference
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
Remove the clutch assembly	N 6.1, Removal of the APTC clutch
Remove the lubrication system	N 2.1, Removal of the oil pump
Remove the alternator-side crankcase cover	N 8, Removal of the alternator-side crankcase cover
Remove the engine starting system	P 3, <u>Electric starting system</u>
Remove the timing belt covers	N 4.2, Removal of the timing belt covers
Remove the timing belts	N 4.2, Removal of the timing system assembly
Remove the cylinder heads	N 4.4, Removal of the cylinder head assembly
Remove the cylinder barrel/piston assemblies	N 5, Removal of the cylinder/piston assembly
Remove the gearchange mechanism	N 7.1, Removal of the gearchange mechanism
Remove the gear interlock plunger	N 7.1, <u>Disassembly of the gear interlock</u> plunger and pawl assembly
Separation of the crankcase halves	N 9.2, <u>Separation of the crankcase halves</u>

Withdraw the selector fork shafts (30).

Move the forks (28) and (29) to disengage them from the slots in the selector drum (13).

Withdraw the selector drum (13) 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 (14).

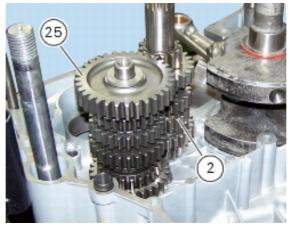


Remove gear selector forks (29) and (28).



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 are left on the shafts, slide them off the ends of the gearbox input (2) and output (25) shafts (Sect. N 9.2, Overhaul of the main bearings).



After removing them from the shafts, install them in the respective outer bearings in the engine crankcase half.

### 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:

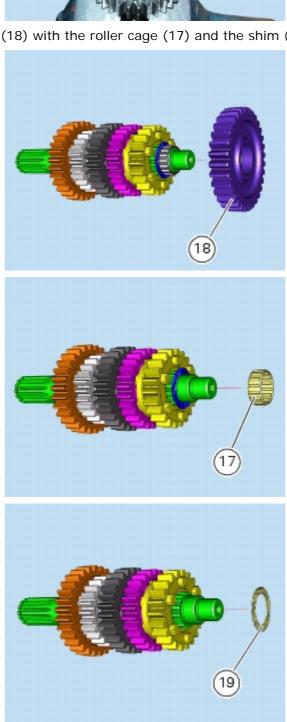
this would potentially lead to jamming when using the gear selector control, making it necessary to reopen the engine crankcase.

Disassembly of the gearbox output shaft

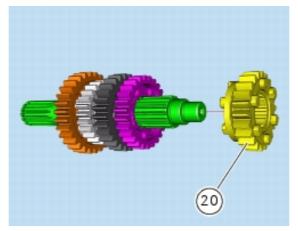
Remove the chain-side shim (15) and clutch-side shim (26) from the output shaft.



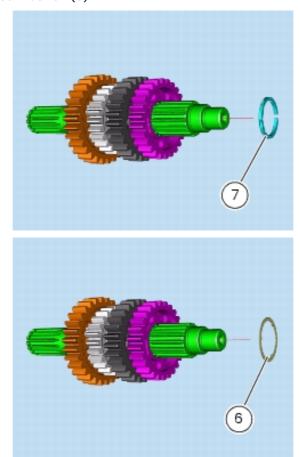
Withdraw the first speed driven gear (18) with the roller cage (17) and the shim (19).



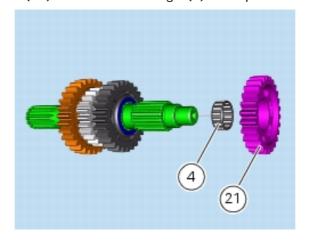
Remove the fifth speed driven gear (20).

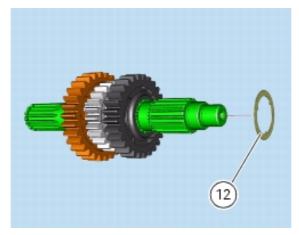


Use two flat blade screwdrivers to remove the circlip (7) taking care not to damage the shaft surface. Remove the circlip (7) and the splined washer (6).

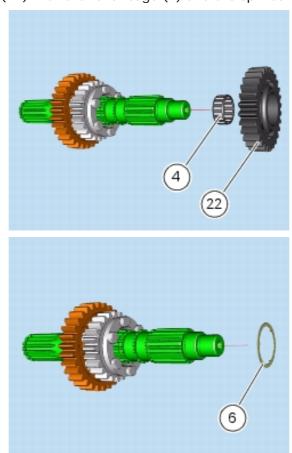


Withdraw the fourth speed driven gear (21) with the roller cage (4) and splined washer (12).

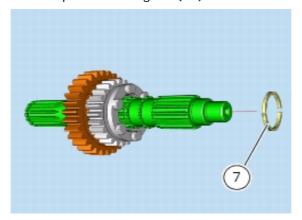


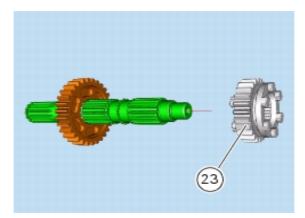


Remove the third speed driven gear (22) with the roller cage (4) and the splined washer (6).

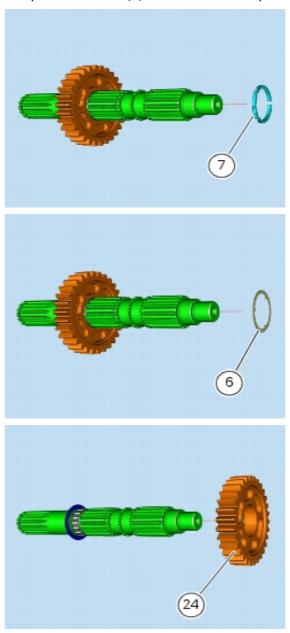


Remove the circlip (7) and remove the sixth speed driven gear (23).

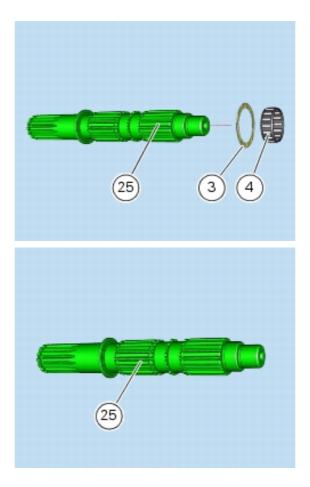




Remove the circlip (7) and withdraw the splined washer (6) and the second speed driven gear (24).

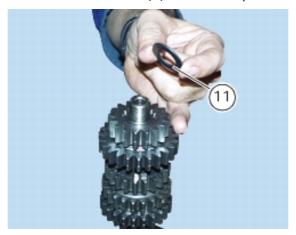


Withdraw the roller cage (4) and the shim (3). All the components have thus been removed from gearbox output shaft (25).

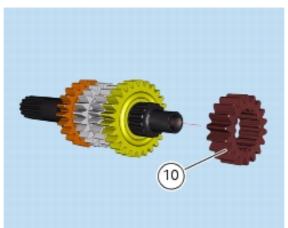


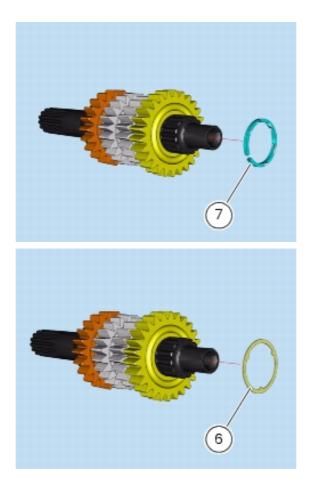
Disassembly of the gearbox input shaft

Remove the chain-side shim (11) and the clutch-side shim (1) from the input shaft.



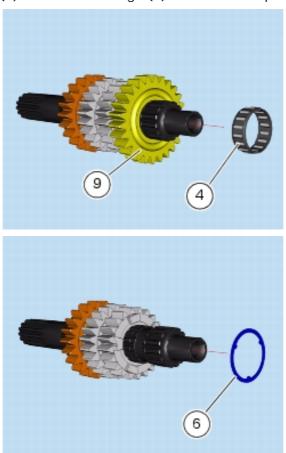
Remove the second speed driving gear (10). Use two screwdrivers to prise out the circlip (7) and the splined washer (6).

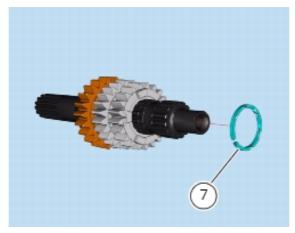




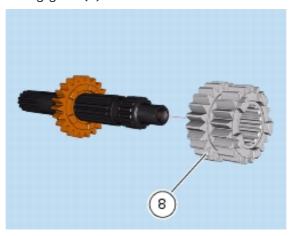


Take care to avoid damaging the surface of the shaft while removing circlip (7). Remove the sixth speed driving gear (9) with its roller cage (4). Remove the splined washer (6) and the circlip (7).

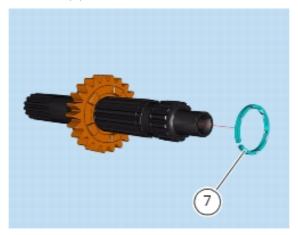


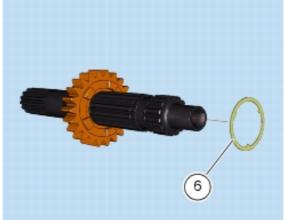


Withdraw the third and fourth speed driving gear (8).

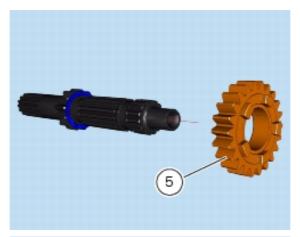


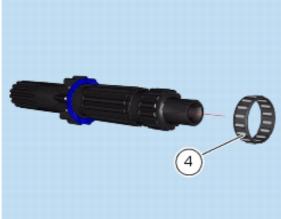
Remove the circlip (7) and the splined washer (6).



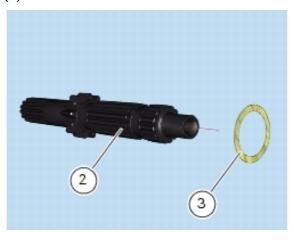


Remove the fifth speed driving gear (5) with the roller cage (4).





Slide the shim (3) off the input shaft (2).



## Overhaul of the gearbox

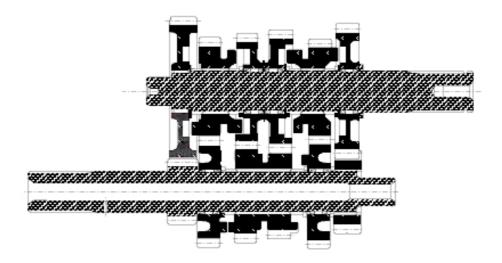
Check the condition of the front coupling dogs of the gears. They must be in perfect condition and with no sign of wear on the edges of the teeth.

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 Section C 1.1, Gearbox.

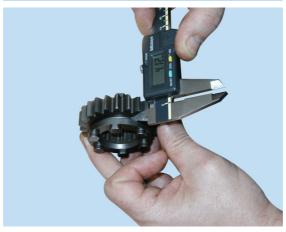
#### Inspection of the gear selector forks

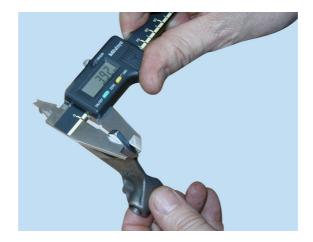
Visually inspect the gear selector forks. Bent forks must be renewed as they may lead to difficulties in gear changing or may suddenly disengage when under load.

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, <u>Gearbox</u>).







#### 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, Shimming the shafts).

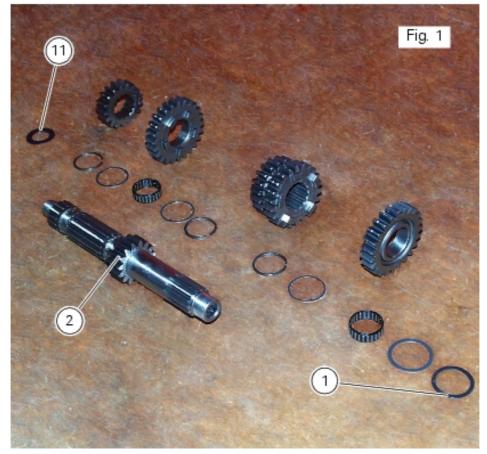


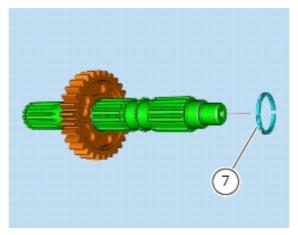
Figure 2 shows all the parts to be reassembled on the gearbox output shaft (25), with calculated end shims (15) and (26) (Sect. N 9.2, Shimming the shafts).



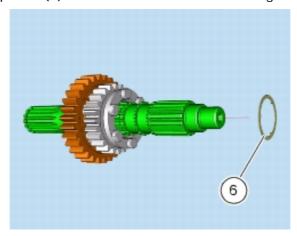
Reassemble the gears on the gearbox shafts by reversing the disassembly procedure.

Take particular care when installing the idler gears. The assembly of the  $3^{rd}$  and  $4^{th}$  speed gears and the relative fixing components on the output shaft is given as an example.

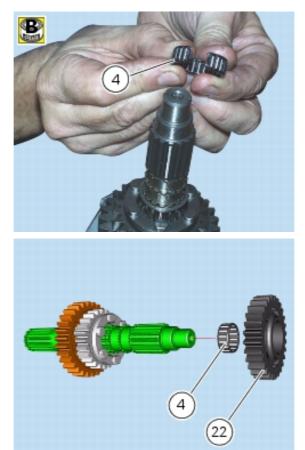
Fit the circlip (7), checking that it is fully inserted into its groove on the shaft. Push the circlip into position with a suitable size tubular drift.



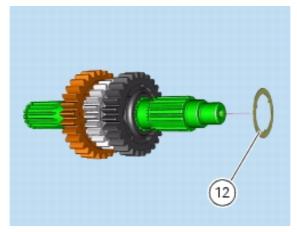
Slide the washer with three internal points (6) over the shaft until it locates against the circlip you have just fitted.



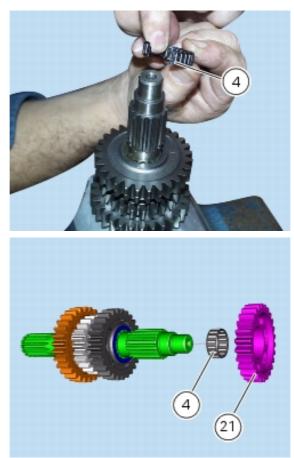
To fit the needle roller cage (4) onto the shaft, first lubricate it with plenty of grease (of recommended type) and then open it slightly to make it easier to slide on to the shaft. Fit the 3<sup>rd</sup> speed gear (22).



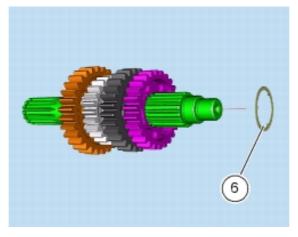
Fit the three-pointed washer (12), which can be distinguished from its counterpart (6) by its bigger outside diameter.

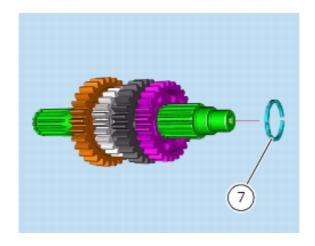


Fit another needle roller cage (4) using the method already described. Fit the  $4^{th}$  speed gear (21).



Fit another 3-pointed washer (6) and another circlip (7) onto the shaft. Seat the circlip using the drift used previously.

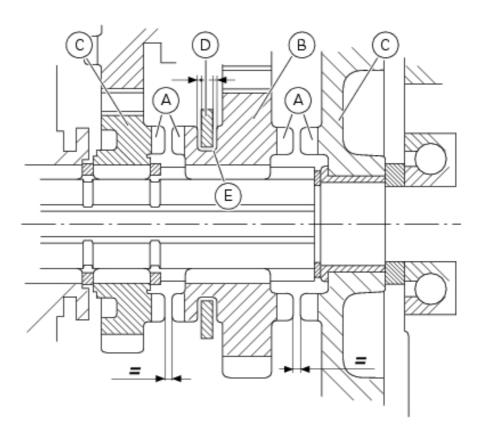




#### Reassembly of the gearbox

To reassemble the gearbox components follow the procedure under Sect. N 9.2 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



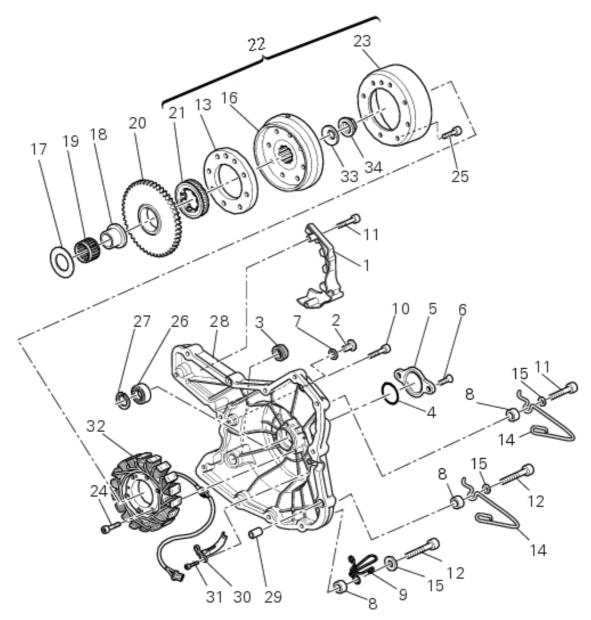
#### (B) when engaging the gears.

Operation	Section reference
Reassemble the engine crankcase halves	N 9.2, Reassembly of the crankcase halves
Refit the gear interlock plunger	N 7.1, Reassembly of the gear interlock plunger and pawl assembly
Refit the gearchange mechanism	N 7.1, Refitting the gearchange mechanism
Refit the cylinder barrel/piston assemblies	N 5, Refitting the cylinder/piston assembly

## Gearbox assembly: gearbox shafts

Refit the cylinder heads	N 4.4, Refitting the cylinder head assembly
Refit the timing belts	N 4.2, Refitting the timing system assembly
Refit the timing belt covers	N 4.2, Refitting the timing belt covers
Refit the engine starter system	P 3, Electric starting system
Refit the alternator-side crankcase cover	N 8, Refitting the alternator-side crankcase cover
Refit the clutch slave cylinder	F 2, Refitting the clutch slave cylinder
Refit the gearchange control	F 5, Refitting the gearchange control
Refit the lubrication system	N 2.1, Refitting the oil pump
Refit the clutch assembly	N 6.1, Refitting the APTC clutch
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

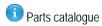
# 8 - Flywheel-alternator



- Front sprocket cover
- 2 Pick-up sensor inspection screw
- 3 Seal
- 4 O-ring
- 5 Cover
- 6 Bolt
- 7 Washer
- 8 Spacer
- 9 Cable guide
- 10 Bolt
- 11 Bolt
- 12 Bolt
- 13 Flange
- 14 Cable clip
- 15 Washer
- 16 Flywheel
- 17 Washer
- 18 Inner ring
- 19 Needle roller bearing
- 20 Electric starter driven gear
- 21 Starter clutch
- 22 Flywheel-starter clutch assembly
- 23 Alternator rotor
- 24 Bolt

#### Flywheel-alternator

- 25 Bolt
- 26 Bearing
- 27 Circlip
- 28 Alternator-side crankcase cover
- 29 Locating bush
- 30 Bracket
- 31 Bolt
- 32 Alternator stator
- 33 Belleville washer
- 34 Flanged nut



Alternator-side crankcase cover Electric starting and ignition



#### **Important**

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

Removal of the alternator-side crankcase cover

Operation	Section reference
Drain the engine oil	D 4, <u>Changing the engine oil and filter</u> cartridge
Remove the gearchange control	F 5, Removal of the gearchange control
Remove the clutch slave cylinder	F 2, Removal of the clutch slave cylinder
Remove the LH footrest	H 4, Removal of the footrest brackets
Remove the front sprocket cover	G 8, Removal of the front sprocket



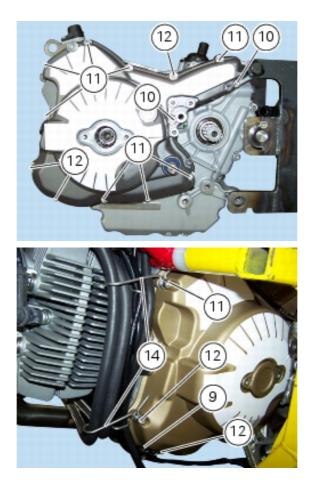
For clarity, the figures show the engine block removed from the frame.

Unscrew the bolts (11) and remove the chain guard (1).

Unscrew the two retaining bolts (6) of the centre cap (5) over the end of the crankshaft.



Unscrew the left-hand crankcase cover bolts (10), (11) and (12). Recover the spacers (8), the washers (15) and the hose guides (9) and (14).



Fix service tool no. **88713.1749** to the holes left vacant by the two bolts (6) you have just removed. Turn the tool shaft slowly to separate the cover (28) from the LH crankcase half.



Disassembly of the alternator-side crankcase cover

Undo the three stator retaining bolts (24) and the two bolts (31) securing the cable guide bracket (30) from inside the alternator-side crankcase cover.

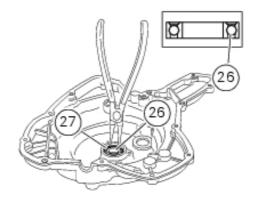
Remove the stator (32) and the cable guide (30).



The alternator-side crankcase cover is fitted with a bearing (26), held in place by circlip (27), which locates on the end of the crankshaft.

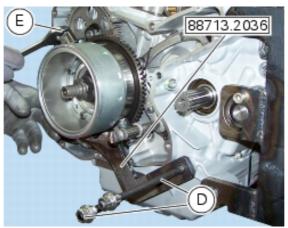
Remove the circlip (27) with circlip pliers.

Remove the bearing (26) using a universal puller.



#### Removal of the flywheel-alternator assembly

Use service tool no. **88713.2036** fixed to the M10 sidestand fixing holes (D). Secure the tool to the flywheel with the bolt (E).

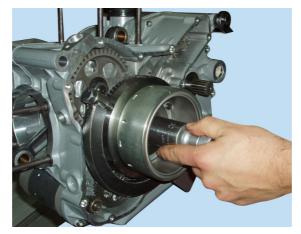


Unscrew the alternator/flywheel nut (34), heating it with a hot air gun; do not use a naked flame as this could damage the starting system components.

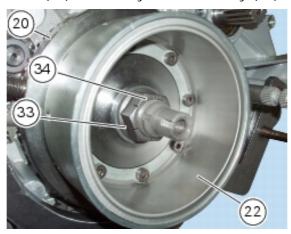


### Warning

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 (34), the Belleville washer (33) and the flywheel assembly (22) complete with the gear (20).



Remove the inner race (18), the needle roller bearing (19) and the washer (17).





Examine the inner race (18), needle roller bearing (19) and internal washer (17) for wear.



The hole in the inner race (18) allows the passage of oil for lubrication of needle roller bearing (19).

#### Checking the flywheel/alternator assembly

Examine the inner part of alternator rotor (23) for 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 assembly.

Unscrew the eight bolts (25) and remove the alternator rotor (23) from the flywheel.



Insert two of the bolts (25) just removed from flywheel rotor-side in their holes in order to remove the flange (13) and the starter clutch (21) from the flywheel (16).

The starter clutch is a slight interference fit on the flange. To remove it, use a suitable drift.

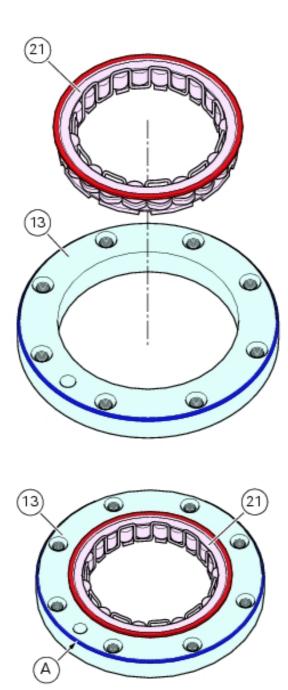


Reassembly of the flywheel-alternator assembly

Install the starter clutch (21) in the flange (13), making sure it is properly seated.



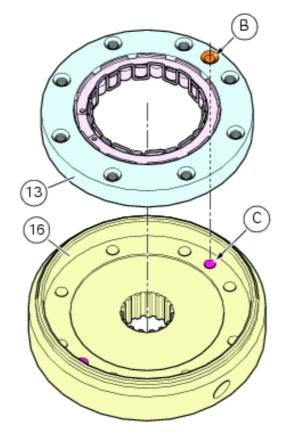
Orient the flange so that the side with the bevelled edge (A) faces the starter clutch.



Seat the flange (13) with the starter clutch in the flywheel (16), aligning the flange locating hole (B) with the flywheel locating hole (C).

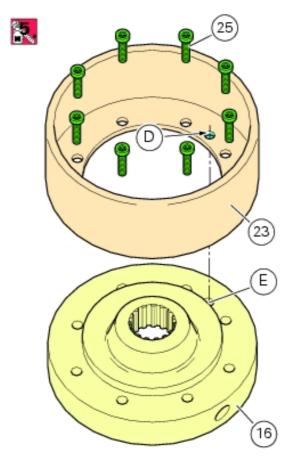
When refitting the flange to flywheel, insert a pin or a wrench inside the hole (C) for the rotor flywheel locating dowel in order to line up the flywheel holes with the flange threads. This is a useful tip, as the holes cannot be aligned after having fitted the flange to the flywheel due to the interference fit.

Orient the flange so that the side with the bevelled edge faces the flywheel.

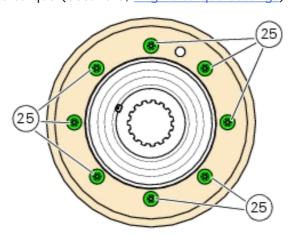




Install the rotor (23) on the flywheel (16), aligning the flywheel locating hole (E) with the rotor locating hole (D). Apply threadlocker to the rotor/flywheel fixing bolts (25) and start them in their threads.



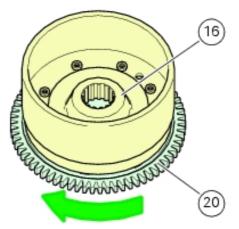
Tighten the bolts (25) to the specified torque (Sect. C 3, Engine torque settings).

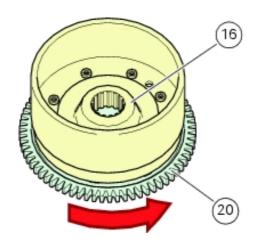


Install the driven gear (20) on the starter clutch, ensuring it is properly seated.

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

Fit the washer (17) (suitably lubricated), needle roller bearing (19), and inner race (18) to the crankshaft. Make sure the inner race is centred relative to the washer.

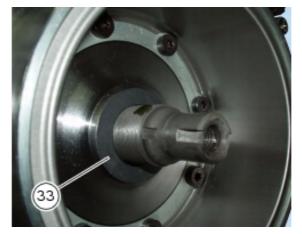


Install the flywheel-rotor-driven gear assembly on the crankshaft, taking care not to alter the position of the inner race (18) relative to the washer (17).

The flywheel reference mark must be aligned with the groove on the crankshaft, in correspondence with the keyway.



Lubricate the contact surfaces of Belleville washer (33) with engine oil. Fit the Belleville washer (33) on the end of the crankshaft.



Apply the recommended threadlocker to the threads of the crankshaft and the flywheel nut (34).



Restrain the rotation of the flywheel with the holding tool 88713.2036.

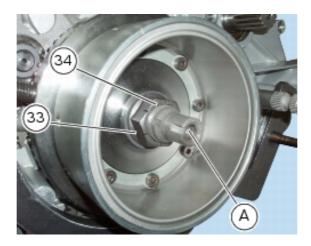




Tighten the nut (34) to the specified torque (Sect. C 3, Engine torque settings).

Remove all traces of Loctite from the threads of the nut (34) and the crankshaft (A).





#### Reassembly of the alternator-side crankcase cover

Fit the stator (32) to the crankcase cover, routing the cable through the notch in the cover. Apply threadlocker to the stator fixing bolts (24) and tighten to the specified torque (Sect. C 3, <a href="Engine torque">Engine torque</a> settings).

Fit the cable clamp (30) and fix it to the cover with the two bolts (31).

Before refitting, make sure that the crankshaft end bearing (26) and relative retaining ring (27) are installed in the alternator-side crankcase cover (28).



## Refitting the alternator-side crankcase cover

Remove any scale and grease from the mating surfaces of the left-hand crankcase half and the crankcase cover. Fit the two locating bushes (29).



Spread a continuous uniform bead of DUCATI liquid gasket on the mating surface of the cover (28), ensuring continuity around the holes for the retaining bolts and locating bushes.

Tap the cover at different positions with a rubber mallet to facilitate its location on the shafts and locating bushes.



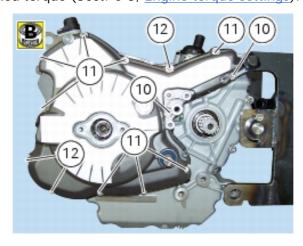


Insert the retaining bolts in their holes following the indications given in the table.

Ref.	Qty	Description
10	2	M6x20 mm bolts
11	8	M6x25 mm bolts
12	3	M6x30 mm bolts

Under the screw (12), located in correspondence with the starter motor, fit the spacers (8), hose clips (9) and (14), and washers (15).

Tighten the fixing bolts to the specified torque (Sect. C 3, Engine torque settings).





Dampen the oil seal (3) with alcohol and install it in the alternator-side crankcase cover, in correspondence with the gearchange shaft (Sect. F 5, Refitting the gearchange control), using the specific installation tool **88713.1411**.

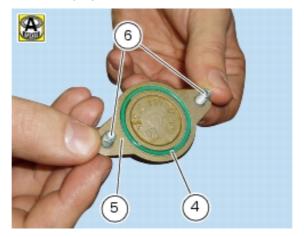


Make sure that the O-ring (4) is installed in the cover (5).

Apply threadlocker to the bolts (6).

Tighten the two retaining bolts (6) of the inspection cover (5) over the end of the crankshaft to the specified torque (Sect. C 3, Engine torque settings).

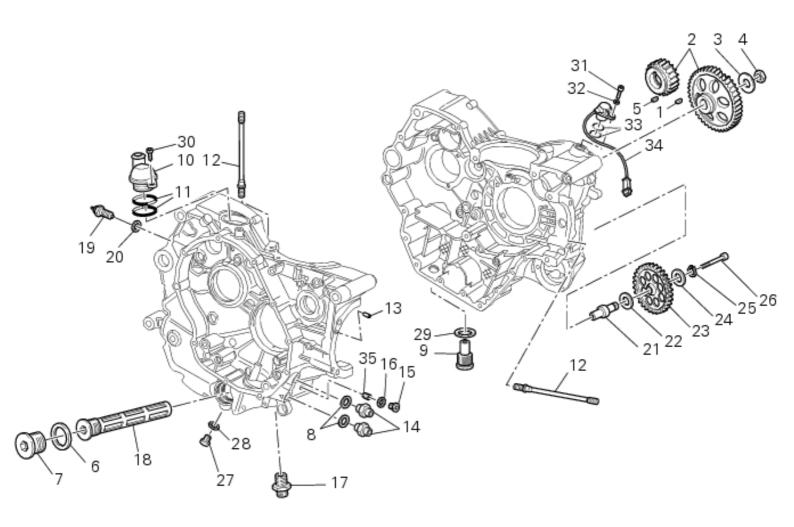
Refit the chain guard (1) and tighten the bolts (11).





Operation	Section reference
Refit the sprocket cover	G 8, Refitting the front sprocket
Refit the LH footrest	H 4, Refitting the footrest brackets
Refit the clutch slave cylinder	F 2, Refitting the clutch slave cylinder
Refit the gearchange control	F 5, Refitting the gearchange control
Top up the engine oil	D 4, Changing the engine oil and filter
	<u>cartridge</u>

## 9.1 - Crankcase assembly: external components



- 1 Key
- 2 Timing gear pair
- 3 Lock washer
- 4 Hex nut
- 5 Key
- 6 Sealing washer
- 7 Plug
- 8 Aluminium gasket
- 9 Plug
- 10 Breather valve
- 11 O-ring
- 12 Cylinder barrel-head stud bolt
- 13 Locating dowel
- 14 Connection fitting
- 15 Plug
- 16 Sealing washer, thickness 2
- 17 Connection fitting
- 18 Gauze pickup filter
- 19 Neutral switch
- 20 Sealing washer
- 21 Gear shaft
- 22 Washer
- 23 Starter motor gear
- 24 Washer
- 25 Circlip
- 26 Bolt
- 27 Plug
- 28 Sealing washer

Crankcase assembly: external components

- 29 Sealing washer
- 30 Bolt
- 31 Bolt
- 32 Washer
- 33 O-ring
- 34 Pickup sensor
- 35 Grub screw



**Timing system** 

Filters and oil pump

Crankcase halves

Electric starting and ignition

Gearchange control



## Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

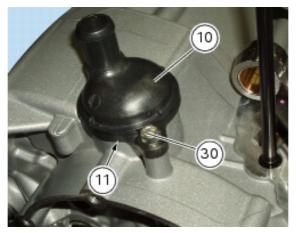
#### Removal of external components

Operation	Section reference
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
Remove the clutch assembly	N 6.1, Removal of the APTC clutch
Remove the oil pump	N 2.1, Removal of the oil pump
Remove the alternator-side crankcase cover	N 8, Removal of the alternator-side crankcase cover
Remove the engine starting system	P 3, Electric starting system
Remove the timing belt covers	N 4.2, Removal of the timing belt covers
Remove the timing belts	N 4.2, Removal of the timing system assembly
Remove the cylinder heads	N 4.4, Removal of the cylinder head assembly
Remove the cylinder barrel/piston assemblies	N 5, Removal of the cylinder/piston assembly

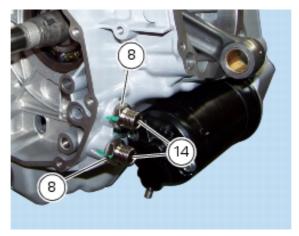


The following removal operations are required in order to renew and/or clean the crankcase halves. If the original crankcase halves are to be reused, then the removal of these components is not essential.

Unscrew the bolt (30) and remove the oil breather valve (10) with the O-rings (11). Check the condition of O-rings (11) and renew them if necessary.



Unscrew and remove the oil inlet and outlet connection fittings (14) from the clutch-side crankcase half and recover the seals (8).



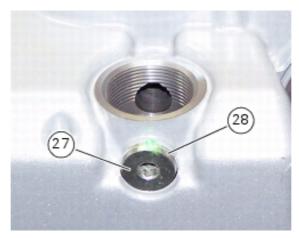
Unscrew and remove the oil filter cartridge (Sect. D 4, <u>Changing the engine oil and filter cartridge</u>). Unscrew and remove the oil filter support connection fitting (17).



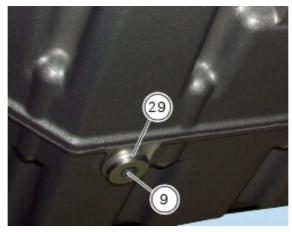
Remove the gauze pickup filter (18) with its seal from the clutch-side crankcase half as described in Section D 4, Changing the engine oil and filter cartridge.



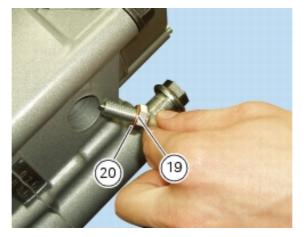
Unscrew the plug (27), taking care to recover the relative seal (28).



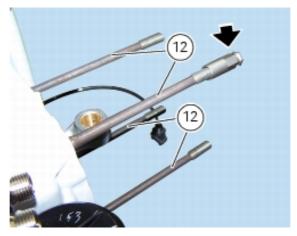
Remove drain plug (9) with its seal (29).



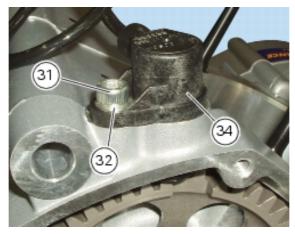
Remove the neutral switch (19) with seal (20).



Remove the cylinder head studs (12) with the aid of the appropriate tool.



To remove the engine sensor (34), unscrew the screw (31) and recover the shim (24) and the washer (32).

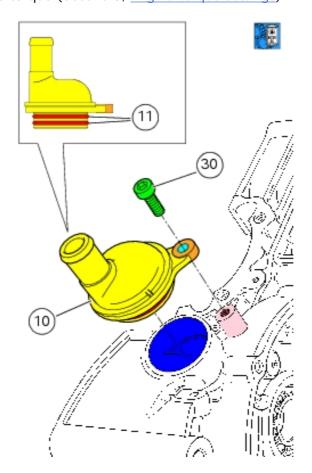


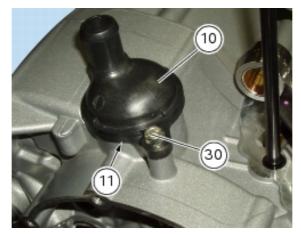
Check the condition of O-rings (33) in the crankcase half and renew them if necessary.



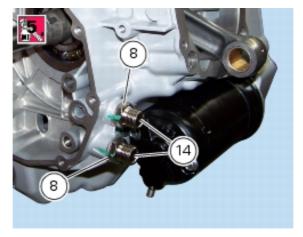
## Refitting the external components

Check the condition of O-rings (11) and renew if necessary. Install the oil vapour breather valve (10) in the crankcase along with O-rings (11), previously lubricated. Tighten the bolt (30) to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>).





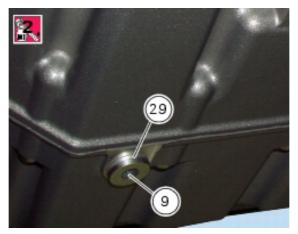
Fit the seals (8) on the connection fittings (14) on the small diameter sides of the fittings. Apply the recommended threadlocker to the smaller diamater threads of the connections fittings (14). Tighten the connection fittings (14) to the specified torque (Sect. C 3, <u>Engine torque settings</u>).



Apply the recommended threadlocker to the connection fitting (17). Tighten the oil filter support connection fitting (17) to the specified torque (Sect. C 3, Engine torque settings).



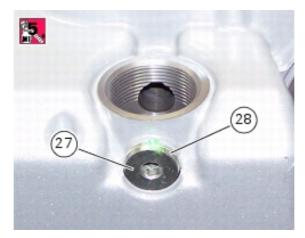
Screw in the drain plug (9) with its seal (29) and tighten to the specified torque (Sect. C 3, <u>Engine torque settings</u>), after applying the recommended threadlocker.



Refit the neutral switch (19) with its seal (20) and tighten to the specified torque (Sect. C 3, Engine torque settings).



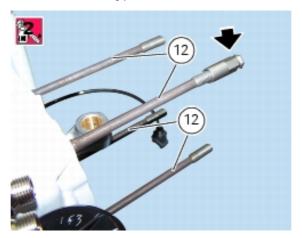
Apply threadlocker to the plug (27), fit it with its seal (28) and tighten to the specified torque (Sect. C 3, <u>Engine torque settings</u>).



Refit the gauze pickup filter (18) with its seal as described in Section D 4, Changing the engine oil and filter cartridge.



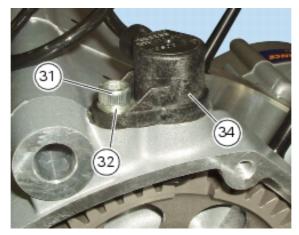
Now fit the studs (12) in the crankcase halves, applying threadlocker and tightening to the specified torque value (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>). Use a tool of the type shown in the illustration.



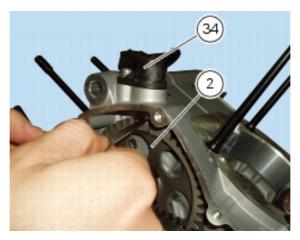
Check that the O-rings (33) are installed in the crankcase.



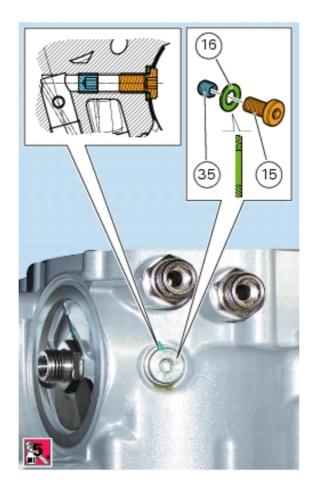
Fit the engine pickup (34) in its seat in the crankcase. Insert the bolt (31) with the washer (32) and tighten to the specified torque (Sect. C 3, Engine torque settings).



Use a feeler gauge to check the clearance between the engine pickup (34) and the timing gear (2). The value must be between **0.6** and **0.8** mm.



If removed, apply threadlocker to the grub screw (35) and tighten it to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>) and fit the seal (16) to the service plug (15): the seal must be oriented so that the square edge faces the clutch-side crankcase. Apply the recommended threadlocker to the thread of the plug (15) and tighten it to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>).



Operation	Section reference
Refit the cylinder barrel/piston assemblies	N 5, Refitting the cylinder/piston assembly
Refit the cylinder heads	N 4.4, Refitting the cylinder head assembly
Refit the timing belts	N 4.2, Refitting the timing system assembly
Refit the timing belt covers	N 4.2, Refitting the timing belt covers
Refit the engine starter system	P 3, Electric starting system
Refit the alternator-side crankcase cover	N 8, Refitting the alternator-side crankcase cover
Refit the oil pump	N 2.1, Refitting the oil pump
Refit the clutch assembly	N 6.1, Refitting the APTC clutch
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

## Removal of the timing gears

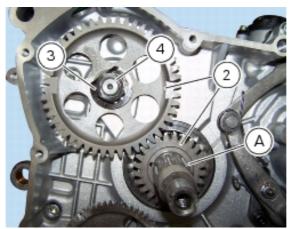
Operation	Section reference	
	D 4, <u>Changing the engine oil and filter</u> <u>cartridge</u>	
Remove the gearchange control	F 5, Removal of the gearchange control	
Remove the clutch slave cylinder	F 2, Removal of the clutch slave cylinder	
Remove the LH footrest	H 4, Removal of the footrest brackets	

Remove the front sprocket cover	G 8, Removal of the front sprocket
Remove the alternator-side crankcase cover	N 8, Removal of the alternator-side crankcase cover
Remove the flywheel/alternator assembly	N 8, Removal of the flywheel-alternator assembly

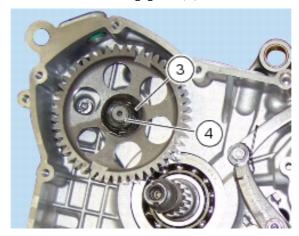
Slide out driving gear (A) of timing gear pair (2).

Relieve the staking on the lock washer (3) of the nut (4).

Restrain the driven timing gear by inserting a pin in one of the holes, and unscrew the nut (4).



Slide off the nut (4), the washer (3) and the driven timing gear (B).



### Refitting the timing gears

Before refitting, check the wear on the timing gear pair (2) and renew if necessary.

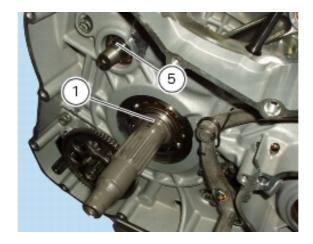


## Important

The timing gears (2) must always be renewed as a pair.



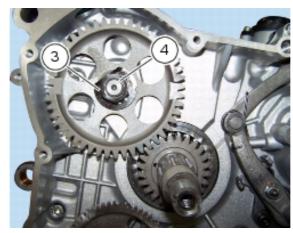
Check that the Woodruff key (1) on the timing gear driveshaft and the Woodruff key (5) on the crankshaft are both present.



Refitting is the reverse of removal.



On completion of the refitting operations, check that tab washer (3) is staked against nut (4) in such a way as to prevent the nut from working loose.



Operation	Section reference
Refit the flywheel/alternator assembly	N 8, Refitting the flywheel-alternator assembly
Refit the alternator-side crankcase cover	N 8, Refitting the alternator-side crankcase cover
Refit the sprocket cover	G 8, Refitting the front sprocket
Refit the LH footrest	H 4, Refitting the footrest brackets
Refit the clutch slave cylinder	F 2, Refitting the clutch slave cylinder
Refit the gearchange control	F 5, Refitting the gearchange control
Fill the engine with oil	D 4, Changing the engine oil and filter cartridge

## Removal of the starter motor idler gear

Operation	Section reference
Drain the engine oil	D 4, <u>Changing the engine oil and filter</u> <u>cartridge</u>
Remove the gearchange control	F 5, Removal of the gearchange control
Remove the clutch slave cylinder	F 2, Removal of the clutch slave cylinder
Remove the LH footrest	H 4, Removal of the footrest brackets

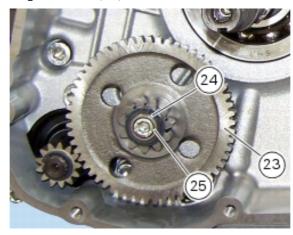
Crankcase assembly: external components

Remove the front sprocket cover	G 8, Removal of the front sprocket
l .	N 8, Removal of the alternator-side crankcase cover
Remove the flywheel/alternator assembly	N 8, Removal of the flywheel-alternator assembly

Remove the circlip (25) and the washer (24).

Remove the starter motor idler gear (23) and shim (22).

Unscrew the bolt (26) securing the idler gear shaft (21) and remove the shaft.





Refitting the starter motor idler gear

Refitting is the reverse of removal.



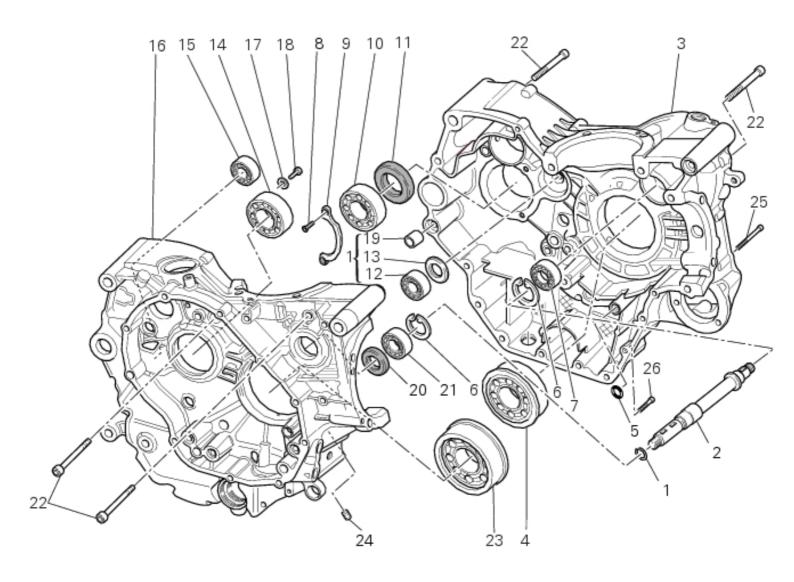
Apply the prescribed threadlocker to the bolt (26) and tighten to the prescribed torque (Sect. C 3, <a href="Engine torque">Engine torque</a> settings).



### Crankcase assembly: external components

Operation	Section reference
Refit the flywheel/alternator assembly	N 8, Refitting the flywheel-alternator assembly
Refit the alternator-side crankcase cover	N 8, Refitting the alternator-side crankcase cover
Refit the sprocket cover	G 8, Refitting the front sprocket
Refit the LH footrest	H 4, Refitting the footrest brackets
Refit the clutch slave cylinder	F 2, Refitting the clutch slave cylinder
Refit the gearchange control	F 5, Refitting the gearchange control
Fill the engine with oil	D 4, Changing the engine oil and filter cartridge

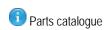
# 9.2 - Crankcase assembly: crankcase halves



- 1 Circlip
- 2 Timing belt driveshaft
- 3 Alternator-side crankcase half
- 4 Bearing
- 5 O-ring
- 6 Circlip
- 7 Bearing
- 8 Bolt
- 9 Retaining plate
- 10 Bearing
- 11 Seal
- 12 Bearing
- 13 Seal
- 14 Bearing
- 15 Bearing
- 16 Clutch-side crankcase half
- 17 Spacer
- 18 Bolt
- 19 Bush
- 20 Seal
- 21 Bearing
- 22 Bolt
- 23 Bearing
- 24 Grub screw

Crankcase assembly: crankcase halves

25 Bolt 26 Bolt



<u>Timing system</u> <u>Crankcase halves</u>



## Important

Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in the exploded view diagram.

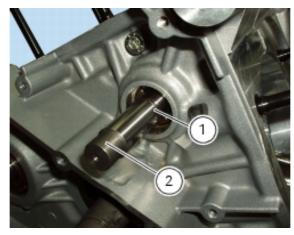
## Separation of the crankcase halves

1	
N 1, Removal of the engine	
N 6.2, Removal of the clutch-side crankcase cover	
N 6.1, Removal of the APTC clutch	
N 2.1, Removal of the oil pump	
N 6.3, Removal of the primary drive gears	
N 8, Removal of the alternator-side crankcase cover	
N 8, Removal of the flywheel-alternator assembly	
N 9.1, Removal of the starter motor idler gear	
P 3, Removal of the starter motor	
N 4.2, Removal of the timing belt covers	
N 4.2, Removal of the timing system assembly	
N 4.4, Removal of the cylinder head assembly	
N 5, Removal of the cylinder/piston assembly	
D 4, Changing the engine oil and filter cartridge	

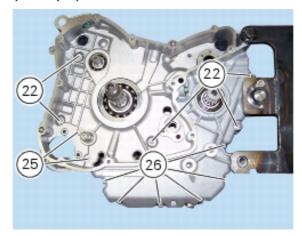
Use two screwdrivers to prise the circlip (1) from the timing gear driveshaft (2) on the clutch-side crankcase half.



Take care to avoid scoring the surface of the shaft while removing the circlip.

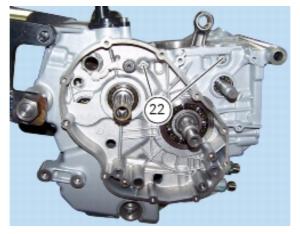


Unscrew the crankcase bolts (22), (25) and (26) from the alternator-side crankcase half (3).





Unscrew the two bolts (22) on the clutch-side crankcase half (16) near the vertical cylinder.

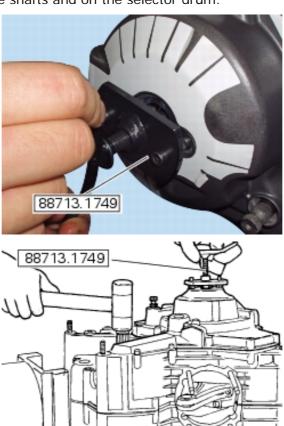


Re-use the alternator-side crankcase cover or a service cover with puller **88713.1749**. Secure it to the crankcase half using several of the original bolts and begin to separate the crankcase halves by turning the central pin of the tool.

Tap the end of the gearbox output shaft with a rubber mallet to separate the crankcase halves.



Take care not to lose the shims on the shafts and on the selector drum.

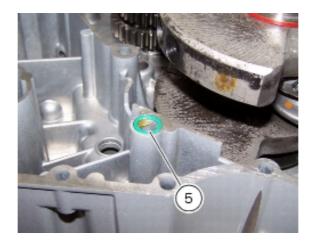


Remove the gearbox shafts and gearbox selector drum from the crankcase (Sect. N 7.2, Removal of the gearbox assembly).

Drive out the crankshaft (C) using a rubber mallet and taking care not to lose the shims (D). Remove the timing belt driveshaft (2).

Recover the O-Ring (5) from the communicating oil way between the crankcase halves.





#### 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 (4) and (23) are in good condition. Note that the main bearings must always be changed in pairs (refer to the procedure below in "Overhaul of the main bearings").

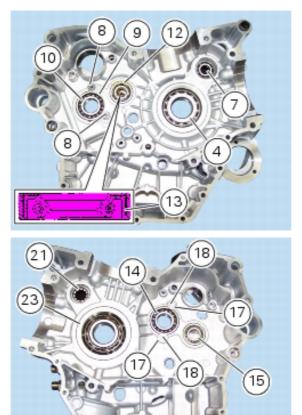


When overhauling an engine it is good practice to renew all the crankcase bearings.

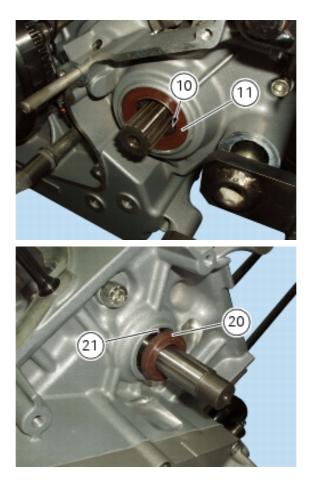
Renew the bearings (10) and (15) on the ends of the gearbox output shaft and the timing belt driveshaft bearings (7) and (21).

After having renewed the gearbox shaft bearings (14) and (12), secure them in the crankcase with the spacers (17) and the retaining plate (9) fixed respectively with screws (18) and (8).

At each overhaul it is recommended to renew also the oil seal (13) located between the bearing (12) and the chainside crankcase half. lubricate the oil seal with denatured alcohol and install it in the crankcase half, orienting it as shown.



At each overhaul it is recommended to renew also the oil seal (11) located outside the bearing (10) and the oil seal (20) outside of the bearing (21).



Check the condition of locating bushes (19). In the event of evident signs of distortion or excessive assembly clearance in their bores, remove the locating bushes using appropriate tools. If the removal of the bushes (19) from the casing proves difficult, use a left-handed thread tap to force the bushes out.

# Important

The bushes (19) must always be renewed when they have been removed using the above procedure.





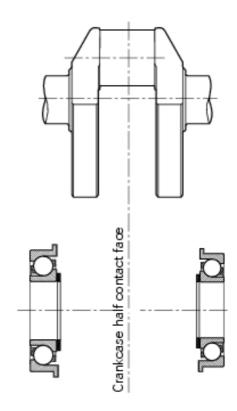
### Overhaul of the main bearings

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 bearings are designed to bear combined loads (radial and-thrust loading).

Bearings of this type can withstand 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:

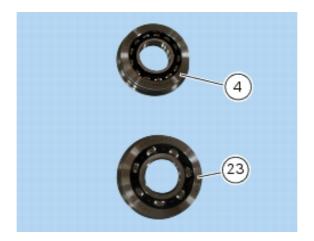
- heat the crankcase half in an oven to 100 °C;
- remove the bearing using a drift and hammer;
- install the new bearing (while the crankcase is still hot) keeping it perfectly square in its seat using a tubular drift that only bears on the outer ring of the bearing;
- allow the parts to cool and check that the bearing is securely seated in the crankcase.





On worn engines, the outer races of the bearing may no longer be a tight fit in the crankcase half.

Check that the interference fit between the crankcase and the installed bearings (4) and (23) is not less than **0.03** mm, otherwise the crankcase halves must be renewed.





## Important

After installing new main bearings, shim the crankshaft as described in the paragraph "Shimming the shafts" and "Reassembly of the crankcase halves" in this section.

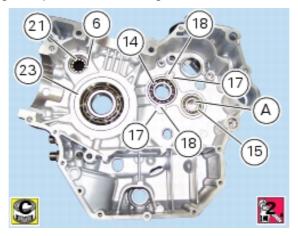
#### Reassembly of the crankcase halves

The crankcase halves must be in good condition and perfectly clean. The mating surfaces must be perfectly flat and free from burrs.

#### Refitting the clutch-side crankcase half

The following parts must be present on the internal side of the crankcase half:

- the output shaft end bearing (15): 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 (14), secured with bolts (18) and retaining spacer (17): apply the recommended
- threadlocker to the bolts (18) and tighten them to the specified torque (Sect. C 3, Engine torque settings);
- the roller bearing (21) with retaining circlip (6) at the timing belt driveshaft.



#### 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 (10) supporting the selector fork shaft.

Apply threadlocker to the bolts (8). Fit the retaining plate (9) to the gearbox output shaft bearing (10) screwing the bolts (8) fully into the chain-side crankcase half.



#### Notes

The bearing retaining plate must be positioned so that the countersunk side is facing upwards.

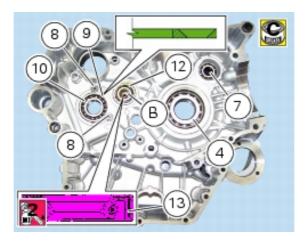
Tighten the bolts (8) to the specified torque (Sect. C 3, Engine torque settings).

The gearbox input shaft end bearing (12) with the inner spacer (13): apply grease to the bearing rollers.

Fit the inner race (B) removed previously from the bearing. Apply grease to the inner race.

The main bearing (4).

The ball bearing (7) with circlip (6), in correspondence with the timing belt driveshaft, oriented so that the closed side of the plastic roller cage faces the crankcase half.





None of the bearings except the main bearings have an obligatory assembly direction: it is good practice to install the bearings so that side with the writing is facing upwards.

#### 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 preload of **0.30** mm to help seat the axial load crankshaft bearings correctly, then insert the inner race in the outer race.

This gives:

SA = LA1 + LA2 + 0.30 - LA.

To calculate the thickness of each shim note that:

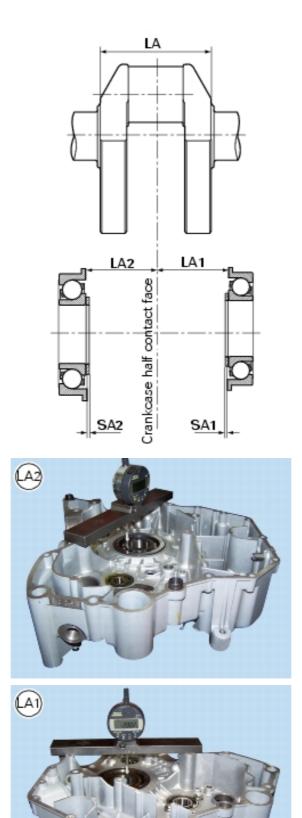
SA = SA1 + SA2

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.





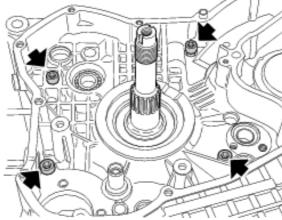
In addition to the above procedure, the following is a practical shimming method, providing a guide on how to calculate the crankshaft shim thicknesses accurately.

Install a shim (A) of minimum thickness (1.90 mm) on each side of the crankshaft to prevent contact between the crankshaft web and the engine block.

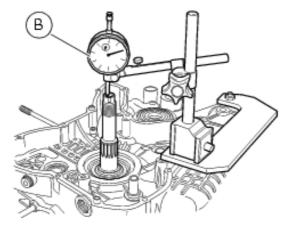
Install the crankshaft and assemble the two crankcase halves.

Fit four M8 bolts into the holes shown in the figure and tighten to the specified torque (Sect. C 3, <a href="Engine torque">Engine torque</a> <a href="Engine torque">Settings</a>).

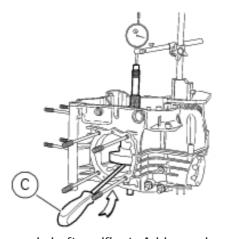




Place a dial gauge (B) with magnetic stand on a support plate fixed to the crankcase. Bring the stylus into contact with the end of the crankshaft and set the dial gauge to zero in this position.



Insert a lever (C) 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.



After assembling the crankcase, the crankshaft should turn with some interference in the new bearings.

Shimming the gearbox shafts

The following shim thicknesses are available as replacement parts:

Position	Clutch side (mm)	Chain side (mm)
Gearbox input shaft	1.2	1.6
Gearbox output shaft	3.15	0.8

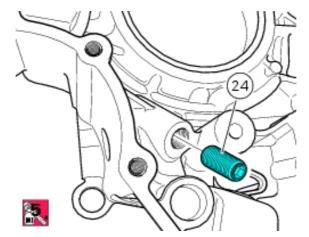
Shimming the gearbox selector drum

The following shim thicknesses are available as replacement parts:

Position	Clutch side (mm)	Chain side (mm)
Gear selector drum	1.0	0.9

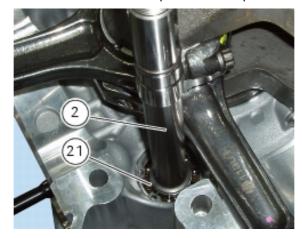
#### Reassembly of the crankcase halves

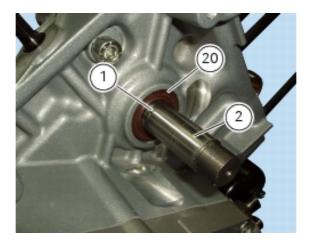
If removed, apply the recommended threadlocker to the grub screw (24) and tighten it to the specified torque (Sect. C 3, Engine torque settings).



Install the timing belt driveshaft (2) in the roller bearing (21) in the clutch-side crankcase half. To avoid damaging the oil seal (20) on the timing belt driveshaft, protect the threaded end of the shaft with the special protective cap **88700.5749**. Dampen the oil seal (20) with alcohol and fit it on the timing belt driveshaft, seating it against the roller bearing (21).

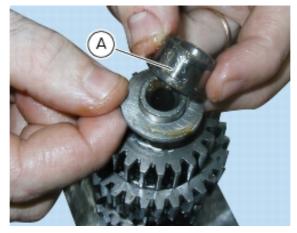
Fit the circlip (1) in the groove on the shaft and remove the protective cap.







When refitting used components, before installing the gearbox assembly in the crankcase half, make sure that the inner races (A) 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.



Install the selector forks of the  $1^{St}$ - $4^{th}$  and  $2^{nd}$ - $3^{rd}$  gears (B) in their respective grooves in the output shaft driven gears.



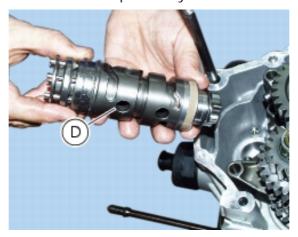


The two selector forks are identical.

Install the  $5^{\mbox{th}}$ - $6^{\mbox{th}}$  gear selector fork (C) in the input shaft driven gear.



Install the selector drum (D) in the crankcase with the previously calculated shim thickness.



Fit the pins (E) in the previously installed selector forks.



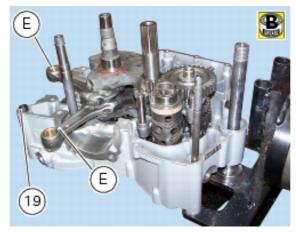
Fit the shimmed crankshaft into the clutch-side crankcase half, positioning the connecting rods (E) in correspondence with the relative cylinder barrel seats.

Check that the two locating bushes (19) are correctly installed.

Grease O-ring (5) to hold it in position and install it on the oil way connecting the two crankcase halves.

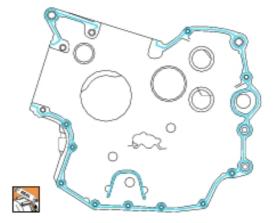
# Important

Make sure that the connecting rods (E) 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.





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 (16) together, tapping with a rubber mallet in the area of the shafts if necessary.

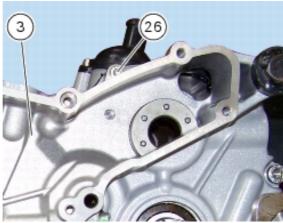


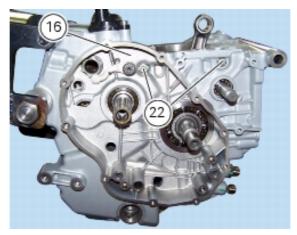
Prepare the crankcase bolts, and insert them in the alternator-side crankcase half (3); note that the bolts are of different lengths.

Ref.	Qty	Description	
22	7	M8x75 mm bolts	
26	7	M6x35 mm bolts	
25	2	M6x75 mm bolts	

Progressively tighten the crankcase bolts until fully seated, starting with the bolts of the largest diameter (M8). Insert two M8 bolts (22) in the clutch-side crankcase (16). Tighten all the bolts to the specified torque (Sect. C 3, Engine torque settings).

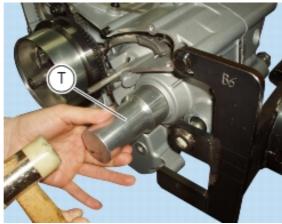






Check that the crankshaft can be turned with a certain amount of interference with the main bearings (the crankshaft should have a pre-load of **0.15** to **0.20** mm); check also that all the parts fitted are free to rotate or move correctly. Install the oil seal (11) on the gearbox output shaft using the specific tool (T).



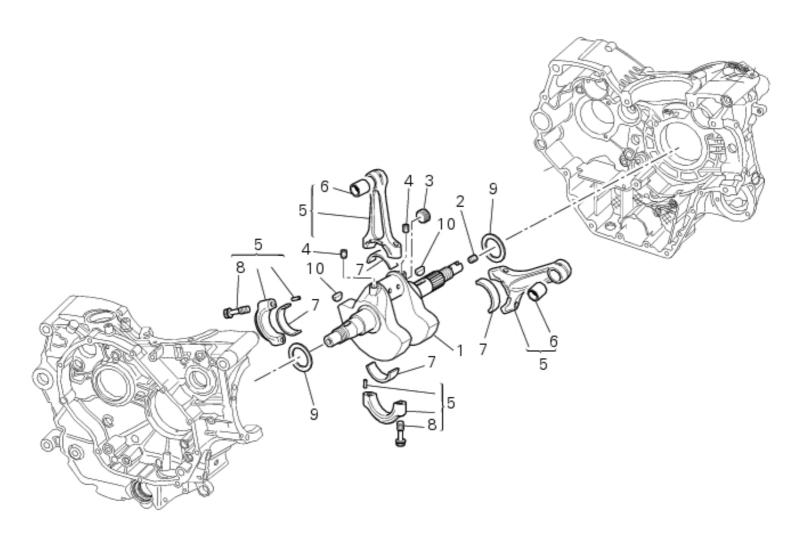


Operation	Section reference
Refit the gauze pickup filter	D 4, Changing the engine oil and filter
	<u>cartridge</u>
Refit the cylinder barrel/piston assemblies	N 5, Refitting the cylinder/piston
dsserribiles	<u>assembly</u>
Refit the cylinder head assemblies	N 4.4, Refitting the cylinder head
	<u>assembly</u>
Refit the timing belts	N 4.2, Refitting the timing system
	<u>assembly</u>
Refit the timing covers	N 4.2, Refitting the timing belt covers
Refit the starter motor	P 3, Refitting the starter motor
Refit the starter idler gear	N 9.1, Refitting the starter motor idler
	<u>gear</u>

### Crankcase assembly: crankcase halves

Refit the flywheel/alternator assembly	N 8, Refitting the flywheel-alternator assembly
Refit the alternator-side crankcase cover	N 8, Refitting the alternator-side crankcase cover
Refit the primary gear	N 6.3, Refitting the primary drive gears and checking backlash
Refit the oil pump	N 2.1, Refitting the oil pump
Refit the clutch assembly	N 6.1, Refitting the APTC clutch
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

# 9.3 - Crankcase assembly: crankshaft/connecting rods assembly



- 1 Crankshaft
- 2 Drilled screw
- 3 Plug
- 4 Grub screw
- 5 Connecting rod assembly
- 6 Bush
- 7 Half bearing
- 8 Special bolt
- 9 Shim
- 10 Key



#### connecting rods



Bold reference numbers in this section identify parts not shown in the figures alongside the text, but which can be found in 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 clutch-side crankcase cover	N 6.2, Removal of the clutch-side crankcase cover
Remove the clutch assembly	N 6.1, Removal of the APTC clutch
Remove the oil pump	N 2.1, Removal of the oil pump
Remove the primary gear	N 6.3, Removal of the primary drive gears
Remove the alternator-side crankcase cover	N 8, Removal of the alternator-side crankcase cover
Removal of the flywheel/ alternator assembly	N 8, Removal of the flywheel-alternator assembly
Remove the starter idler gear	N 9.1, Removal of the starter motor idler gear
Remove the starter motor	P 3, Removal of the starter motor
Remove the timing belt covers	N 4.2, Removal of the timing belt covers
Remove the timing belts	N 4.2, Removal of the timing system assembly
Remove the cylinder head assemblies	N 4.4, Removal of the cylinder head assembly
Remove the cylinder barrel/piston assemblies	N 5, Removal of the cylinder/piston assembly
Remove the gauze pickup filter	D 4, Changing the engine oil and filter cartridge
Separate the crankcase halves	N 9.2, Separation of the crankcase halves

After separating the crankcase halves, withdraw the crankshaft (1) complete with connecting rods (5).

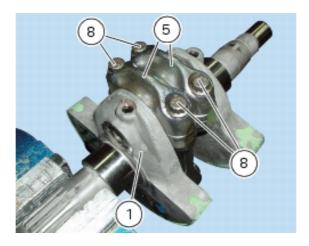


Disassembly of the crankshaft/connecting rods assembly

To disassemble the crankshaft/connecting rods assembly, undo the screws (8) and separate the connecting rod (5) from the crankshaft (1).



Take care not to mix up components of different con-rods and maintain the original orientation.



### Overhaul of the connecting rods

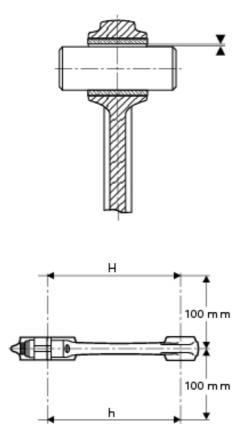
Make the following dimensional checks on the connecting rods:

- assembly clearance with gudgeon pin at time of fitting (Sect. C 1.1, Cylinder/Piston).

In case of excessive wear, 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 diameter of the big-end must be within the specified tolerance limits (Sect. C 1.1, Cylinder/Piston).

It is preferable to use crankshafts and connecting rods of the same size class.



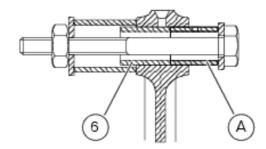
#### Renewal of the connecting rod bearings

It is good practice to renew the bearings (7) each time the engine is overhauled. Replacement bearings are supplied ready for assembly and they must not be reworked with scrapers or emery cloth.

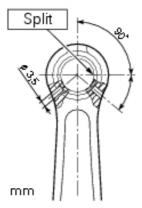


#### Renewal of the small end bushing

To renew the bushing (6) use the tool shown in figure to simultaneously drive out the old bushing and install the new one (A).

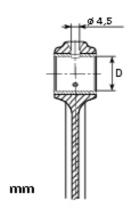


Position the new small-end bushing so that the split is at 90° relative to the upper hole in the small-end.



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 18.006 to 18.024 mm.



#### Crankshaft overhaul

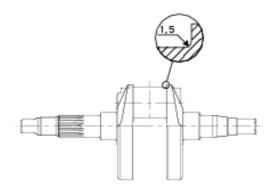
The main bearing and big-end journals should not be scored or grooved;

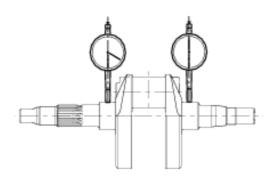
the threads, keyways, and slots must be in good condition.

Check for fretting or burrs in the fillet between journal and shoulder.

Fillet radius: **1.5** mm.

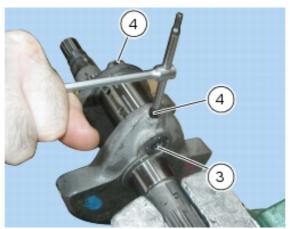
With the aid of a micrometer, measure out-of-round and taper of the big-end journals, taking the measurements in various different directions (Sect. C 1.1, <a href="Cylinder/Piston">Cylinder/Piston</a>).

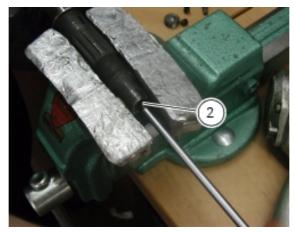




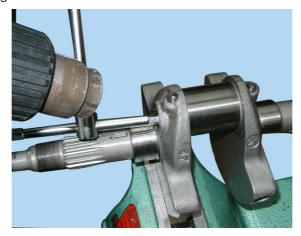
Use a dial gauge to measure the alignment of the main journals by setting the crankshaft between two opposing centres (Sect. C 1.1, Cylinder/Piston).

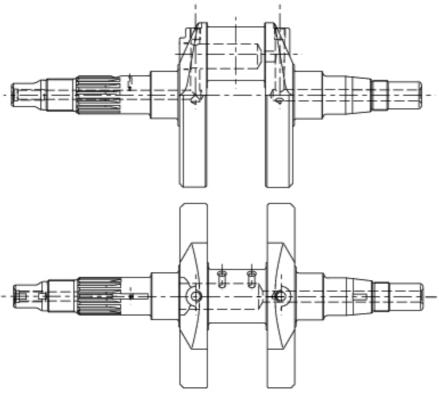
Unscrew all the plugs (4), (3) and (2) from the crankshaft, heating the crankshaft, if necessary, to remove the threadlocker applied at the time of assembly.



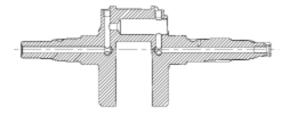


Use a hot air gun capable of reaching 150  $^{\circ}\text{C}.$ 

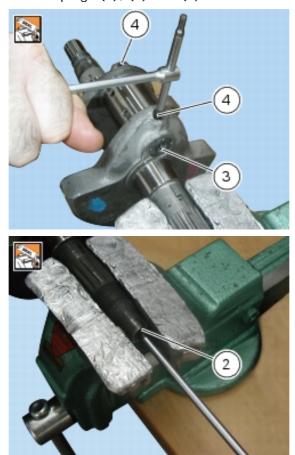




Clean all the oilways using suitable diameter metal brushes and then blow with compressed air to remove any residues that have accumulated and are restricting the oil flow.



Apply DUCATI liquid gasket on the threads of plugs (3), (4) and (2) and then refit the plugs.



Tighten all the plugs to the specified torque (Sect. C 3, Engine torque settings).

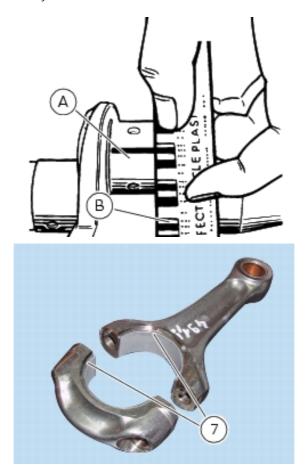
#### Big-end bearing shell-journal clearance

To check the assembly clearance between the bearing shells and crankshaft journals you need to lay a strip (A) of "GREEN Plastigauge PG-1" on the journal.

Fit the connecting rod with the original big-end bearing shells (7) (see procedure on next page) and tighten the bolts (8) to a torque of 49 Nm.

Remove the connecting rod and compare the width of the Plastigage strip to the scale (B).

If the width, which corresponds to the existing clearance, is not within the specified tolerance limits (big-end bearing shell-journal clearance indicated in Sect. C 1.1, <a href="Cylinder/Piston">Cylinder/Piston</a>), it will be necessary to renew either the bearing shells or the crankshaft.

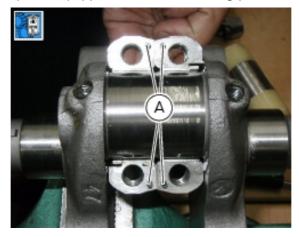


### Reassembly of the connecting rods

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 and cap are equipped with their locating pins (A).



Wash the pins and dry them with compressed air.

Clean and lubricate the journals and con-rod bearing shells with engine oil and fit the con-rods in their original mounting positions.

Fit the caps to the corresponding connecting rods. Make sure that the mark on the cap is the on the same side as the mark on the connecting rod.



Use the recommended grease to lubricate the threads and underside of the heads of the new bolts (8) and the threaded hole in the connecting rod, packing in grease from both sides of the hole.



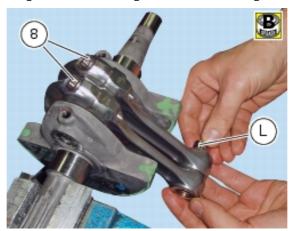
### Warning

The grease utilised is an irritant in contact with the skin. Wear protective gloves.

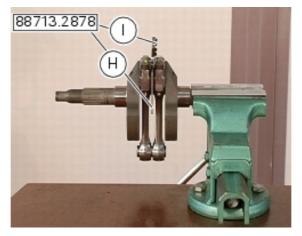


Lubrication of big-end cap bolts is essential to obtain the correct coupling and to prevent breakage of the parts. The connecting rod screws may be used and tightened **once only**, after which they must be discarded.

Temporarily fit the gudgeon pin (L) to align the connecting rods, and then tighten the screws.

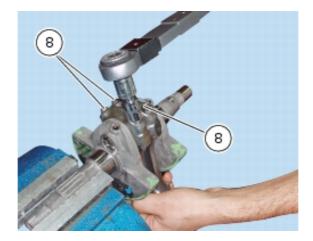


Fit the spacer (H) of the tool **88713.2878** between the connecting rods and take up residual axial play with the fork feeler gauge (I) of the tool **88713.2878** which is available in the following thicknesses: **0.1** mm - **0.2** mm - **0.3** mm.



Tighten the screws (8) in three stages to the specified torque (Sect. C 3, <u>Engine torque settings</u>), using a torque wrench. Hold the wrench as shown in the photo.

Withdraw the feeler gauge and check that the connecting rod/crankshaft endfloat is: 0.15 to 0.35 mm.



### Refitting the crankshaft/connecting rod assembly

Install the connecting rod/crankshaft assembly in the crankcase and follow the shimming procedure as described in Sect. N 9.2, <u>Shimming the shafts</u>.



## Important

Make sure that the connecting rods (5) 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
Reassemble the engine crankcase halves	N 9.2, Reassembly of the crankcase halves
Refit the gauze pickup filter	D 4, Changing the engine oil and filter cartridge
Refit the cylinder barrel/piston assemblies	N 5, Refitting the cylinder/piston assembly
Refit the cylinder head assemblies	N 4.4, Refitting the cylinder head assembly
Refit the timing belts	N 4.2, Refitting the timing system assembly
Refit the timing covers	N 4.2, Refitting the timing belt covers
Refit the starter motor	P 3, Refitting the starter motor
Refit the starter idler gear	N 9.1, Refitting the starter motor idler gear
Refit the flywheel/alternator assembly	N 8, Refitting the flywheel-alternator assembly

### Crankcase assembly: crankshaft/connecting rods assembly

Refit the alternator-side crankcase cover	N 8, Refitting the alternator-side crankcase cover
Refit the primary gear	N 6.3, Refitting the primary drive gears and checking backlash
Refit the oil pump	N 2.1, Refitting the oil pump
Refit the clutch assembly	N 6.1, Refitting the APTC clutch
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

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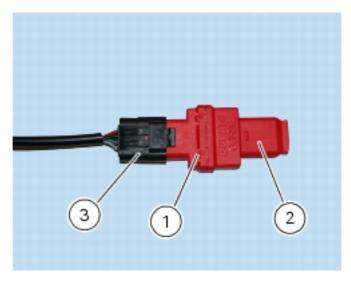
# 10 - USB Data Acquisition kit 125

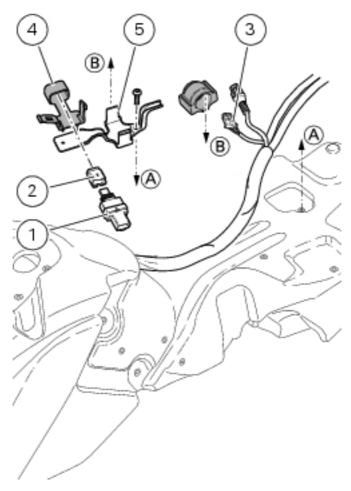
# 10 -USB Data Acquisition kit

A USB data acquisition kit (1) is supplied. To use the kit, remove the seat (Sect. E 3, Removal of the seat), locate the DDA in the clip (4) of the plate (5) fixed to the fuel tank; fit the cap (2) and connect the wiring connector (3) to the main wiring loom. Refer to the instrument panel functions (Sect. P 7, DDA data acquisition).



Each time the data acquisition kit disconnected, remember to replace the cap on the relative connector.

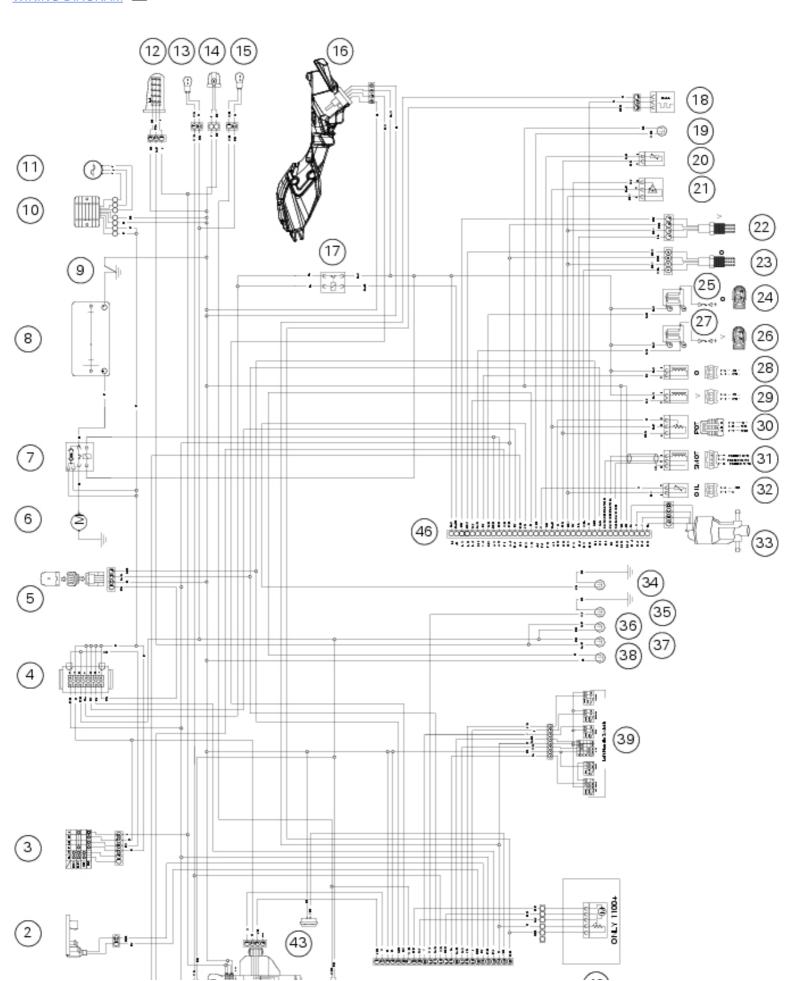


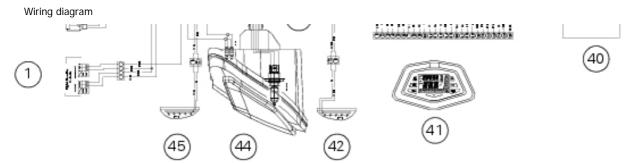




# 1 - Wiring diagram







### Key to wiring diagram

- 1 Right-hand handlebar switch
- 2 Immobilizer antenna
- 3 Key switch
- 4 Fusebox
- 5 Data acquisition/Diagnostics
- 6 Starter motor
- 7 Starter contactor with MASTER fuse
- 8 Battery
- 9 Engine earth/Electrical system earth
- 10 Regulator
- 11 Alternator
- 12 Tail light
- 13 Rear right turn signal
- 14 Number plate light
- 15 Rear left turn signal
- 16 Fuel tank
- 17 Injection relay
- 18 Speed sensor
- 19 Sidestand switch
- 20 Air temperature sensor
- 21 MAP pressure sensor
- 22 Vertical lamba sensor
- 23 Horizontal lambda sensor
- 24 Horizontal cylinder coil
- 25 Horizontal cylinder spark plug RH
- 26 Vertical cylinder coil
- 27 Vertical cylinder spark plug RH
- 28 Horizontal cylinder injector
- 29 Vertical cylinder injector
- 30 Throttle position sensor
- 31 Rpm/timing sensor
- 32 ECU oil temperature sensor
- 33 Stepper motor
- 34 Neutral switch
- 35 Oil pressure switch
- 36 Rear brake light switch
- 37 Front brake light switch
- 38 Clutch switch
- 39 Left-hand handlebar switch
- 40 Exhaust valve motor (not present on the HYM 796)
- 41 Instrumentation (instrument panel)
- 42 Front left turn signal
- 43 Horn
- 44 Headlight
- 45 Front right turn signal
- 46 ECU

#### Wiring colour codes

- **B** Blue
- W White
- **V** Violet
- **Bk** Black
- Y Yellow
- **R** Red
- Lb Light blue

**Gr** Grey

**G** Green

**Bn** Brown

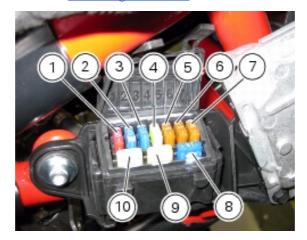
O Orange

P Pink

### Key to fuse box

Position	Item	Rating
1	Key on, starter contactor, lambda, eng. stop	10 A
2	Lights	15 A
3	Loads	15 A
4	Injection	20 A
5	ECU	5 A
6	Instrument panel	5 A
7	DDA and battery charging	5 A
8	Spare	20 A
9	Spare	20 A
10	Spare	15 A

For fuse checking procedure, see Section P 6, Checking the fuses.



### 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.

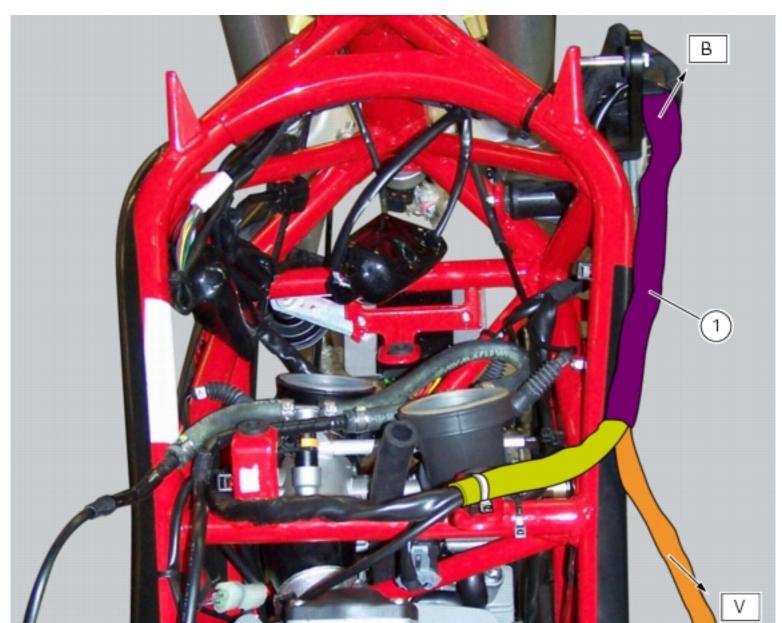
Position		Description
1	<u>Plate A</u>	Main wiring branch
2	<u>Plate B</u>	Injection relay
3	<u>Plate B</u>	ECU connector
4	<u>Plate H</u>	Front left turn signal connector
5	<u>Plate B</u>	Fusebox
7	<u>Plate H</u> - <u>Plate L</u>	Front right turn signal connector
8	<u>Plate C</u>	Pick-up connector
9	<u>Plate C</u>	Horizontal cylinder injector connector
10	<u>Plate C</u>	Air temperature sensor

11	Plate C	Pressure sensor lead (MAP)
12	Plate D	Pick-Up
13	Plate E	Regulator/alternator connector
14	Plate E	Voltage regulator
15	Plate E	Alternator cable
16	Plate F	Horn connector
17	Plate F	Horizontal cylinder coil connector
18	Plate G	Keyswitch connector
19	Plate G	Key-switch
20	<u>Plate G</u>	Immobilizer antenna connector
21	Plate G	Immobilizer antenna wire
22	<u>Plate H</u>	Left-hand handlebar switch
23	<u>Plate H</u>	Left-hand handlebar switch connector
24	<u>Plate H</u>	Clutch wire
25	<u>Plate H</u>	Clutch connector
26	<u>Plate H</u> - <u>Plate L</u>	Right-hand handlebar switch
27	<u>Plate H</u> - <u>Plate L</u>	Right-hand handlebar switch connector
28	<u>Plate H</u> - <u>Plate L</u>	Front brake light wire
29	<u>Plate H</u>	Front brake light connector
30	Plate S	Engine temperature sensor connector
31	<u>Plate N</u>	Instrument panel connector
32	Plate O	Speed sensor connector
33	Plate O	Oil pressure switch
34	Plate O	Rear brake light connector
35	Plate O	Rear brake light sensor
36	<u>Plate N</u>	Left front side light
37	Plate N	Right front sidelight
38	Plate N	Headlight connector
39	<u>Plate R</u>	Vertical cylinder injector connector
40	<u>Plate R</u>	Stepper motor connector
41	Plate R	Negative terminal
42	<u>Plate R</u>	Potentiometer connector
43	<u>Plate R</u> - <u>Plate T</u>	Sidestand connector
44	Plate T	Sidestand wire
45	Plate Q	Vertical cylinder coil connector
46	Plate O	Neutral indicator light wire
47	<u>Plate V - Plate W</u>	Vertical cyl. lambda sensor connector
48	<u>Plate O - Plate P</u>	Speed sensor
49	<u>Plate V - Plate W</u>	Fuel tank flange connector
50	<u>Plate V</u>	Starter contactor connector
E4		
51	<u>Plate V</u>	Rear left turn signal connector

### Wiring diagram

53	Plate V	Nymber plate light connector
54	Plate V	Exhaust valve actuator connector (exhaust valve not present)
55	Plate V	DDA connector
56	<u>Plate V - Plate X</u>	Tail light connector
57	<u>Plate R - Plate V - Plate Y</u>	Negative battery lead
58	<u>Plate T - Plate V - Plate Y</u>	Starter motor/contactor cable
59	Plate O	Horizontal cylinder lambda sensor connector
60	<u>Plate O</u> - <u>Plate P</u>	Horizontal lambda sensor
61	Plate S	Engine temperature sensor
62	Plate V	Contactor/Battery positive

Plate A



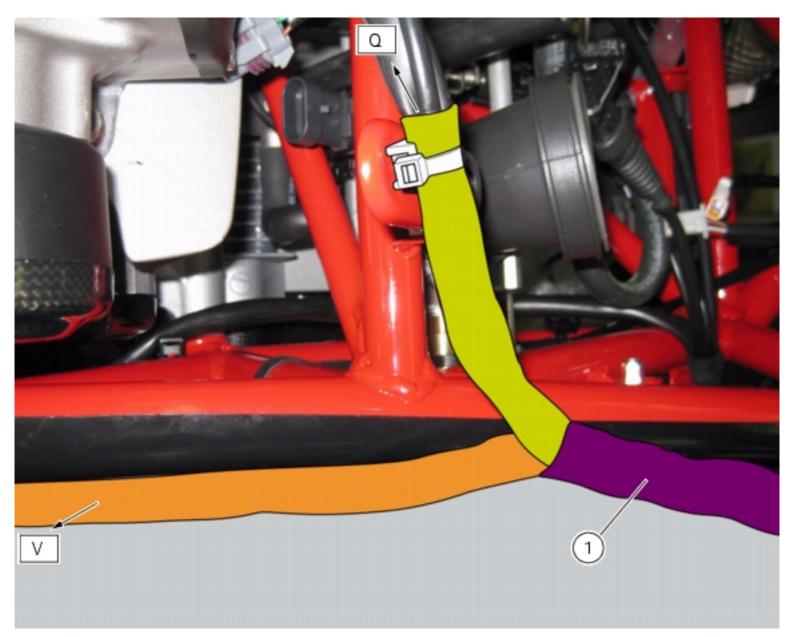
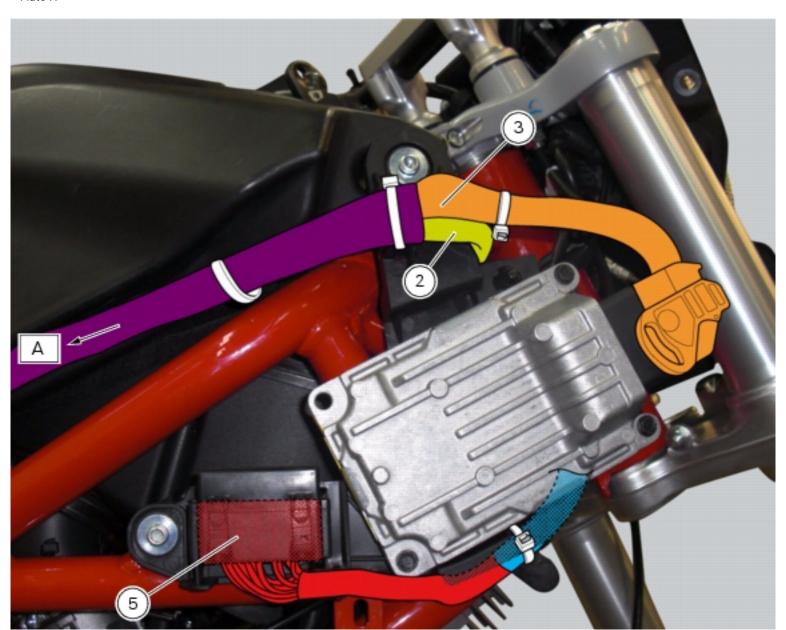
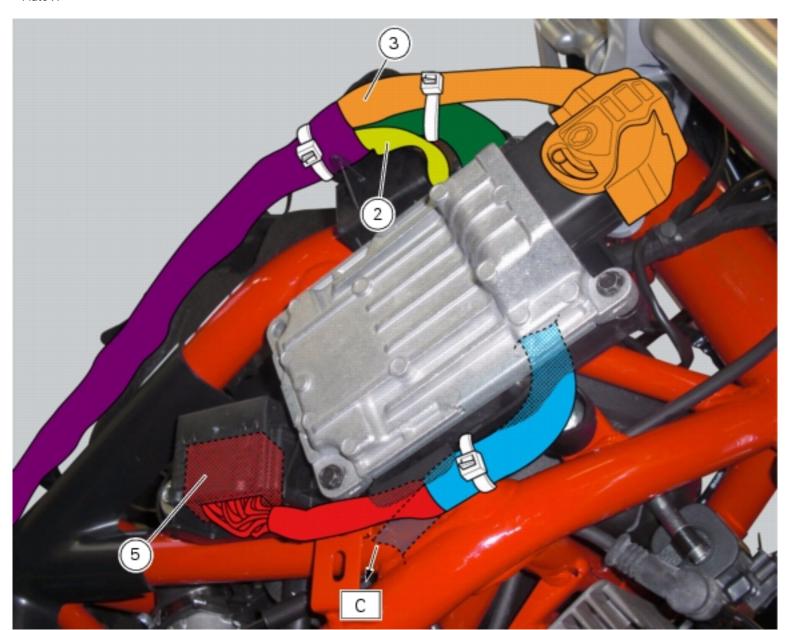
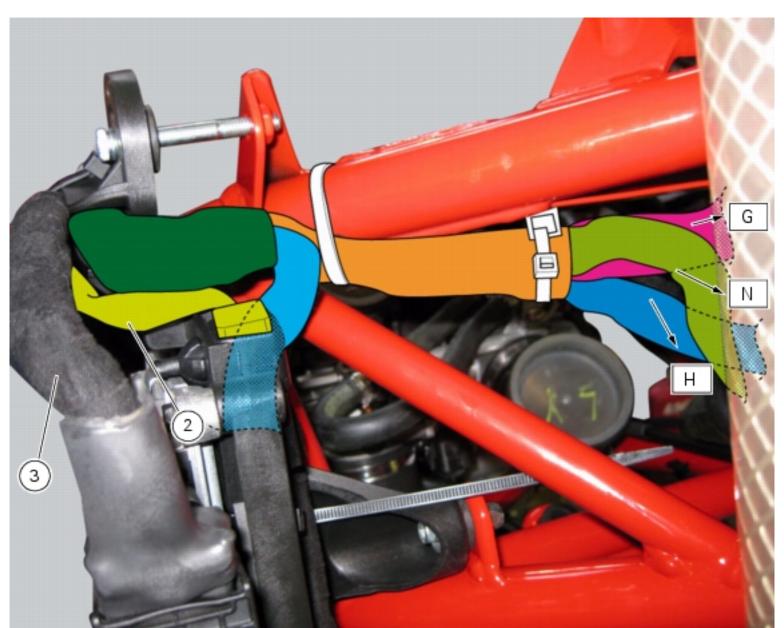
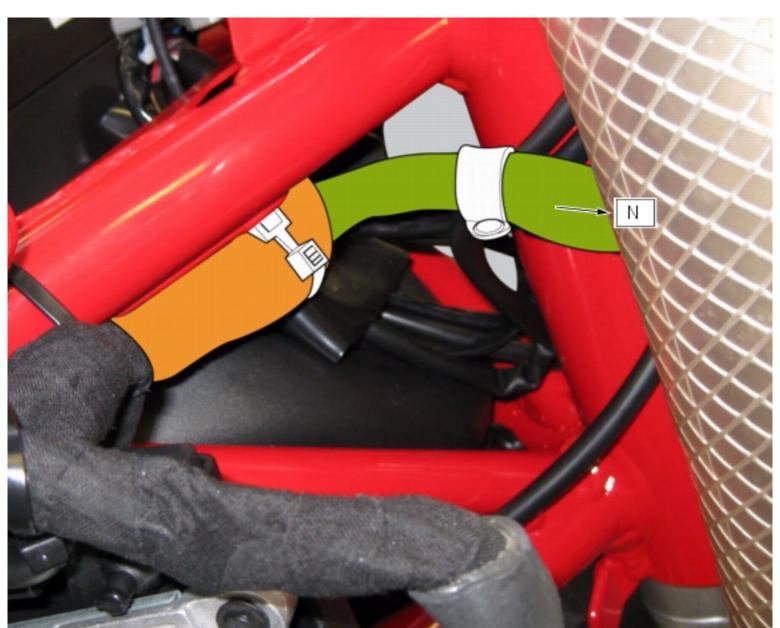


Plate B









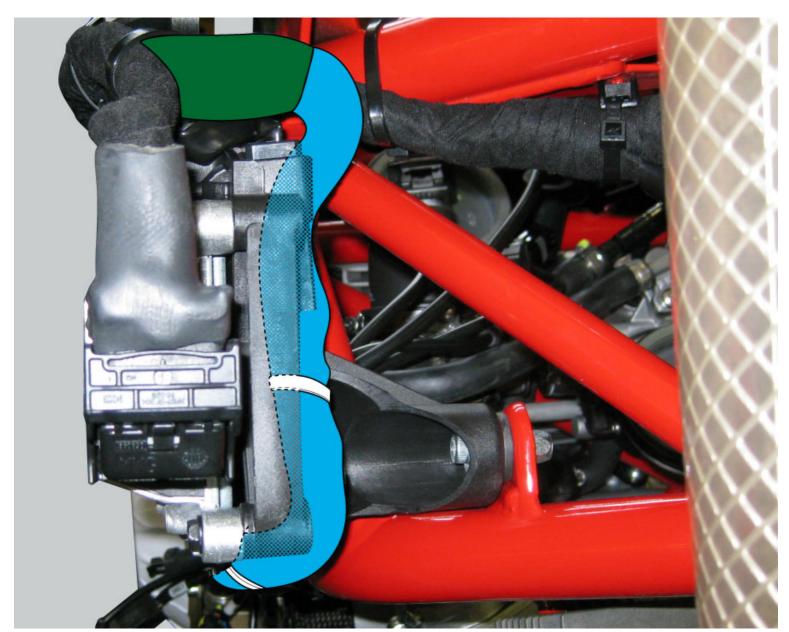
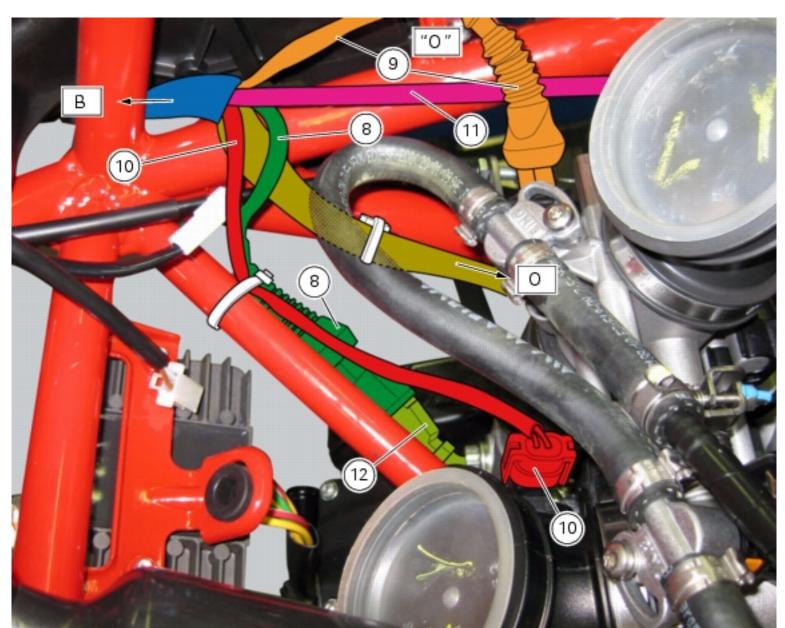
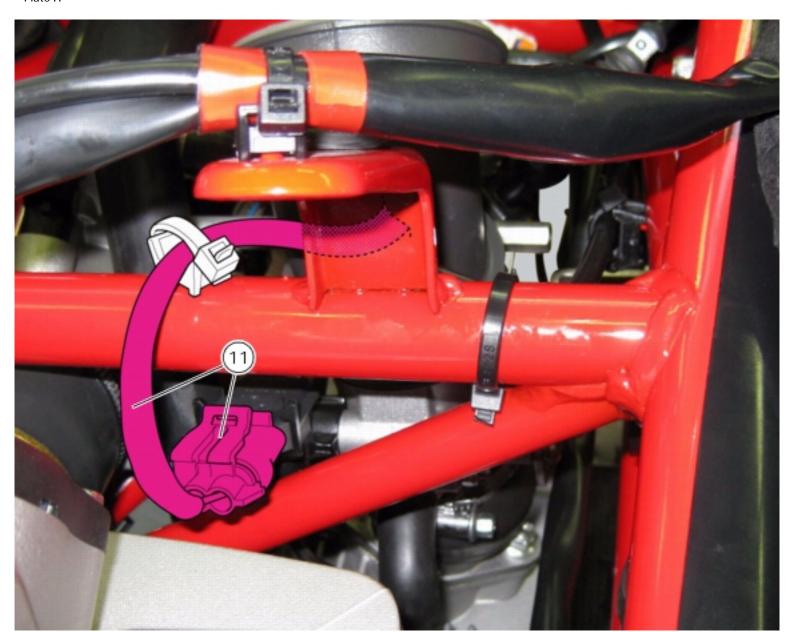


Plate C





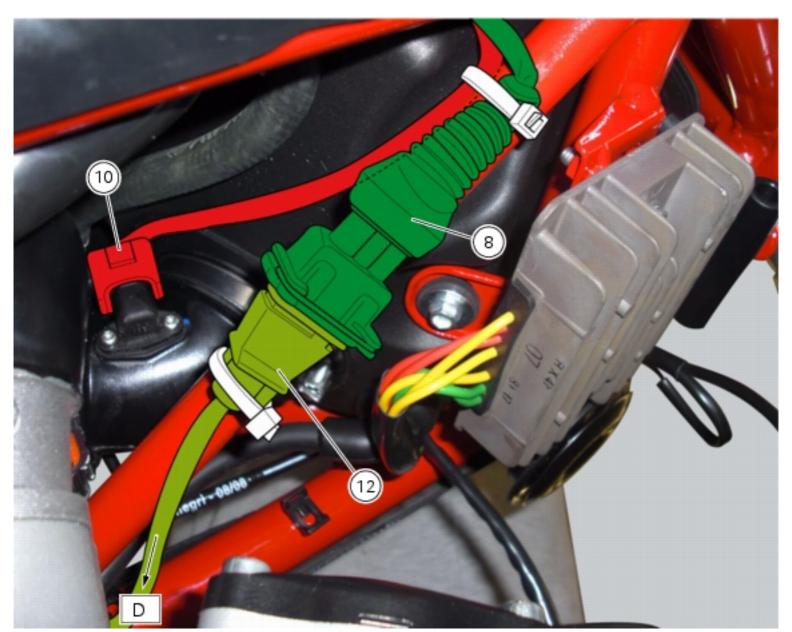


Plate D

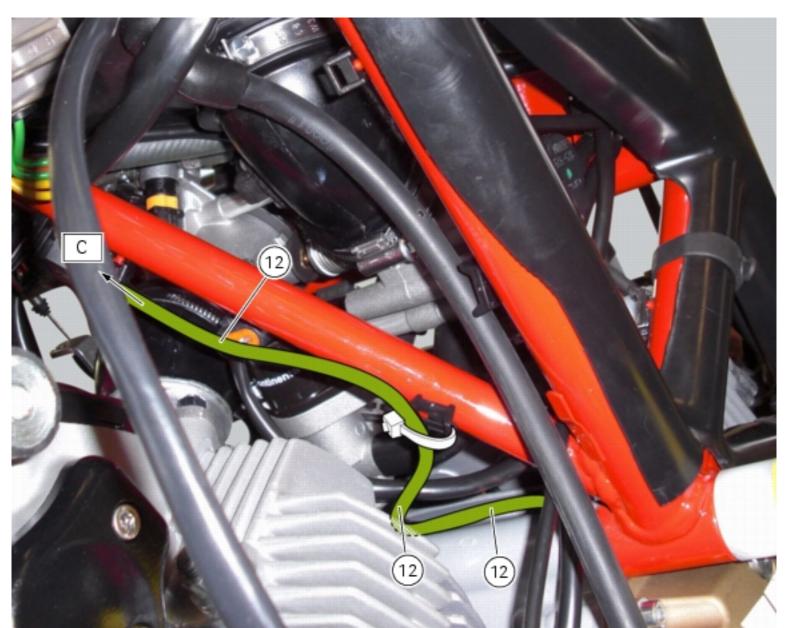
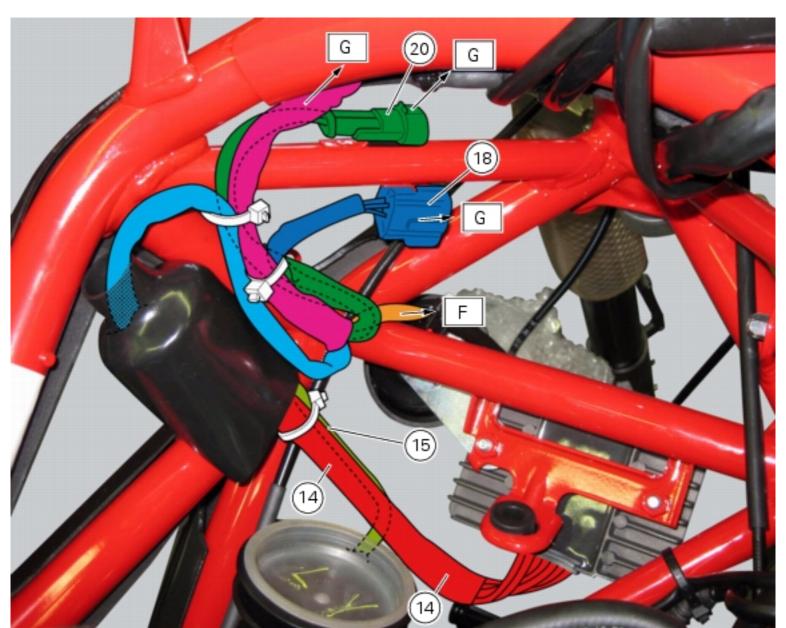
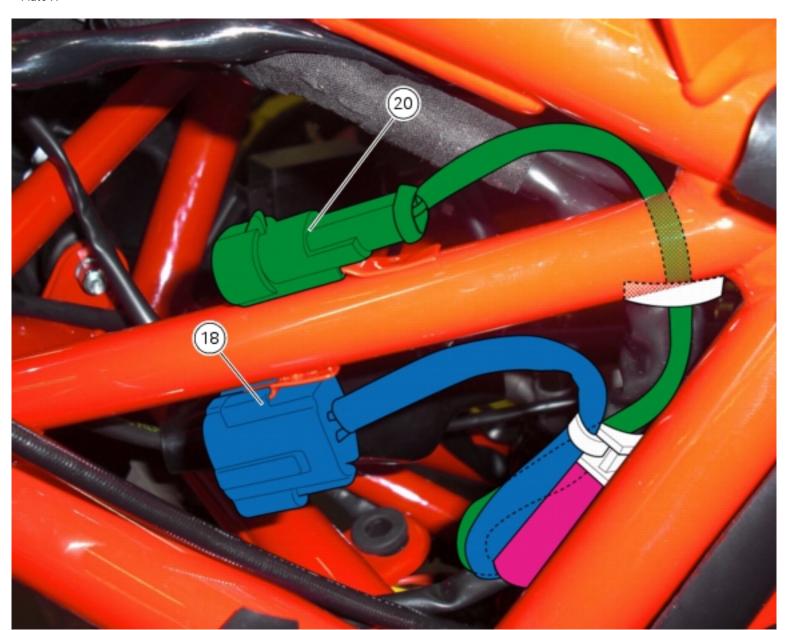
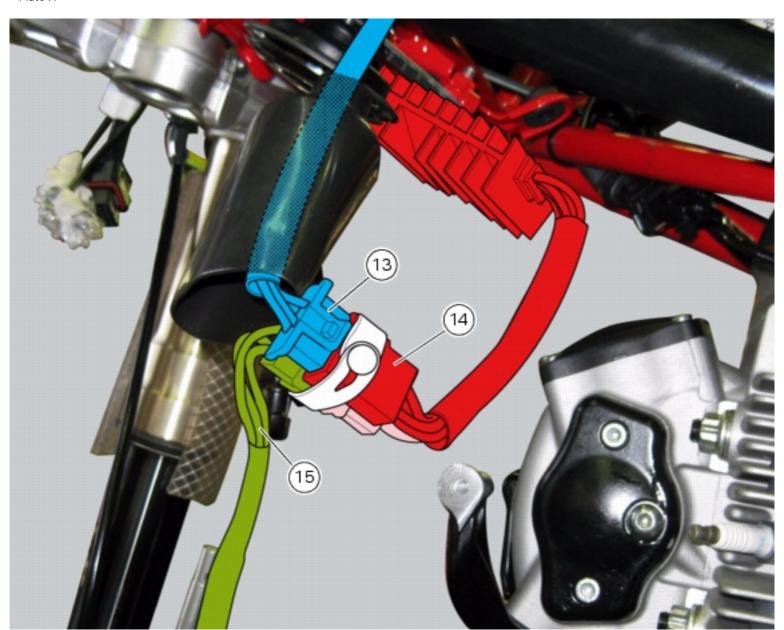




Plate E







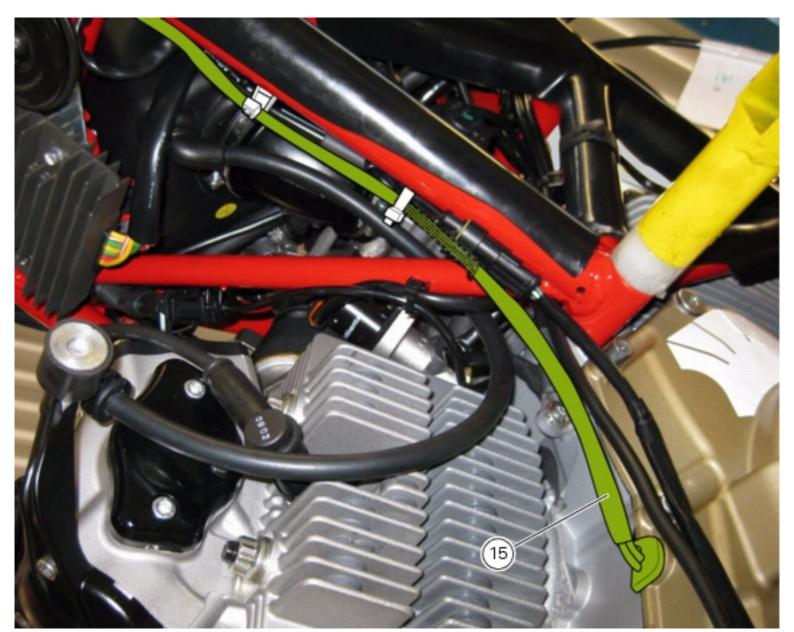


Plate F



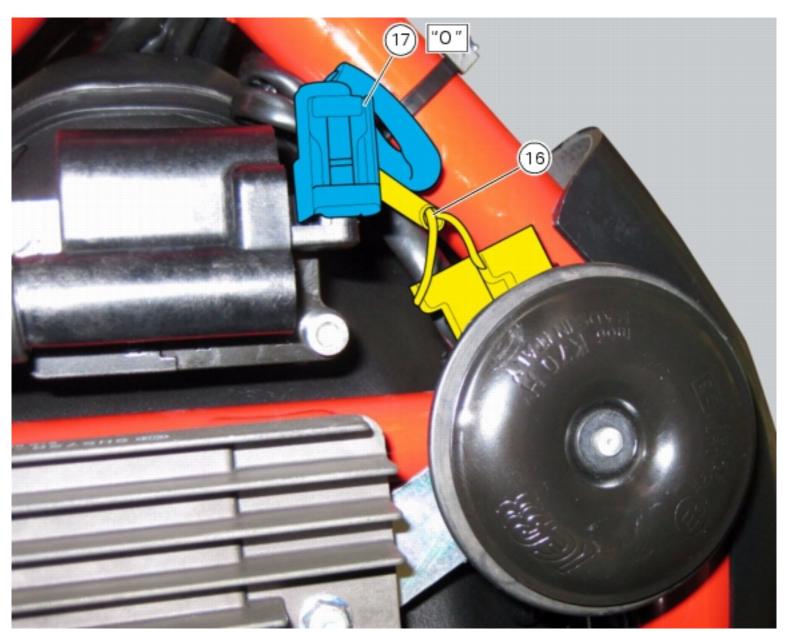
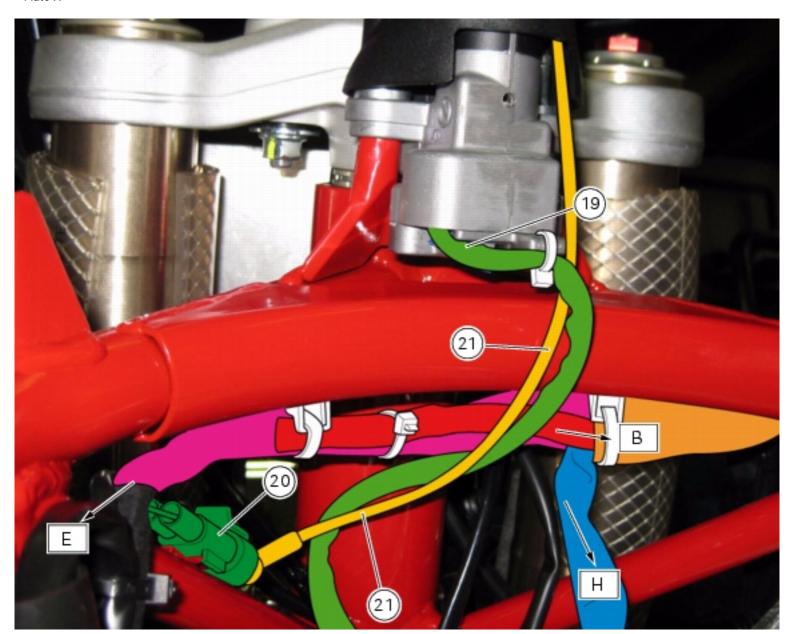


Plate G



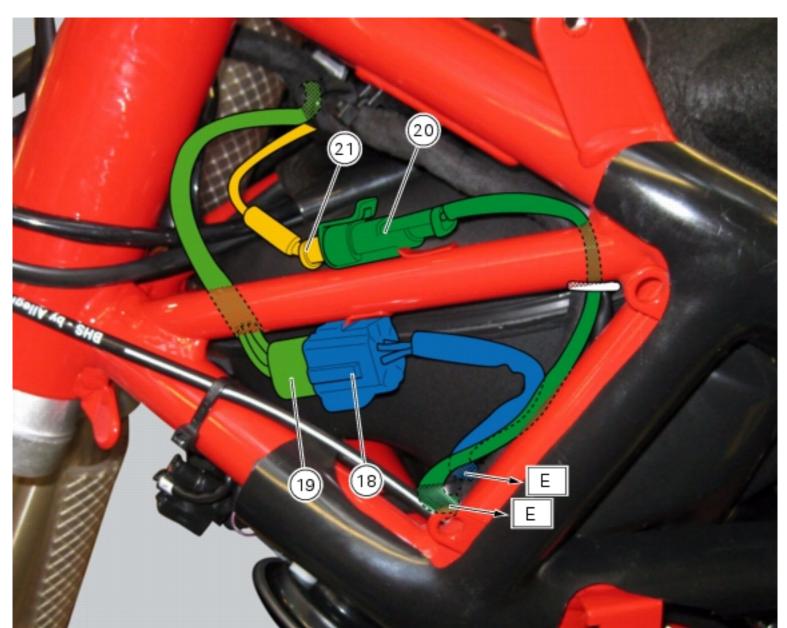
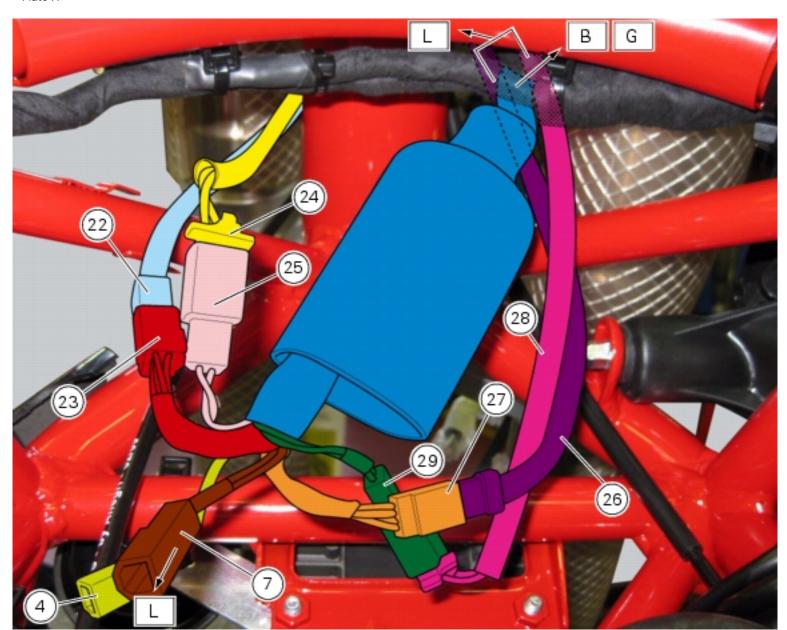


Plate H







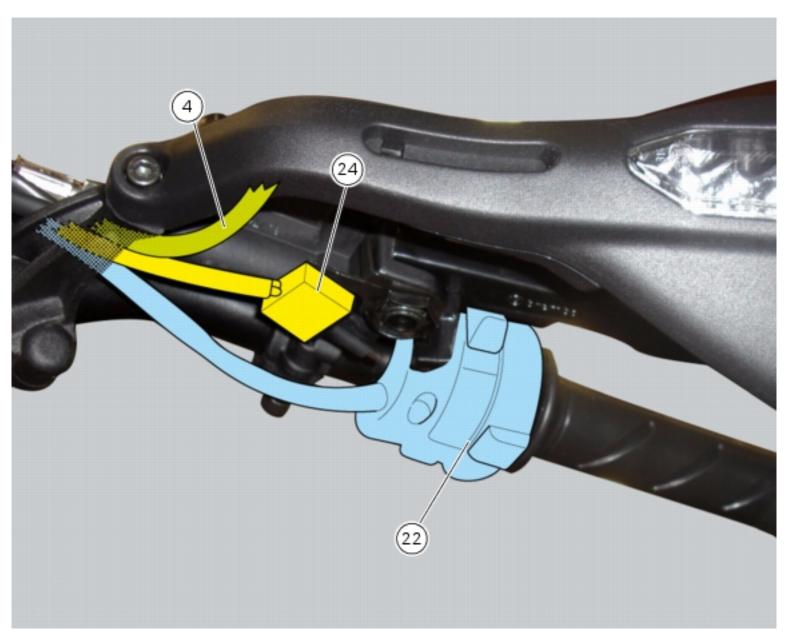


Plate L

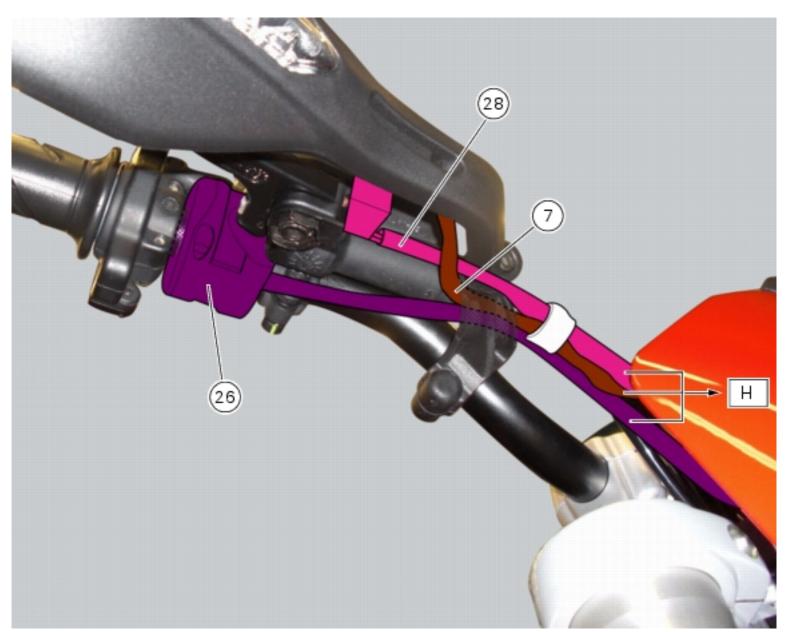
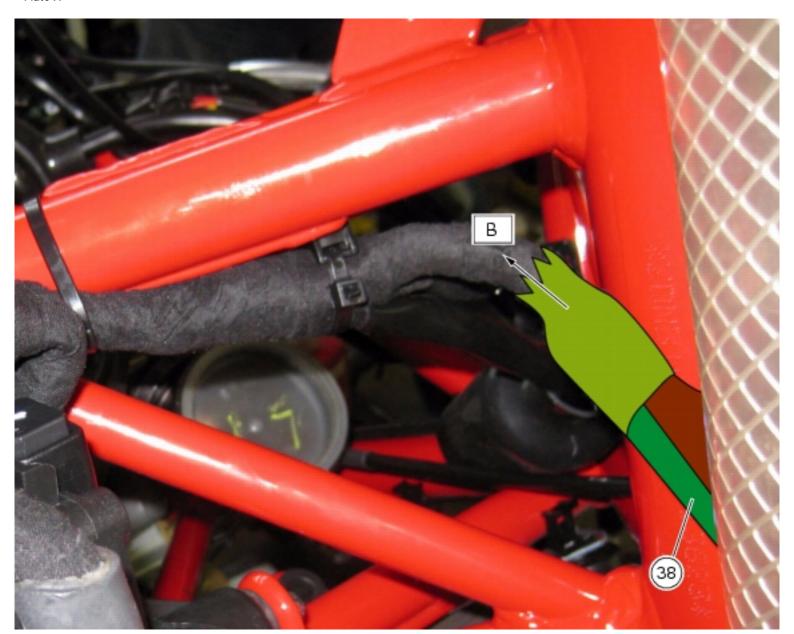
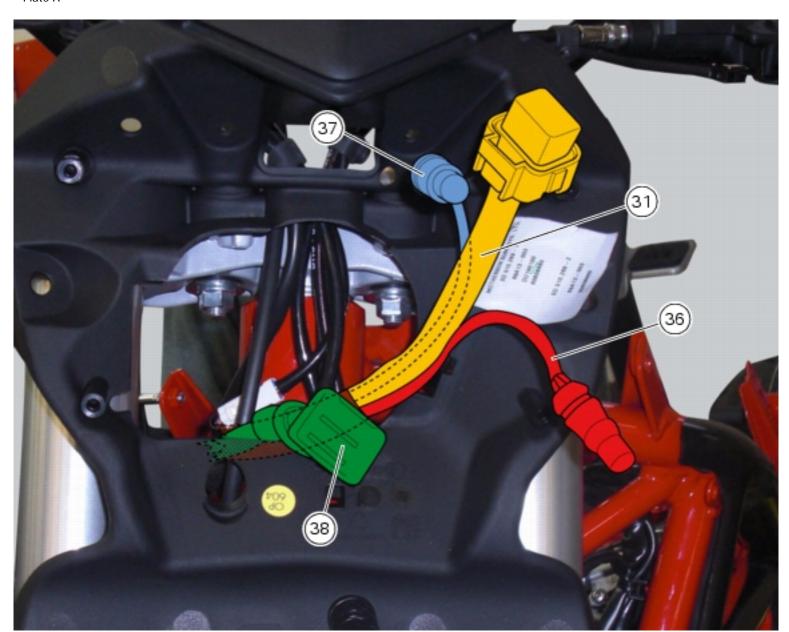


Plate N





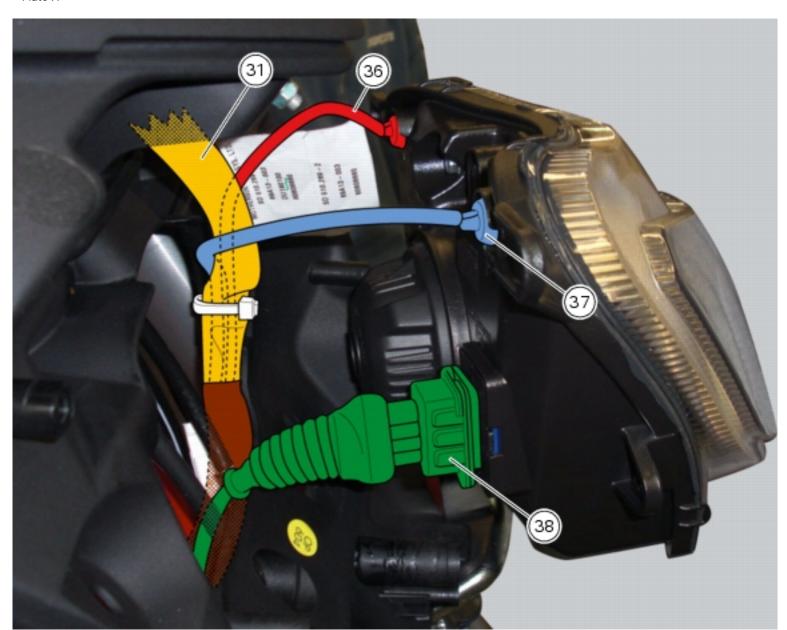
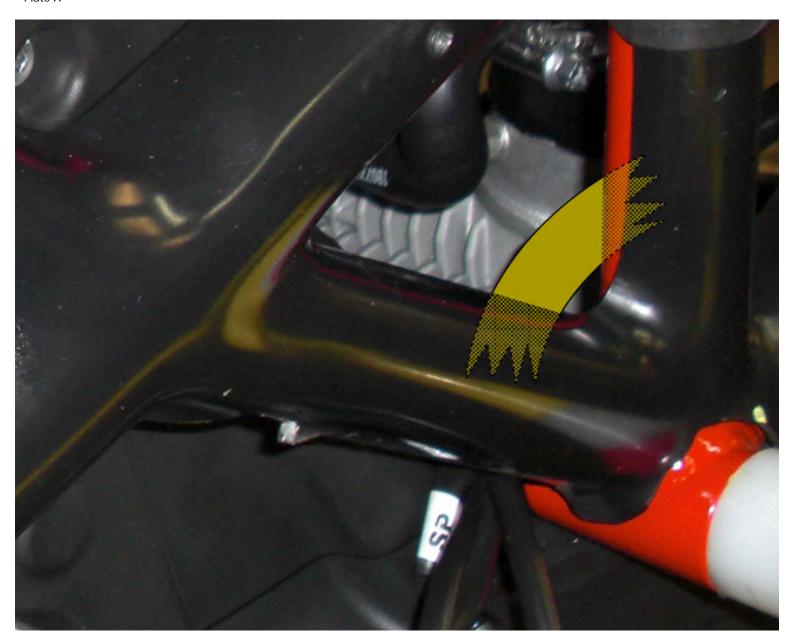
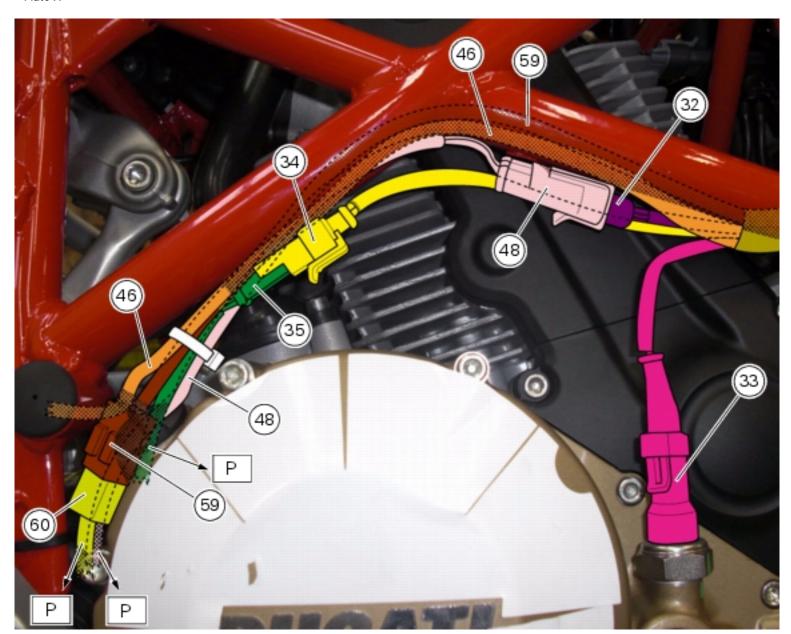


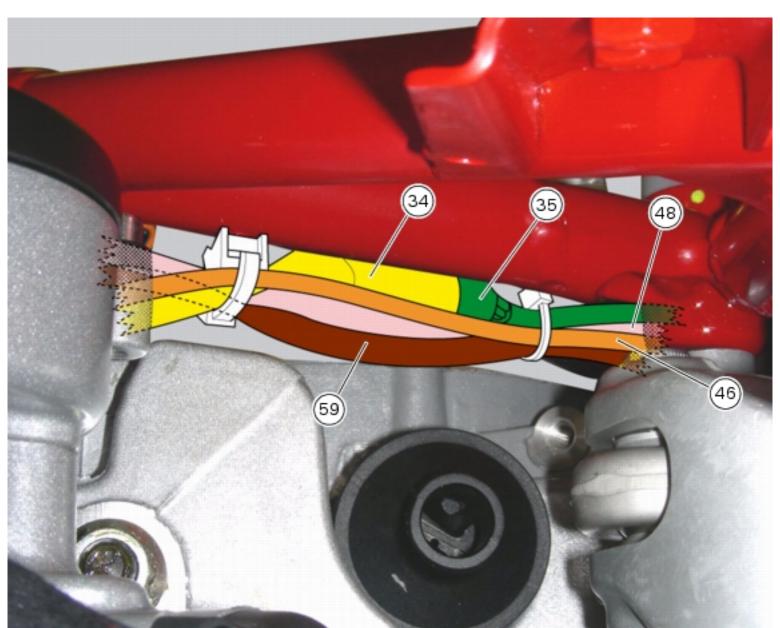


Plate O









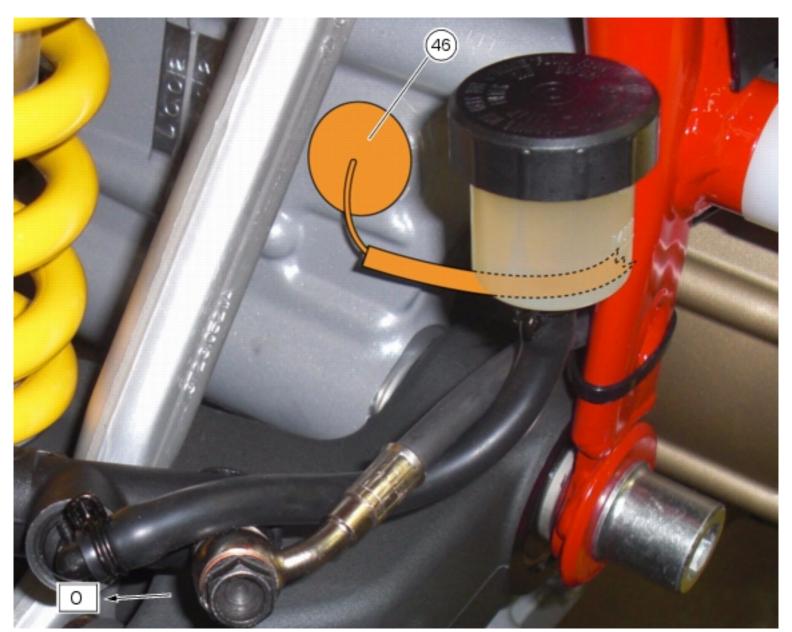
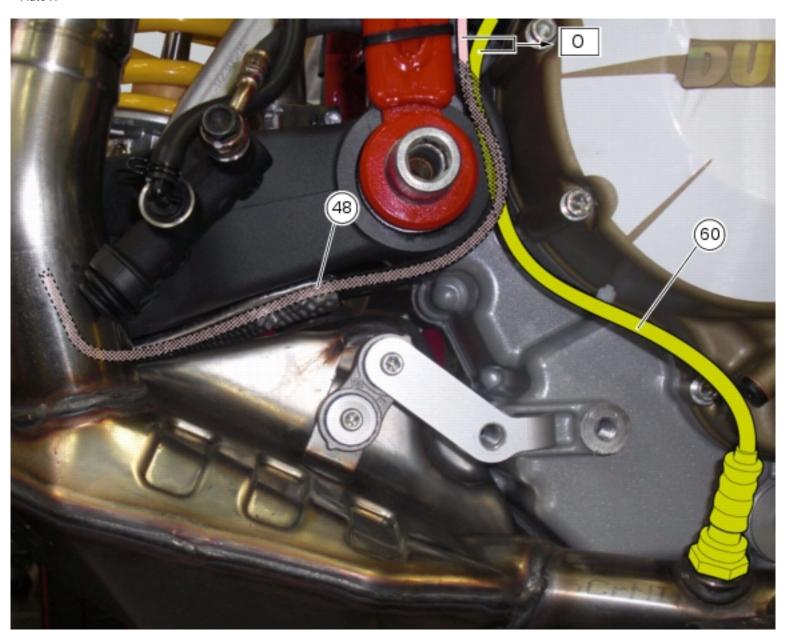


Plate P



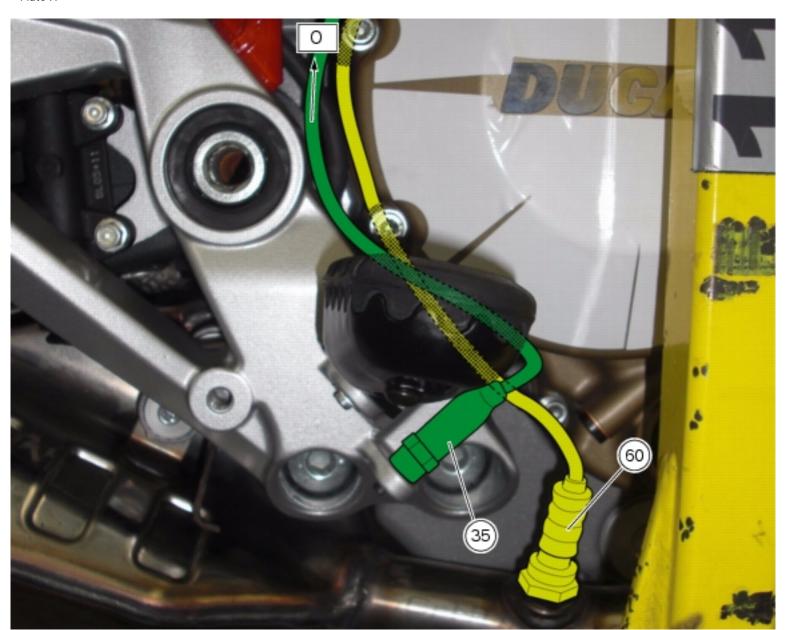






Plate Q

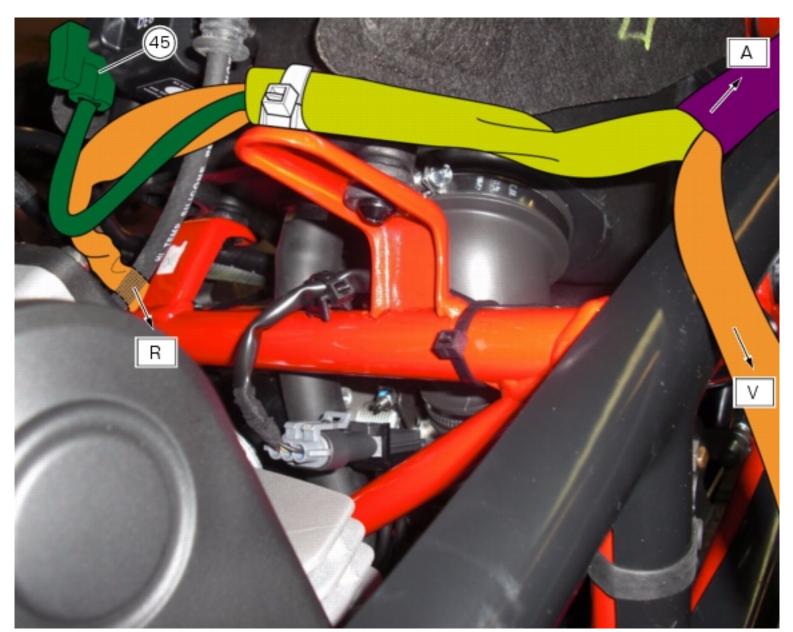
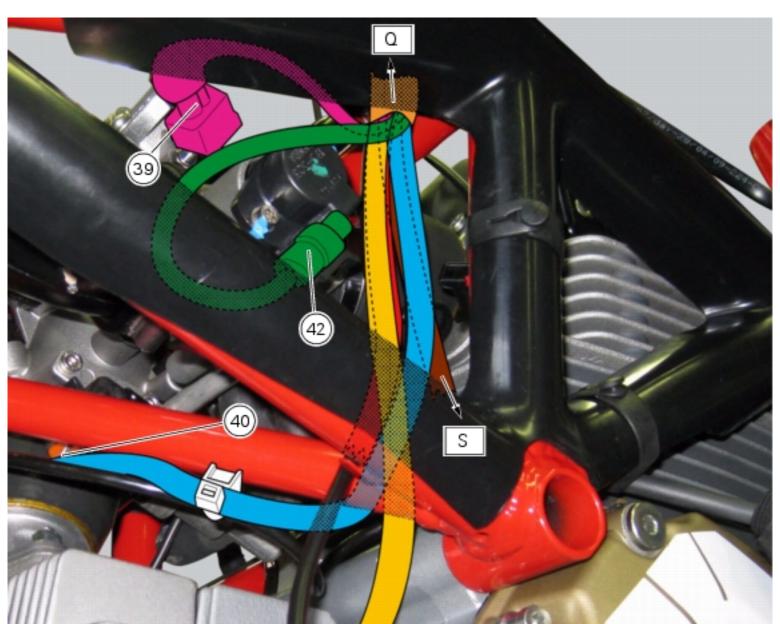
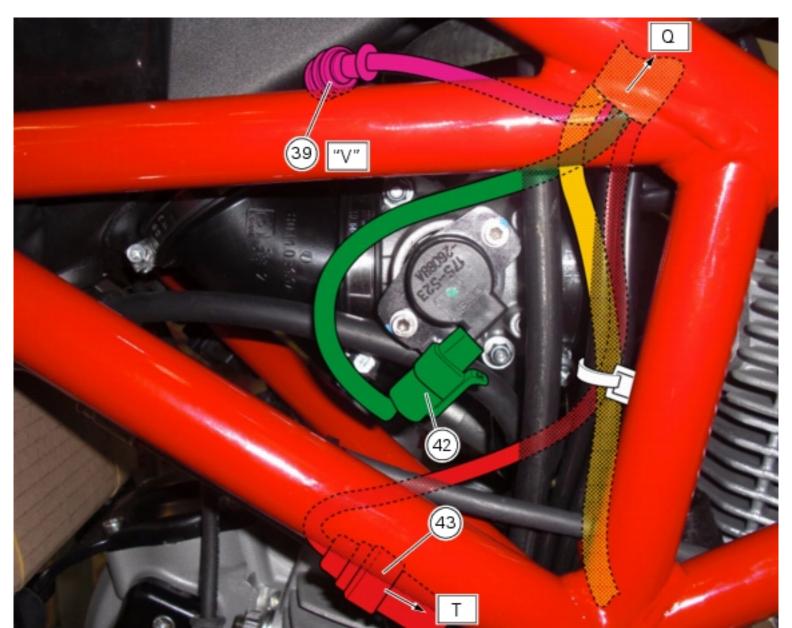


Plate R





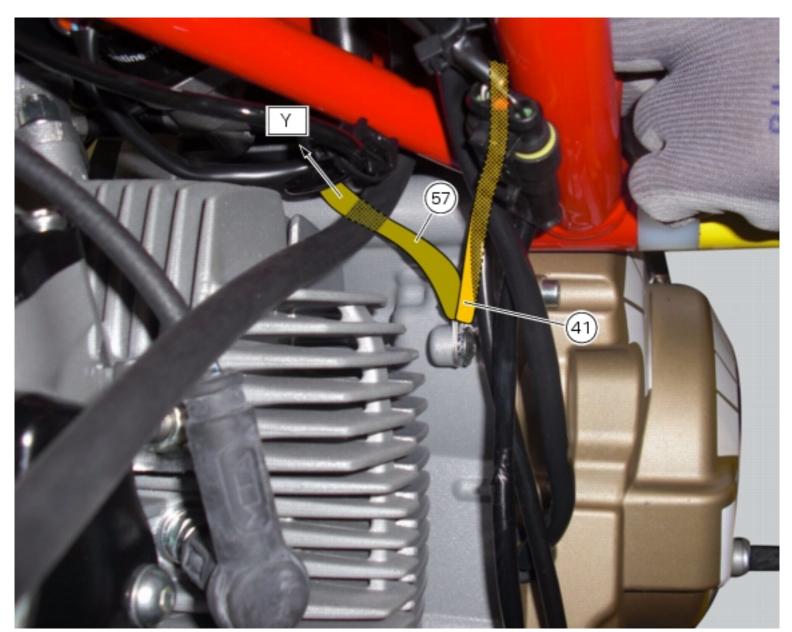


Plate S





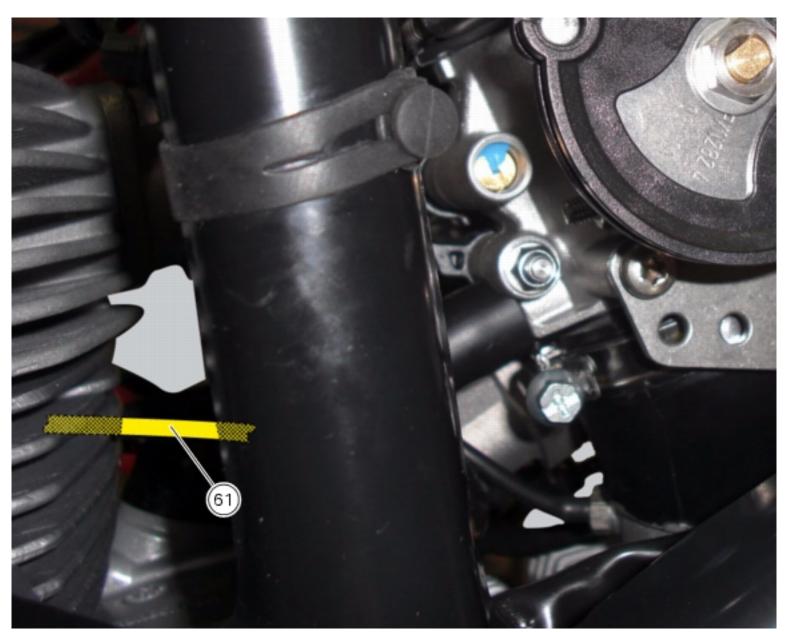


Plate T

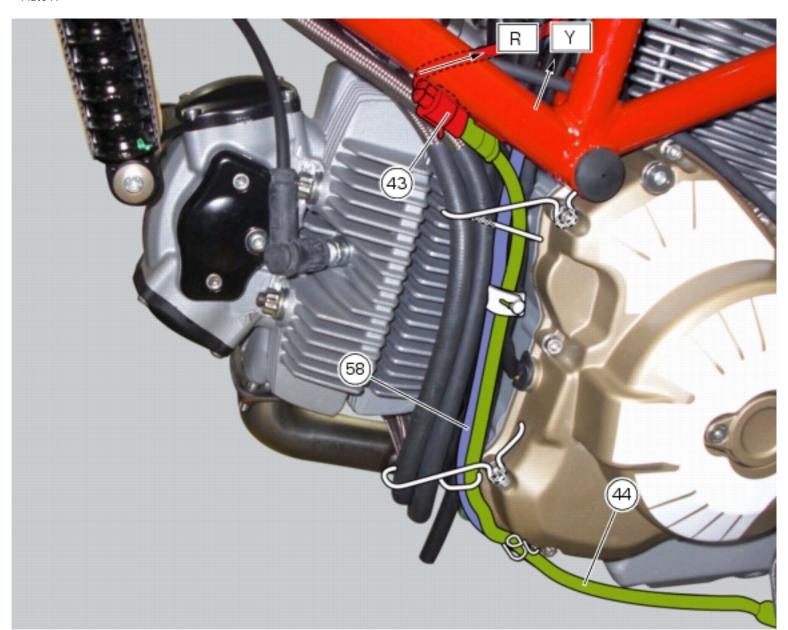




Plate U

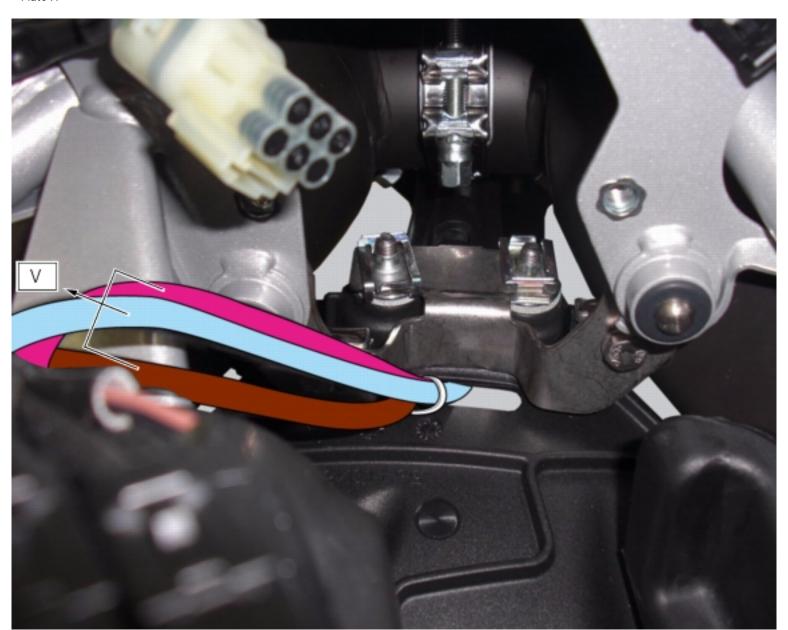
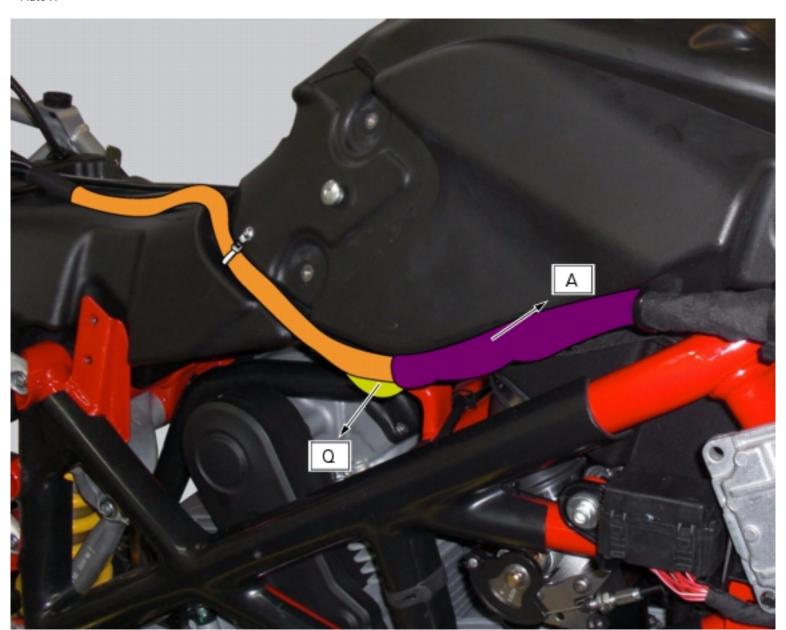
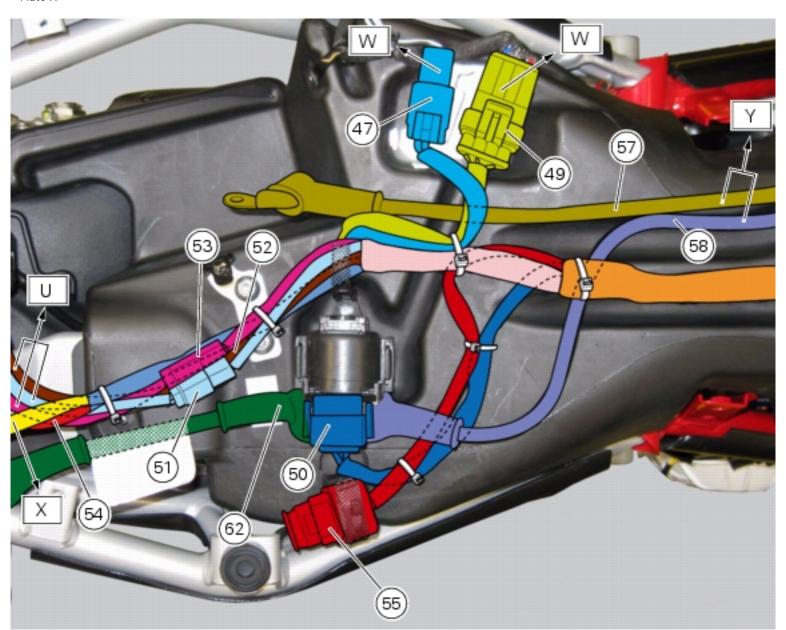




Plate V







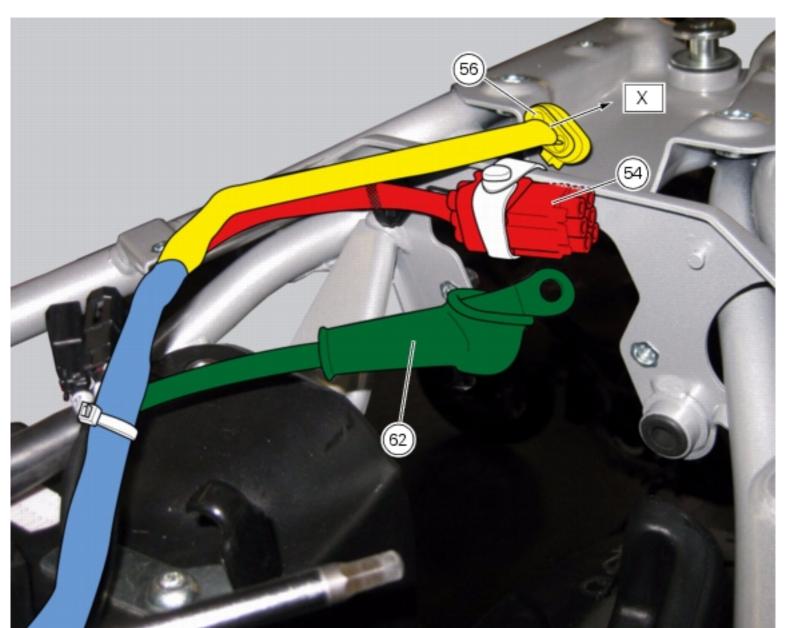
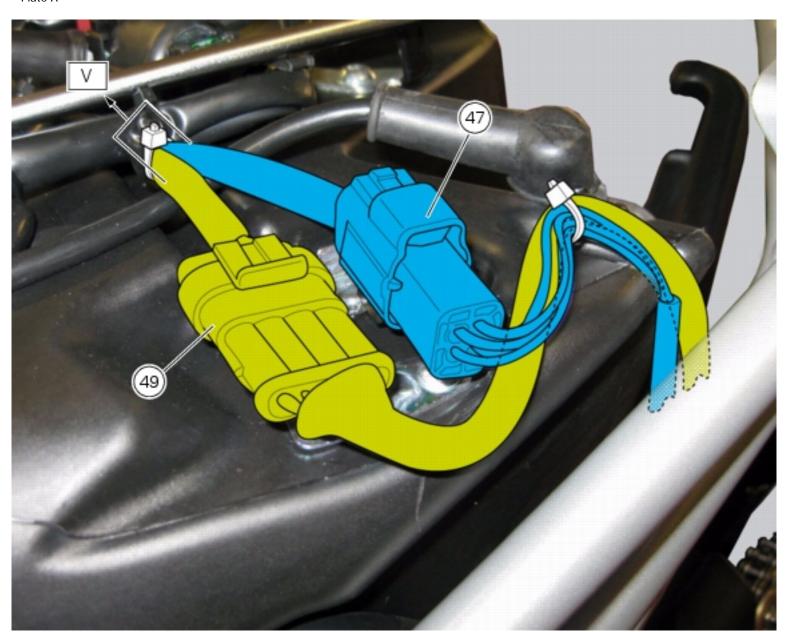
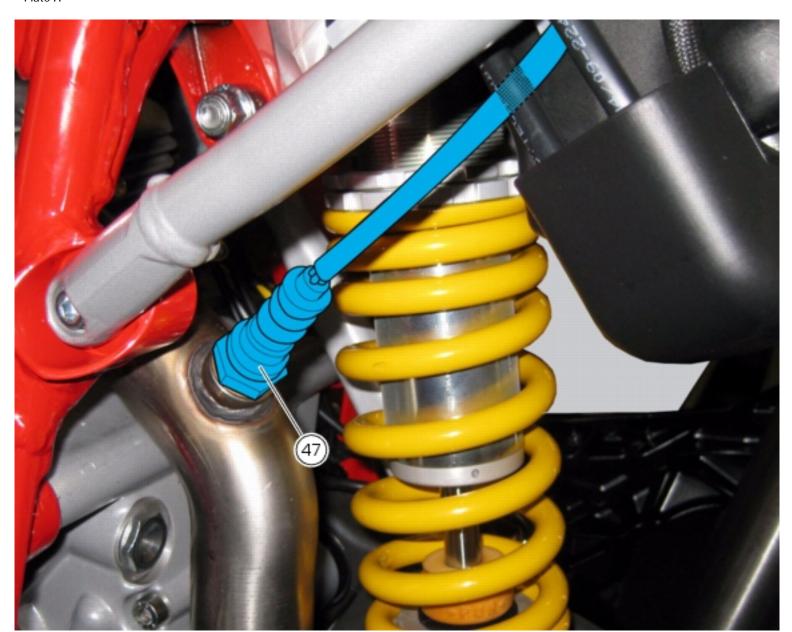


Plate W





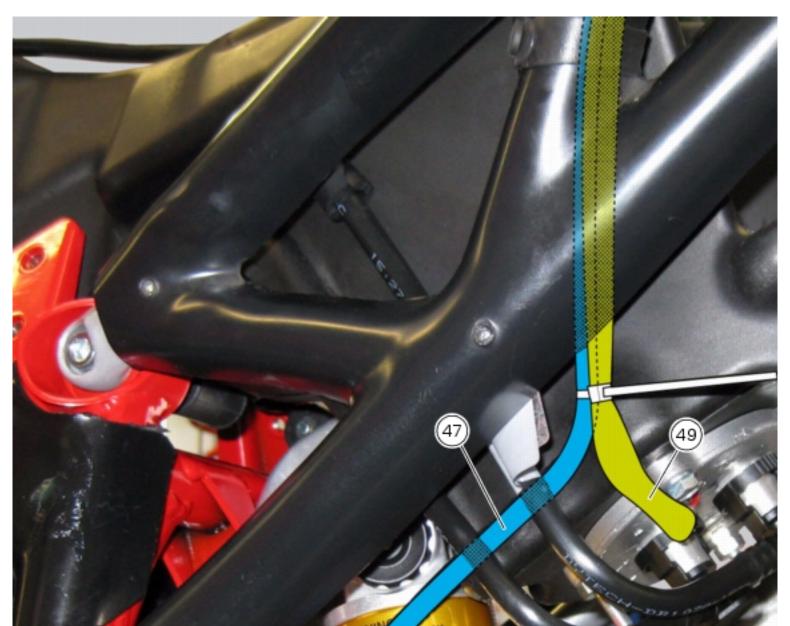


Plate X

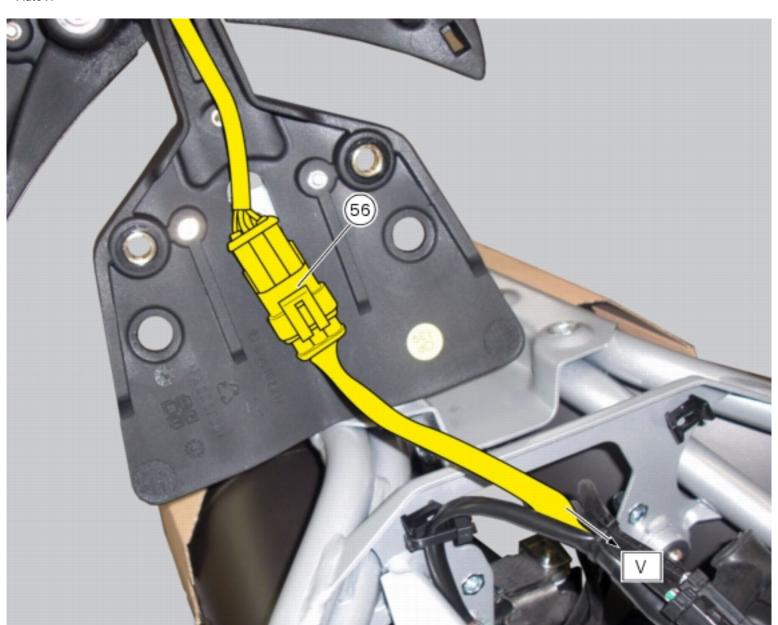
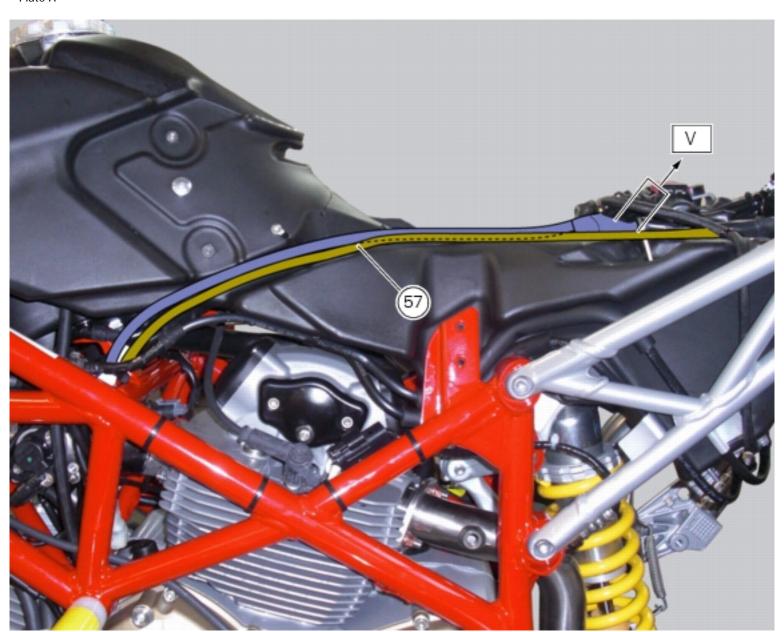






Plate Y





# 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:

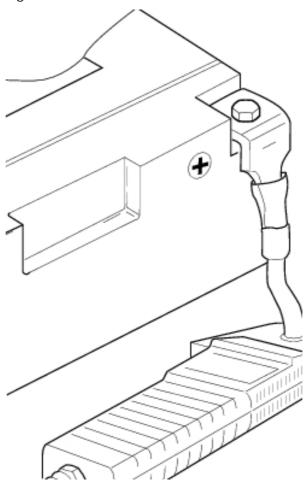
refer to "Testing the battery charging system", Sect. D 5. With the "DDS" tester you can determine the engine rpm required for the alternator to produce sufficient current to charge the battery, feed the fuel injection/ ignition system and all the electrical equipment on the motorcycle. When applied 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, <u>Diagnostic instruments</u>); connect the multimeter probes to the battery terminals, select the DC scale on the multimeter and check for the presence of **14.5** V $\pm$ **0.5** at an engine speed of 3000 rpm.



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:

Use fast charging in emergencies only.

Type of charging	Volt	Ampere (A)	Time (Hours)
Normal	12	1.8	5-10
Fast	12	9	1

#### 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).

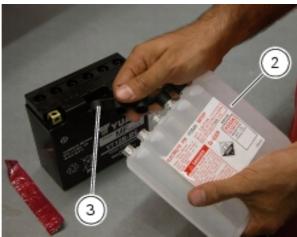


Make certain that the electrolyte is of the specific type for your battery.



Remove the container with the electrolyte from the plastic bag. Remove the cap strip (3) from the container (2).







**I** Important

Keep the cap strip (3) to hand because it will be used later as plugs for the battery cells.



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.

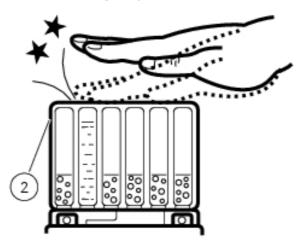




## Notes

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. Gently tap the bottom of the reservoir (2) to encourage complete discharge of the liquid. 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.

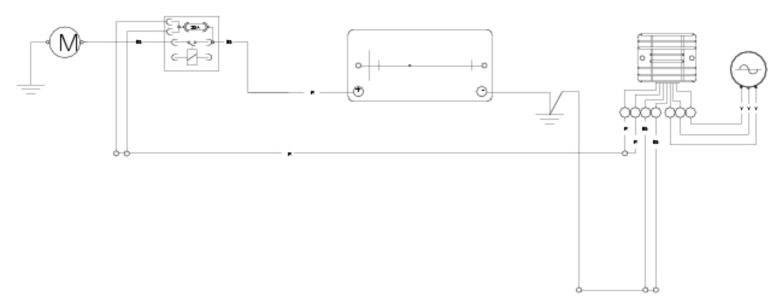
Battery charging system

Rest the cap strip on the filler holes without fixing it. Recharge the battery as described in the paragraph "Recharging the battery".

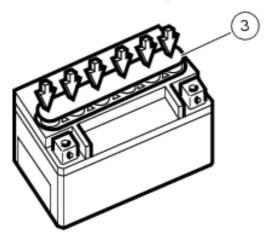


Notes

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**

Safety rules



#### Warning

Read carefully the relevant safety rules before working on the battery (Sect. A 3, <u>General safety rules</u>). When under charge, batteries produce explosive gases. Keep batteries away from heat sources, sparks or open flames.

Instructions for use

The battery is a sealed, maintenance-free type and therefore requires no servicing installation.



Notes

Always keep the battery clean. Apply grease around the battery terminal clamps to prevent corrosion.

Battery charging system



Never remove the valve cover on the top of the battery or add more liquid to the battery. 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



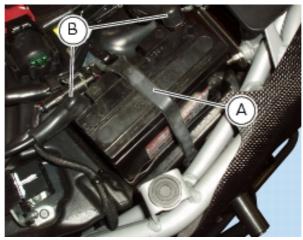
#### Notes

References (48) and (44) are the same as those indicated in the plates in the chapter "Routing of wiring on frame", Sect. P 1.

Remove the seat (Sect. E 3, Removal of the seat).

Unhook the rubber retaining strap (A) and remove the terminal covers (B).

Unscrew the bolts on the terminal clamps (48) and (44). Always start with the negative terminal.





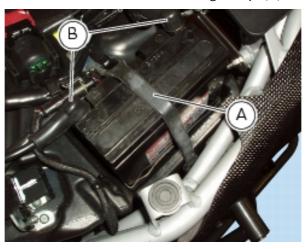
### Refitting the battery

Install the battery on the support on the fuel tank.

Check that the contacts are not oxidised and tighten the terminal clamp bolts (48) and (44) to the specified torque (Sect. C 3, <u>Frame torque settings</u>); apply a water repellent spray.



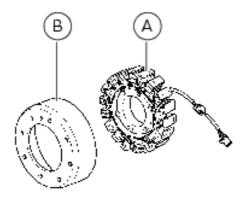
Replace the terminal covers (B) and reattach the rubber retaining strap (A).



Refit the seat (Sect. E 3, Refitting the seat).

#### 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 faults, use the DDS tester and follow the instructions given under the heading "Checking the charging system current", Sect. D 5.

The absolute value of voltage measured across the terminals of two of the three yellow cables (measured value will be the same whichever the combination) must be within the range indicated in the table below. (Ambient temperature: **20** °C)



Before testing, disconnect the alternator wiring from the electrical system when the ignition key is set to OFF.

Engine rpm	2000	6000
effective <b>V</b>	27±10	78±10

Values significantly lower than those indicated above can be due to:

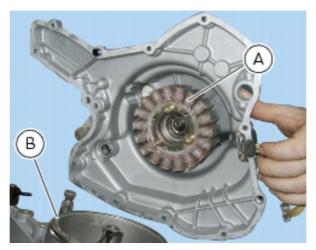
- partially demagnetised rotor;
- short-circuited windings.

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

Operation	Section reference
Drain the engine oil	D 4, <u>Changing the engine oil and</u> <u>filter cartridge</u>
Remove the gearchange control	F 5, Removal of the gearchange control
Remove the clutch slave cylinder	F 2, Removal of the clutch slave cylinder
Remove the LH footrest	H 4, Removal of the footrest brackets
Remove the front sprocket cover	G 8, Removal of the front sprocket
Disconnect the electrical wiring on the alternator side	P 1, Routing of wiring on frame

Remove the alternator-side crankcase cover, the stator (A) and rotor (B) (Sect. N 8, Removal of the alternator-side crankcase cover).



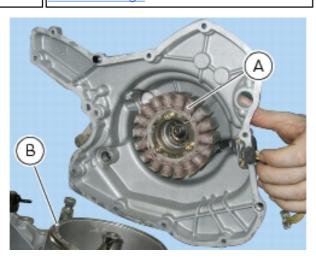
## Refitting the alternator

Fit the rotor (B), the stator (A) and the alternator-side crankcase cover.

Operation	Section reference
Reconnect the electrical wiring on the alternator side	P 1, Routing of wiring on frame
Refit the sprocket cover	G 8, Refitting the front sprocket
Refit the LH footrest	H 4, Refitting the footrest brackets
Refit the clutch slave cylinder	F 2, Refitting the clutch slave cylinder
Refit the gearchange control	F 5, Refitting the gearchange control

Refill the engine with oil

D 4, <u>Changing the engine oil and</u> filter cartridge



## Regulator/rectifier

The regulator (1) is fixed to the motorcycle frame.

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.



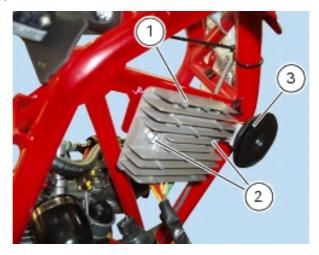
#### Notes

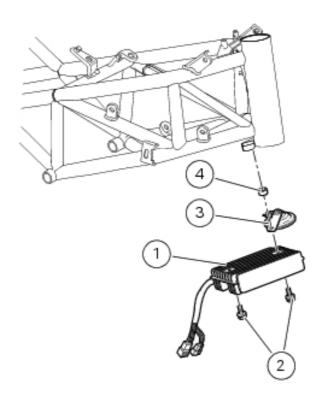
Check the charging current using the DDS tester, following the instructions given in the paragraph "Testing the battery charging system" (Sect. D 5).

## Removal of the regulator

Disconnect the main wiring loom connector (B) (see plates in the chapter "Routing of wiring on frame", Sect. P 1).

Unscrew the bolts (2) securing the regulator to the frame: recover the horn (3), which is secured by one of the two bolts (2) and the spacers (4).





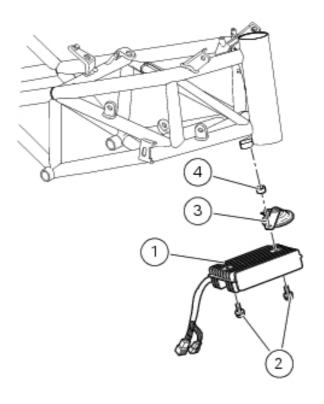


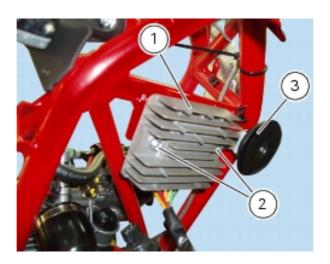
Do not disconnect the battery cables when engine is running because this would cause irreparable damage to the regulator.

## Refitting the regulator

Locate the regulator (1) with the horn (3) and the spacers (4) on the frame and secure with the bolts (2). Tighten the bolts (2) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).

Connect the regulatorr to the main wiring loom (Sect. P 1, Routing of wiring on frame).





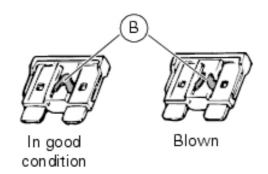
## Regulator fuse

The **30** A fuse located on the fuel tank protects the electronic regulator. To gain access to the fuse, remove the seat (Sect. E 3, Removal of the seat) and disconnect the contactor connector (A).



Battery charging system

A blown fuse can be identified by breakage of the inner filament (B).





Important

Switch the ignition key to  ${f OFF}$  before replacing a fuse to avoid possible short circuits.



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



The references of the elements shown below are to be found in the "Wiring diagram", Section P 1.

## Electric starting system

The key components of the electric starting system are a contactor (1) and a starter motor (2) fed by the battery (3).

The engine starting strategy is managed entirely by the engine ECU (4), which monitors the following inputs:

- Engine Stop button (5)
- Engine start button (6)
- Neutral sensor (7)
- Sidestand sensor (8)
- Clutch microswitch (9).

When these inputs are combined in the required manner, the engine control unit (4) 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.

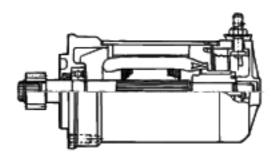
Safety device functions table

	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
Х	X	Х	OFF	OFF
NEUTRAL	PULLED	DOWN	ON	ON
NEUTRAL	RELEASED	DOWN	ON	ОИ
GEAR	RELEASED	DOWN	ON	OFF
GEAR	PULLED	DOWN	ON	OFF
NEUTRAL	PULLED	UP	ON	ON
NEUTRAL	RELEASED	UP	ON	ОИ
GEAR	RELEASED	UP	ON	OFF
GEAR	PULLED	UP	ON	ОИ

## 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,

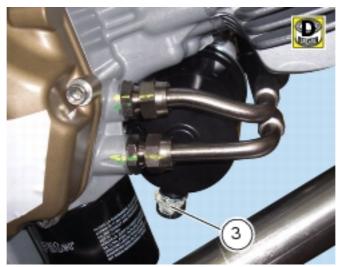
#### Electric starting system

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.

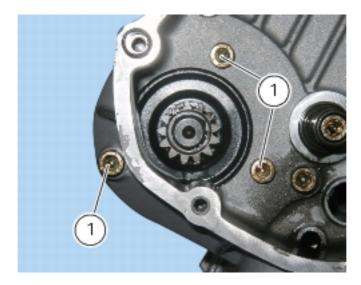
#### Removal of the starter motor

Operation	Section reference
Drain the engine oil	D 4, Changing the engine oil and
	<u>filter cartridge</u>
Remove the gearchange control	F 5, Removal of the gearchange
	<u>control</u>
Remove the clutch slave cylinder	F 2, Removal of the clutch slave
	<u>cylinder</u>
Remove the LH footrest	H 4, Removal of the footrest brackets
Remove the front sprocket cover	G 8, Removal of the front sprocket
Remove the alternator-side crankcase	N 8, Removal of the alternator-side
cover	<u>crankcase cover</u>
Remove the timing gears and the	N 9.1, Removal of the starter motor
starter idler gear	<u>idler gear</u>

Disconnect the starter motor/starter contactor cable (3) (see plates in the chapter "Routing of wiring on frame", Section P 1).



Unscrew the retaining bolts (1).





The starter motor retaining bolts are assembled with threadlocker.

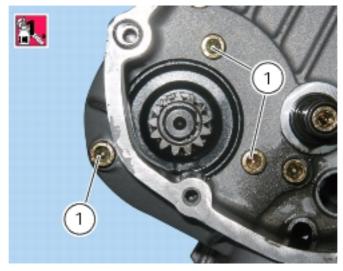
Slide out the starter motor and gasket (2).



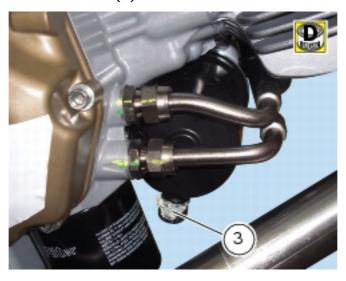
## Refitting the starter motor

Inspect the condition of the gasket (2) and renew if necessary. Locate the gasket (2) and the starter motor on the crankcase and tighten the bolts (1) to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>.





Connect the starter motor/contactor cable (3).





Fill the cap with protective grease before fitting it on the starter motor

Operation	Section reference
Refit the timing gears and the starter idler gear	N 9.1, Refitting the starter motor idler gear
Refit the alternator-side crankcase cover	N 8, Refitting the alternator-side crankcase cover
Refit the sprocket cover	G 8, Refitting the front sprocket
Refit the LH footrest	H 4, Refitting the footrest brackets
Refit the clutch slave cylinder	F 2, Refitting the clutch slave cylinder
Refit the gearchange control	F 5, Refitting the gearchange control
Fill the engine with oil	D 4, <u>Changing the engine oil and</u> <u>filter cartridge</u>

Starter contactor

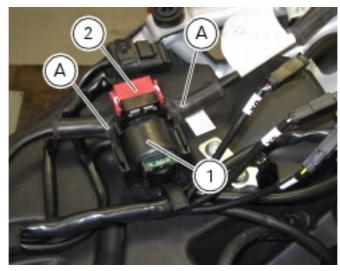
Electric starting system

Operation	Section reference
Remove the seat	E 3, Removal of the seat

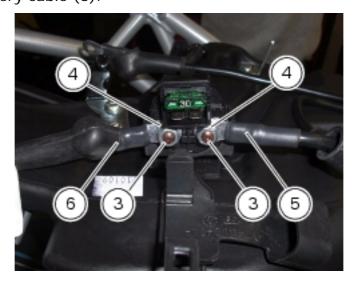
The contactor (1) is fixed to the fuel tank.

Disconnect the battery (Sect. P 2, Battery).

Disconnect the wiring connector (2) of the starter contactor from the wiring harness. Remove the protective caps (A).

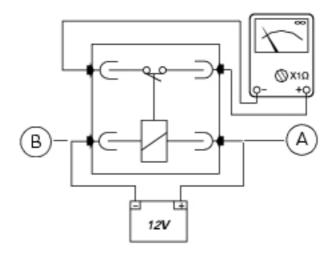


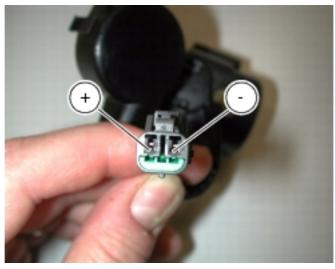
If necessary, remove the contactor from its seating.
Unscrew the nuts (3), taking care to recover the spring washers (4).
Remove the starter motor-contactor cable (5).
Remove the contactor-battery cable (6).



Checking operation of the starter contactor

Apply 12 V (battery voltage) across the positive terminal (A) and negative terminal (B) of the connector.

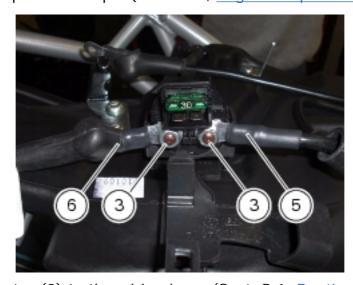




With a multimeter connected between the two terminals (threaded studs (+) and (-)) of the contactor, check for electrical continuity (Sect. P 9, <u>Diagnostic instruments</u>). If there is no electrical continuity, renew the contactor.

Connect the wires (5) e (6) to the contactor terminals.

On refitting, ensure that terminals (+) and (-) are not oxidized; apply water repellent spray. Tighten the nuts (3) to the specified torque (Sect. C 3, <a href="Engine torque settings">Engine torque settings</a>).



Reconnect the wiring connector (2) to the wiring loom (Sect. P 1, Routing of wiring on frame). Refit the cover.



Insert the contactor in its seat on the fuel tank: the contactor must be inserted fully home, i.e. until the four retaining teeth of the support bracket protrude on the contactor side.

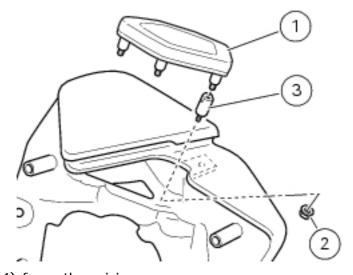
# 4 - Lights and indicating devices

# Removal of the instrument panel

To remove the instrument panel (1), remove the movable headlight fairing (Sect. E 1, Removal of the headlight fairing).



Unscrew the nuts (2), recovering the spacer (3).



Disconnect the connector (4) from the wiring. Refitting is the reverse of removal; tighten nuts (2) to the specified torque (Sect. C 3, <a href="Frame torque settings">Frame torque settings</a>).



# Changing bulbs

Changing the headlight bulbs

Operation	Section reference
Remove the headlight fairing	E 1, Removal of the headlight fairing

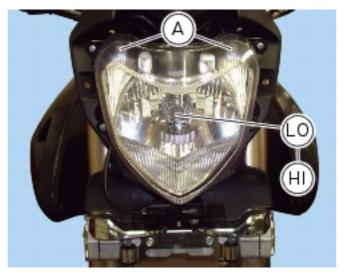
Before replacing a burnt out light bulb, ensure that the replacement bulb has the same voltage and power rating as specified for the lighting device in question (Sect. C 1.1, <u>Lights/instrument panel</u>).



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).



Low beam (LO)/High beam (HI)

To acces the the headlight bulbs, undo the screws (1) with a hex socket wrench.





Withdraw the headlight support towards the front of the motorcycle sufficiently to release the knob (2).

Unscrew the knob (2) in anti-clockwise direction.



Unhook the spring (3).

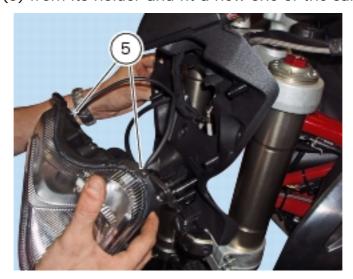


The bulb (4) is of the bayonet-type: press and twist anti-clockwise to remove. Push in the new bulb and turn it clockwise until it clicks into place.



Side lights (A)

Remove the side light bulb (5) from its holder and fit a new one of the same type.



## Refitting the bulbs

After changing the bulbs, reconnect the wiring connectors to the light terminals.

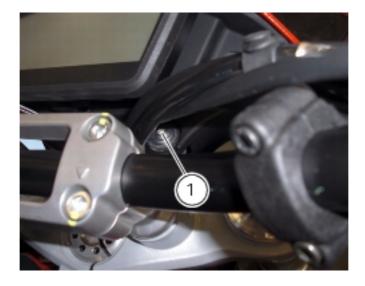


Reposition knob (2) of the headlight in its seating, and secure it to the headlight screwing it in clockwise.



Reposition the headlight support on the motorcycle and refit the bolts (1) to the frame.





Operation	Section reference
Refit the headlight fairing	E 1, Refitting the headlight fairing

## Changing the number plate light bulb

Pull out the rubber sleeve (11) and remove the bulb.



## 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.



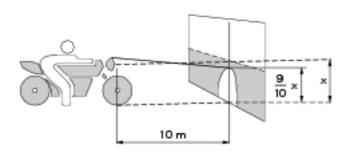
If possible, perform this check in conditions of low ambient light.

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.



This is the procedure specified by Italian regulations for checking the maximum height of the light

beam.



Unscrew the bolts (A) with a hex socket wrench and withdraw the headlight support towards the front of the motorcycle to access the headlight aim adjuster screws.



The vertical alignment of the headlamp can be adjusted manually by turning screw (1). The horizontal alignment of the headlight can be adjusted manually by turning screw (2).



Screws (1) and (2) have no travel limit.

Lights and indicating devices



Refit all parts removed.

# 5 - Indicating devices

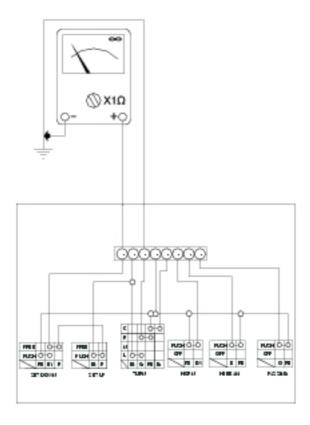
## Checking the indicating devices

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 harness (Sect. P 1, Routing of wiring on frame).

Test the device using either an analogue or digital multimeter (Sect. P 9, Diagnostic instruments).



The same checks 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 red/blue and and blue/white wires to check for electrical continuity, which must be present when the HORN is pressed (see Sect. P 9, <u>Diagnostic instruments</u>, 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 grey and red/blue wires from the turn signal switch and check for electrical continuity when operating the right turn signals (see Sect. P 9, <u>Diagnostic instruments</u> concerning operation of the multimeter). Repeat the above procedure for the left turn signal, but connect the multimeter to the black and grey 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.

## High beam headlight (HI)

The test method is the same; connect the meter to the blue and red/blue wires.

## Flasher (PASSING)

Check for continuity across the orange and red/blue wires.

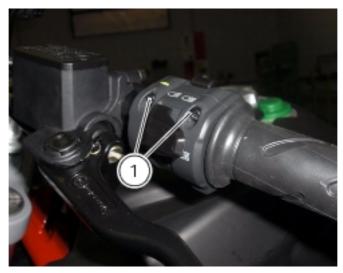
## set down pushbutton

Check for continuity across the red/blue and blue/yellow wires.

set up pushbutton

Check for continuity across the black and red wires.

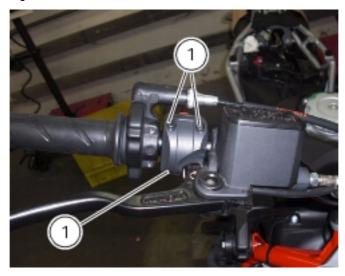
Refit the left-hand handlebar switch and tighten the bolts (1) to the specified torque (Sect. C 3, Frame torque settings).





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.



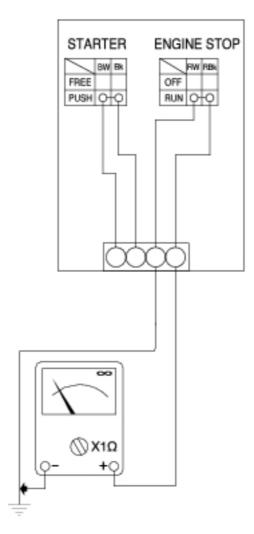
The colours mentioned in the following descriptions refer to the colours of the wires from the switch and not to the colours of the wires of the main electrical system.

#### **Engine Stop button**

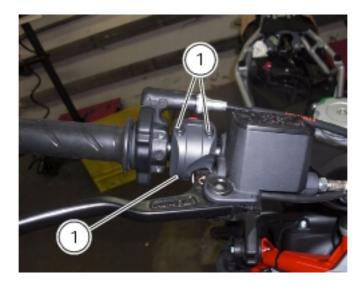
Using a multimeter, check for continuity between the Red/Black and Red/White wires (see Sect. P 9, <u>Diagnostic instruments</u> for information on the operation of the multimeter). When the button is in RUN position, there should be electrical continuity between the two wires. When the button is in 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 button

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, <u>Diagnostic instruments</u> 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.



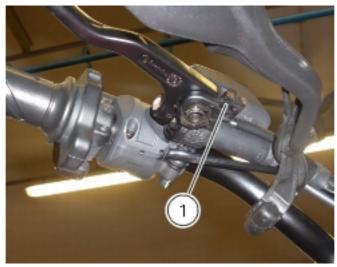
Refit the left-hand handlebar switch and tighten the bolts (1) to the specified torque (Sect. C 3, Frame torque settings).



Checking the front and rear brake light switches, neutral light switch, oil pressure switch and clutch switch

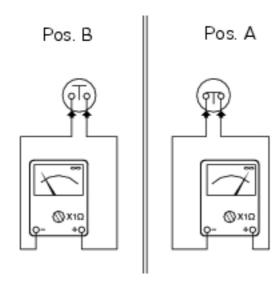
## Brake light switches

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, <u>Diagnostic instruments</u> 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.





Indicating devices



#### 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 the engine control unit 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 that the section of circuit between neutral switch and engine ECU is not earthed.

### Oil pressure sensor

To test the operation of the engine oil pressure sensor (4), proceed as follows. Use the DDS tester to check that the oil pressure in the 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 allowed operating range and the "low engine 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 indicator light fails to 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 is within the specified range and the "engine oil pressure low" 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 fails to switch off use a multimeter and 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

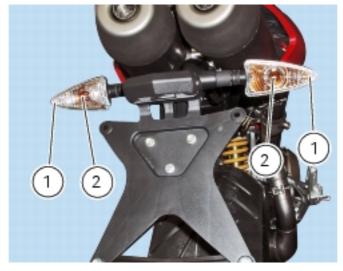
For the clutch switch (5), proceed in the same manner as for the **brake light** switches (see the beginning of this paragraph).



# Changing bulbs

Changing the rear turn signal bulbs

To change the bulbs of the rear turn signals unscrew the bolt (1) and remove the lens (2).



The bulb (3) is of the bayonet-type: press and twist anti-clockwise to remove. Replace the burned out bulb with a new one of the same type. Press the bulb in and twist clockwise until it clicks into place.

Refit the lens (2), tightening fixing bolt (1).

## Changing the front turn signal bulbs

The front turn signals (1) are integrated in the hand guard assembly (Sect. E 1, Removal of the hand guards - rearview mirrors) and in the event of malfunction, the mirror/turn signal assembly must be renewed as a complete unit.



# 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, Routing of wiring on frame) and use a multimeter (Sect. P 9, Diagnostic instruments) 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, <u>Diagnostic instruments</u> concerning operation of the multimeter). The resistance reading should be near zero and, if present, the audible continuity 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

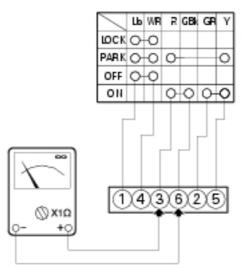
- check for electrical continuity. The resistance reading should be near zero and, if present, the audible continuity signal should be emitted;

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 audible continuity 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 audible continuity signal should be emitted.





The same checks can also be performed using the "DDS" tester (Sect. D 5, DDS tester).

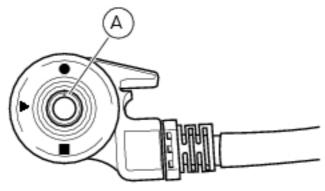
## Checking the sidestand switch

Remove the switch from the sidestand and disconnect the main wiring loom connector from the switch (see "Routing of wiring on frame", Sect. P 1).

Use an analogue or digital multimeter (Sect. P 9, <u>Diagnostic instruments</u>) to check operation of the switch (see table).









The same checks can also be performed using the "DDS" tester (Sect. D 5, DDS tester).

Pos. pin (A)	Items	Rating
--------------	-------	--------

#### Protection and safety devices

• - 🛦	0	X
▲ - ■	X	0
Multimeter pos.		Green/
	Green	Yellow
	White	Black

0 = Open contact

X = Closed contact

# Checking the fuses

The main fusebox (1) is located on the right-hand side of the motorcycle and is accessed by removing the right-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.

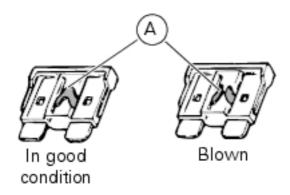


For ampere ratings, refer to the "Wiring diagram", Sect. P 1.



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).





Switch the ignition key to **OFF** before replacing a fuse to avoid possible short circuits.

Protection and safety devices



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 fuse box, the motorcycle has a **30** A fuse (2) located alongside the ECU to protect the electronic regulator (Sect. P 2, Regulator/rectifier).

## 7 - Instruments

### Instrument panel

For removal of the instrument panel, follow the indicationns given in Section P 4, Removal of the instrument panel.



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.

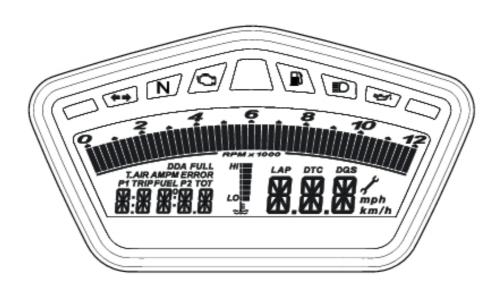
#### Instrument panel system

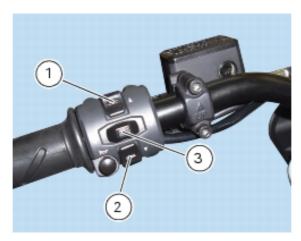
The instrument panel comprises a LCD digital display unit.

The information shown in the display can be accessed using the rwo control buttons (1), (2), the turn signal off button (3) and the headlight flasher button (4) on the left-hand handlebar switch. Underneath the digital display there are six indicator lights (three per side) and a further three 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.



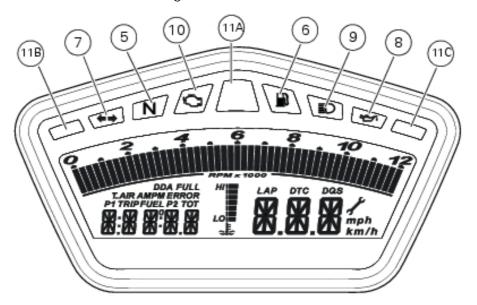




#### Indicator lights

The following indicator lights are mounted on the instrument panel.

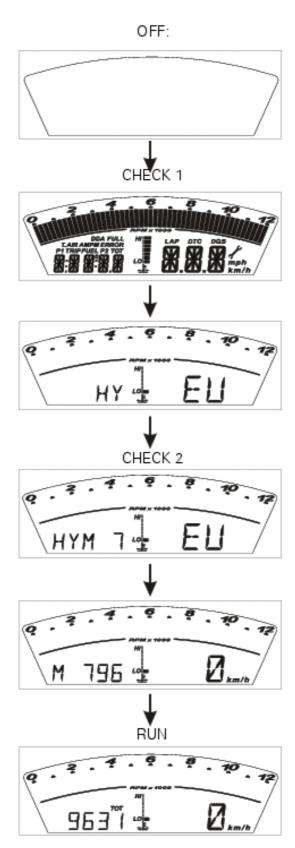
- 5 Neutral (N) indicator (green): illuminates when the gearbox is in neutral.
- 6 Fuel reserve warning light (amber): illuminates when there are only approximately 2 litres of fuel left in the tank.
- 7 Turn signal indicator lights (green): start flashing when the turn signals are in operation.
   Engine oil pressure warning light (red): illuminates when the engine oil pressure is too low. This light should come
   8 on when the ignition is switched to ON and normally goes out a few seconds after engine starts. It may come on
- 8 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.
- 9 High beam indicator light (blue): illuminates when the high beam headlight is on.
- 10 "EOBD engine/vehicle diagnostics light" (amber): the engine ECU illuminates this light steadily to indicate errors and, in certain cases, the consequent engine lockup.
- 11 Rev limiter light over rev (red):
  - Indicator lights 11B + 11C: illuminate steadily 400 rpm before intervention of the rev limiter.
- Indicator lights 11A + 11B + 11C: illuminate steadily 800 rpm before intervention of the rev limiter.
- Indicator lights 11A + 11B + 11C: start flashing when the rev limiter is reached.



## 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 also, for 2 seconds, in place of the motorcycle speed, the version (EU, UK, USA, CND, FRA, JAP). The model is scrolled on the display once only.



At Key-On, the instrument panel always shows the following information (de-activating any previously activated functions):

- Odometer
- Speed
- Engine rpm bargraph
- Engine oil temperature bargraph

At this point, by pressing switch (1) " $\nabla$ " it is possible to switch from the odometer display function (TOT) to the following functions:

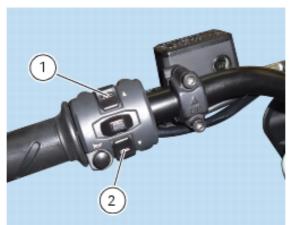
- TRIP
- TRIP FUEL (only if active)
- Clock
- before returning to the Odometer (TOT) function.

If, however, you press button (2) "▼" the system enters MENU mode and displays the following functions in sequence:

- Error (only if at least one error is present)

#### Instruments

- BATT
- RPM
- Light Set
- LAP (OFF or ON)
- LAP MEM
- DDA (OFF or ON)
- Erase DDA
- TIME Set
- CODE (only active if at least one IMMOBILIZER error is present).





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 (2) "\vec{v}" for 3 seconds.

Total distance travelled indicator (odometer)

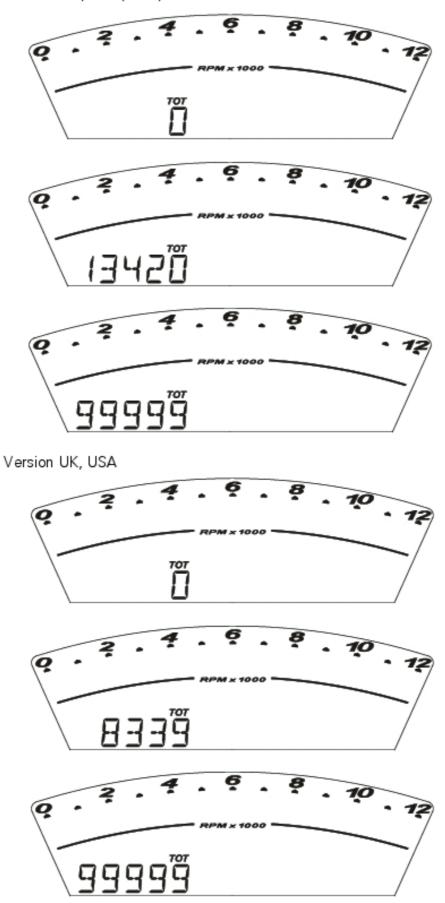
This function displays the total distance travelled.

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.

Version EU, CND, FRA, JAP



## Motorcycle speed

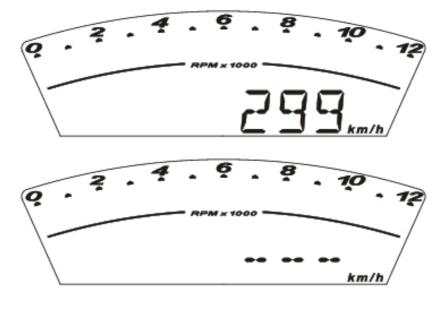
This function displays the motorcycle speed.

The instrument panel receives actual speed value (expressed in km/h) from the ECU and displays the value increased by 8%.

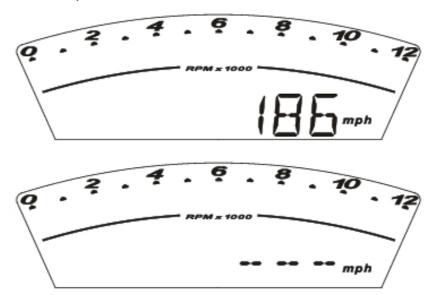
The maximum speed that can be displayed is 299 km/h (186 mph).

Over 299 km/h (186 mph) the display will show a series of dashes "- - -" (steadily lit - not flashing).

Version EU, CND, FRA, JAP



Version UK, USA

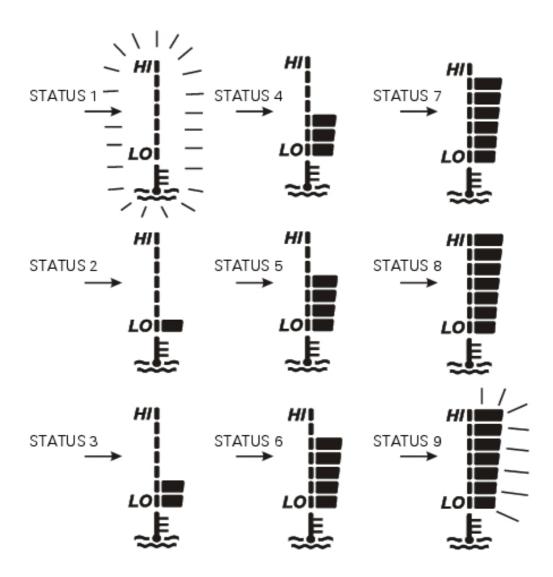


#### Engine oil temperature indicator

This function displays the engine oil temperature.

#### Display indications:

- if the temperature is between -40 °C and +70 °C, the display shows "STATUS 2".
- if the temperature is between +71 °C and +90 °C, the display shows "STATUS 3".
- if the temperature is between +91 °C and +175 °C, the display shows "STATUS 4".
- if the temperature is between +176 °C and +187 °C, the display shows "STATUS 5".
- if the temperature is between +188 °C and +192 °C, the display shows "STATUS 6".
- if the temperature is between +193 °C and +196 °C, the display shows "STATUS 7".
- if the temperature is between +197 °C and +199 °C, the display shows "STATUS 8".
- if the temperature is 200 °C the display shows "STATUS 9" with the series of dashes flashing; in the event of a FAULT with the sensor, the display will flash "STATUS 1.



"TRIP" meter

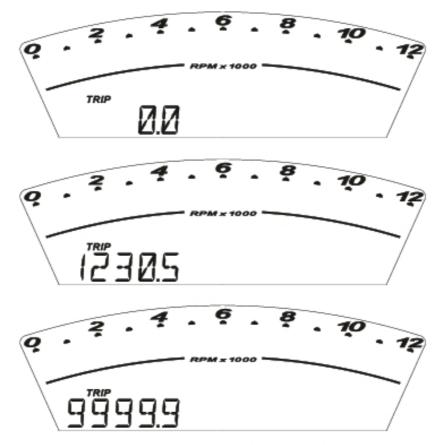
This function displays the distance travelled since the last reset.

While in this function, if you press switch (1)  $^{\text{``}}\Delta''$  for 3 seconds, the reading is reset to zero.

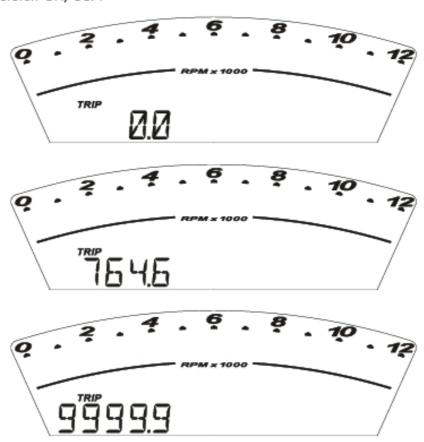
If the reading exceeds 999.9, it is reset to zero and the count restarts automatically.

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.

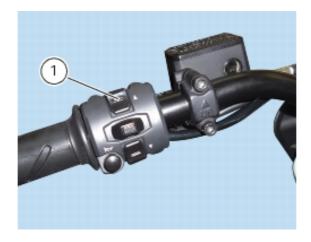
Version EU, CND, FRA, JAP



Version UK, USA



Instruments



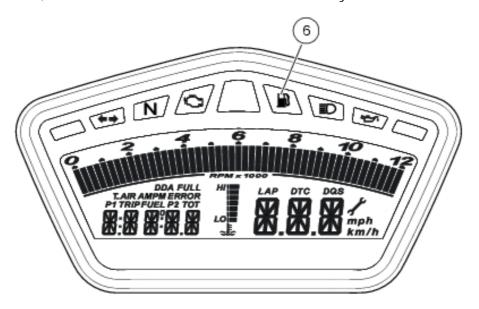
"TRIP FUEL" (distance travelled on reserve fuel) indicator

This function displays the distance travelled on reserve fuel.

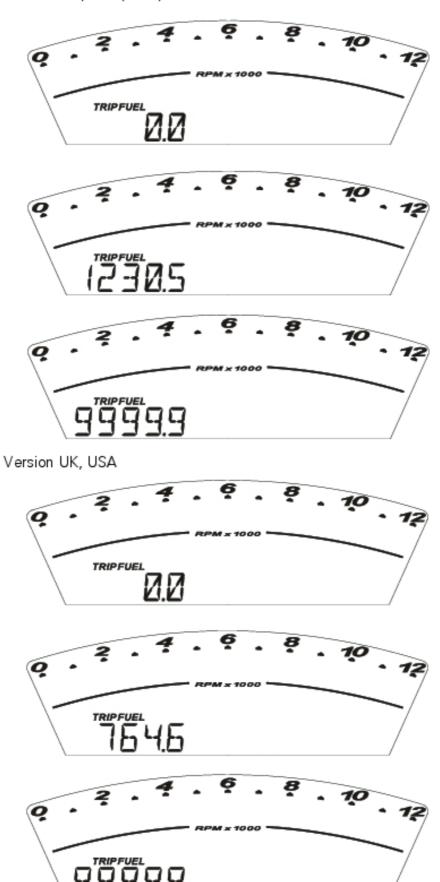
When the fuel warning light (6) comes on, the TRIP FUEL meter is activated automatically, regardless of the function displayed. If the fuel level remains in reserve, the reading is saved even after Key-Off.

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.



Version EU, CND, FRA, JAP



Service indicator

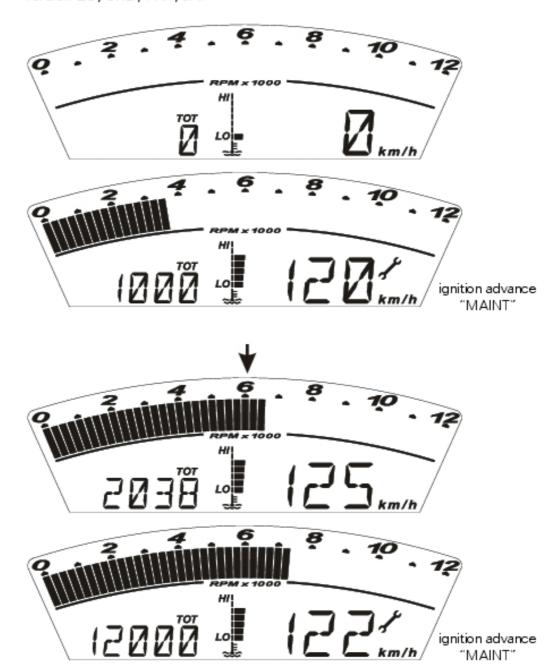
Indicates that the next service is due.

The indicator ( ) signals when the next service is due. The service indicator is displayed at the following intervals:

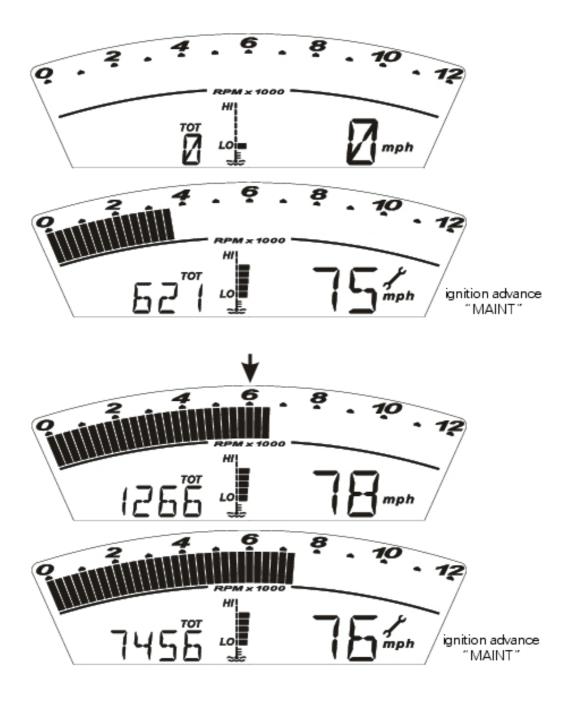
- after the first 1000 km on the odometer;
- every 12000 km on the odometer.

The service indicator will remain on the display until reset.

Version EU, CND, FRA, JAP



## Version UK, USA



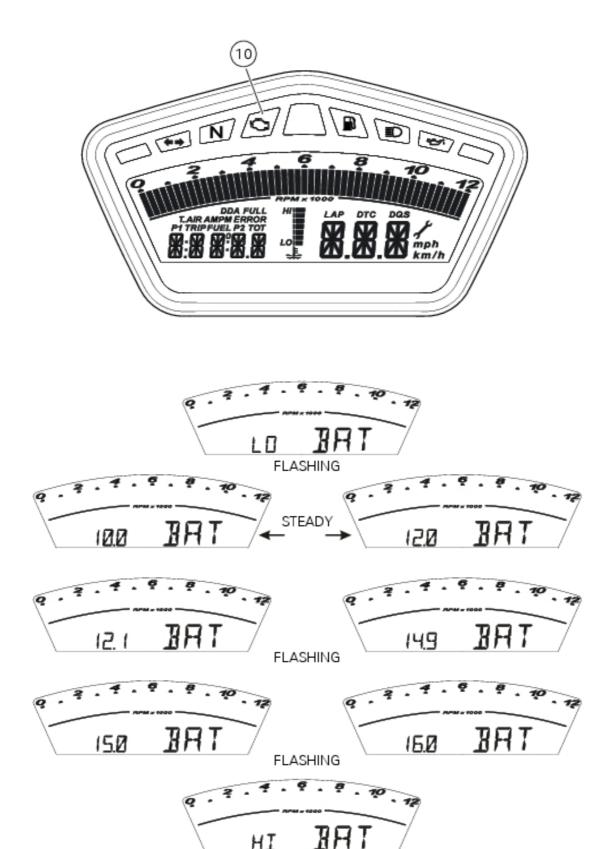
#### Battery voltage indicator (BATT)

This function displays the battery charge level.

To display this function, go into the menu and select the "BAT" 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 "EOBD Vehicle/
- Engine diagnostics" warning light (10) comes on;
- if the reading is greater than or equal to 16.1 Volts, the message "HI" flashes on the display and the "EOBD Vehicle/
- Engine diagnostics" warning light (10) comes on.



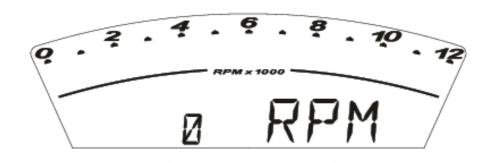
Engine idle speed adjustment (rpm)

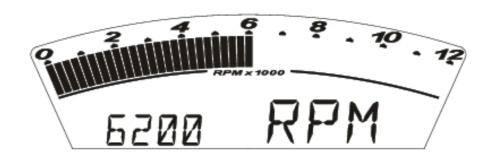
This function displays the engine idle speed adjustment.

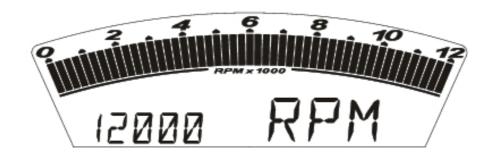
To display the function, access the menu and select the "RPM" page.

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.

FLASHING







## LIGHT SET backlighting adjustment

This function allows adjustment of the brightness of the display backlighting.

To enable the function, enter the menu and select the "LIGHT SET" page.

While in this page, press the reset button (3) for 3 seconds to enable adjustment and display the following pages in sequence:

page 1 - "LIGHT MAX" setting:

This page sets backlighting to maximum brightness; press switch (1) "▲" to move to page 2.

page 2 - "LIGHT MID" setting:

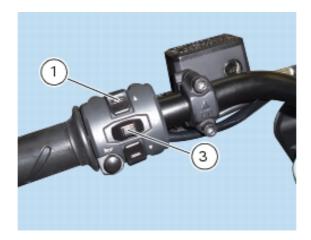
This page reduces the backlighting by approximately 30% relative to maximum brightness; press switch (1)  $^{\text{M}}$  to return to page 3.

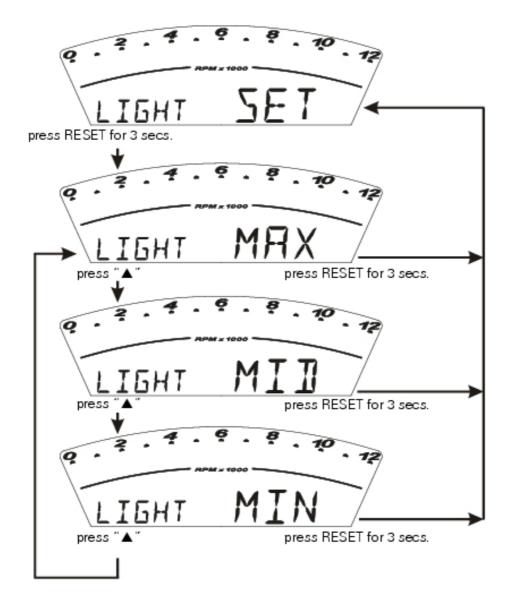
page 3 - "LIGHT MIN" setting:

This page reduces the backlighting by approximately 70% relative to maximum brightness; press switch (1)  $^{\text{M}}$  to return to page 1.

In each of the three pages, pressing the reset button for 3 seconds will select the corresponding backlighting brightness, save it to memory, and return you to the "LIGHT SET" page.

In the event of an interruption of the power supply from the battery (Batt-OFF), when power is restored at the next Key-On, the backlighting will be set by default to maximum brightness.





#### LAP function

This function displays the recorded lap time.

To activate this function, enter the menu and set the "LAP" function to "On" by pressing the reset button (3) for 3 seconds.

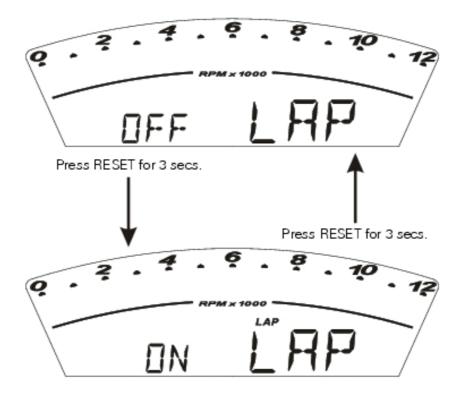
START and STOP the timer by pressing the high beam FLASH switch (4) on the left-hand handlebar switch. When the LAP function is active, each time you press the flasher switch, the display will show the lap time for 10 seconds, before reverting to normal mode.

You can save a maximum of 30 laps in the memory.

If the memory is full, each time you press the flasher switch, no more lap times can be saved and the display will show the flashing message "FULL" for 3 seconds until the memory is reset.





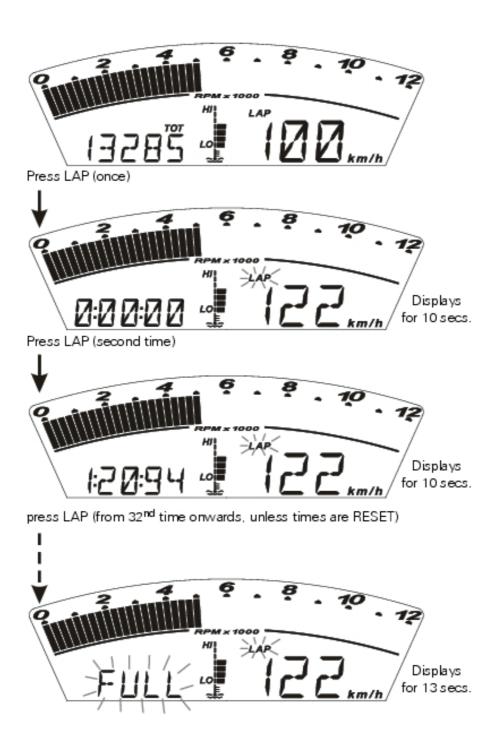


When you switch the LAP function off from the menu, the lap in progress will not be saved.

If the LAP function is active and the instrument panel 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 9 minutes, 59 seconds and 99 hundredths, it restarts from 0 (zero) and continues until the function is switched off.

If the LAP function is activated and the "memory" is not reset, but less than 30 laps are saved (e.g.: 18 laps saved) the display will save all the remaining laps until the memory is full (in this case a further 12 laps can be saved). In this function, lap time only is displayed, but other data are also saved (MAX rpm, rev limiter if reached) for viewing at a later date in the Lap Memory function.

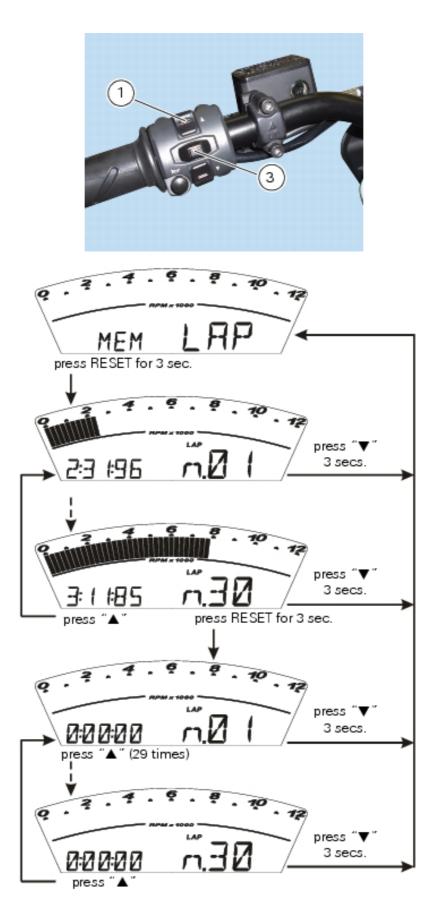


## LAP Memory display

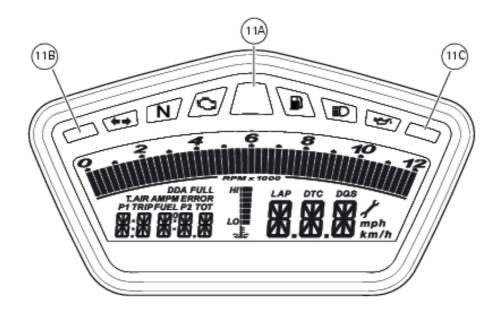
Displays the data saved using the LAP function: lap time, MAX speed and MAX rpm (and limiter if reached). To display the saved lap times, enter the menu and select the "LAP MEM" page.

From this menu page, if you hold pressedreset (3) for 3 seconds, the data for the "1st 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) " $\blacktriangle$ ", the display scrolls through the 30 saved times, before returning to the 1<sup>st</sup> lap. If you hold the reset button (3) for 3 seconds while displaying the saved times, the instrument panel immediately resets all the saved times. In this case, if the LAP function was active, it is switched off automatically. 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 (11A), (11B) or (11C) will illuminate during the display of the saved times.



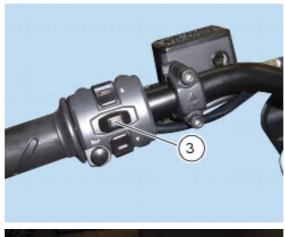
## DDA data acquisition

This function activates the DDA (Ducati Data Analyzer) (Sect. P 10, <u>USB Data Acquisition kit</u>). In order to acquire data, the DDA must be connected to the motorcycle wiring loom.

To activate the DDA, go into the menu and set the "DDA" to "On" by pressing reset (3) for 3 seconds.

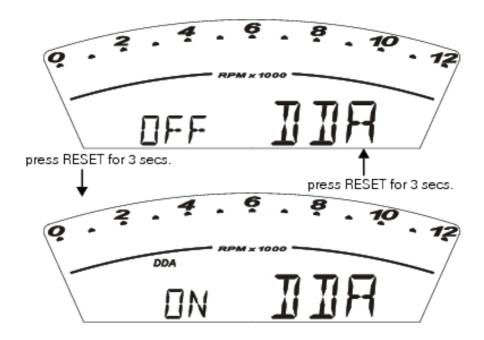
The text DDA (small) will illuminate and will remain visbile even outside the menu.

To START and STOP the lap separator press the high beam FLASH button (4) on the left-hand handlebar switch.





If the DDA function is active and the instrument panel is suddenly switched off (Key-Off), the function is automatically disabled.



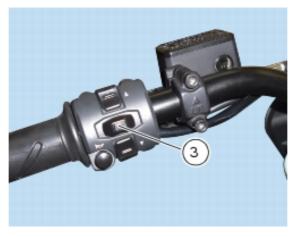
#### Erase DDA

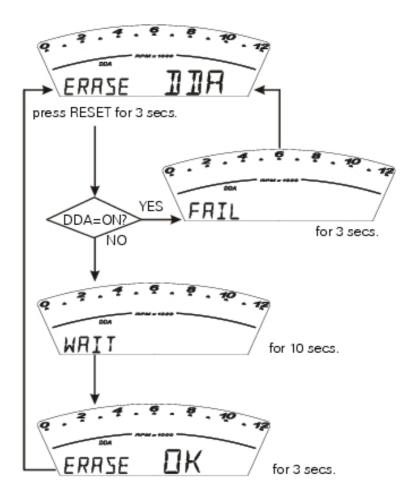
This function enables you to delete the data saved on the DDA: in order to delete data, the DAQ must be connected to the motorcycle wiring loom.

To delete the data, enter the menu and select the "Erase DDA" page.

If you press reset (3) for 3 seconds and the DDA is not acquiring data, the message "WAIT..." appears on the display for 10 seconds. After 10 seconds, the message "ERASE OK" appears for 2 seconds, to confirm that the DDA data has been deleted.

If you press reset (3) for 3 seconds and the DDA is acquiring data, the DDA memory is not cleared and the display shows the message "FAIL" for 2 seconds.





#### Clock setting function

This function is used to set the clock time.

To set the clock, enter the menu and select the "TIME Set" page.

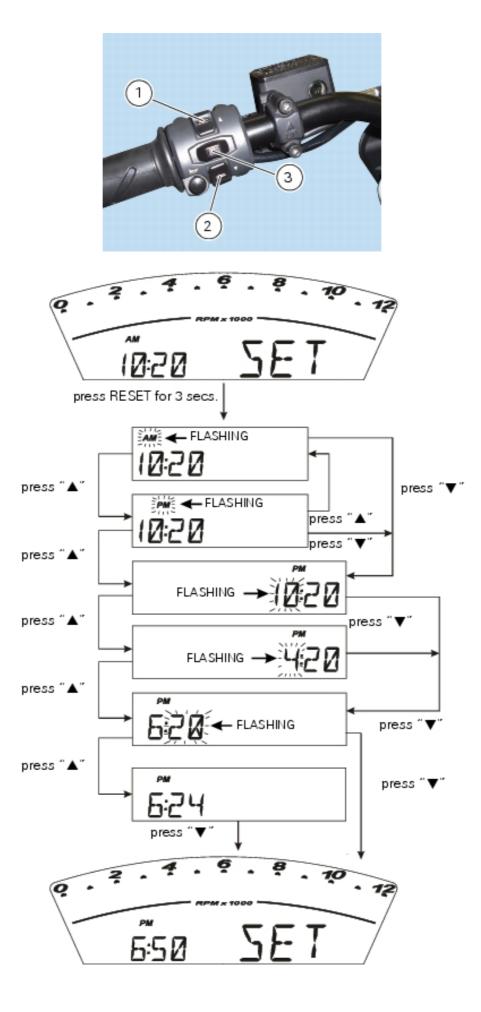
From this page, if you press reset (3) for 3 seconds, you enter clock setting mode.

On entering this function, the message "AM" flashes on the display; if you press switch (1) " $\blacktriangle$ ", the message "PM" flashes on the display; pressing switch (1) " $\blacktriangle$ " again returns you to the previous step (if the time is 00:00, when you switch from AM to PM the time 12:00 will appear);

press button (2) " $\blacktriangledown$ " to proceed to set the hours value, which now starts flashing. Each time you press the switch (1) " $\blacktriangle$ ", the count advances cyclically in steps of 1 hour; if you hold pressed the switch (1) " $\blacktriangle$ ", the count advances cyclically in steps of 1 hour every second (when the switch is held down continuously, the hours do not flash); press button (2) " $\blacktriangledown$ " to proceed to set the minutes value, which now starts flashing. Each time you press the switch (1) " $\blacktriangle$ ", the count advances cyclically in steps of 1 minute; if you hold pressed switch (1) " $\blacktriangle$ ", the count advances cyclically in steps of 1 minute every second. If switch (1) " $\blacktriangle$ " is held pressed for more than 5 seconds, the minutes advance by 1 every 100 ms (when the switch (1) " $\blacktriangle$ " is held pressed continuously, the seconds do not flash); if you press switch (1) " $\blacktriangle$ ", the system exits setting mode and displays the newly set time.



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.



Instrument panel diagnostics



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		ETTOT	
0	TPS	01	Generic error of the throttle position sensor (TPS)	
0	PRESS	02	Generic pressure sensor error	
0	T OIL	03	Generic error of the engine coolant temperature sensor	
O	T-AIR	04	Generic error of the internal air temperature sensor (ECU)	
0	BATT	05	Generic battery voltage error	
0	LAMB	06	Generic error of the lambda sensor heater	
0	FUEL	07	Generic fuel reserve error	
0	COIL	09	Generic coil error	
0	INJE	10	Generic fuel injector error	
0	STRT	12	Generic starter contactor error	
0	R INJ	13	Generic injection relay error	
0	STEPP	14	Generic stepper motor error	
0	ECU	16	Generic engine ECU error	
0	PK UP	17	Generic pick-up sensor error	
0	SPEED	18	Generic speed sensor error	
0	IMMO	19	Generic immobilizer error	
0	CAN	20	Generic CAN line error	
0	LIGHT	21	Generic error of main/low beam headlights	

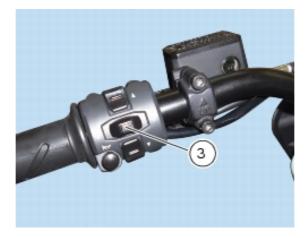
## Immobilizer override procedure

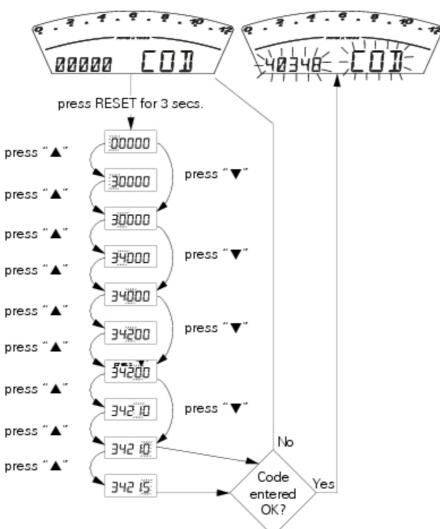
Should the immobilizer become locked, you can perform the "Immobilizer Override" procedure from the instrument panel by entering the respective function as described below. Select the "CODE" page from the menu.



This menu is only active if there is at least one immobilizer error.

With this menu page selected, the initial code is always displayed as "00000". If you now hold the reset button (3) 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.

Each time you press switch (1) "▲", the number increases cyclically in steps of one digit every second.

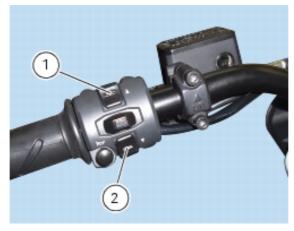
press button (2) " $\nabla$ " to proceed to set the second digit, which now starts flashing. Each time you press switch (1) " $\Delta$ ", the number increases cyclically in steps of one digit every second.

press button (2) "▼" to proceed to set the third digit, which now starts flashing. Each time you press switch (1) "▲", the number increases cyclically in steps of one digit every second.

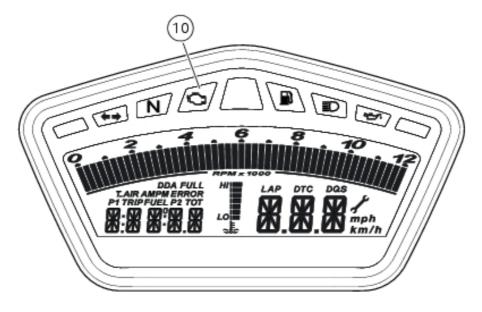
press button (2) "▼" to proceed to set the fourth digit, which now starts flashing. Each time you press switch (1) "▲", the number increases cyclically in steps of one digit every second.

press button (2) "▼" to proceed to set the fifth digit, which now starts flashing. Each time you press switch (1) "▲", the number increases cyclically in steps of one digit every second.

pressing switch (2) " $\nabla$ " to confirm the code.



If the code has been entered correctly, the message CODE and the code itself will flash simultaneously for 4 seconds. The "EOBD Vehicle/Engine diagnosis" warning light (10) 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. If instead the code has been entered incorrectly, the instrument panel will automatically return to the "CODE" menu and display the code "00000".

#### Automatic turn signal "CANCEL" function

When one of the turn signal has been switched on it can be switched off by pressing the RESET button (3). If the rider does not press "RESET" button, the turn signal will be cancelled automatically when the motorcycle has travelled a further 1 km (0.6 mile) from the point at which it was originally switched on. Operation of the turn signals will be disabled if the power supply voltage exceeds 16 Volt (the instrument panel "protection" mode is activated). Turn signal operation is also disabled if the power supply voltage falls below 6 Volt, as general operation of the instrument panel cannot be guaranteed.



#### Gradual headlight SWITCH ON/OFF function

On Key-On, the low beam headlight (LO) is switched on gradually (time required to switch on approximately

#### 2 seconds).

Headlight switch off (Key-Off) is also "gradual" (approximate time taken 2 seconds).

The gradual headlight switch on/off function is possible because the low beam headlight iscontrolled directly by the instrument panel.

Operation of the low beam headlight will be disabled if the power supply voltage exceeds 16 Volt (the instrument panel "protection" mode is activated). Low beam headlight operation is also disabled if the power supply voltage falls below 6 Volt, as general operation of the instrument panel cannot be guaranteed.

#### 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, the headlight is switched off while the engine is being started and switched back on again when the engine is running.

## Service Menu

This MENU provides some useful functions for your DUCATI Dealer.

To enter this MENU, press switch (2) "▼" and simultaneously turn the keyswitch from OFF to ON.



## Warning

Within this "MENU" all other functions are excluded and motorcycle starting is disabled.

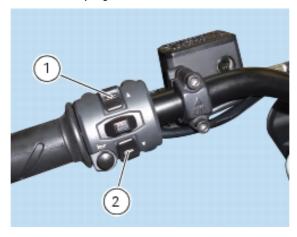
The first function to be displayed is always "Immobilizer Reprogramming" (00000 PRO).

At this point, pressing switch (1) "▲" displays the "Special Settings" function (UNIT SET).

After having made the required changes, turn the key switch from "ON" to "OFF" to save the new settings to memory. The new parameter settings will be applied at the next Key-On.

#### Example:

- the count-down, because the keys have been erased from memory and the immobilizer is to be reprogrammed with the new keys;
- the new units of measurement for the values displayed and the new version indication.



#### 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 "00000PRO".

On entering this page, the initial code is always displayed as "00000". If you press the RESET button (3) 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;
- each time you press the switch (1) "\( \Lambda''\), the number increases cyclically in steps of one digit every second;
- press switch (2) "▼" to proceed to set the second digit, which will now start flashing. Each time you press switch (1) "\neq", the number increases cyclically in steps of one digit every second;
- press switch (2) "▼" to proceed to set the third digit, which will now start flashing. Each time you press switch (1) "▲", the number increases cyclically in steps of one digit every second;
- press switch (2) "▼" to proceed to set the fourth digit, which will now start flashing. Each time you press switch (1) "↑" the number increases cyclically in steps of one digit every second:
- "▲", the number increases cyclically in steps of one digit every second; press switch (2) "▼" to proceed to set the fifth digit, which will now start flashing. Each time you press switch (1)
- \_press switch (2) → to proceed to set the fifth digit, which will now start hashing. Each time you press switch (1)

   "▲", the number increases cyclically in steps of one digit every second;
- press switch (1) "\( \Lambda''\) to confirm the code.

At this point, if the code was entered incorrectly, the instrument panel will display the initial code "00000". There is no limit to the number of times the code may be entered incorrectly.

If the code has been entered correctly, the message "COD" and the code entered will flash simultaneously; at this point, 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, reprogram the keys using the procedure described in "Programming the Immobilizer".



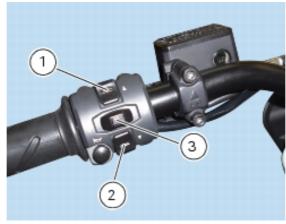
#### Notes

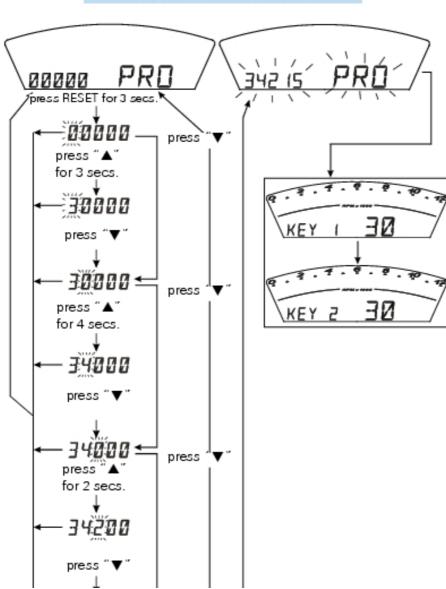
During this stage, the immobilizer system will immobilize the engine until the keys have been reprogrammed.

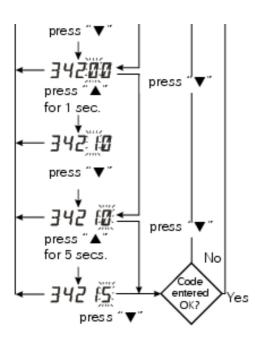


## Warning

In the programming procedure, once the new keys have been inserted, the instrument panel cancels the old keys from the system but does NOT cancel from memory either of the two electronic codes saved during the FIRST immobilizer programming procedure. This means that the electronic code on the Code Card will continue to perfom its dual function, providing access to both the "Immobilizer ovveride" procedure and the "Immobilizer reprogramming" procedure.







#### Loss of the Code Card

Without knowing the electronic code on the CODE CARD, it is impossible to:

- reprogram 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).

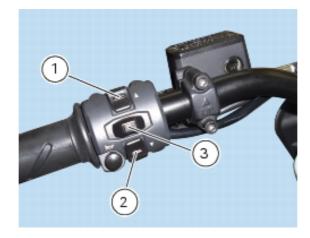
If the new instrument panel is programmed with the keys renewed previously, it will be possible to start the motorcycle but the electronic code shown on the CODE CARD will no longer enable you to:

- reprogram 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.

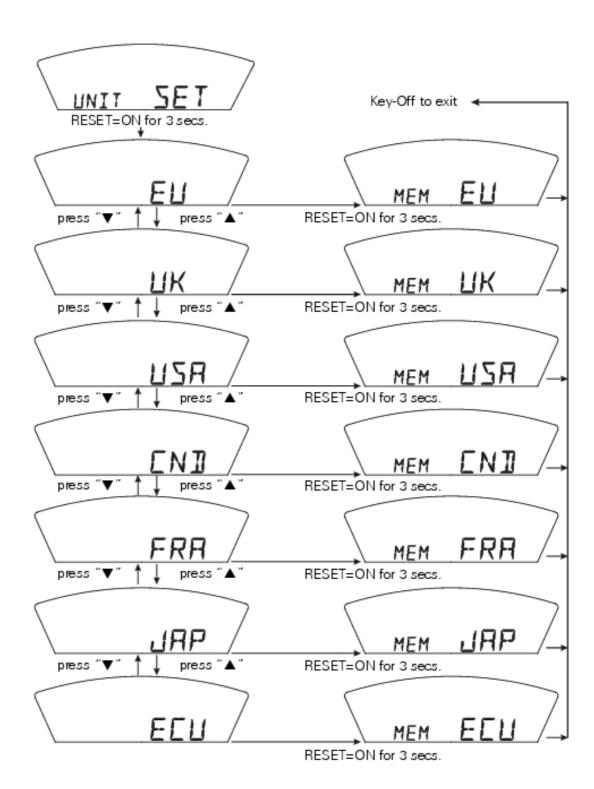
The ECU automatically communicates to the instrument panel the motorcycle model and the units of measurement to be used on the display: to change these parameters, go into the "Service Menu" and select the "SET UNIT" function. PressRESET (3) to display the versions.



Each time you press switch (1)  $^{\mathbf{w}}$  or (2)  $^{\mathbf{w}}$ , the instrument panel scrolls through the following sequence of options, which flash on the display:

	Units of measurement			
COUNTRY	Speed	Air 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 the reset button (3) for 3 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.



Programming the immobilizer

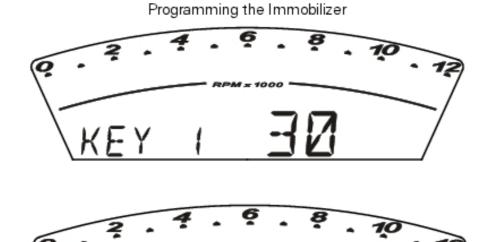
This instrument panel function enables programming of the Immobilizer System.



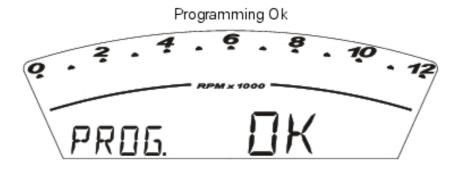
Only 2 keys may be programmed.

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.

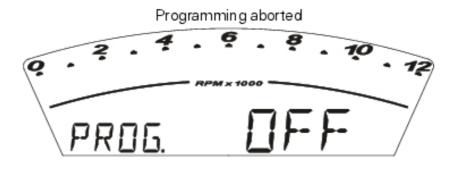


If the procedure was successful, the instrument panel will display the message "PROG" steadily for 3 seconds before returning to normal display mode.



### 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 the Immobilizer Recovery

## Instruments

and Immobilizer Reprogramming procedures.

## 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 that is used for programming the immobilizer system and which enables engine starting.

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 receives its power from 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.

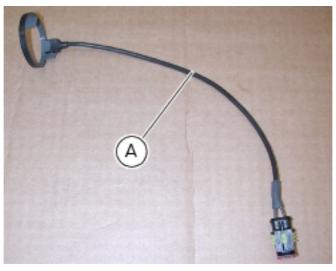


The circuits in the key grips are not shockproof and may therefore be damaged by violent impact.

#### 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

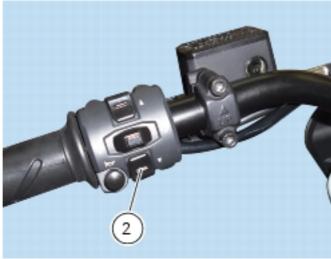
At key-on (switching on the instrument panel by turning the key) the decoder (incorporated in the instrument panel) activates the antenna, which emits an electromagnetic field that serves to power the transponder in the key grip. The transponder responds by transmitting the code that is stored on its 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.

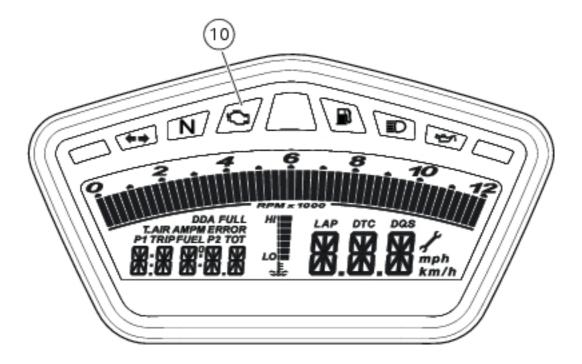
#### Warning light signals and immobilizer indications

When the ignition key is turned from ON to OFF, the immobilizer system activates the engine lock. When the ignition key is turned from OFF to ON to start the engine:

- 1) if the code is recognised, the protection system releases the engine lock. When you press the START button (C), the engine starts;
- 2) if the code is not recognised, the diagnostics warning light (10) comes on and if, when you press switch (2) "▼", the "Error IMMO" message appears on the display, this indicates that the code has not been recognised. In this case, turn the ignition key back to OFF and then to ON again. If the engine still does not start, try again with the other black key. If the engine still does not start, proceed with fault diagnosis.







Removal of the immobilizer and ignition switch

## Set the ignition switch to **OFF**.

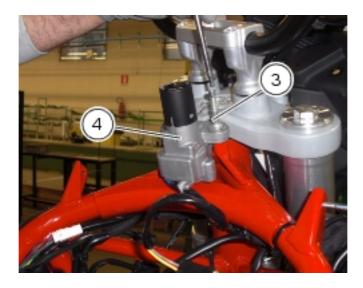
Disconnect the immobilizer antenna connector (A) and ignition switch connector (B).



Unscrew the nuts (1) securing the ignition switch cover (2) and remove it along with the immobilizer antenna.



Unscrew the bolts (3) and remove the igntiion switch (4) from the frame.

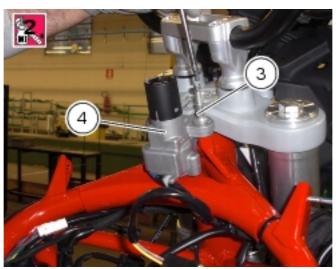


Refitting the immobilizer and ignition switch

Apply the recommended threadlocker to the bolts (3).

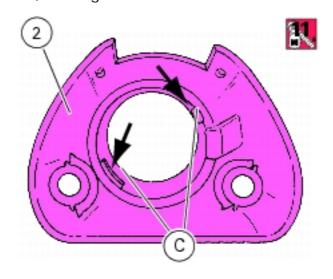
Locate the igntion switch (4) on the frame and tighten the bolts (3) to the specified torque (Sect. C 3, <u>Frame torque settings</u>).

Apply a drop of Loctite to the inside of cover (2).



Carefully install the antenna (3) inside the cover (2), securing it with the two lugs (C) on the cover itself.

Fit the cover to the ignition switch, leading the antenna cable downwards.





Tighten the nuts (1) to the specified torque (Sect. C 3, Frame torque settings).



Disconnect the wiring connector of the ignition switch (B) and the connector of the antenna immobilizer (A) from the main wiring loom.



## 9 - Diagnostic instruments

For information on the "DDS" tester, refer to Section 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.



The DDS tester (Sect. D 5, <u>DDS tester</u>) can perform the functions of a digital multimeter.

Diagnostic instruments

#### 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  $\sim$ ).

#### 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.



