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W9110.2 W9110.2

DUCATI 

1098 2007 Workshop Manual

Section A

General

1 - How to use this manual	3
Layout of the manual	4
2 - Symbols - Abbreviations - References	5
Product specifications	6
3 - Hazardous Products - Warnings	8
General safety rules	8
General maintenance indications	10

Section B

Information about the model

1 - Identification data	3
Identification data for the Superbike 1098	3

Section C

Technical data

1.1 - Technical specifications	3
General	3
Colours	4
Transmission	4
Timing system/valves	5
Crankshaft	5
Cylinder/Piston	5
Gearbox	6
Cooling system	6
Front wheel	6
Front suspension (1098)	6
Front suspension (1098S)	7
Rear wheel	7
Rear suspension (1098)	7
Rear suspension (1098S)	7
Hydraulic brakes	8
Charging system/alternator	8
Injection - ignition system	8
Fuel system	8
Lights/instrument panel	9
1.2 - Dimensions	10
2 - Fuel, lubricants and other fluids	11
3 - Torque settings	12
Frame torque settings	12
Engine torque settings	13

4 - Service tools	16	A
Special tools for the engine	16	
Special tools for the frame	22	

Section D

Use and maintenance

1 - Preliminary checks	3	C
Running-in precautions	3	
Pre-ride checks	4	
2 - Starting - Engine warmup	5	D
Starting the engine	5	
3 - Routine maintenance table	6	E
Programmed maintenance plan: operations to be carried out by the dealer	6	
Programmed maintenance plan: operations to be carried out by the dealer	8	
4 - Maintenance operations	9	F
Checking the engine oil level	9	
Changing the engine oil and filter cartridge	10	
Checking valve clearances	13	G
Adjusting the valve clearances	14	
Checking the coolant level	15	
Change the coolant	16	H
Changing and cleaning the air filters	17	
Changing the brake fluid	19	
Draining the braking circuit	22	L
Fill the brake system with fluid	24	
Changing the clutch fluid	27	
Draining the clutch hydraulic circuit	28	M
Filling the clutch circuit	30	
Adjusting the steering head bearings	32	
Adjusting the chain tension	33	N
Checking brake pad wear and changing brake pads	35	
Adjusting the throttle cable	38	
Adjusting the clutch lever and front brake lever	40	P
Adjusting the position of the gearchange and rear brake pedals	41	
Adjusting the front fork	42	
Adjusting the rear shock absorber	43	
Adjusting the rear ride height	45	
5 - Diagnostic instruments	47	
Description of the Ducati Diagnostic System instrument	48	M
Tester power supply	50	
DDS tester	53	
Checking and adjusting timing belt tension	54	N
Resetting the throttle position sensor (TPS)	58	
Adjusting the idle speed	62	
Checking the engine oil pressure	66	
Cylinder compression test	71	
Fuel pressure test	74	
Immobilizer override procedure	77	P
Guided diagnosis	81	

A	Testing the battery charging system	84
	Deactivating the "maintenance" indication on the instrument panel	87
	Icons table	90
B	Section E	
	Fairings	
	1 - Headlight shell - rear-view mirrors	3
C	Removal of the rear-view mirrors	4
	Refitting the rear-view mirrors	5
	Removal of the headlight shell	6
	Refitting the headlight shell	8
D	2 - Fairing panels	11
	Removal of the side fairings	12
	Removal of the front shield	14
	Refitting the front shield	14
E	Refitting the side fairings	15
	3 - Seat - seat cowling and side panels	17
	Removal of the seat	18
	Removal of the side panels and seat cowling	19
F	Refitting the side panels and seat cowling	22
	Refitting the seats	26
	Refitting the pillion seat	27
	4 - Front mudguard	28
G	Removal of the front mudguard	28
	Refitting the front mudguard	29
H	Section F	
	Controls - Devices	
	1 - Throttle and choke controls	3
L	Adjusting the throttle cable	4
	Removal of the throttle cable	4
	Refitting the throttle twistgrip	5
	2 - Hydraulic clutch control	7
M	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	13
N	3 - Front brake control	16
	Removal of the front brake master cylinder	17
	Refitting the front brake master cylinder	18
P	4 - Rear brake control	19
	Removal of the complete rear brake control	20
	Disassembly of the rear brake master control	21
	Refitting the rear brake control	22

5 - Gearchange control

- Removal of the complete gearchange control
- Disassembly of the gearchange control
- Refitting the gearchange control

23
24
25
26

A**B****Section G****Wheels - Suspension - Brakes****1 - Front wheel**

- Removal of the front wheel
- Overhauling the front wheel
- Refitting the front wheel

3
4
6
9

C**2 - Front fork (1098)**

- Removal of the front forks
- Overhauling the front forks
- Refitting the front forks

11
12
13
20

D**3 - Hydraulic front brake**

- Maintenance operations
- Removal of the front brake system
- Refitting the brake discs
- Overhauling the front brake components
- Refitting the front brake system

22
23
24
26
27
28

E**F****4 - Rear wheel**

- Removal of the rear wheel
- Overhauling the rear wheel
- Refitting the rear wheel

30
31
32
33

G**5 - Rear swingarm**

- Removal of the rear eccentric hub
- Removal of the rear eccentric hub
- Removal of the swingarm
- Inspecting the swingarm pivot shaft
- Overhauling the rear swingarm
- Refitting the swingarm

34
35
37
39
41
42
46

H**L****6 - Hydraulic rear brake**

- Removal of the rear brake caliper
- Removal of the rear brake disc
- Refitting the rear brake caliper

48
49
50
51

M**7 - Rear suspension**

- Rear suspension system
- Removal of the rear shock absorber
- Overhauling the rear shock absorber
- Removal of the rear suspension rocker arm
- Overhauling the rear suspension rocker arm
- Disassembly and overhaul of the shock absorber tie-rod
- Refitting the rear suspension

52
53
54
55
56
57
58
59

N**P**

8 - Final drive

61

A Inspecting the final drive

62

Removal of the front sprocket

63

Refitting the front sprocket

65

Renewal of the rear sprocket

67

Refitting the rear sprocket

68

B Washing the chain

69

Lubricating the chain

69

C Section H

Frame

D 1 - Handlebars

3

Removal of the handlebars

4

Refitting the handlebars

5

2 - Steering

6

E Adjusting the steering head bearings

7

Steering angle adjustment

8

Removal of the steering head components

9

Refitting the steering head components

11

F 3 - Steering damper (1098)

14

Removal of the steering damper

15

Refitting the steering damper

16

G 4 - Footrest brackets

17

Removal of the footrests

18

Refitting the footrests

19

5 - Stands

20

H Removal of the sidestand.

21

Refitting the sidestand

23

6 - Frame inspection

24

Disassembly of structural components and the frame

25

Checking the frame

29

L Reassembly of structural components and the frame

31

7 - Number plate holder

33

Removal of the number plate holder

34

M Section L

Fuel / Exhaust System

N 2 - Fuel tank

3

Removal of the fuel tank

4

Removal of the fuel filler cap assembly

6

Refitting the fuel filler cap assembly

7

P Renewal of the fuel tank flange

8

Refitting the fuel tank flange

9

Refitting the fuel tank

10

6 - Airbox - Throttle Body

Removal of the throttle body
Refitting the airbox and throttle body

14
15
23

A**7 - Air intake**

Removal of the air filters
Refitting the air filters

29
30
31

B**8 - Exhaust system**

Removal of the exhaust system
Refitting the exhaust system

32
33
37

C**Section M****Injection - ignition system****2 - Fuel injection-ignition system**

3

D**3 - System components**

Electronic Control Unit (ECU)
Removal of the battery support
Refitting the battery support
Electric injector
Air pressure sensor
Coolant temperature sensor
Air temperature sensor
Ignition coils
Throttle Position Sensor (TPS)
Rpm/timing sensor
Injection relay
CAN Line

4
4
6
9
14
15
16
17
18
21
22
23
24

E**F****G****Section N****Engine****1 - Removal-refitting of the engine assembly**

Removal of the engine
Refitting the engine

5
6
9

L**2.1 - Lubrication system: oil pump**

Removal of the oil pump
Disassembly of the oil pump
Reassembly of the oil pump
Refitting the oil pump

10
11
12
13
14

M**2.2 - Lubrication system: oil cooler**

Removal of the lubrication system
Oil cooler inspection
Refitting the lubrication system

15
16
18
18

N**P**

	3.2 - Cooling system: radiator	20
A	Removal of the radiator	21
	Renewal of the cooling fan	23
	Refitting the radiator	24
	Removal of the cooling system hoses and unions	26
B	Refitting the cooling system hoses and unions	29
	3.3 - Cooling system: water pump	32
	Removal of the water pump	33
	Refitting the water pump	36
C	4.1 - Cylinder head assemblies: checks and adjustments	41
	Checking and adjusting the valve clearances	42
	Checking valve lift	44
	Checking the engine timing	46
D	4.2 - Cylinder head assemblies: timing	49
	Removal of the timing belt covers	50
	Removal of the tensioner pulley/timing belt	51
	Removal of the camshaft pulleys/idler pulley	51
E	Removal of the tensioner and idler pulley mounting studs	52
	Disassembly of the camshaft pulleys	53
	Removal of the timing belt driveshaft pulleys	54
	Refitting the timing belt driveshaft pulleys	56
	Refitting the idler and tensioner pulley mounting studs	58
F	Reassembly of the timing pulleys	59
	Refitting the camshaft pulley/idler pulley	60
	Refitting the timing belts	63
	Refitting the timing covers	65
G	4.4 - Cylinder head assemblies: camshafts	66
	Removal of the camshafts	67
	Checking the camshafts and supports	69
	Refitting the camshafts	70
H	Removal of the intake manifold and coolant union	76
	Refitting the intake manifold and coolant union	77
	4.5 - Cylinder head assemblies: valves–rocker arms	78
	Removal of the cylinder heads	79
L	Removal of the valves	80
	Removal of the valve rocker arms	81
	Overhaul of cylinder head components	84
	Reassembly of the cylinder head	91
	Fitting the cylinder head assemblies	98
M	5 - Cylinder/piston assemblies	100
	Disassembly of the cylinder/piston	101
	Overhaul of the cylinder barrel/piston components	104
	Refitting the cylinder/piston assembly	109
N	6.1 - Clutch assembly: clutch	113
	Description	114
	Disassembly of the clutch	115
P	Inspection and overhaul of the clutch components	120
	Reassembly of the clutch	122

6.2 - Clutch assembly: right-hand side crankcase cover	126	
Removal of the right-hand side crankcase cover	127	A
Disassembly of the right-hand side crankcase cover	128	
Reassembly of the right-hand crankcase cover	129	
Refitting the right-hand side crankcase cover	131	
6.3 - Clutch assembly: primary drive gears	133	B
Removal of the primary drive gears	134	
Refitting the primary drive gears and checking backlash	137	
7.1 - Gearbox assembly: gearchange mechanism	140	C
Removal of the gearchange mechanism	141	
Disassembly of gear interlock plunger and pawl assembly	143	
Refitting the gear interlock plunger and pawl assembly	144	
Refitting the gearchange mechanism	145	
7.2 - Gearbox assembly: gearbox shafts	147	D
Removal of the gearbox assembly	148	
Disassembly of the gearbox shafts	150	
Overhaul of the gearbox	155	
Inspection of the gear selector forks	156	E
Inspection of the gear selector drum	157	
Reassembly of the gearbox shafts	158	
Reassembly of the gearbox	162	
8 - Flywheel/alternator	163	F
Removal of the left-hand side crankcase cover	164	
Disassembly of the left-hand crankcase cover	166	
Removal of the flywheel/alternator assembly	167	
Overhaul of the flywheel/alternator assembly	169	
Refitting the flywheel/alternator assembly	177	G
Refitting the left-hand crankcase cover	179	
9.1 - Crankcase assembly: external components	182	H
Removal of external components	183	
Refitting the external components	186	
Removal of the timing gears	190	
Refitting the timing gears	191	
Removal of the starter motor idler gear	192	
Refitting the starter motor idler gear	193	L
Checking the engine sensor air gap	194	
9.2 - Crankcase assembly: crankcase halves	195	M
Separation of the crankcase halves	196	
Overhaul of the crankcase halves	199	
Main bearings	203	
Reassembly of the crankcase halves	204	
Shimming the shafts	207	
Reassembly of the crankcase halves	212	N
9.3 - Crankcase assembly: connecting rods	218	
Removal of the connecting rods assembly	219	
Disassembly of the connecting rods	220	
Overhaul of the connecting rods	221	
Reassembly of the connecting rods	226	P
Refitting the connecting rods.	228	

A	Section P	
	Electric system	
B	1 - Wiring diagram	4
	Key to wiring diagram	5
	Wiring colour codes	6
	Key to fusebox	6
	Routing of wiring on frame	7
C	Plate 1	9
	Plate 2	9
	Plate 3	10
	Plate 4	10
	Plate 5	11
D	Plate 6	11
	Plate 7	12
	Plate 8	13
	Plate 9	14
	Plate 10	14
E	Plate 11	15
	Plate 12	15
	Plate 13	16
	Plate 14	17
	Plate 15	18
F	Plate 16	19
	Plate 17	20
	Plate 18	21
	Plate 19	22
	Plate 20	23
G	Plate 21	24
	Plate 22	24
	Plate 23	25
	Plate 24	26
H	Plate 25	27
	Plate 26	28
	Plate 27	29
	Plate 28	30
	Plate 28	31
L	Plate 29	32
	Plate 30	33
	Plate 31	34
	Plate 32	35
	Plate 33	36
M	Plate 34	37
	Plate 35	38
	2 - Battery charging system	39
N	Checking the battery charging system	39
	Recharging the battery	40
	Topping up the electrolyte	41
	Battery	44
	Alternator	46
P	Regulator/rectifier	49

3 - Electric starting system	52	
Electric starting system	52	A
Starter motor	53	
Starter contactor	56	
4 - Lights and indicating devices	59	B
Changing light bulbs	59	
High beam headlights relay	62	
Headlight aim	64	
5 - Indicating devices	65	C
Checking the indicating system components	65	
Coolant temperature sensor	72	
Fan relay	73	
Checking operation of the fan relay	73	
Changing light bulbs	74	D
6 - Protection and safety devices	78	
Checking protection and safety device components	78	
Checking the fuses	80	E
7 - Instruments	81	
Instrument panel	81	
Instrument panel system	82	
Display settings and functions	84	F
8 - Immobilizer and transponder	102	
9 - Diagnostic instruments	110	G
Using a multimeter to check the electrical systems	110	
10 - USB Data Acquisition (DAQ) (for 1098S only)	112	

H**L****M****N****P**

General

A
B
C
D
E
F
G
H
L
M
N
P

section		General
A		
A	1 - How to use this manual	3
	Layout of the manual	4
B	2 - Symbols - Abbreviations - References	5
	Product specifications	6
B	3 - Hazardous Products - Warnings	8
	General safety rules	8
	General maintenance indications	10
C		
D		
E		
F		
G		
H		
L		
M		
N		
P		

2

1098/1098S - M.Y. 2007 - edition 00

1 - How to use this manual

This manual has been prepared for technical personnel at Ducati Authorized Service Centres with 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, since we consider that specialized technical personnel 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

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E

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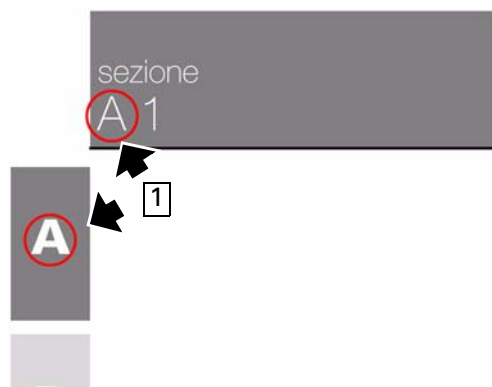
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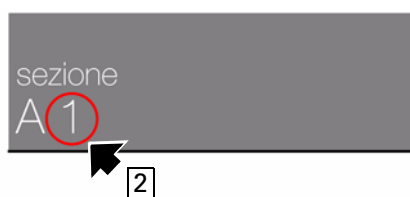
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Layout of the manual

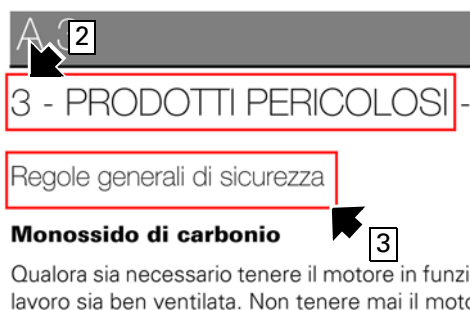
This manual is divided into sections (1), each identified by a letter.



Each section (1) includes several chapters (2), which are numbered consecutively.



The chapters (2) may be further subdivided into paragraphs (3).



The manual describes all repair operations starting from the fully assembled motorcycle.

The full procedure is described up to the point in which the motorcycle is restored to its fully assembled starting condition.

Important

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

Important

The layout of the manual is designed in such a way as to be applicable to all the different models manufactured by DUCATI MOTOR HOLDING.

To facilitate reading of the manual, the table of contents of the chapters is identical for all motorcycle models.

2 - Symbols - Abbreviations - References

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

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



Warning

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



Important

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



Notes

This symbol indicates additional useful information for the current operation.

Text references

(X)

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

(X)

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

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C

D

E

F

G

H

L

M

N

P

Product specifications

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

Symbol	Specifications	Recommended product
	Engine oil (for specifications, see Sect. C 2, Fuel, lubricants and other fluids).	SHELL Advance Ultra 4
	DOT 4 special hydraulic brake fluid.	SHELL Advance Brake DOT 4
	SAE 80-90 gear oil or special products for chains with O-rings.	SHELL Advance Chain or Advance Teflon Chain
	Anti-freeze (nitride, amine and phosphate free) 30 to 40% solution in water.	SHELL Advance coolant or Glycoshell
	GREASE A Multipurpose, medium fibre, lithium grease.	SHELL Alvania R3
	GREASE B Molybdenum disulphide grease, high mechanical stress and high temperature resistant.	SHELL Retinax HDX2
	GREASE C Bearing/joint grease for parts subject to prolonged mechanical stress. Temperature range: -10 to 110 °C.	SHELL Retinax LX2
	GREASE D Protective grease, with anti-corrosive and waterproofing properties.	SHELL Retinax HD2
	GREASE E PANKL grease - PLB 05.	
	GREASE F OPTIMOL grease - PASTE WHITE T.	
	LOCK 1 Low-strength threadlocker.	Loctite 222
	LOCK 2 Medium-strength threadlocker, compatible with oil.	Loctite 243
	LOCK 3 High-strength threadlocker for threaded parts.	Loctite 270
	LOCK 4 Flange sealant resistant to high mechanical stress and solvents. Resists high temperatures (up to 200 °C) and pressures up to 350 Atm; fills gaps up to 0.4 mm.	Loctite 510
	LOCK 5 Permanent adhesive for smooth or threaded cylindrical fasteners on mechanical parts. High resistance to mechanical stress and solvents. Temperature range: -55 to 175 °C.	Loctite 128455
	LOCK 6 Pipe sealant for pipes and medium to large fasteners. For water and gases (except oxygen). Maximum filling capacity: 0.40 mm diameter clearance.	Loctite 577
	LOCK 7 Speed bonder for rubber and plastics with elastomer charged ethylic base.	Loctite 480

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

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C

D

E

F

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H

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3 - Hazardous Products - Warnings

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General safety rules

Carbon monoxide

B

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.

C

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 the area in which fuel is stored.

D



Warning

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

Hot parts

E



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.

F



Warning

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

Used engine oil

G



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.

H

Brake pad dust

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



Warning

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

L

Brake fluid



Warning

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

M

Coolant

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

N



Warning

Take care not to spill engine coolant on the exhaust system or engine parts. These parts may be hot and ignite the coolant, which will subsequently burn with invisible flames.

P

Coolant (ethylene glycol) is an irritant and is poisonous when ingested. Keep away from children.

Never remove the radiator cap when the engine is hot. The coolant is under pressure and will cause severe burns if it comes into contact with the skin.

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

Battery



Warning

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

A

B

C

D

E

F

G

H

L

M

N

P

General maintenance indications

A

Useful tips

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

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

B

C

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.

D

E

F

G

H

L

M

N

P

Information about the model

A
B
C
D
E
F
G
H
L
M
N
P

A	1 - Identification data	3
	Identification data for the Superbike 1098	3

B

C

D

E

F

G

H

L

M

N

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1 - Identification data

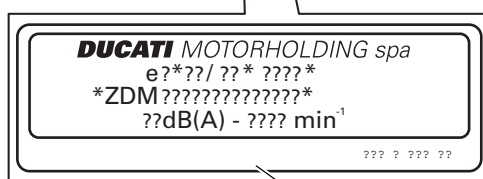
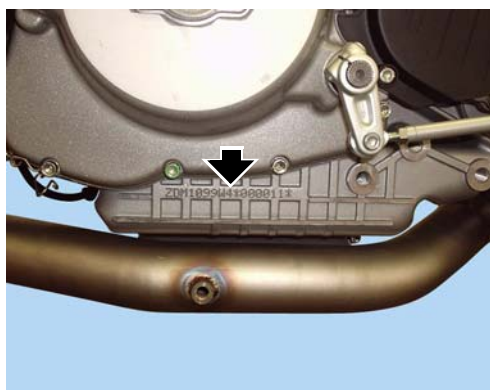
Identification data for the Superbike 1098

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



Notes

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



A

A

B

C

D

E

F

G

H

L

M

N

P

Data stamped on the frame

Europe version

- 1 Manufacturer: Ducati Motor Holding
- 2 Type, same on all 1098 models.
- 3 Variant
- 4 Version
- 5 Year of manufacture (7=2007)
- 6 Manufacturing facility
- 7 Progressive serial No.

Data stamped on the frame
Europe version

ZDM H7 00 AA X B 000001

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 (7=2007)
- 5 Manufacturing facility
- 6 Progressive serial No.

Data stamped on the frame
US version

ZDM 1 X B EW ★ X B 000000

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

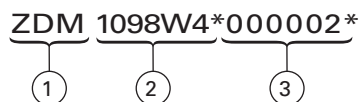
Data stamped on engine

Europe version

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

Data stamped on engine
Europe version

ZDM 1098W4*000002*



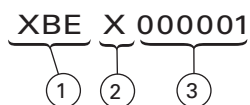
Data stamped on engine

US version

- 1 Engine type
- 2 Model year
- 3 Progressive production No.

Data stamped on engine
US version

XBE X 000001



A

B

C

D

E

F

G

H

L

M

N

P

Technical data

A

B

C

D

E

F

G

H

L

M

N

P

	1.1 - Technical specifications	3
A	General	3
	Colours	4
	Transmission	4
	Timing system/valves	5
B	Crankshaft	5
	Cylinder/Piston	5
	Gearbox	6
	Cooling system	6
	Front wheel	6
C	Front suspension (1098)	6
	Front suspension (1098S)	7
	Rear wheel	7
	Rear suspension (1098)	7
	Rear suspension (1098S)	7
D	Hydraulic brakes	8
	Charging system/alternator	8
	Injection - ignition system	8
	Fuel system	8
	Lights/instrument panel	9
E	1.2 - Dimensions	10
	2 - Fuel, lubricants and other fluids	11
F	3 - Torque settings	12
	Frame torque settings	12
	Engine torque settings	13
G	4 - Service tools	16
	Special tools for the engine	16
	Special tools for the frame	22
H		
L		
M		
N		
P		

1.1 - Technical specifications

General

	Reference	Technical specifications
Motorcycle dimensions	Total length	2100 ± 20 mm
	Total width	730 ± 20 mm
	Total height	1110 ± 20 mm
	Wheelbase	1430 ± 20 mm
	Handlebar height	875 ± 20 mm
	Dry weight without liquids and battery	186 kg (1098S), 188 kg (1098)
	Weight fully laden	No greater than 390 kg
Frame	Type	AL450 steel tube trellis frame
Subframe	Type	AL450 steel tube trellis frame
	Steering head angle	23° 30' - 24° 30'
	Steering angle	28° 30' RH - 28° 30' LH
	Steering damper	Showa (1098) Öhlins (1098S)
	Front suspension (1098)	SHOWA: upside-down hydraulic fork with adjustable compression, rebound and spring preload. Fork leg dia. 43 mm, TIO treated
	Front suspension (1098S)	ÖHLINS: FG315 hydraulic upside-down radially mounted fork with adjustable compression, rebound and spring preload. Fork leg dia. 43 mm, TIN treated.
	Travel along leg axis:	127 mm (1098) 120 mm (1098S)
	Rear suspension (1098)	SHOWA: Progressive linkage with a rocker arm connecting the frame and upper pivot point of the shock absorber. The shock absorber has adjustable rebound and compression damping and spring preload. At the lower pivot point it is connected to the swingarm. The swingarm hinges on a pivot shaft that passes through the frame and engine. Wheel travel: 127 mm. Shock absorber travel: 59.5 mm.
	Rear suspension (1098S)	ÖHLINS: Progressive linkage with a rocker arm connecting the frame and upper pivot point of the shock absorber. The shock absorber has adjustable rebound and compression damping and spring preload. At the lower pivot point it is connected to the swingarm. The swingarm hinges on a pivot shaft that passes through the frame and engine. Wheel travel: 127 mm. Shock absorber travel: 59.5 mm.
	Front wheel	Lightweight alloy, 5Y-spokes
	Front wheel size	MT 3.50x17"
	Front tyre size	120/70 - ZR 17
	Rear wheel	Light alloy, five Y-spokes with cush drive
	Rear wheel size	MT 6.00x17"
	Rear tyre size	190/55 - ZR 17
	Type of tyre	Radial tubeless tyres

A	Reference		Technical specifications
	Front brake		Hydraulic with 2 calipers
	Rear brake		Hydraulic with 1 caliper
B	Engine	Type	Longitudinal 90° "L" twin cylinder, four-stroke
		Bore	104 mm
		Stroke	64.7 mm
		Displacement	1099 cm³
C		Compression ratio	12.5 ± 0.5:1
		Max power at crankshaft (95/1/EC)	113 kW (156 CV) @ 9750 rpm
		Max power at crankshaft on acceleration bench	117 kW (160 CV) @ 9750 rpm
		Max torque at crankshaft (95/1/EC)	116 Nm (10.81 Kgm) at 8000 rpm
D		Maximum crankshaft torque measured on acceleration bench	122 Nm (11.1 Kgm) at 8000 rpm
		Idling speed	1300±50 rpm
		Max. engine speed	10700 rpm
E		Timing system	With toothed belt, double overhead camshaft, 4 valves per cylinder and 8 rocker arms
		Lubrication system	Forced lubrication by pump, with oil cooler
		Oil pump type	Gear pump
F		Cooling system	Liquid cooling
		Air filter	Two filter units
		Crankshaft type	One-piece
Colours			
G	Description		Part no.
	1098/1098S	Ducati Anniversary Red	F_473.101 (PPG)
		Transparent	228.880 (PPG)
H	Red frame with black wheels		
	Transmission		
L	Reference		Technical specifications
	Clutch		Dry multi-plate clutch
	Clutch control		Hydraulic
M	Gearbox		6 speed
	Primary drive		32/59
	Final drive		15/38
N	Gearbox type		With constant mesh spur gears, operated by a lever on the left side of the bike
	Transmission	Gear ratios	
		1 st	15/37
P		2 nd	17/30
		3 rd	20/28
		4 th	22/26
		5 th	23/24
		6 th	24/23

Timing system/valves

	Reference	Adjusting clearance	Checking clearance
Timing diagram	With 1 mm valve clearance		
	Intake	Opening 15° B.T.D.C. Closing 58° A.B.D.C	
	Exhaust	Opening 60° B.B.D.C. Closing 20° A.T.D.C.	
	Intake valve diameter Exhaust valve diameter	42 mm 34 mm	
Valve lift	With 0 mm valve clearance	Intake 11.8 mm Exhaust 10.6 mm	
	Opening rocker - intake	0.13÷0.18 mm	0.10 to 0.25 mm
	Opening rocker - exhaust	0.13÷0.18 mm	0.10÷0.25 mm
	Closing rocker - intake	0.05÷0.10 mm	0.05÷0.25 mm
	Closing rocker - exhaust	0.05÷0.10 mm	0.05 to 0.25 mm
Belt tensioning	DDS	110 Hz (horizontal) 110 Hz (vertical)	110 Hz (horizontal) 110 Hz (vertical)
	Minimum limit value	70 Hz	70 Hz

Crankshaft

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

Cylinder/Piston

	Reference	Standard value	Service limit
Cylinder barrel	Max. bore ovality		0.03 mm
	Max. bore taper		0.03 mm
	Diameter Section A Section B Section C	104.000 mm to 104.010 mm 104.010 mm to 104.020 mm 104.020 mm to 104.030 mm	
Piston-to-bore clearance		0.085÷0.105	
Piston	Piston outside diameter measured at 6.0 mm from piston base	100 mm	0÷0.01 mm
	Diameter Section A Section B Section C	103.905 mm to 103.915 mm 103.915 mm to 103.925 mm 103.925 mm to 103.935 mm	
Connecting rod	Connecting-rod big-end diameter	45 mm	
	Crankshaft class	Connecting rod class	Bearings colour
Big-end bearing pairings	A B A B	A A B B	Blue + Yellow Yellow + Yellow Blue + Blue Blue + Yellow
Gudgeon pin-to-piston clearance		0.010 to 0.018 mm	0.035 mm
Gudgeon pin-to-connecting rod clearance		0.035 to 0.048 mm	0.065 mm

A	Reference		Standard value	Service limit
	Engine cylinder compression measured with DDS instrument	13÷15 bar	11 bar (MIN.), difference between the two cylinders: 2 bar (MAX.)	
B	Gearbox			
		Reference	Standard value	Service limit
C	Gearbox shafts	Endfloat		0.05 to 0.25 mm
	Selector drum	Endfloat		0.10÷0.40 mm
	Gear selector fork	Selector fork end thickness	3.90÷4.00 mm	
		Selector fork-to-gear clearance	0.070÷0.285 mm	0.4 mm
D	Cooling system			
		Reference	Technical specifications	
E	Type	Loop water cooling with double-fan curved radiator and mixing thermostat		
	Coolant capacity	2.7±0.5 litres		
F	Front wheel			
		Reference	Standard value	Service limit
G	Minimum tread depth	In the most worn part		2 mm
	Tyre pressure	(Cold)	2.1 bar - 2.3 kg/cm ²	
	Axle runout	On 100 mm		0.2 mm
	Wheel rim runout	Radial	0.8 mm	2 mm
H		Axial	0.5 mm	2 mm
	Front suspension (1098)			
I		Reference	Technical specifications	
	Type	Showa: Hydraulic upside-down fork equipped with external adjusters for adjustment of rebound and compression damping and preload (for inner springs of fork legs).		
J	Fork	Stanchion diameter	43 mm	
		Travel along leg axis	127 mm	
K		Hydraulic damping standard setting. Unscrew the adjuster from fully closed position (counter clockwise)	compression: 3/4 turn rebound: 12 clicks	
		Spring preload	18 mm	
L		Oil charge per leg	439 cc	
M				
N				
P				

Front suspension (1098S)

	Reference	Technical specifications
Type		Öhlins: FG315 hydraulic upside-down radially mounted fork with external adjusters for adjustment of rebound, compression, and preload (for inner springs of fork legs).
Fork	Stanchion diameter:	43 mm
	Travel along leg axis:	120 mm.
	Hydraulic damping standard setting. Unscrew the adjuster from fully closed position (counter clockwise)	compression: 8 clicks rebound: 10 clicks
	Oil capacity per fork leg	155 mm

Rear wheel

	Reference	Standard value	Service limit
Minimum tread depth	In the most worn part		2 mm
Tyre pressure	(Cold)	2.2 bar - 2.4 kg/cm ²	
Swingarm pivot shaft runout	On 100 mm		0.2 mm
Wheel rim runout	Radial	0.8 mm	2 mm
	Axial	0.5 mm	2 mm
Chain	Make Type	DID 525 HV 2	
	Dimensions	5/8" x 5/16"	
	No. of links	97+1 joining link	

Rear suspension (1098)

	Reference	Technical specifications
Type		Showa: progressive monoshock with adjustable rebound, compression and spring preload
Shock absorber	Travel	59.5 mm
	Standard setting	compression: 2 turns rebound: 2 turns
	Spring preload	28 mm
	Wheel travel	127 mm

Rear suspension (1098S)

	Reference	Technical specifications
Type		Öhlins: progressive monoshock with adjustable rebound, compression and spring preload
Shock absorber	Travel	59.5 mm
	Unscrew the adjuster from fully closed position (clockwise)	compression: 10 clicks rebound: 10 clicks
	Spring preload	23 mm
	Wheel travel	127 mm

Hydraulic brakes

	Reference	Standard value	Service limit
FRONT			
Brake disc	Type	Semi-floating drilled dual disc	
	Shim	4.5 ± 0.1 mm	4 mm (min.)
	Braking surface material	Steel	
	Flange material	Aluminium	
	Disc diameter	330 mm	
Brake caliper	Make	Brembo	
	Type	M4 - 34	
	Pad friction material	TT2910	
Brake master cylinder	Type	PR 18/19	
REAR			
Brake disc	Type	Fixed drilled disc	
	Shim	5 ± 0.1 mm	4.5 mm (min.)
	Material	Steel	
	Diameter	245 mm	
Brake caliper	Make	Brembo	
	Type	P 34 C	
	Pad friction material	FERIT I/D 450 FF.	
Brake master cylinder	Type	PS11b	

Charging system/alternator

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

Injection - ignition system

	Reference	Technical specifications
Ignition	Type	Inductive electronic ignition
Starting	Type	Electric starter motor 12 V-700 W
Spark plugs	Make and type	NGK MAR10A - J
	Electrode gap	0.6÷0.7 mm
Fuel system	Unleaded fuel	95-98 RON
	Throttle body	ø 60 mm
	Injectors per cylinder:	1
	Holes per injector:	12

Fuel system

	Make	Type
Electronic Control Unit	Marelli	5AM2

Lights/instrument panel

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

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1.2 - Dimensions



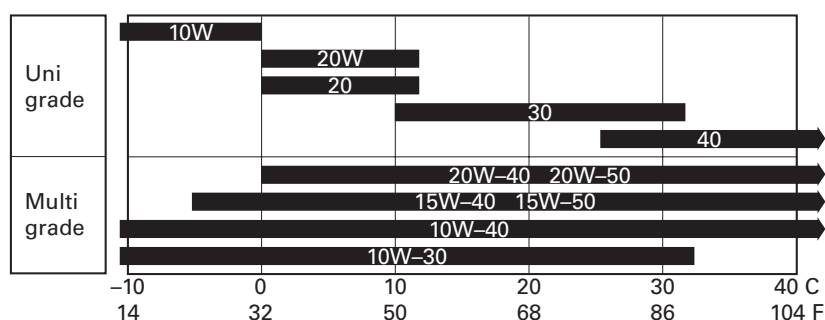
2 - Fuel, lubricants and other fluids

Fuel, lubricants and other fluids	Type	dm ³ (litres)
Fuel tank, including a reserve of 3 dm ³ (litres)	Unleaded fuel with 95 fuel octane rating (at least)	15.5
Lubrication circuit	SHELL Advance Ultra 4	3.4
Front/rear brake and clutch circuits	SHELL Advance Brake DOT 4	-
Protection for electrical contacts	SHELL Advance Contact Cleaner	-
Front fork for 1098 only	SHELL Advance Fork 7.5 or DONAX TA	0.511 (each leg)
Front fork for 1098S only	SHELL Advance Fork 7.5 or DONAX TA	115 mm (each leg) oil level height
Cooling system	SHELL Advance Coolant or Glyco SHELL 35-40% + water	2.3



Important

The use of fuel or lubricant additives is not permitted.



Engine oil

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

Oil viscosity

SAE 10W-40

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

3 - Torque settings

A

Frame torque settings

Part	Thread (mm)	Nm ±10% Tolerance	Notes
------	-------------	-------------------	-------

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Engine torque settings

Part	Thread (mm)	Nm	Min.	Max.	Notes
Idler and tensioner pulley bolts	M20x1	50	45	55	LOCK 2 or TB1324
Camshaft pulley retaining nut	M17x1	71	64	78	GREASE A
Rocker arm shaft covers	M12x1.25	15	14	16	LOCK 2 or TB1324
Coolant temperature sensor on coolant outlet union	M12x1.5	23	20	26	LOCK 4 – Restrain the insert when tightening
Cylinder head nut:	M10x1.5				Apply GREASE C to the underside of the nut and the thread of the stud
Stage 1	20				
Stage 2	40	38	42		
Stage 3	60	57	63		
Cam cap bolt:	M8x1.25	Apply Shell Ultra 4 grease			
Stage 1		10	9	11	
Stage 2		22.5	21	25	
Coil retaining screw	M6x1	10	9	11	
Pulley flange retaining bolts	M6x1	10	9	11	
Rocker cover bolt	M6x1	10	9	11	
Exhaust manifold stud	M6x1	10	9	11	LOCK 2 or TB1324
Vacuum gauge connection screw on cylinder head	M6x1	5	4	6	LOCK 2 or TB1324
Evaporative emissions canister fitting on cylinder head	M6x1	5	4	6	LOCK 2 or TB1324
Air breather fitting on horizontal cylinder head	M6x1	5	4	6	LOCK 2
Air breather blanking screw on vertical cylinder head	M6x1	10	9	11	LOCK 6
Intake manifold bolt	M6x1	10	9	11	
Bolts securing coolant unions to cylinder head	M5x1	8	7	9	pre-applied Tecnologic 150 threadlocker
Oil cartridge	M16x1.5	11	10	12	Engine oil on gasket
Oil cartridge nipple	M16x1.5	42	38	46	LOCK 2 or TB1324
Oil pick-up pipe plug	M14x1.5	24	21	27	LOCK 5 or TB1375B
Oil drain plug	M12x1.5	20	18	22	
Clutch cover oilway blanking plug	M10x1.5	15	13	17	LOCK 5
Neutral sensor	M10x1.25	10	9	11	
Oil pump adapter bolt	M10x1				LOCK 5 or TB1375B
Clutch cover inner oilway screw	M10x1.5	15	13	17	LOCK 5
Cylinder head/barrel stud	M10x1.5	25	23	26	LOCK 2 or TB1324
Hor. cylinder cover + swingarm attachment bolt:	M8x1.25				
Stage 1		19	22	28	
Stage 2		25	22	28	
Vertical cylinder cover bolt:	M8x1.25				
Stage 1		19	22	28	
Stage 2		25	22	28	
Gear stop lever bolt	M8x1.25	18	16	20	LOCK 2 or TB1324
Blow-by valve bolt	M6x1	10	9	11	
Chain side secondary bearing retaining bolt	M6x1	10	9	11	LOCK 2
Clutch side primary bearing retaining bolt	M6x1	10	9	11	LOCK 2 or TB1324
Crankcase screw – idler area	M6x1	10	9	11	

	Part	Thread (mm)	Nm	Min.	Max.	Notes
A	Outer crankcase screw	M6x1	9	8.5	9.5	
	Oil pick-up gauze filter bolt	M6x1	14	13	15	
	Left-hand side crankcase cover screw	M6x1	10	9	11	
B	Bosch sensor bolt	M6x1	10	9	11	
	Right-hand side crankcase cover screw	M6x1	9	8.5	9.5	
	Chain cover oil circuit blanking screw	M6x1	5	4	6	LOCK 5
C	Right-hand side crankcase cover screw	M6x1	9	8.5	9.5	
	Under-piston oil jet retaining screw	M5x0.8	8	7	9	LOCK 2 or TB1324
	Oil cooler nipple	M14x1.5	27	24	30	LOCK 5 or TB1375B
D	Vertical cylinder cover bolt: Stage 1	M8x1.25	19	22	28	
	Stage 2		25	22	28	
	Crankcase hollow screw		20	18	22	
E	Left-hand side crankcase cover screw	M6x1	10	9	11	
	Drylock left-hand side crankcase cover screw	M6x1	10	9	11	pre-applied Loctite 516
	Starter motor mounting bolt	M6x1	10	9	11	LOCK 2 or TB1324
F	Starter motor rear bolt	M6x1	10	9	11	LOCK 2 or TB1324
	Idler gear shaft retaining bolt	M6x1	10	9	11	LOCK 2 or TB1324
	Front sprocket retaining nut	M24x1	190	171	209	GREASE B
G	Flywheel retaining nut	M24x1	330	313	346	LOCK 5
	Connecting rod cap bolts: Stage 1	M10x1	35			Apply GREASE B to thread
	Pause for 2 sec., then back off through 360°					
H	Stage 2		20			
	Stage 3		35			
	Stage 4, Angle-tighten 65°±1°					
I	Torque check		70÷103			
	Crankshaft grub screw	M8x1.25	13	11	15	TB 1375B
	Drilled crankshaft grub screw	M8x1.25	13	11	15	TB 1375B
J	Selector drum locating screw	M16x1.5	30	27	33	
	Gear stop lever screw	M8x1.25	18	16	20	LOCK 2 or TB1324
	Selector claw bolt	M8x1.25	25	22	28	
K	Selector claw locator nut	M6x1	10	9	11	
	Selector claw bolt	M6x1	9	8.5	9.5	LOCK 2 or TB1324
	Idler and tensioner pulley bolts	M20x1	50	45	55	LOCK 2 or TB1324
L	Camshaft pulley retaining nut	M15x1	71	64	78	GREASE A
	Timing belt driveshaft gear nut	M14x1	55	50	60	GREASE A
	Idler and tensioner pulley nut	M8x1.25	25	22	28	GREASE A
M	Timing belt cover screw	M6x1	10	9	11	LOCK 2 or TB1324
	Self-tapping screw for timing belt cover filter	M3.5				
	Dry clutch centre nut	M25x1	250	236	264	LOCK 5
N	Oil filler plug	M22x1.5	5	5	6	
	Wet clutch centre nut	M20x1	120	115	125	GREASE B
	Oil temperature sensor	M12x1.5	18	16	19	LOCK 4
P	Oilway blanking plug	M10x1	20	18	22	LOCK 5

Part	Thread (mm)	Nm	Min.	Max.	Notes
Dry clutch drum bolts	M8x1.25	35	33	37	LOCK 4
Right-hand side crankcase cover screw	M6x1	9	8.5	9.5	
Clutch spring bolt	M5x0.8	5	5	7	
Coolant inlet union	M30x1.5	25	23	27	LOCK 5
Coolant outlet union	M22x1.5	25	23	27	LOCK 5
Pick-up sensor inspection screw	M12x1	15	13	17	LOCK 2 or TB1324
Water pump cover plug	M10x1	20	18	22	
Spark plug	M10x1	12	11	13	
Coolant pump bearing stop screw	M6x1	10	9	11	LOCK 2 or TB1324
Stator wiring clamp bracket bolt	M6x1	10	9	11	LOCK 2 or TB1324
Water pump cover plug	M6x1	10	9	11	
Left-hand crankcase cover screw	M6x1	10	9	11	
Inspection cover screw	M6x1	4.5	4.5	6	
Alternator rotor/flywheel bolt	M6x1	13	11	15	LOCK 2 or TB1324
By-pass pump cap	M15x1	25	22	28	LOCK 2 or TB1324
Oil pump retaining bolt	M6x1	10	9	11	
Oil pump retaining bolt	M8x1.25	26	23	29	
Oil pump retaining bolt	M6x1	10	9	11	
Coolant outlet union	M22x1.5	25	23	27	LOCK 5
Coolant circuit hose clamps		2.5	2	3	

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



Notes

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

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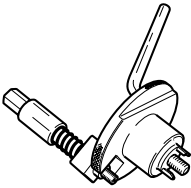
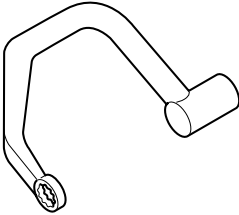
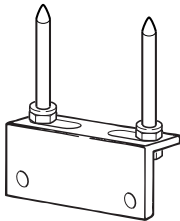
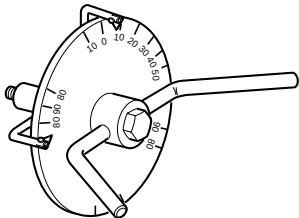
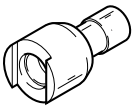
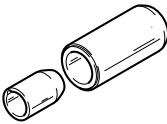
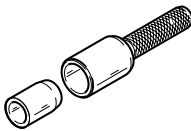
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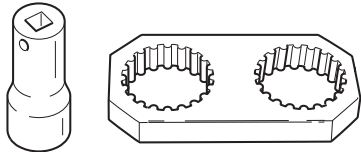
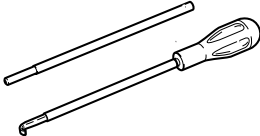
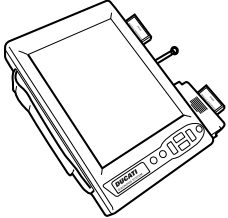
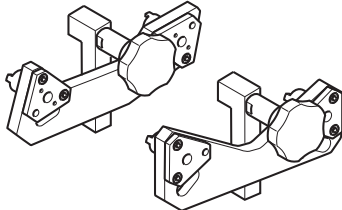
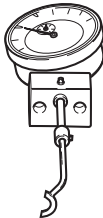
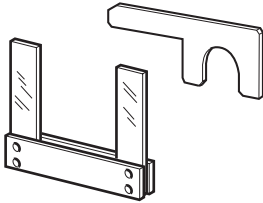
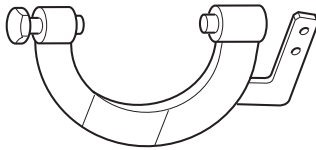
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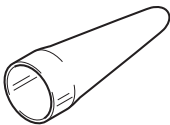
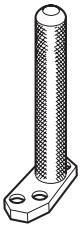
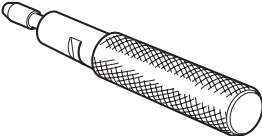
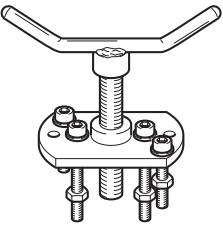
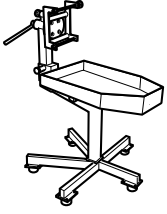
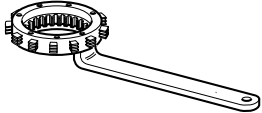
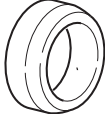
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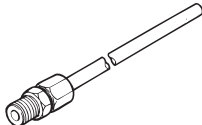
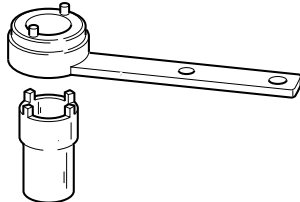
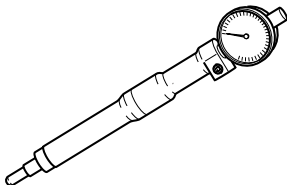
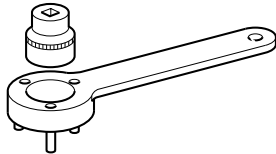
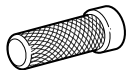
4 - Service tools

Special tools for the engine

Part No.	Designation	
88713.2011	Tool to lock crankshaft at Top Dead Centre	
88713.2676	Wrench for tightening cylinder head nuts	
88713.2103	Stand for cylinder head assembly	
88765.1523	Timing check tool	
88713.1821	Wrench for tightening timing belt tensioner pulley shafts	
88713.2861	Camshaft oil seal installer	
88713.2060	Gearbox output shaft oil seal installer	

Part No.	Designation		
88713.1806	Tool for tightening Z=20 camshaft pulley		A B
88713.2069	Rocker spring tensioning kit		C
97900.0215	DDS (Ducati Diagnosis System) + cylinder negative pressure measuring kit		D E
88765.1524	Timing belt pulley timing tools		F
88765.1518	Valve lift gauge		G H
88713.2878	Fork-type feeler gauge 0.1 mm, 0.2 mm, 0.3 mm		L M
88713.2874	Alternator holding tool for tightening nut		N P

Part No.	Designation	
88713.1920	Tool for installing O-rings on crankcase studs	
88713.2827	Plate for gear selector fork positioning	
88713.2442	Tool for installing valve guide seals	
88713.1749	Puller for drive pulley and cover	
88713.1832	Engine repair bench	
88713.2133	Clutch centre wrench	
88700.5665	Clutch cover assembly tool	

Part No.	Designation	
88713.1886	Engine cover sheet	
88713.1010	Exhaust gases pick-up connector	
88713.1805	Tool for tightening timing belt driveshaft pulley	
88765.1188	Top Dead Centre test gauge	
88713.2102	Wrench for tightening primary sprocket ringnut	
88713.0869	Water pump front seal installer	
88713.0870	Installation tool for counter plate for water pump front seal	

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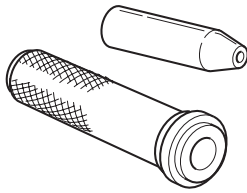
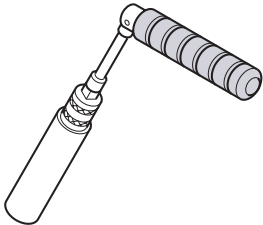
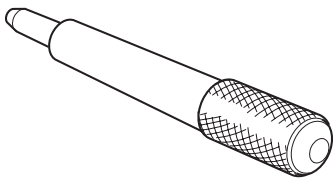
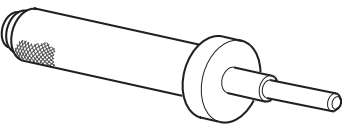
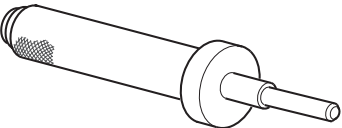
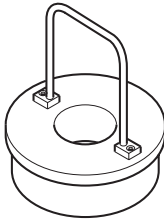
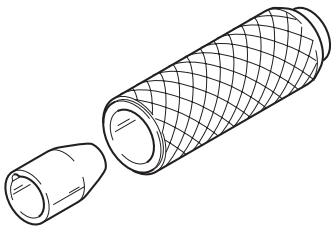
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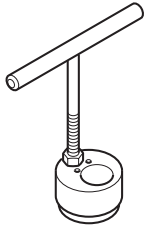
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Part No.	Designation	
88700.5749	Crankcase assembly cap	
88713.2877	Sparkplug wrench	
88713.2842	Inlet/exhaust valve guide installer	
88713.2846	Exhaust valve seat installer	
88713.2847	Inlet valve seat installer	
88713.2870	Connecting rod guide tool	
88713.2834	Punch and sleeve for installing camshaft circlip	

Part No.

Designation

88713.2832	Timing belt tensioner pulley wrench	
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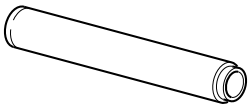
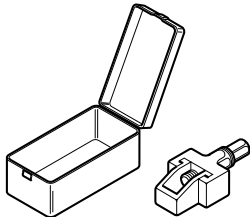
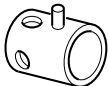
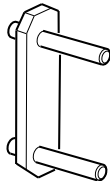
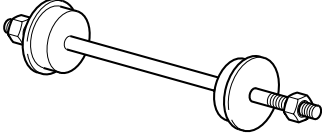
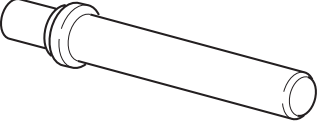
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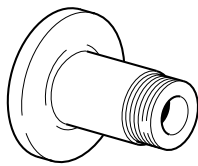
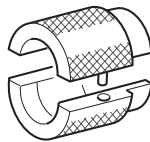
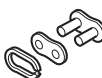
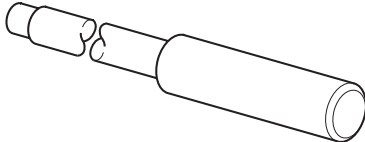
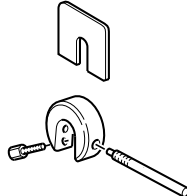
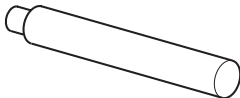
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Special tools for the frame

A	Part no.	Designation	
B	88713.1072	Drift for installing half bearing in bottom yoke	
C	88713.1213	Chain assembly tool	
D	8000.70139	Front wheel axle wrench	
E	88713.1040	Engine/frame support	
F	88713.1058	Wrench for steering stem nut	
G	88713.1062	Tool for installing steering head bearings	
H	88713.1071	Drift for installing rocker arm roller bearings	

Part no.	Designation	
88713.1073	Real wheel balancing tool	
88713.1038	Wrench for adjustment of the eccentric hub	
88713.1096	Tool for overhauling SHOWA forks/fitting oil seals	
677.4.003.1A	Chain joining link	
88713.1074	Swingarm pivot shaft removal tool	
88713.0957	SHOWA fork spacer holder	
88713.1057	Steering damper bearing installer	

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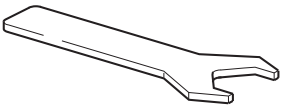
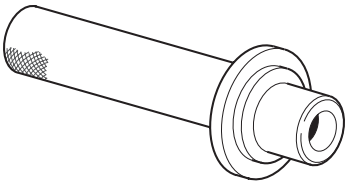
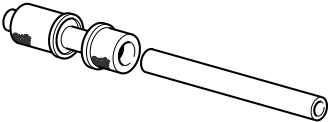
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Part no.	Designation	
88713.1077	Seat lock nut wrench	
88713.1068	Swingarm roller bearing installer	
88713.2409	Swingarm bearing installer	

Use and maintenance

A

B

C

D

E

F

G

H

L

M

N

P

	1 - Preliminary checks	3
A	Running-in precautions	3
	Pre-ride checks	4
	2 - Starting - Engine warmup	5
B	Starting the engine	5
	3 - Routine maintenance table	6
	Programmed maintenance plan: operations to be carried out by the dealer	6
	Programmed maintenance plan: operations to be carried out by the dealer	8
C	4 - Maintenance operations	9
	Checking the engine oil level	9
	Changing the engine oil and filter cartridge	10
	Checking valve clearances	13
D	Adjusting the valve clearances	14
	Checking the coolant level	15
	Change the coolant	16
	Changing and cleaning the air filters	17
	Changing the brake fluid	19
E	Draining the braking circuit	22
	Fill the brake system with fluid	24
	Changing the clutch fluid	27
	Draining the clutch hydraulic circuit	28
	Filling the clutch circuit	30
F	Adjusting the steering head bearings	32
	Adjusting the chain tension	33
	Checking brake pad wear and changing brake pads	35
	Adjusting the throttle cable	38
G	Adjusting the clutch lever and front brake lever	40
	Adjusting the position of the gearchange and rear brake pedals	41
	Adjusting the front fork	42
	Adjusting the rear shock absorber	43
	Adjusting the rear ride height	45
H	5 - Diagnostic instruments	47
	Description of the Ducati Diagnostic System instrument	48
	Tester power supply	50
L	DDS tester	53
	Checking and adjusting timing belt tension	54
	Resetting the throttle position sensor (TPS)	58
	Adjusting the idle speed	62
	Checking the engine oil pressure	66
M	Cylinder compression test	71
	Fuel pressure test	74
	Immobilizer override procedure	77
	Guided diagnosis	81
	Testing the battery charging system	84
N	Deactivating the "maintenance" indication on the instrument panel	87
	Icons table	90

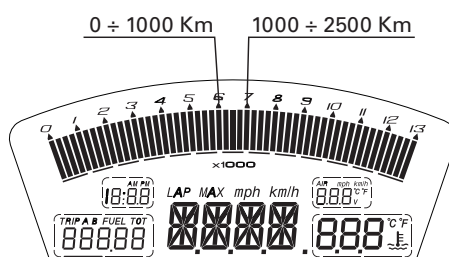
1 - Preliminary checks

Running-in precautions

Maximum engine speed

Rpm limits to be observed during the running-in period and in normal use:

- 1 Up to **1000** km;
- 2 From **1000** to **2500** km.



Maximum engine speed up to 1000 km

During the first **1000** km, keep an eye on the rev counter. The indicator must not exceed **5500-6000** rpm. During the first hours of riding, it is advisable to 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 hard braking and do not keep the brake applied for too long. This is to allow the new pads to bed in against the discs. To allow all the mechanical moving parts of the motorcycle to adapt to one another and above all to avoid adversely affecting the life of basic engine parts, it is advisable to avoid harsh acceleration and not to run the engine at high rpm for too long, especially uphill. It is also advisable to check the drive chain frequently and ensure that it is lubricated as required.

Maximum engine speed from 1000 to 2500 km

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



Important

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

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Pre-ride checks

A



Warning

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

Before starting, check the following points:

B

Fuel level in the tank

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

C

Engine oil level

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

Brake and clutch fluid

Check the fluid levels in the respective reservoirs.

D

Coolant

Check coolant level in the expansion reservoir. Top up if necessary (Sect. C 2).

E

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.

F

Lights and indicators

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

G

Key locks

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

Sidestand

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

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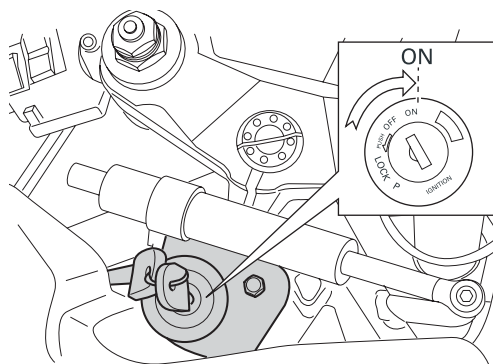
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2 - Starting - Engine warmup

Starting the engine

This motorcycle is equipped with an automatic starter (stepper motor). This allows automation of the engine warmup procedure. For information on the operation of the Stepper motor, see Sect. M 3.

Turn the ignition switch to ON. Make sure both the green light and the red light on the instrument panel come on (Sect. P 7, Instrument panel).



Allow the engine to start on its own, without turning the throttle twistgrip.

Important

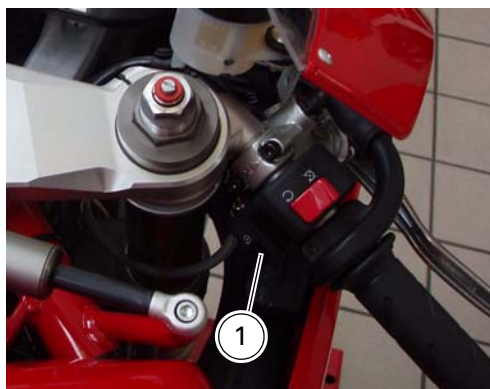
The oil pressure warning light should go out a few seconds after the engine has started. If the light stays on, stop the engine and check the oil level (Sect. P 7, Instrument panel).

Never start the engine when the oil pressure is too low.

Notes

This model is equipped with servo-assisted starting; this function provides servo-assisted engine starting by pressing and immediately releasing button (1). When you press button (1) the starter motor runs automatically for a period of time that varies according to the engine temperature.

The system disengages the starter motor as soon as the engine starts. If the engine fails to start, wait at least 2 seconds before pressing button (1) again.



Important

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

Warning

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

3 - Routine maintenance table

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

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

List of operations and frequency (distance or time interval *)	km x1000	1	12	24	36	48	60
	miles x1000	0.6	7.5	15	22.5	30	37.5
	Months	6	12	24	36	48	60
Change the front fork oil					•		
Check the forks and rear shock absorber for oil leaks			•	•	•	•	•
Check the front sprocket retaining bolts			•	•	•	•	•
General lubrication and greasing			•	•	•	•	•
Check and recharge the battery			•	•	•	•	•
Road test the motorcycle		•	•	•	•	•	•
General cleaning			•	•	•	•	•

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

(1) Operation to be carried out only at the specified distance intervals.

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

A

List of operations and frequency (distance or time interval *)	km x1000	1
	miles x1000	0.6
	Months	6
Check 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		•

B

C

D

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

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4 - Maintenance operations

Checking the engine oil level

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

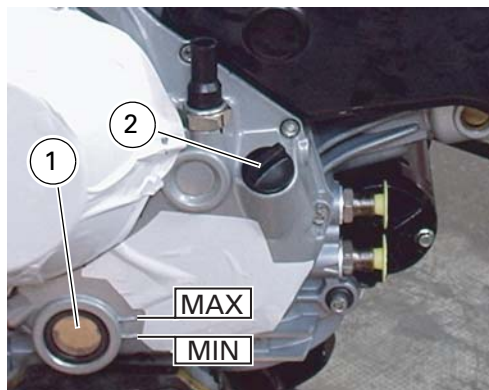
Stop the engine and allow a few minutes for the oil to settle to a steady level.

Check the level with the motorcycle perfectly vertical and with the engine warm (but not running).

The oil must be between the MIN and MAX marks. If the oil level is low, remove the RH half fairing (Sect. E 2) and top up.

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

Refit the filler plug and all previously removed parts.



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Changing the engine oil and filter cartridge

A



Notes

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

B

Remove the side fairings (Sect. E 2).

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

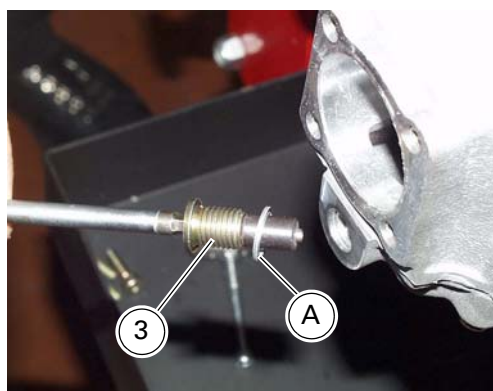


Warning

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

C

Remove any metallic deposits from the end of the magnetic drain plug (3). Refit the drain plug complete with gasket (A) to the sump.



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Tighten to the specified torque value (Sect. C 3).

Remove the filter cartridge (4) from the sump using a standard filter wrench.



Important

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

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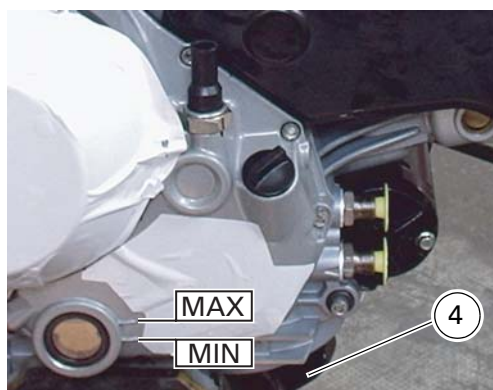
Lubricate the rubber seal of the new filter (4) with engine oil before installing it.

Screw the cartridge into place and tighten to the specified torque (Sect. C 3).



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.



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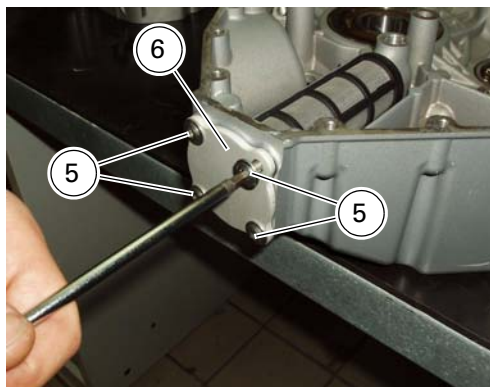
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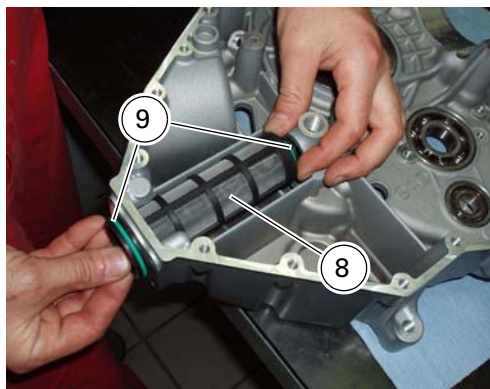
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Every two oil changes, clean the oil pickup gauze filter.
Undo the four bolts (5) securing the outer cap (6) and plug.
Take care not to damage the gasket (7).



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



Clean the filter with petrol and compressed air. Take care not to damage the gauze.
Refit the gauze filter (8), gasket (7) and O-ring (9) to the cap (6).

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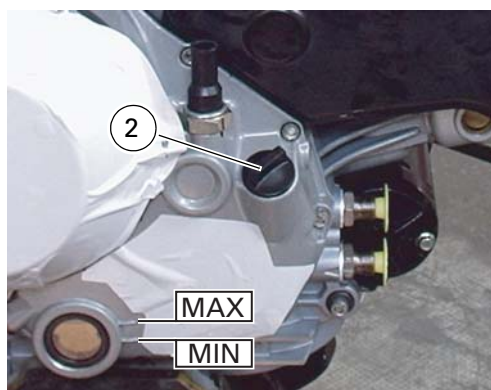
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Remove the filler plug (2) and fill with oil of the recommended type (Sect. C 2) up to the MAX line in the sight glass. Refit the filler plug (2). Run the engine at idle speed for a few minutes.



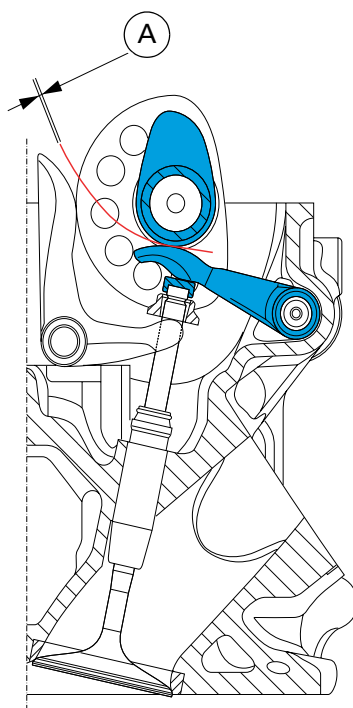
Check for oil leaks. Check that the oil pressure light on the instrument panel switches off a few seconds after the engine starts. If not, switch off the engine and trace the fault. After a few minutes, check the oil level again and top up to the MAX level line, if necessary. Refit any parts you have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

Checking valve clearances

Proceed as described in Sect. N 4.1.

With the valve in the rest position, slide a feeler gauge between rocker arm and the cam to measure the clearance:
The clearances must be within the specified limits:

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



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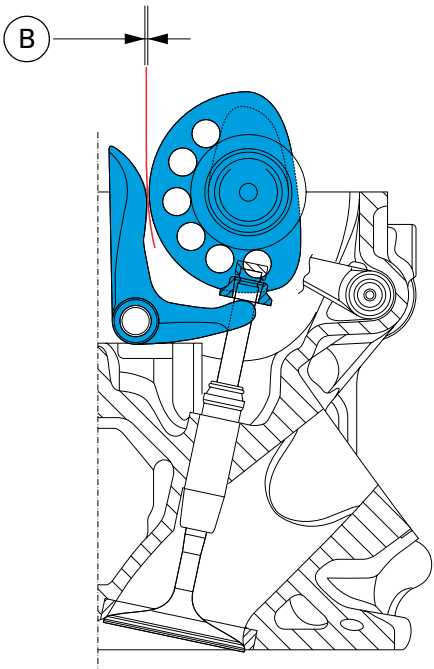
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With the valve in the rest position, slide a feeler gauge between the closing rocker arm and the closing shim to measure the clearance:

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

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



Adjusting the valve clearances

Proceed as described in Sect. N 4.1.

Checking the coolant level

At the intervals specified in the "Routine Maintenance" chart (Sect. D 3), check the coolant level in the expansion tank, located on the right-hand side of the motorcycle.

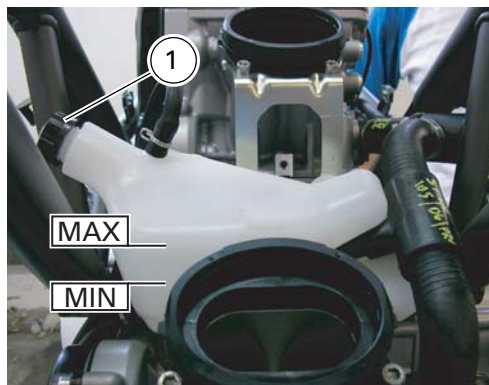
The coolant level must be between the MAX and MIN marks on the tank.

If the level is low, top up with the recommended coolant.

Remove the RH side fairing (Sect. E 2).

Remove the filler cap (1) and top up to the specified level.

Refit the cap (1) and replace any parts removed.



For optimal operating conditions (coolant mixture starting to freeze at -20 °C), the recommended liquid antifreeze should be mixed with water in the following percentages:

ANTIFREEZE: **35÷40%** of volume;

WATER: **65÷60%** of volume.



Important

Avoid using particularly hard water with a high mineral salt content, as this could damage the engine.

Increase the amount of coolant to up to **55%** of volume in the case of very cold climates.



Important

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

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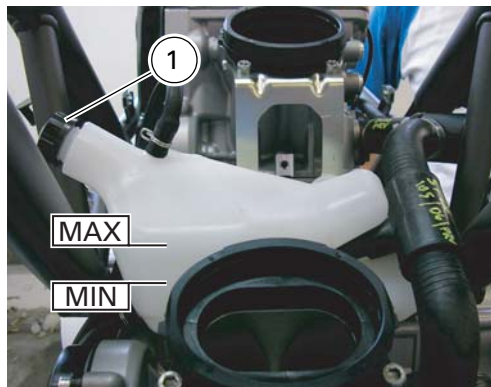
Change the coolant



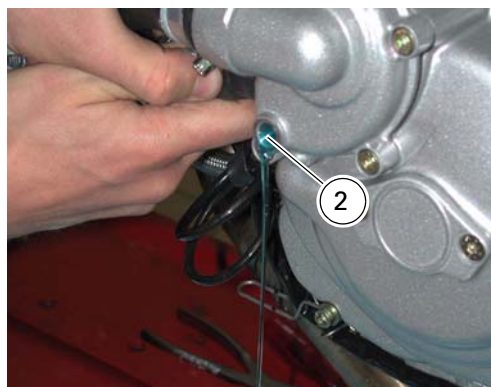
Warning

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

- Remove the right-hand fairing (Sect. E 2).
- Remove the expansion tank filler cap (1).



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



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



Warning

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



Important

Check the cooling circuit for possible leaks.

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

Changing and cleaning the air filters

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

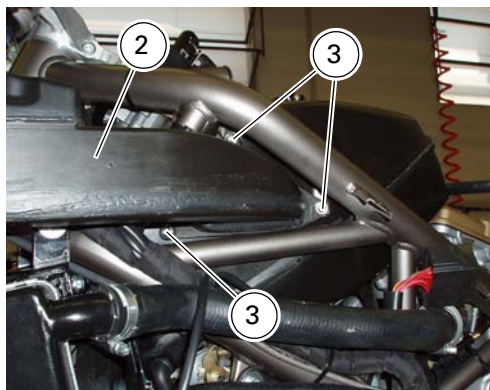
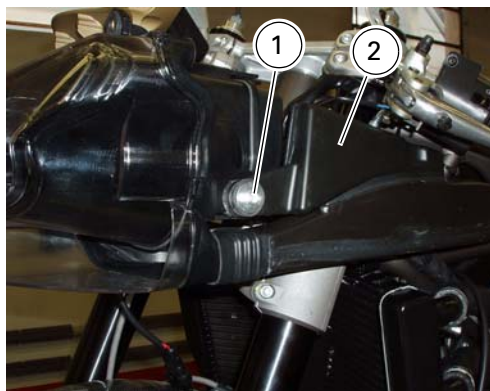
Operation	Section reference
Remove the side fairings	E 2
Remove the headlight shell	E 1



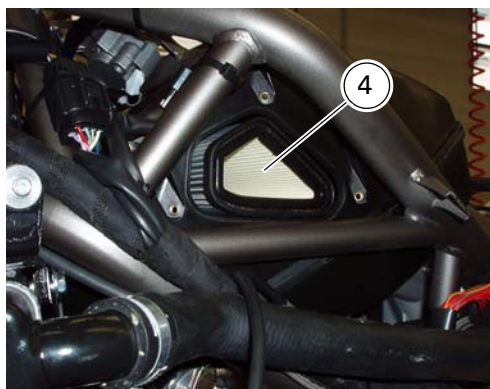
Notes

The images show the motorcycle without the fuel tank: the operation described is possible also with the fuel tank fitted.

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



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



Clean the filter element with a compressed air jet or renew it if necessary.



Important

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

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

A



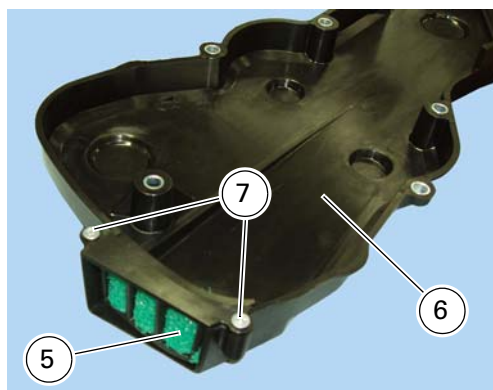
Important

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

B

Check the air filter (5) located in the horizontal cylinder timing belt cover (6): to remove the filter, remove the cover (Sect. N 4.2) and remove the screws (7).

After inspection, refit the filter (5), tighten the screws (7) and replace the horizontal cylinder timing belt cover (6) (Sect. N 4.2).



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Changing the brake fluid



Warning

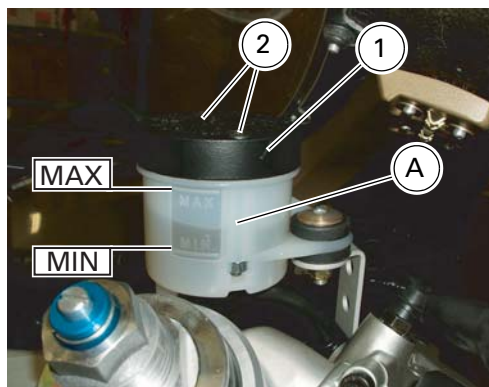
Brake fluid will damage painted surfaces if spilled on them. In addition, it is very harmful in contact with the skin or with the eyes; in the event of accidental contact wash the affected area with abundant running water.

Changing the fluid in the front brake circuit

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

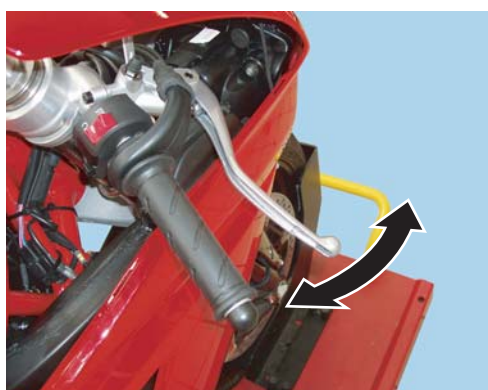
Aspirate the brake fluid from inside the reservoir (A).

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 (3) and insert the other end of the tubing in a container placed on the floor.

Loosen the bleed valve (3) to allow fluid to escape.



Warning

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

Allow the fluid to flow from the bleed valve (3) until it changes colour.

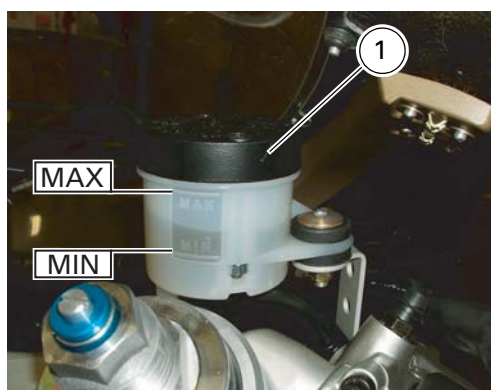
Tighten the bleed valve (3) and restore the correct fluid level in the reservoir.



Notes

Repeat this operation on each brake caliper.

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

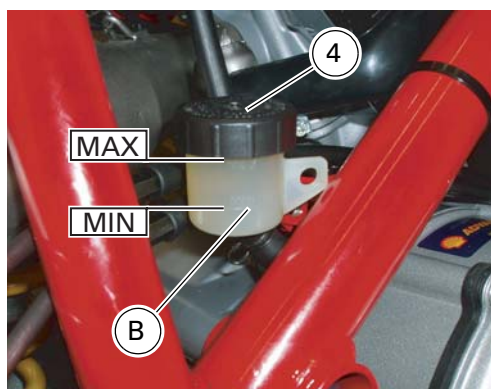


Changing the rear brake circuit fluid

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

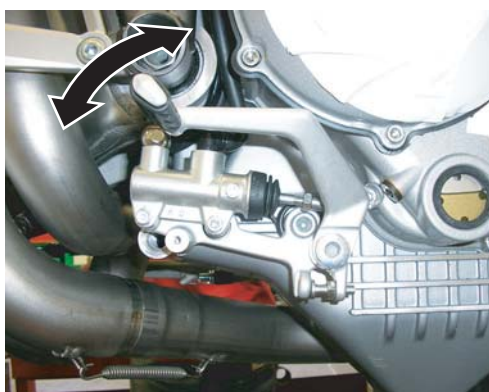
Aspirate the brake fluid from inside the reservoir (B).

Fill the reservoir (B) with new brake fluid up to the **MAX** mark.

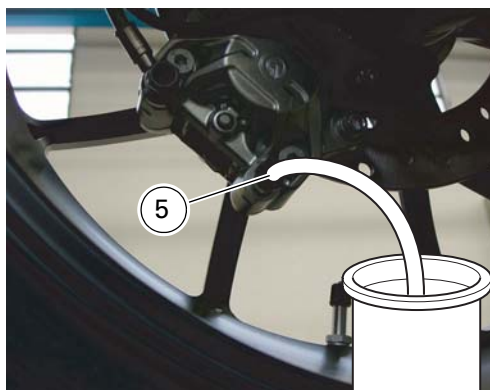


Operate the brake pedal two or three times to pressurize the circuit.

Hold the pedal pressed down.



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



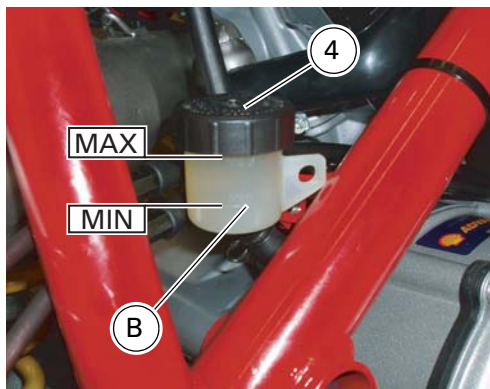
Warning

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

Allow the fluid to flow from the bleed valve (5) until it changes colour.

Tighten the bleed valve (5) and restore the correct fluid level in the reservoir.

Replace the cap (4), screwing it firmly on to the reservoir (B).



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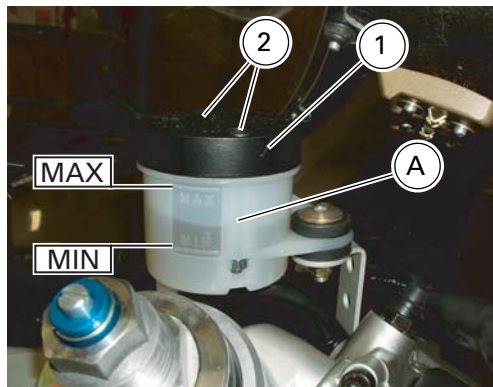
Draining the braking circuit



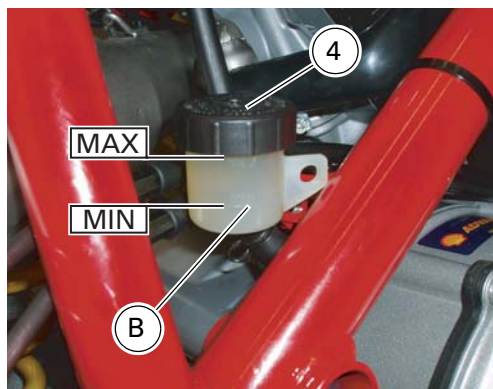
Warning

Brake 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.

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



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



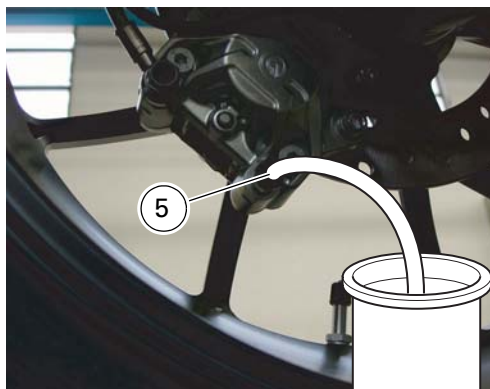
Connect a commercially available brake bleeder to the bleed valve (3) or (5).
Loosen the bleed valve (3) or (5) and pump with the bleeder until no more fluid is draining off.



Notes

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

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



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

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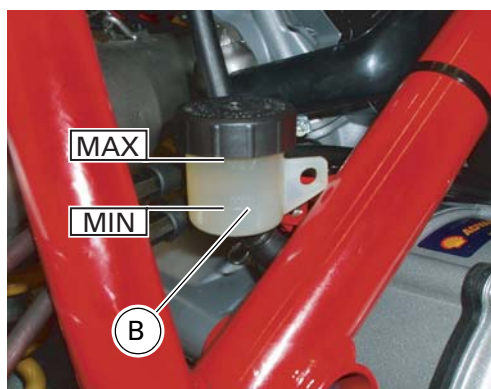
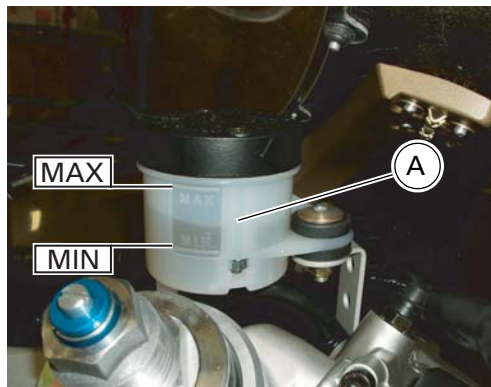
Fill the brake system with fluid



Warning

Brake 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.

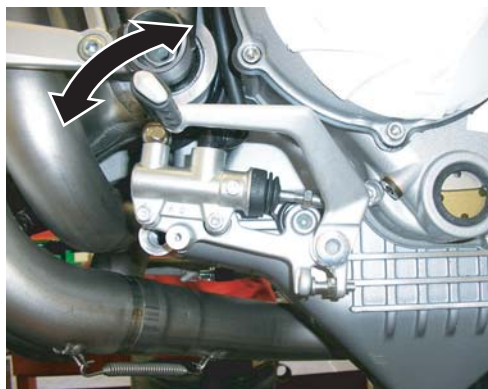
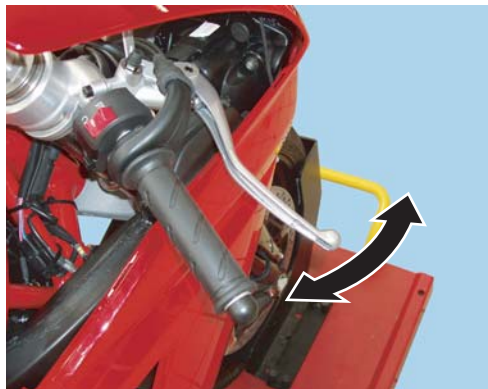
Fill the reservoir (A) or (B) with the recommended fluid taken from a previously unopened container.



Important

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

Operate the brake lever (or pedal) several times to allow the fluid to reach all points of the circuit and expel any air.



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



Notes

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

Pump with the bleeder and loosen off the bleed valve (3) or (5). Check that the reservoir level does not fall below the **MIN** mark. Repeat the bleeding operation until the fluid flowing from the tube is completely free of air bubbles.

Tighten the bleed valve (3) or (5) to the specified torque (Sect. C 3).

If you do not have a brake bleeding tool available, connect a length of transparent plastic tubing to the bleed valve (3) or (5) as described in the draining procedure.



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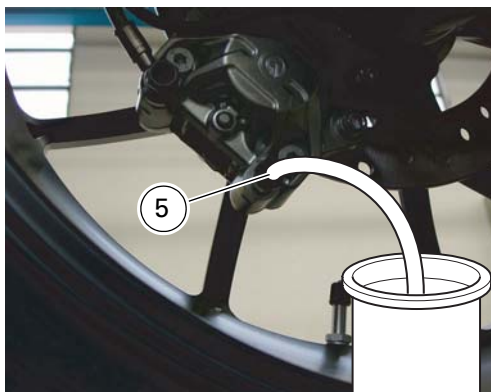
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Open the bleed valve (3) or (5) by a **1/4** turn and operate the brake lever (or pedal) several times until the fluid starts coming out of the bleed valve. Pull the lever fully in and loosen off the bleed valve by at least a **1/4** of a turn. Wait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

D



Important

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

Repeat the bleeding operation until air bubbles no longer come out of the plastic tube.

Bleed air out of the bleed valves one at a time.

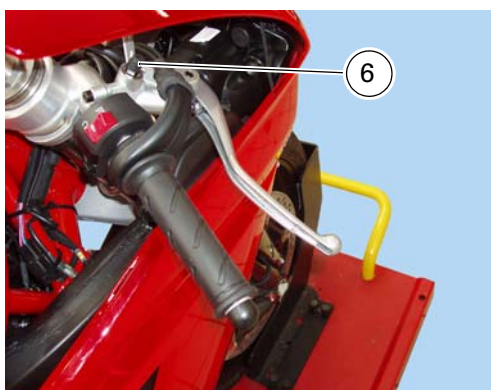
Tighten the bleed valve (3) or (5) to the specified torque (Sect. C 3). Replace the dust cap.

To completely eliminate any air that could remain at the top of the front brake master cylinder, repeat the same procedure for the bleed valve (6).

Top the fluid up to the correct level and tighten the screws (2) on reservoir (A) and replace cap (4) on reservoir (B).

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Changing the clutch fluid



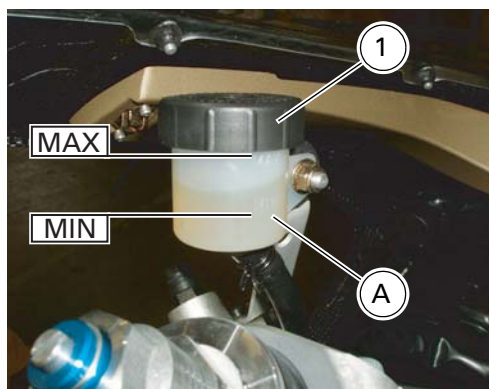
Warning

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

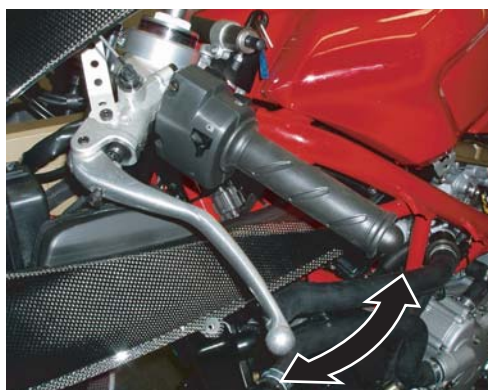
Remove the cap (1) and membrane from the clutch fluid reservoir (A).

Aspirate the brake fluid from inside the reservoir (A).

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

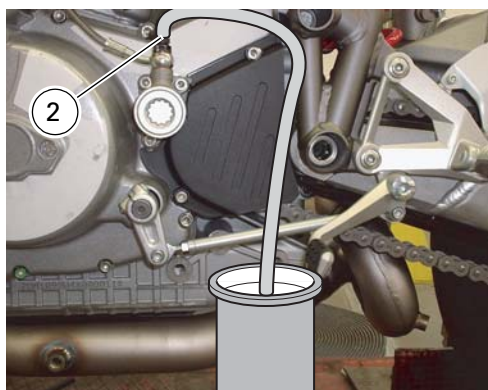


Operate the clutch lever two or three times until the circuit is pressurized. Hold the lever pulled in towards the handgrip.



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

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

Allow the fluid to flow from the bleed valve (2) until a different colour liquid appears. Tighten the bleed valve (2) to the specified torque (Sect. C 3) 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).

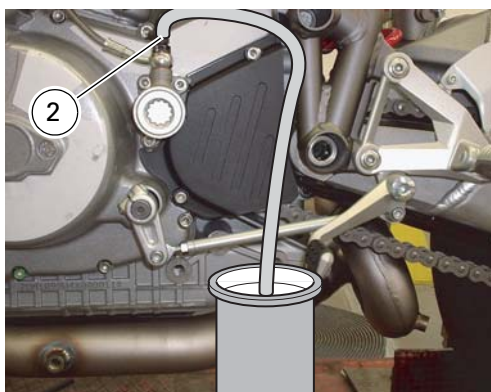


Notes

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

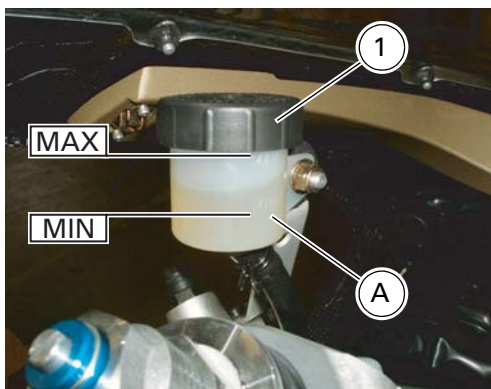
Loosen off the bleed valve and pump with the bleeding tool until no more fluid emerges.

If you do not have a bleeding tool available, attach a length of transparent plastic tubing to the bleed valve (2) and insert the other end of the tubing in a container of old clutch fluid placed on the floor.

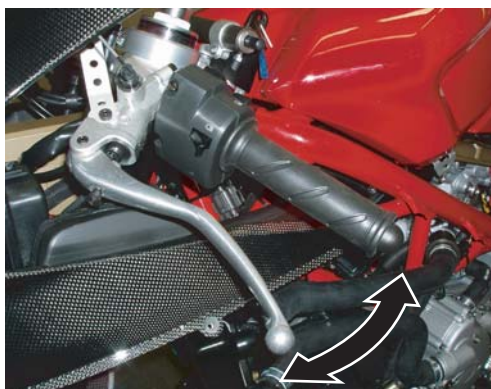


Unscrew the bleed valve by a **1/4** turn.

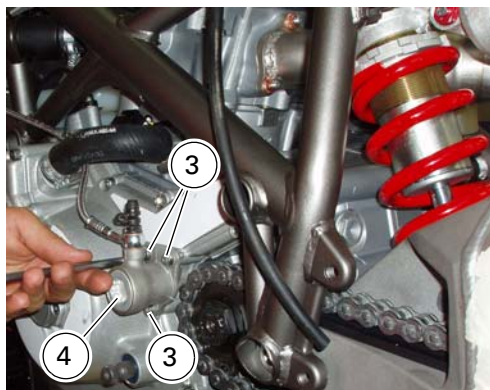
Remove the cap (1) and membrane from the clutch fluid reservoir (A).



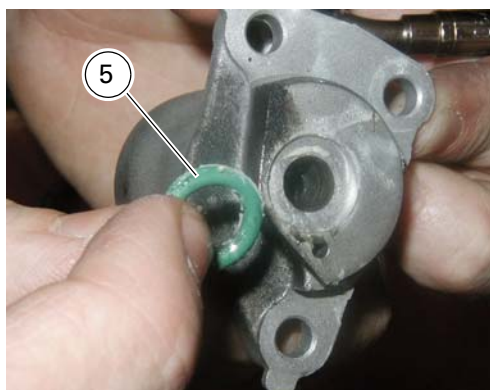
Operate the clutch lever until all the fluid has been expelled.



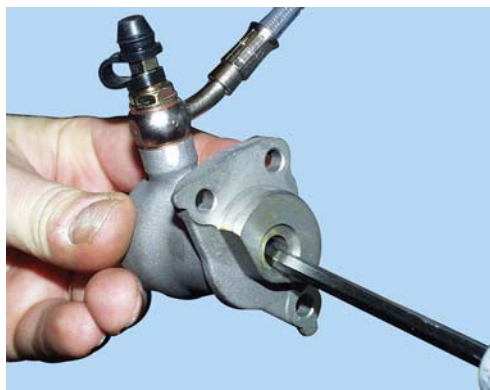
To help drain the circuit fully, unscrew the three retaining screws (3) and remove the slave cylinder cap from the engine.



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



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



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

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Filling the clutch circuit



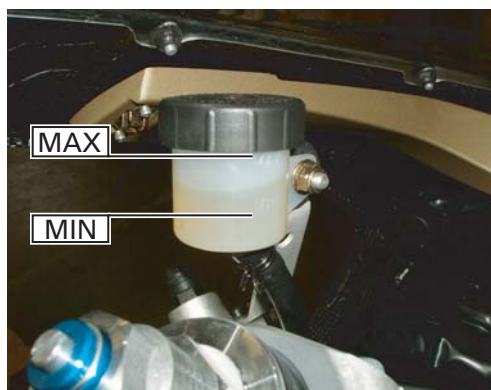
Warning

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

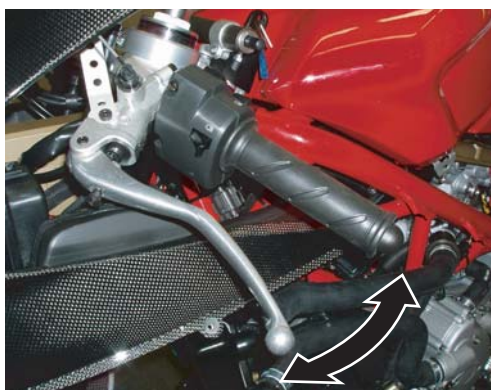


Important

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



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



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

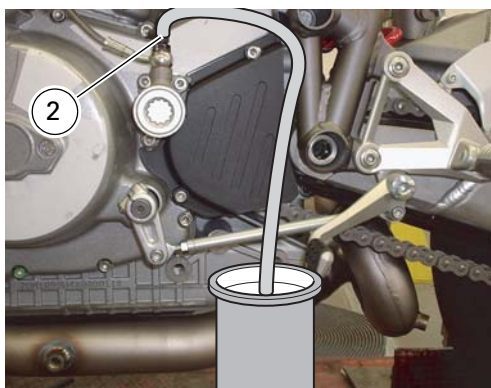


Notes

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

Pump with the bleeding tool and loosen off the bleed valve (2). Check that the reservoir level does not fall below the **MIN** mark. Repeat the bleeding operation until the fluid flowing from the tube is completely free of air bubbles.

If you do not have a bleeding tool available, connect a length of transparent plastic tubing to the bleed valve (2) as outlined in the draining procedure.



Open the bleed valve by a **1/4** turn and operate the clutch lever several times until the fluid starts to emerge from the bleed valve (2).

Pull the lever fully in and then slacken off the bleed valve by at least a **1/4** turn.

Wait for a few seconds, then release the lever gradually while simultaneously closing the bleed valve (2).



Important

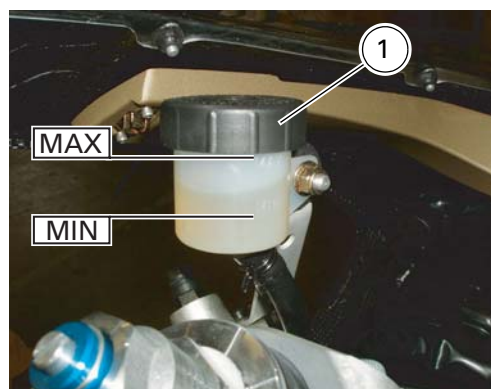
Do not release the clutch lever until the bleed valve has been fully tightened.

Repeat the bleeding operation until air bubbles no longer come out of the plastic tube.

Tighten the bleed valve (3) to the specified torque (Sect. C 2). Replace the dust cap.

Top up the fluid level to approximately **3** mm above the **MIN** mark on the reservoir.

Replace the cap (1) with the membrane.



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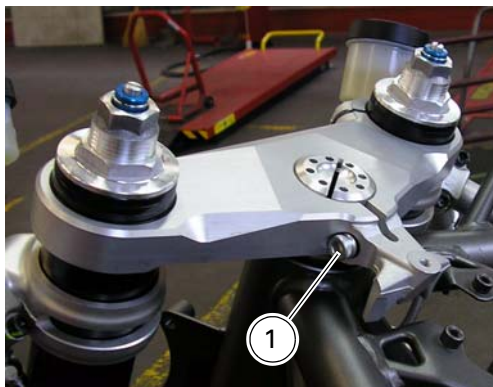
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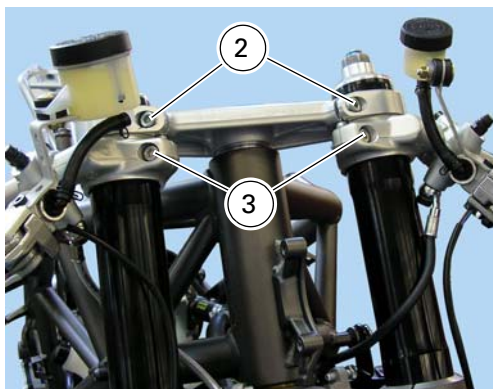
Adjusting the steering head bearings

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

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

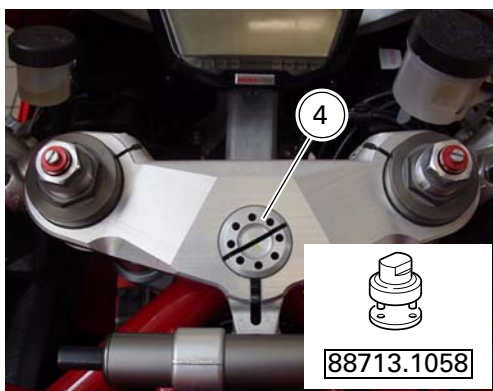


Loosen the clamp bolts (2) securing the top yoke to the fork legs and loosen the handlebar bolts (3).



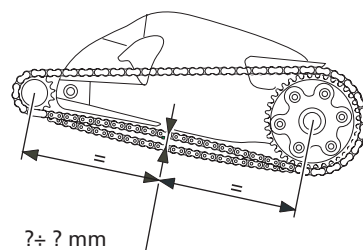
Using special wrench **88713.1058**, tighten the adjuster nut (4) to the specified torque (Sect. C 3).

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



Adjusting the chain tension

Move the motorcycle slowly until you find the point at which the upper section of the chain is most taut.
Place the motorcycle on its sidestand.
Push the chain upwards with one finger in correspondence with the mid point of the swingarm (see label).
The lower run of the chain should deflect by approximately **33÷35 mm**.



To adjust the tension, proceed as follows:

Slacken off the two clamp bolts (1) that secure the rear wheel hub to the swingarm.



Apply the pin wrench part no. **88713.1038**, inserting the pin in a notch on the eccentric hub (2).

Rotate the eccentric hub (2) to obtain the correct chain tension.

Rotate the hub anti-clockwise to tighten the chain or clockwise to slacken it (as viewed from left-hand side of the bike).



Important

An incorrectly tensioned chain will lead to accelerated wear of the transmission components.

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If the clamp bolts (1) are removed, lubricate the threads and the underside of the head of each bolt, then tighten the bolts (1) to the specified torque in the sequence 1-2-1.



Warning

For the safety of the rider, it is essential that the eccentric hub clamp bolts are correctly tightened (Sect. C 3).



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

When the motorcycle is consigned to the customer after changing the brake pads, inform the customer that the brake must be used gently for the first 100 km to allow the pads to bed in completely.

Checking front brake pad wear.

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



Important

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

Change the brake pads as follows:

Remove the calipers (Sect. G 3).

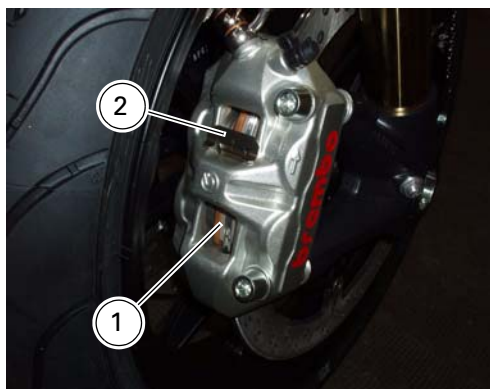
Remove the safety clips (2) and force the caliper pistons back into their bores by forcing the old brake pads apart.

Remove the worn pads (1).



Notes

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



Insert the new pads with the relative safety clips (2).

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

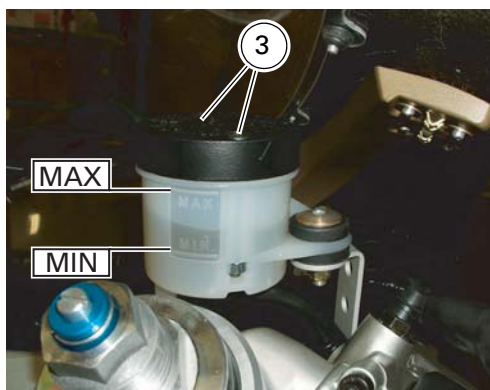
Check that the brake fluid level in the master cylinder reservoir is above the **MIN** mark.

If necessary, top up as follows.

Turn the handlebar so that the reservoir is level.

Unscrew the two crosshead screws (3) and remove the reservoir cover.

Remove the inner membrane from the reservoir and top up with the recommended fluid to the maximum level mark.



Refit all previously removed components.

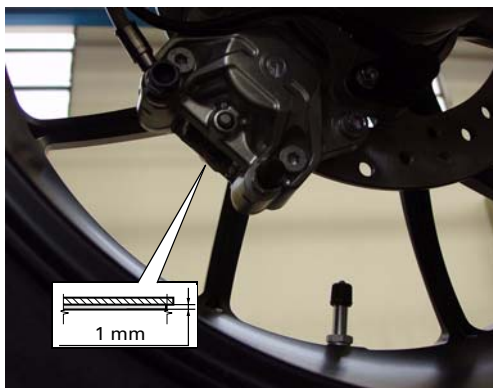
Checking rear brake pad wear

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



Important

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



Change the brake pads as follows:

Remove the safety clip (1) (on the inner side of the caliper) from the pad retaining pin.

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

Withdraw the brake pad retaining pin (2) from the outside.

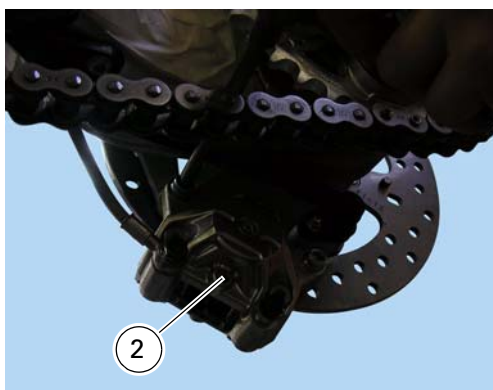
Remove the clip (3) from between the two caliper halves.

Remove the worn pads.

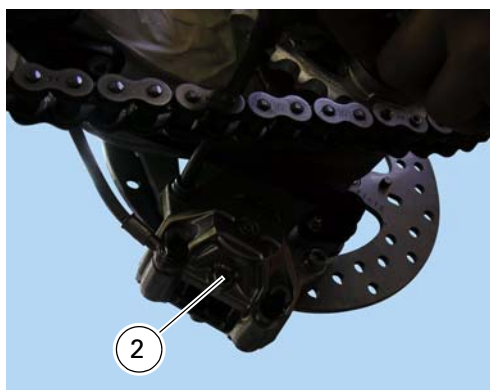


Notes

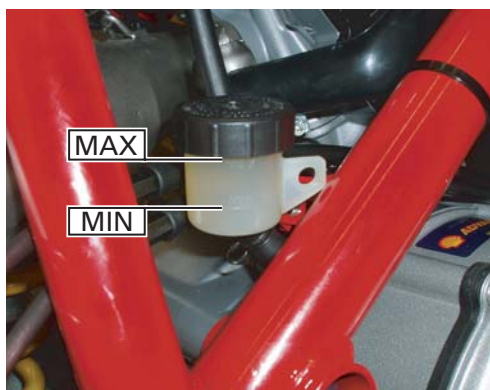
Change pads that have a shiny or “vitrified” appearance.



Insert the new pads and clip (3). Fit the retaining pin (2) from the outer side and secure it with the safety clip (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 reservoir (4) is between the **MIN** and **MAX** marks. If not, unscrew the reservoir cover (4) and top up with the recommended brake fluid.



Notes

If it proves difficult to change the brake pads, first remove the calipers (Sect. G 6).



Warning

As the brake calipers are components of vital importance to the safety of the motorcycle, refer to the instructions in Sect. G "Wheels - Suspensions - Brakes", and in particular, on reassembly, take care to tighten the caliper bolts to the specified torque (Sect. C 3).

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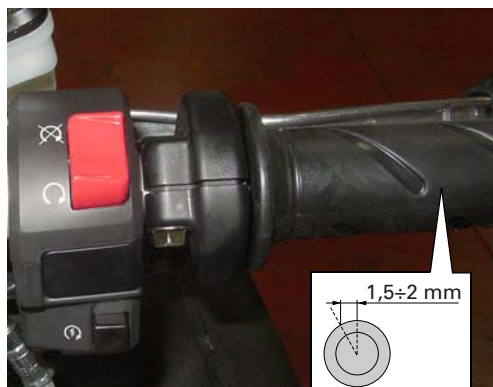
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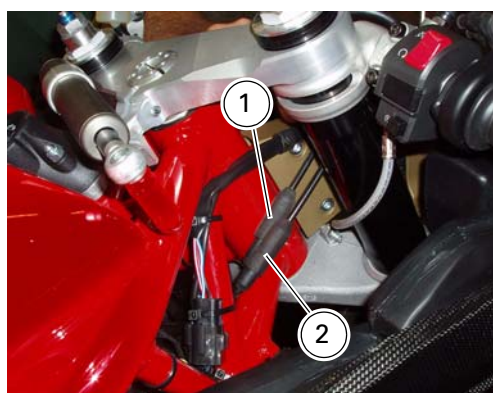
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Adjusting the throttle cable

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



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



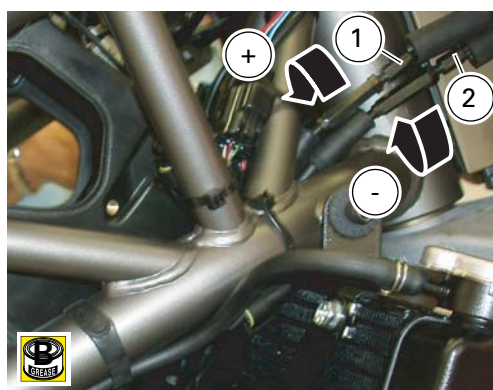
Peel back the sleeves to access the adjusters and slacken the locknuts.

Adjust both adjusters by the same amount: turn clockwise to increase free play, anti-clockwise to decrease free play.

When finished, tighten the locknuts and replace the sleeves.

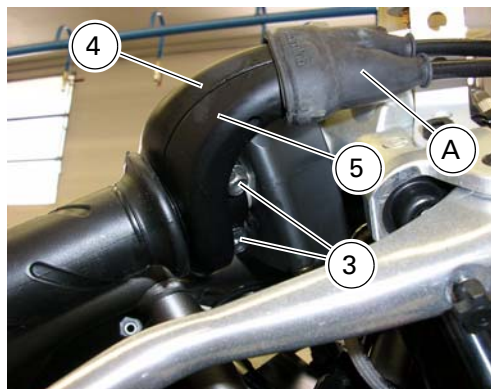
Periodically check the condition of the outer cables of the throttle opening (1) and closing cables (2). The plastic covering should show no signs of pinching or cracking.

Lubricate the ends of the inner cables with the prescribed grease periodically to ensure they run freely.



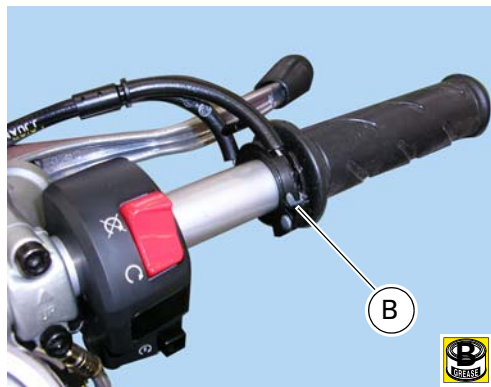
Operate the throttle to make sure the inner cable slides smoothly inside the outer cable. If you feel excessive resistance or stiffness, renew the cable.

To lubricate the throttle twistgrip, peel back the rubber sleeve (A), unscrew the screws (3) and remove the twistgrip housings (4) and (5).



Lubricate the ends of the cable and the race (B) with the recommended grease.

When refitting the cover, make sure that the cables are correctly positioned in the race (B).



Locate the housings (4) and (5) in the handlebar hole (C).

Secure the housings (4) and (5) with screws (3) tightened to the specified torque (Sect. C 3).



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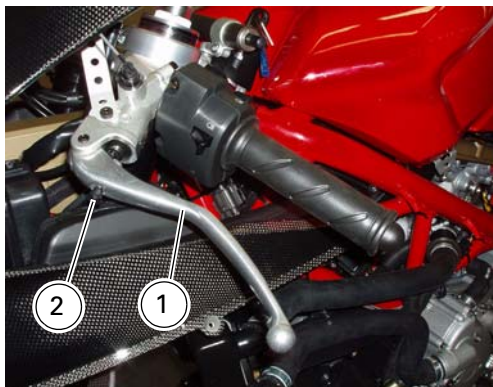
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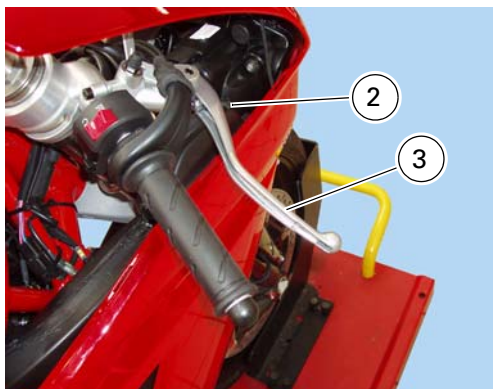
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Adjusting the clutch lever and front brake lever

The lever (1) disengages the clutch. The span adjuster (2) serves to alter the distance of the lever from the handlebar. Lever distance is adjusted by 10 clicks of the knob (2). Turn the knob clockwise to move the lever away from twistgrip, or counter clockwise to move it closer.



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.



Warning

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

Adjusting the position of the gearchange and rear brake pedals

The position of the gearchange and rear brake pedals in relation to the footrests can be adjusted to suit the preferred riding position.

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

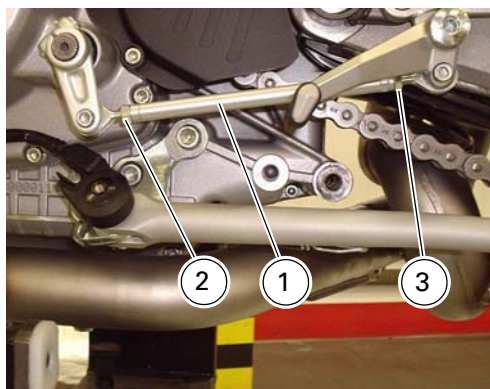
Restrain the tie-rod (1) and slacken the locknuts (2) and (3).



Notes

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

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



To adjust the position of the rear brake pedal, proceed as follows.

Loosen the locknut (4).

Turn the pedal travel adjustment bolt (5) until the pedal is in the desired position.

Tighten the lock nut (4) to the specified torque (Sect. C 3).

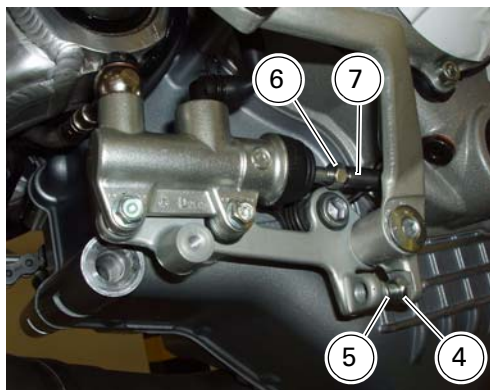
Operate the pedal by hand to make sure it has **1.5 to 2 mm** of free play before the brake begins to bite.

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

Slacken off the locknut (7) on the pushrod.

Screw the rod into the clevis (6) to increase play, or unscrew it to reduce play.

Tighten the lock nut (7) to the specified torque (Sect. C 3) and re-check the free play.



Adjusting the front fork

A

The front fork can be adjusted for rebound, compression and spring preload.

The settings are adjusted by way of external adjuster screws:

- 1) to adjust rebound damping;
- 2) to adjust spring preload;
- 3) to adjust compression damping.

B

Place the motorcycle in an upright position and ensure that it is stable.

To adjust the rebound damping setting, turn the adjuster (1) on the top of each fork leg with a flat-blade screwdriver (1098) or the special wrench (1098S).

Turn the adjuster (3) on the bottom of each fork leg with a flat-blade to adjust the compression damping setting.

C

As you turn the adjusters (1 and 3), you will hear them click. Each click corresponds to different damping setting. Turn the adjuster fully clockwise for the stiffest damping (position 0). This will be your starting point. Now turn the adjuster screws anticlockwise and listen for the clicks that identify setting positions "1", "2" and so on.

To change the preload on the spring inside each fork leg, turn the hexagonal adjusting nut (2) with a 22-mm hexagon wrench.

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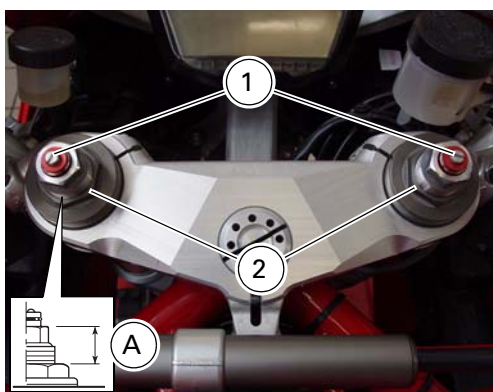
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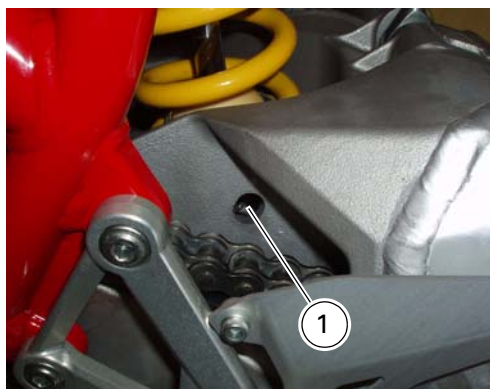


The STANDARD factory settings are as follows:

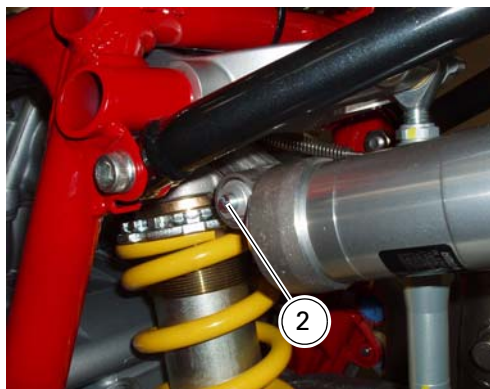
- compression: 3/4 turn (1098), 8 clicks (1098S);
- rebound: 12 clicks (1098), 10 clicks (1098S).
- Spring preload (A): 18 mm (1098).

Adjusting the rear shock absorber

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



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



STANDARD setting:

(1098)

from the fully closed position (turned fully clockwise), unscrew:

rebound adjuster (1): 2 turns;

Compression adjuster (2): 2 turns;

Spring preload: 28 mm.

(1098S)

from the fully closed position (turned fully clockwise), unscrew:

rebound adjuster (1): 10 clicks;

Compression adjuster (2): 10 clicks;

Spring preload: 23 mm.

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The two nuts (3) on the upper part of the shock absorber serve to adjust the preload on the outer spring. To adjust the spring preload, unscrew the upper adjuster nut using a pin wrench. Screw the lower nut in or out to increase or reduce the preload. Once the desired spring preload has been set, lock down the upper ring nut.

B

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D



Warning

To turn the preload adjuster ring nuts, use only a specific tool and take care, otherwise the wrench pins may suddenly slip out of the ring nut. This could injure your hands.

Never use a wrench with a too small pin or with a too short handle.

E



Warning

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



Important

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

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Adjusting the rear ride height

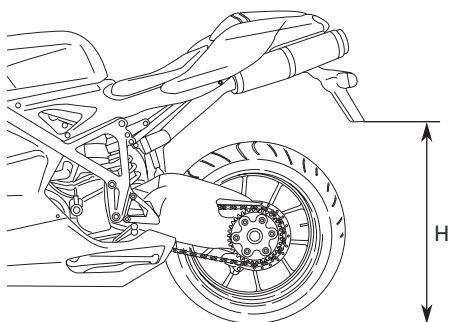
The original frame geometry represents the result of extensive testing by DUCATI engineers in the widest possible range of riding conditions. Modifying the frame geometry is a very critical operation, and can be dangerous if carried out by untrained persons. Given that this motorcycle is often used in competition, DUCATI has decided to equip this motorcycle with the means to alter the geometry of the rear suspension and the steering head to suit the needs of different circuits and track conditions.

Changing the rear height

To determine the existing rear ride height, proceed as follows:

Park the motorcycle on level surface and support it in an upright position.

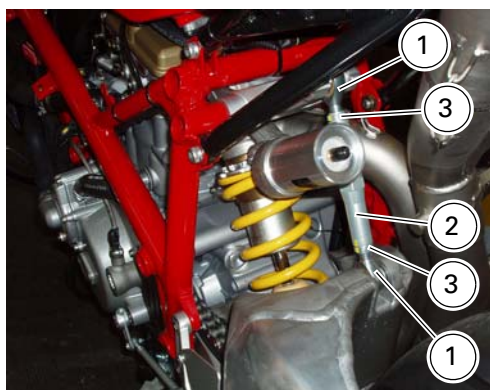
Measure the height (H). Make a note of the measurement so as to be able to restore the original setting later on.



To alter the height (H), adjust the tie-rod (2) as follows:

Loosen lock nuts (3) on ball joint end fittings (1); note that the **lower lock nut has a left-hand thread**.

Using a wrench on the flats in the centre, turn the tie-rod (2) to obtain the desired height.



Warning

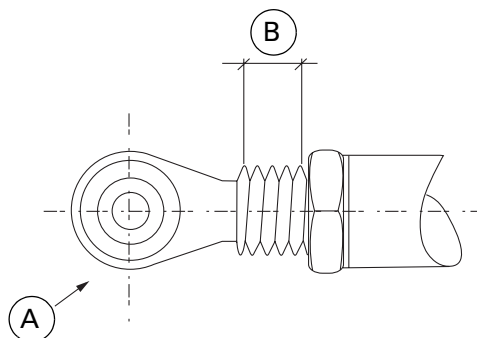
The length of the tie-rod (2) between the centres of the two ball joints (1) must not exceed **166.7 mm**.

Tighten the lock nuts (3) to the specified torque (Sect. C 3).

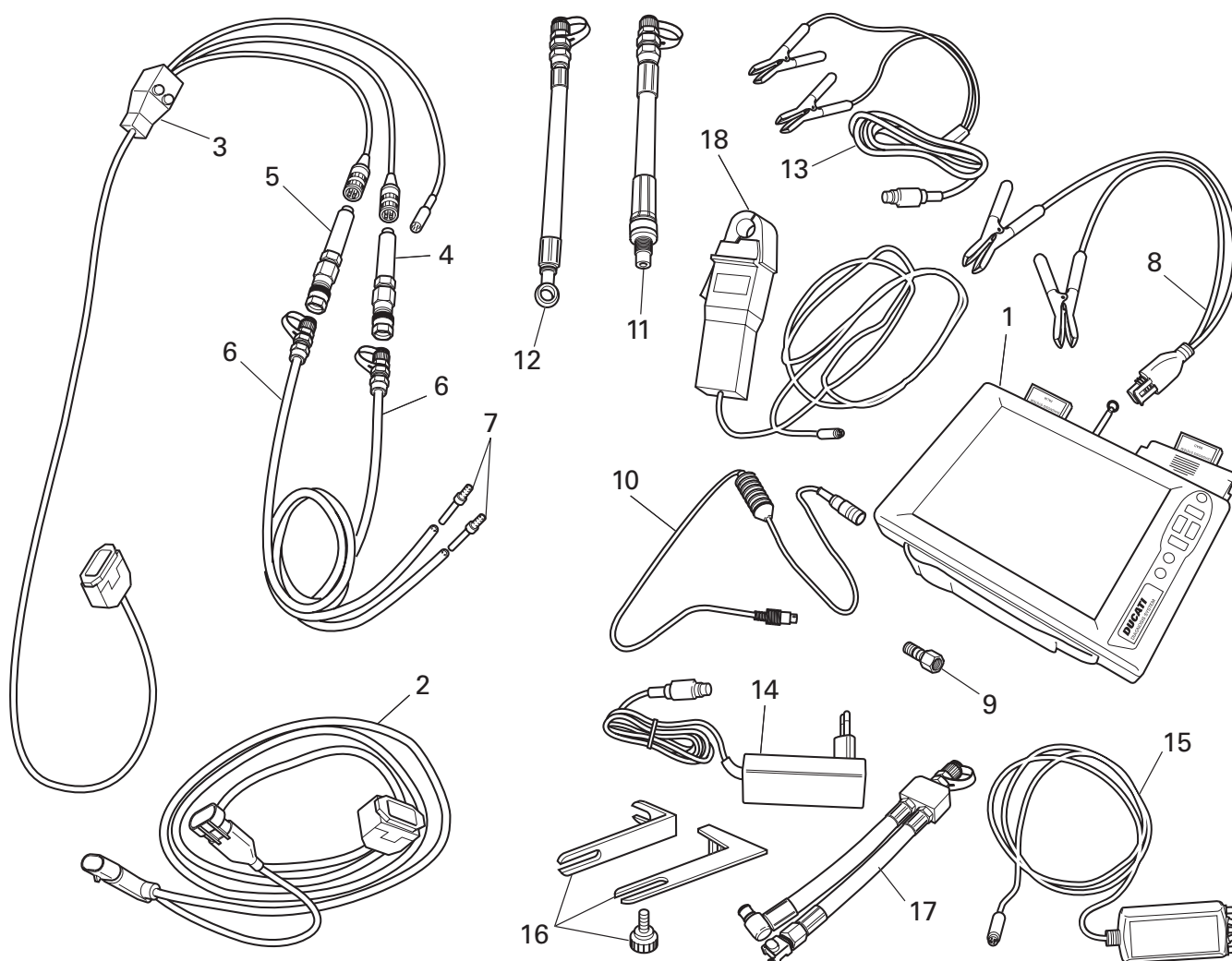


Warning

The maximum distance that the UNIBALL end fitting (A) can be unthreaded from the tie-rod body is 5 threads, or 7.5 mm (B).



5 - Diagnostic instruments



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

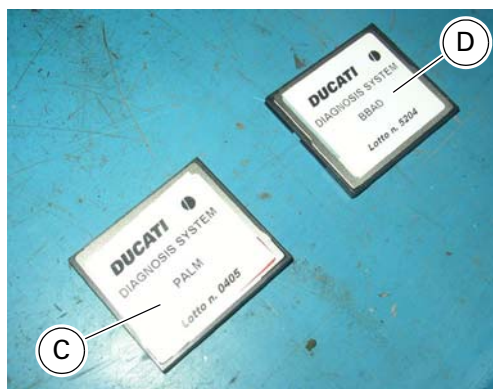
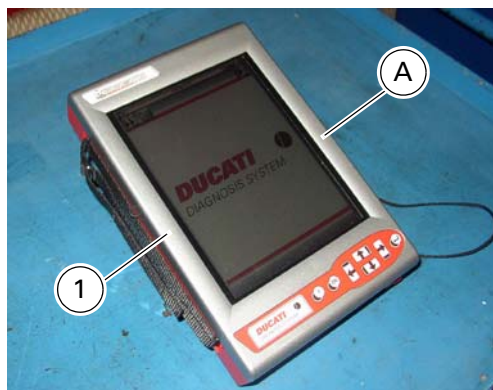


Important

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

Description of the Ducati Diagnostic System instrument

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



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

The self-diagnosis module (B) enables communication between the DDS tester (1) and the motorcycle's on-board electronic control unit (ECU).

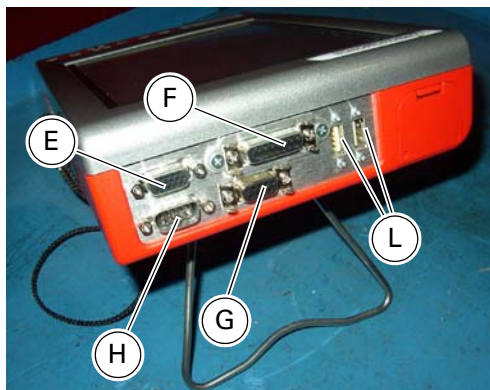
The user interface software resides in the display memory card (C) which is housed in the palm-top display unit (A).

The software that enables communication with DUCATI ECUs resides in the BBAD memory card (D), which is housed in the BBAD self-diagnosis module (B).

The display unit is equipped with two connection panels: one at the top of the instrument and one at the bottom.

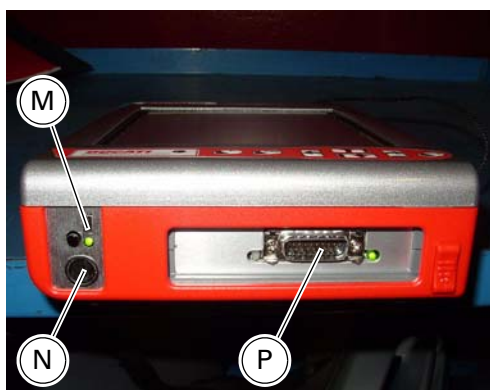
The top connection panel has 6 connection sockets with the following functions:

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



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

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



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

Technical data

Power supply:

- mains - 220 V;
- from 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

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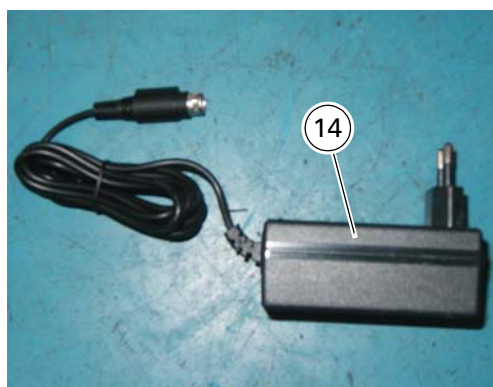
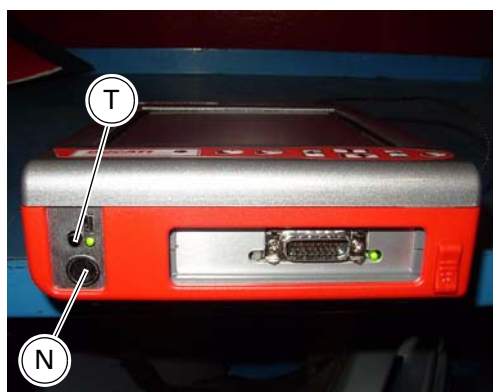
P

Tester power supply

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



- from the mains power supply by connecting the mains adapter (14) to the power connection socket (N);
 - from the motorcycle by connecting the specific cables (see paragraph "Connection to motorcycle");
 - from the tester's internal battery: the battery (Q) is housed in the top part of the tester. To operate the tester (1) using the internal battery and to recharge the battery, refer to the "User Manual" supplied with the DDS tester.
- To switch on the display, press the button (T).



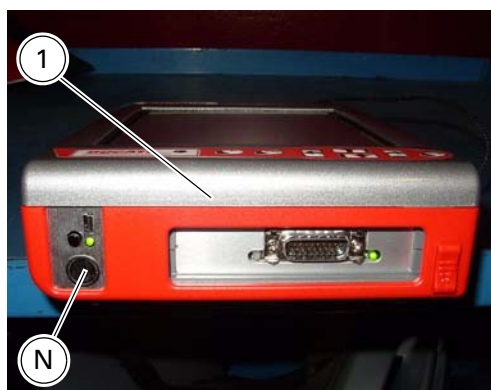
Connection to motorcycle

The tester requires a power supply of between **9** and **16** Volts DC

When using the tester, take care never to allow the power supply to fall below the minimum voltage: this situation could occur during engine starting and idling on motorcycles in which the battery is not in perfect working order. If the tester detects a power supply voltage of less than **9** Volt, the current procedure will be aborted; when the voltage returns to within the acceptable tolerance limits the procedure must initiated again from the beginning.

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

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



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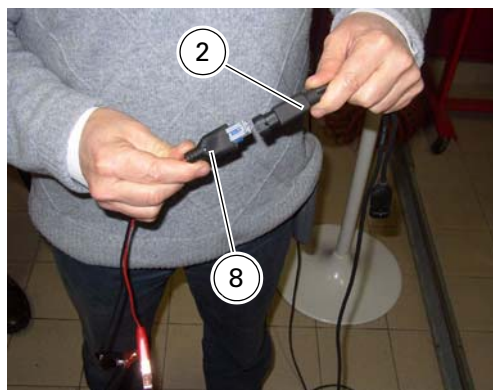
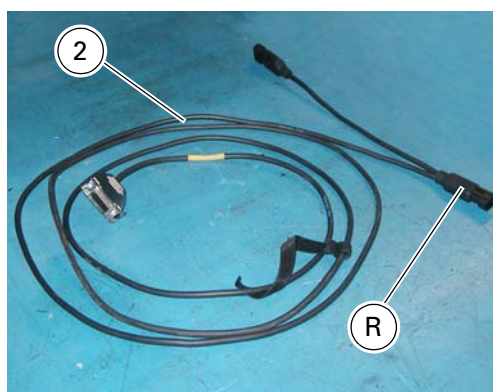
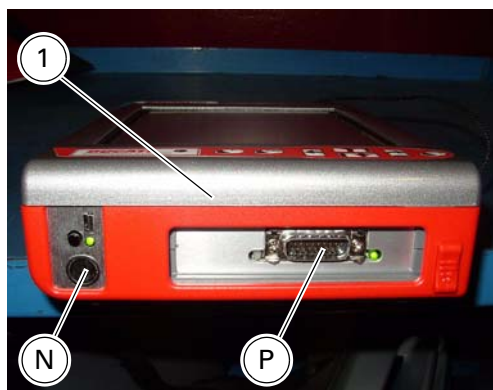
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- connect the power and diagnostic cable (2) to the diagnostic connection socket (P) on the tester; then connect the battery socket adapter (8) to the connection socket (R) on the power and diagnostics cable (2) and to the motorcycle battery.



Notes

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

DDS tester

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

- Retrieval of errors (faults) of the ignition - injection system stored in the engine control unit memory and their subsequent deletion, if required.
- Reading of engine parameters (rpm, coolant and air temperature, atmospheric pressure, throttle opening, battery voltage, injection times and ignition advance, etc.).
- Active diagnostics. Activation of ignition - injection system transducers to check functionality and correct control signal (fuel pump, ignition coils, rev counter, injectors, etc.). With this function it is also possible to enter the code to override the immobilizer.
- Road test. Makes it possible 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).

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Checking and adjusting timing belt tension

A



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

B



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.

C

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

D



E

F

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 notch (D) on the right-hand crankcase cover (20).

G

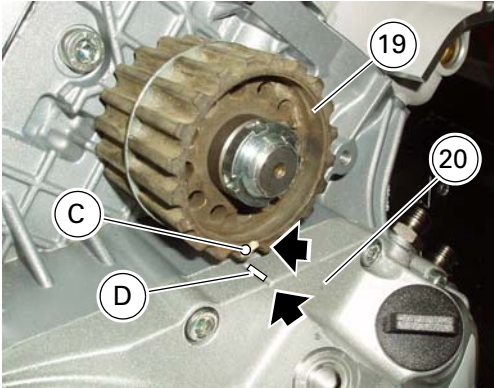
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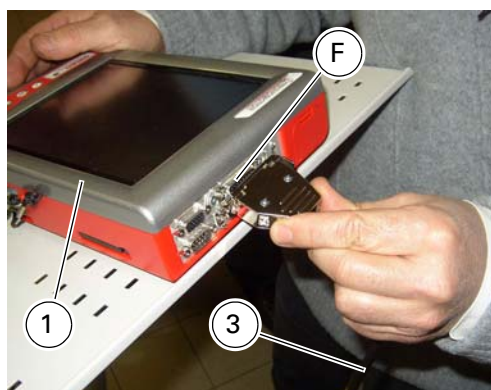
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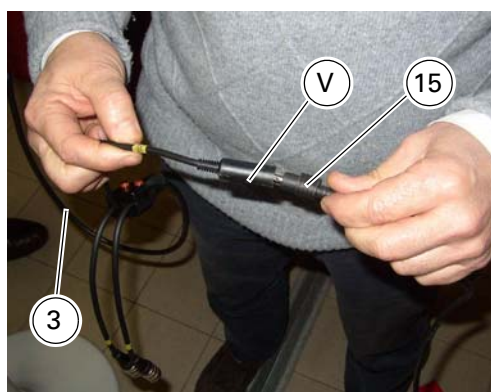


Switch on the DDS tester (1); see paragraph entitled "Tester power supply".

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

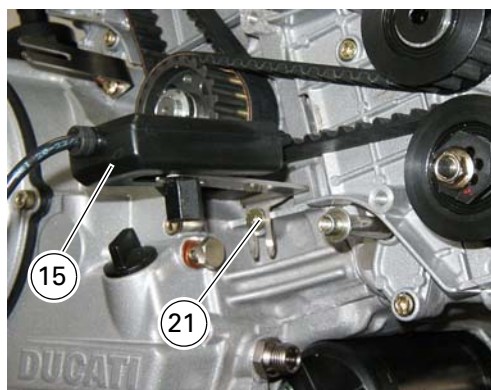


Connect the belt tension sensor (15) to the connector (V) of the power and diagnostics cable (Measurement Module) (3).



Fix the mounting bracket of the belt tension sensor (15) using the timing belt cover screw (21).

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



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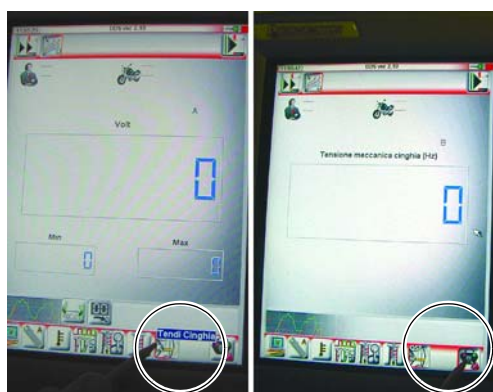
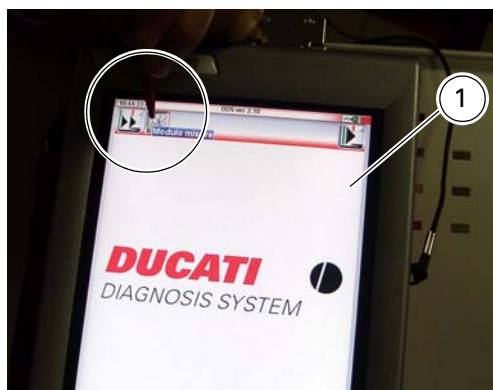
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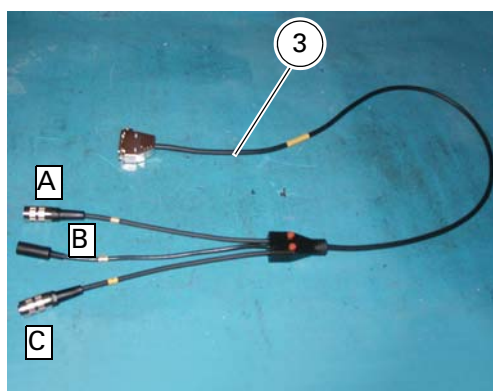
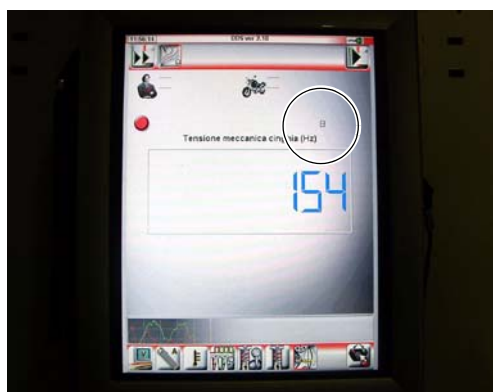
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On the DDS tester (1), select the "Measurement module" function by pressing the corresponding icon; then press the "Belt Tension" icon followed by the "Start" icon to access the "Mechanical belt tension" screen.



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



Notes

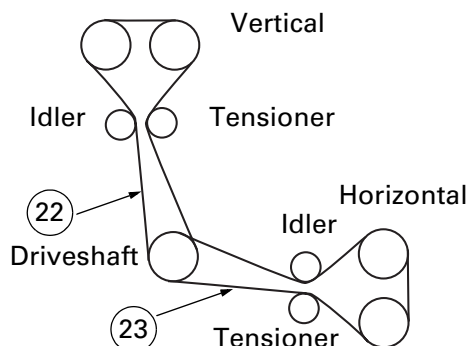
Do not flick the belt several times repeatedly, as the minimum time necessary for the DDS tester to take a reading is **1** second.



Warning

Check the tension on the belt runs (22) and (23) indicated in the figure.

The tension values are specified in Sect. C 1.1, Timing system/valves.



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 tension (Sect. C 1.1, Timing system/valves) or in any event, to not less than 80% of these values.

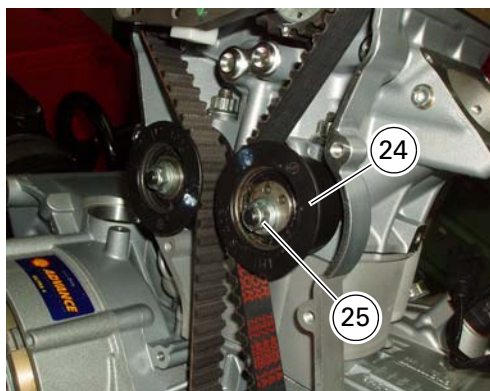
If the tension is incorrect, increase or reduce belt tension by loosening the nut (25) and moving the adjustable tensioner pulley (24).

Tighten the nut (25) securing the tensioner pulley.

Re-check the timing belt tension.

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

Once finished, tighten the nut (25) of the tensioner pulley (24) to the specified torque (Sect. C 3, Engine torque settings).



Position the crankshaft so that the piston of the vertical cylinder is at TDC of the power stroke (valve closed) 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
Refit the right-hand side fairing	E 2

Resetting the throttle position sensor (TPS)

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

Warning

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

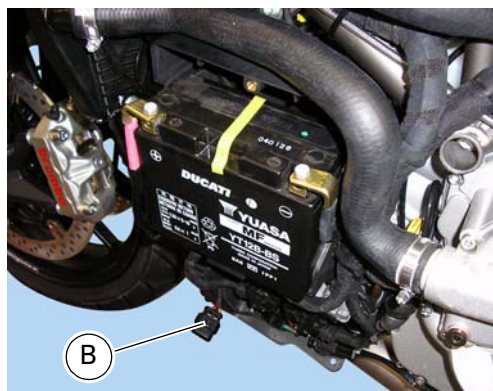
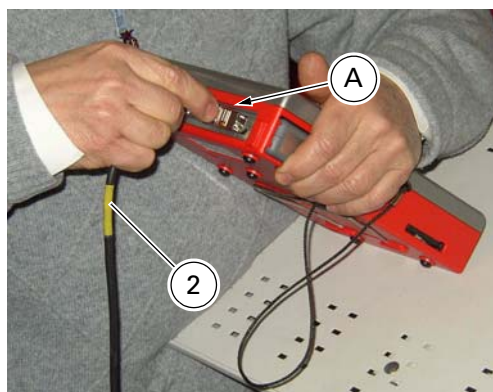
Make sure the butterfly valve is seated against the stop (throttle twistgrip fully closed).

In this position you can teach the ECU the angle of the position sensor. To do this, use the DDS tester and follow the procedure described below.

Raise the fuel tank (Sect. L 2, Removal of the fuel tank).

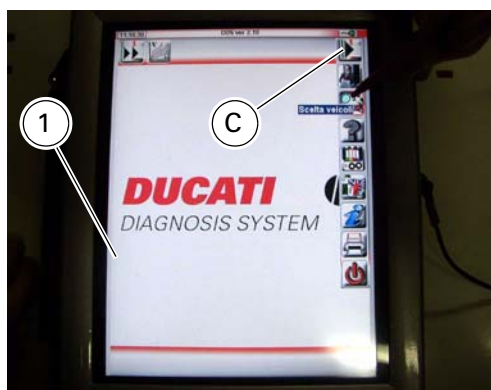
Switch on the DDS tester (1); see paragraph entitled "Tester power supply".

Connect the power and diagnostics cable (2) to the diagnostics connector (A) on the tester and to the diagnostics socket (B) on the motorcycle.

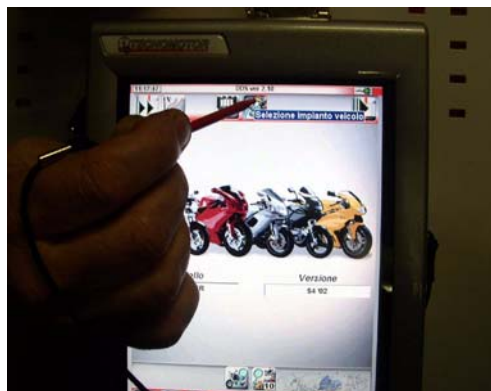


Enter the general functions menu by pressing the "Menu 1" icon (C).

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



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



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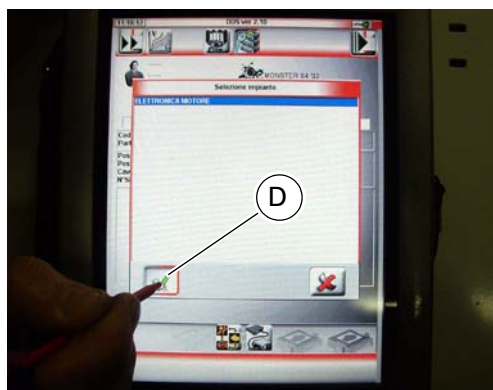
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Select "Engine electronics" and press the "Confirm" icon (D). Next, press the "Self-diagnosis" icon to access the corresponding function.



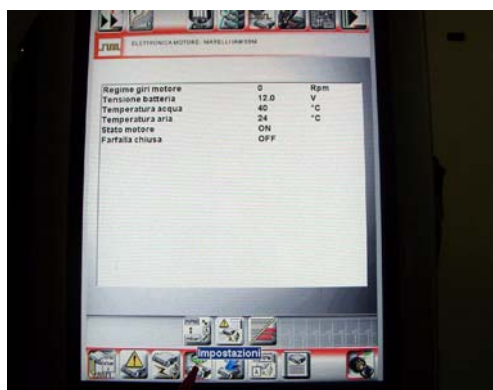
The DDS tester will interrogate the electronic control unit and display the parameters analysed with their relative values.



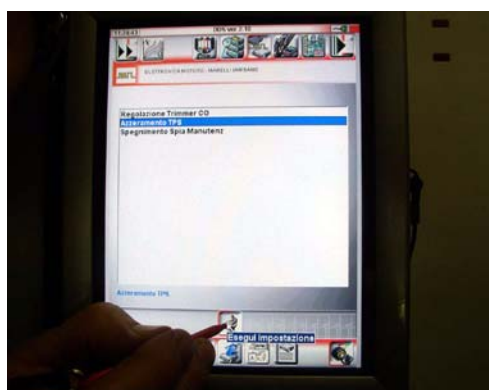
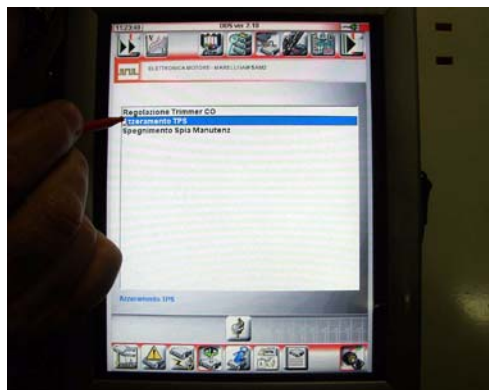
Notes

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

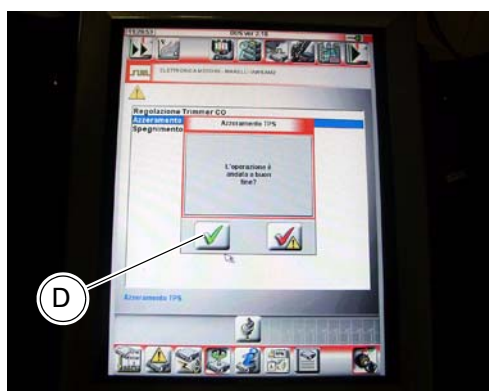
Press the "Settings" icon to display the special parameters.



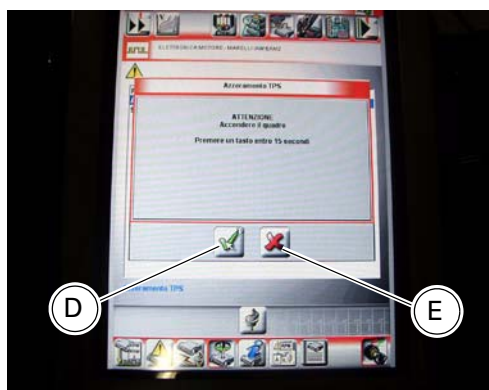
Select the option "Reset TPS" and then press the icon "Apply".



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



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



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

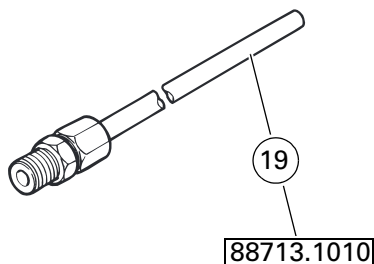
Adjusting the idle speed



Notes

This adjustment should be carried out in an ambient temperature equal to or greater than 19 °C.

Connect the inserts of the Exhaust Gas analyser part no. **88713.1010** to the outlets on the exhaust pipes, using the connection fittings (19).



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

Make sure that the throttle cable freeplay is correctly adjusted.

Reset the TPS to zero as described in the paragraph "Resetting the throttle position sensor (TPS)" in this section.

Check:

- that the throttle angle value read by the DDS tester with the engine switched off is $2.7^{\circ} \pm 0.1^{\circ}$; if not, repeat the procedure "Resetting the throttle position sensor".

Open the bypass screws (20) from the fully closed position by a 3/4 turn.



Start the engine and wait for the coolant temperature to reach 75 °C.

When the coolant temperature exceeds 75 °C, start the adjustment procedure described here below, bearing in mind that on completion of the operation the coolant temperature should not be greater than 100 °C.

Test the CO level, checking the value is greater than 0.7 on both cylinders.



Warning

If the engine is shut off, before proceeding with adjustment of the CO level, wait a minute after restarting for the enrichment phase to finish (Kranc time).

If the CO value is lower than 0.7, close the bypass screw (20) of the relative cylinder by a 1/4 turn and wait 15 seconds before taking the exhaust gas reading again.

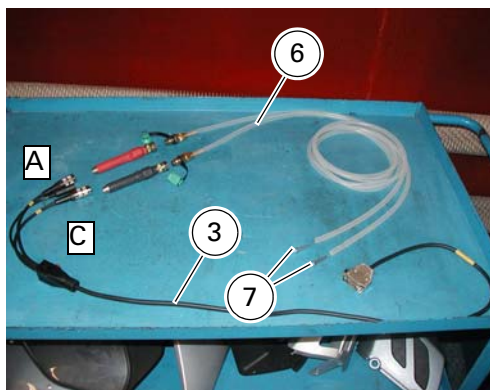
If the CO value is correct, check the idle speed rpm: this should be between 1250 ± 1350 rpm (1300 ± 50 rpm); if the rpm is not in this specified range, repeat the adjustment procedure described in "Resetting the TPS".

If the adjustment does not produce a positive result, carry out the "Cylinder synchronisation" procedure described below to make sure that the vacuum levels produced in the intake manifolds are balanced.

Cylinder synchronisation

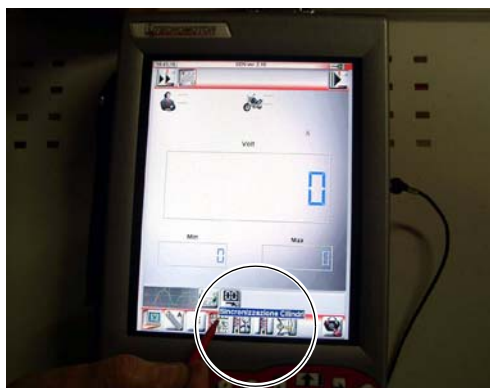
Connect the Measurement Module cable (3) to the Measurement Module connector on the DDS (see paragraph "Description of the Ducati Diagnostic System instrument").

Connect the vacuum/pressure pipes (6) to the connectors (A) and (C) of cable (3) and connect the fittings (7) to the pipes.

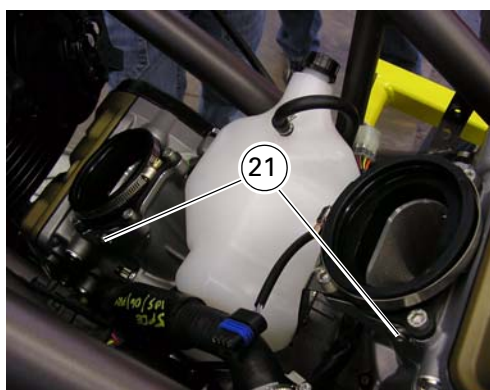


Switch on the DDS tester; see heading "Tester Power Supply".

Enter the "Measurement module" function. Press the "Cylinder synchronisation" icon.



The socket to which the Measurement Module cable (3) is to be connected is indicated on the screen with a capital letter: A, B or C. Remove the screws (21) from the cylinder heads and install the fittings (7) in their place.



Close the bypass screws (20) completely.



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).

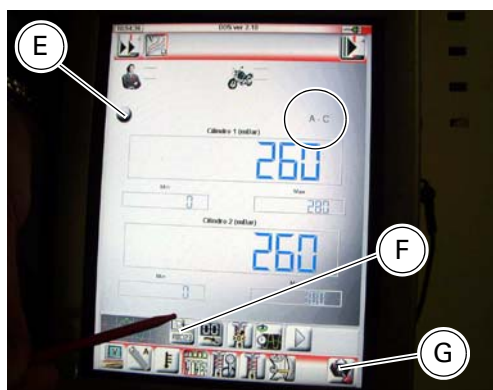
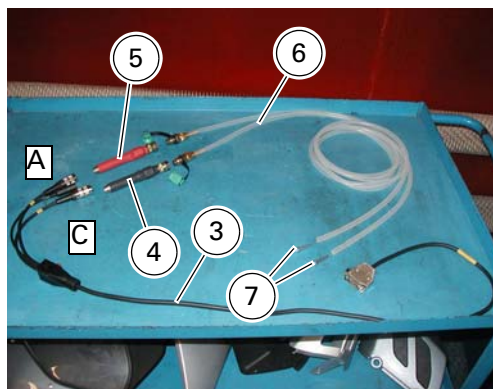
Press the "Start" icon to begin the cylinder pressure measurement procedure.

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).

Correct balancing is obtained when the two lines of the graph are superimposed or when the two numerical values indicated are equal.



The values can be reset by pressing the "Reset" icon.

If the cylinders are not balanced, turn the bypass screw (20) of the cylinder with the lowest vacuum level (the highest value) backing it off slightly (a 1/4 turn at a time) until the two lines on the graph coincide, or until identical numerical values are displayed, if numerical display is selected.



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Checking the engine oil pressure

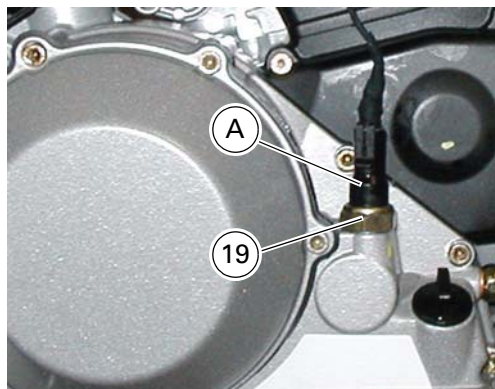


Notes

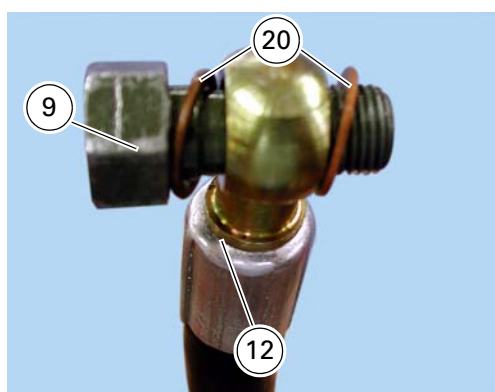
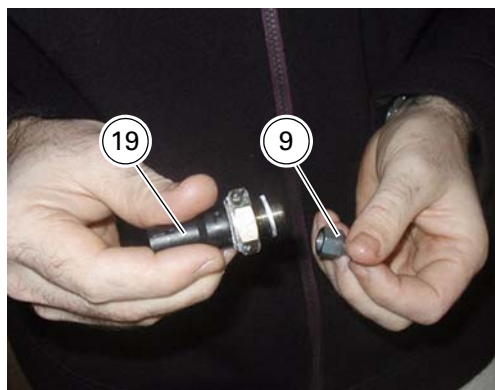
The on-screen icons used during this procedure are explained in a table at the end of this section.

To measure the pressure of the lubrication circuit, use the engine oil pressure test point (19) as follows:
Remove the RH side fairing (Sect. E 2).

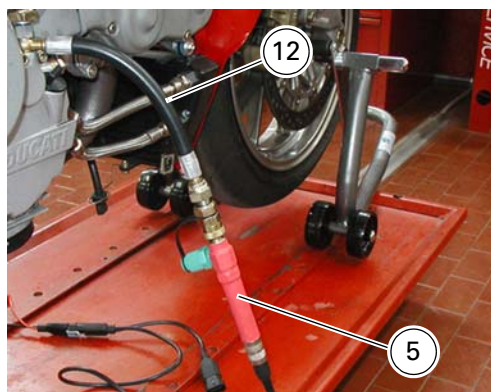
Disconnect the wiring connector (A) and remove the pressure switch (19), taking care to recover the seal.



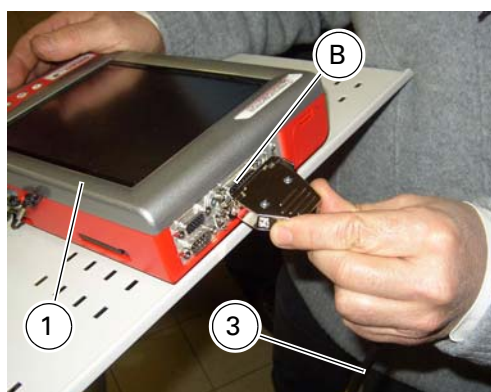
Insert the fitting (9) into the connection on the hose (12), interposing the two copper sealing washers (20). Insert the fitting (9) of the pipe (12) in the threaded hole (M10x1 mm) of the right-hand crankcase cover and screw it fully home. Refit the pressure switch (19) on the fitting (9) along with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



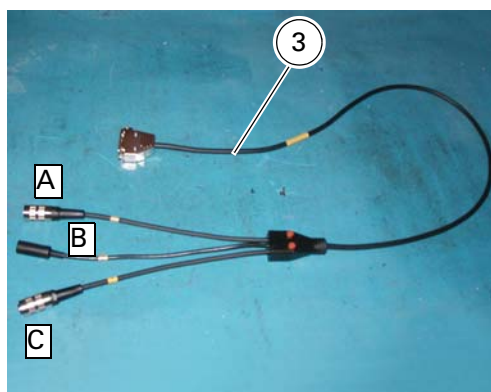
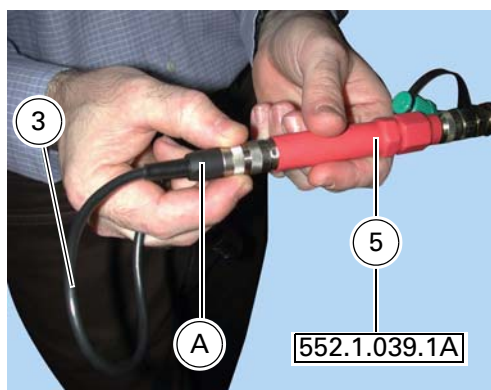
Connect the pressure sensor (5) to the pipe (12) to transform the pressure signal into an electrical signal.



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).



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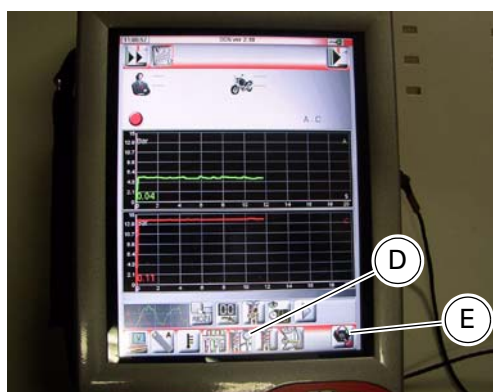
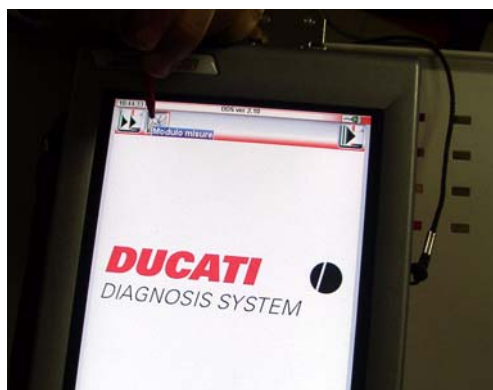
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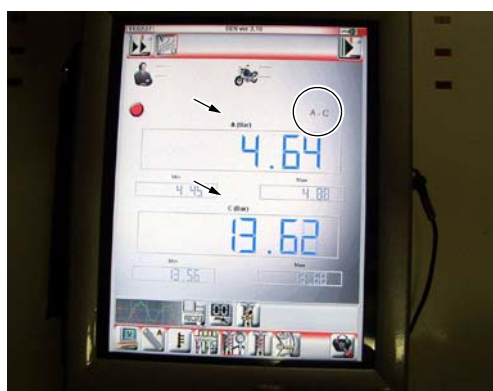
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On the DDS tester (1), select the "Measurement module" function by pressing the corresponding icon; then press the "Pressure Test" icon (D) followed by the "Start" icon (E).

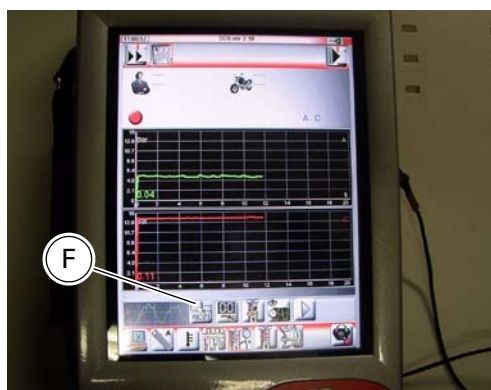


The socket to which the cable (Measurement Module) (3) is to be connected is indicated on the screen with a capital letter: A, B or C.



Start the engine.

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



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



Oil pressure test values:



Warm engine

(Minimum oil temperature = **80 °C**)

1100 to 1300 rpm

greater than **0.8** bar

3500 ÷ 4000 rpm

greater than **4** bar



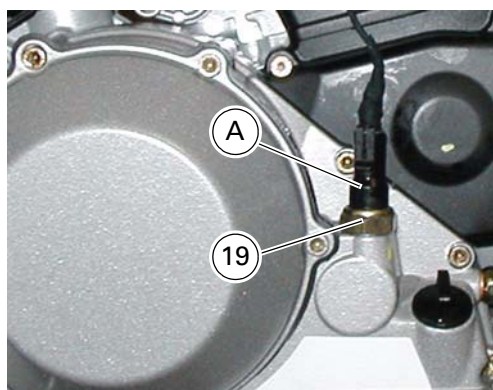
Important

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

Excessively high pressure may indicate that the relief valve is stuck. Excessively low pressure, on the other hand, may be caused by the relief valve being stuck in the open position, the relief valve spring being too weak, or a faulty oil pump. Other causes are excessively worn seals and gaskets or a badly worn engine.

Remove the tool and refit the pressure switch (19) along with its seal. Tighten the pressure switch to the specified torque (Sect. C 3, Engine torque settings).

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



Disconnect the DDS tester.
Refit the RH side fairing (Sect. E 2).

Cylinder compression test



Notes

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

Engine performance is directly correlated to the pressure that can be measured in the combustion chambers of the two cylinders. Excessive or insufficient pressure, or an excessive difference between the two cylinders, will result in a reduction in engine performance and can lead to component failure.

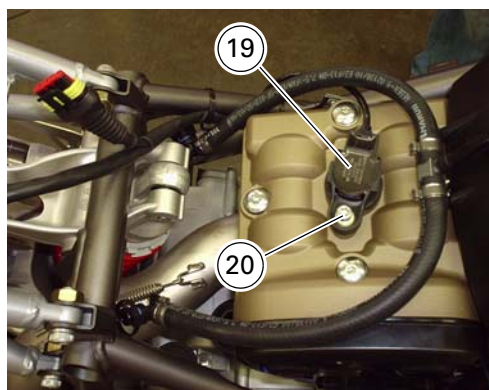
Run the engine and allow it to warm up to the point at which fan operation starts, at least once.

Remove the engine outer structures.

Open the throttles completely.

Remove the HT leads (19), unscrewing the nuts (20) of both spark plugs.

Remove the spark plug from the cylinder to be tested.



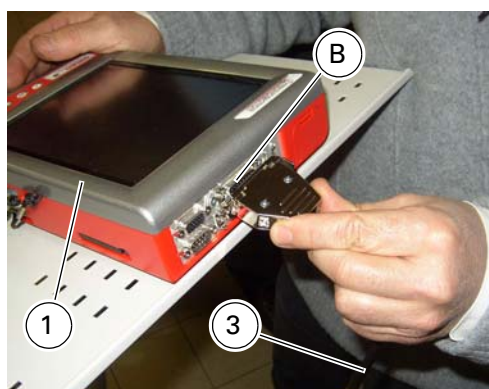
Connect the HT lead to earth to prevent sparking.

Screw the cylinder compression fitting (11) into the spark plug bore.

Connect the pressure sensor (5) to the cable (11).

Switch on the DDS tester (1); see paragraph entitled "Connection to motorcycle"

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



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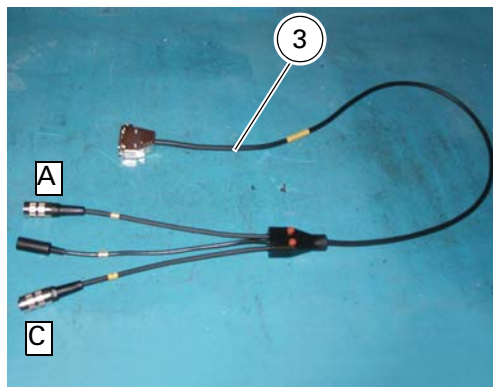
P

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

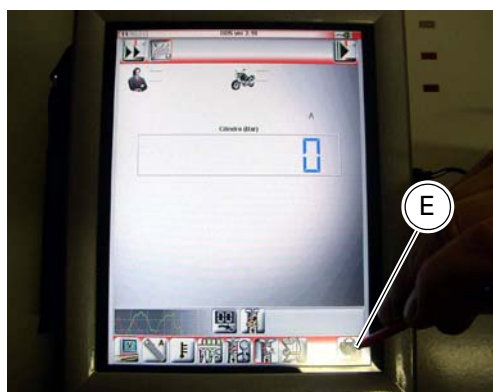
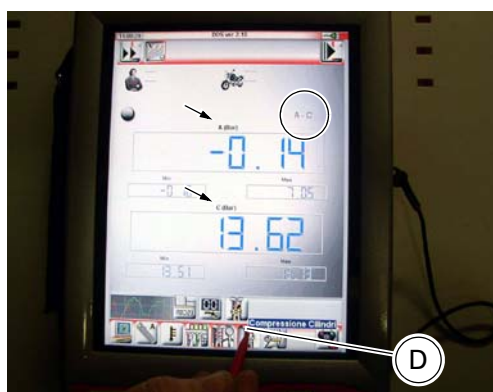


Notes

Measure the compression on one cylinder at a time.



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



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

Turn over the engine with the starter motor until the pressure stops rising.

Check the pressure in each cylinder:

- standard value: **13 to 15** bar;
- minimum value: **11** bar;
- maximum permissible difference between cylinders: **2** bar.



An excessively high pressure value can be caused by:

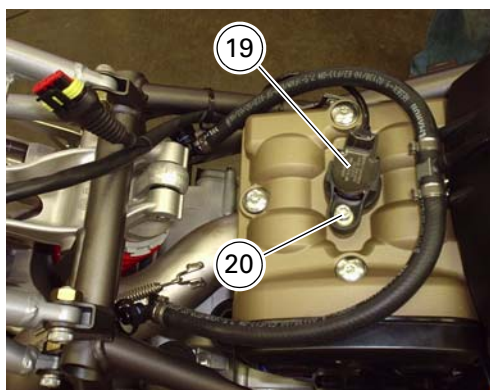
- build up of deposits in the combustion chamber.

An excessively low pressure value can be caused by:

- gas escaping between the cylinder head and the cylinder;
- worn valve seats;
- bent valve stems;
- incorrect valve clearances;
- worn cylinder or piston rings.

Refit the sparkplugs, position the HT leads (19) in their respective housings and tighten the nuts (20) to the specified torque (Sect. C 3).

When the check has been completed, refit the outer structures.



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Fuel pressure test



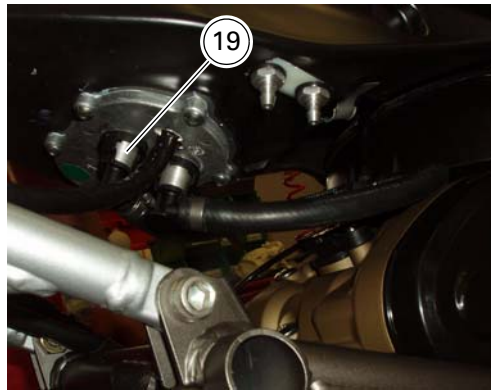
Notes

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

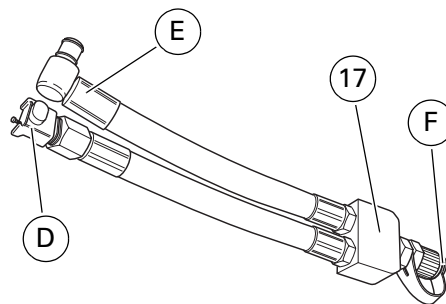
Before carrying out this procedure, you need to detach the fuel tank-seat-cowling assembly (Sect. E 3) from the motorcycle but without removing it.

Slightly raise the fuel tank and place a pad underneath it so as to be able to access the fittings on the flange.

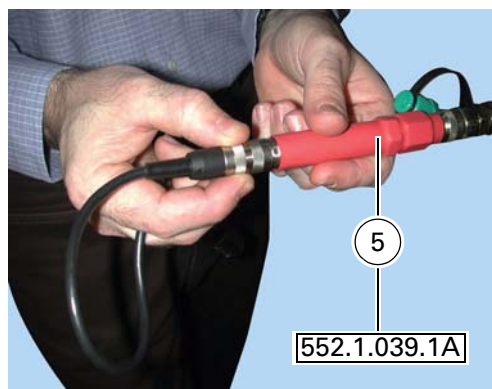
Remove the fuel feed hose (19).



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

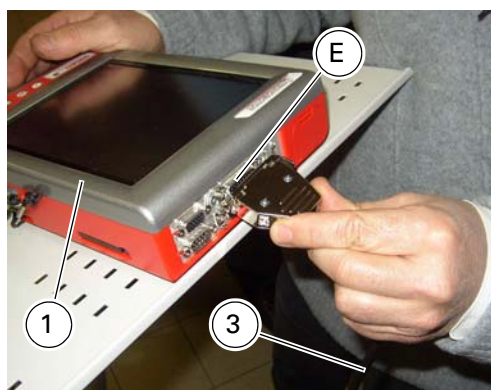


Connect the pressure sensor (5) to the test outlet (F) of the pipe (17) to transform the pressure signal into an electrical signal.

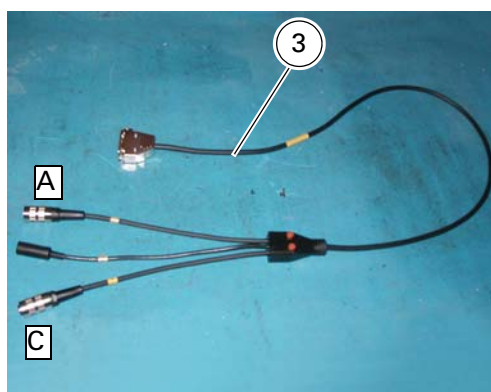


Switch on the DDS tester (1); see paragraph entitled "Tester power supply".

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



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



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



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

The values may be displayed in three different ways: in one numeric form and in two graphic forms; to select the desired display type, press the "Value display" icon (H).

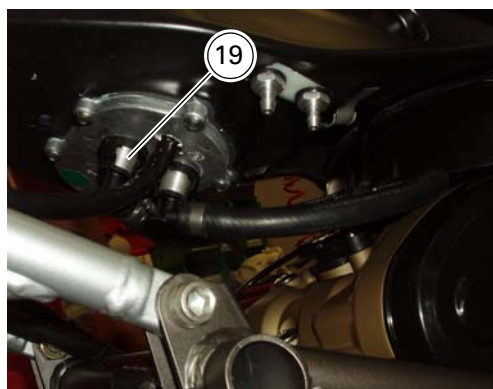


The measured value is indicated alongside the letter (A) or (C) identifying the cable used for the measurement: i.e. if you used connector (A) of the cable (3), the measured value will be displayed next to the letter (A) on the screen.

The maximum pressure must be **3** bar (nominal).

On completion of the test, remove all the components of the test instrument and refit the fuel feed hose (19).

Refit the fuel tank-seat-cowling assembly (Sect. E 3).



Immobilizer override procedure



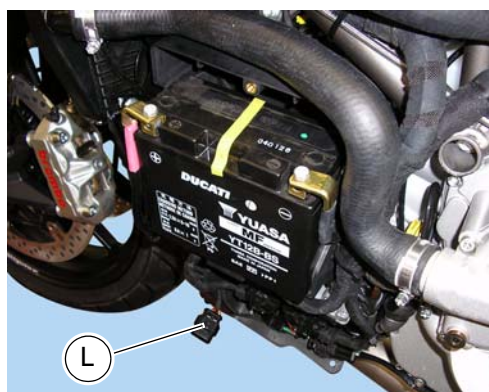
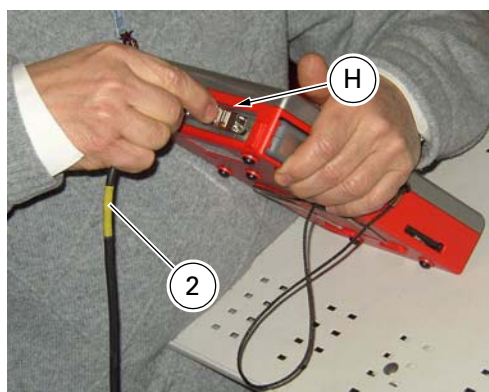
Notes

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

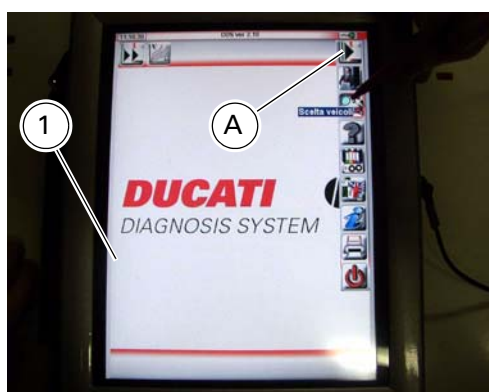
In the event of a malfunction of the immobilizer system, it is possible to start the engine using an emergency procedure: this procedure, which is described in full in Sect. P 8, Immobilizer and transponder requires a secret code which may be entered using the DDS tester.

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

Connect the power and diagnostics cable (2) to the diagnostics connector (H) on the tester and to the diagnostics socket (L) on the motorcycle.



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



A

B

C

D

E

F

G

H

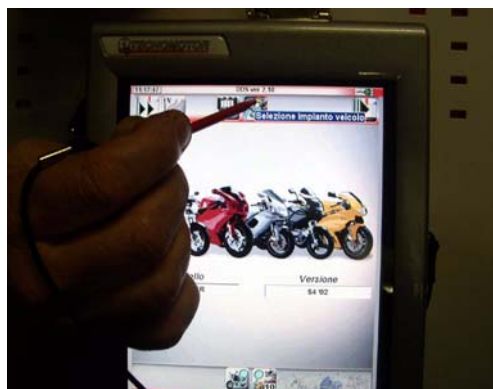
L

M

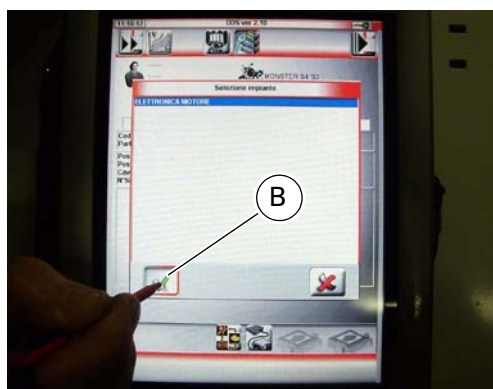
N

P

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



Press the "Select system" icon 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.

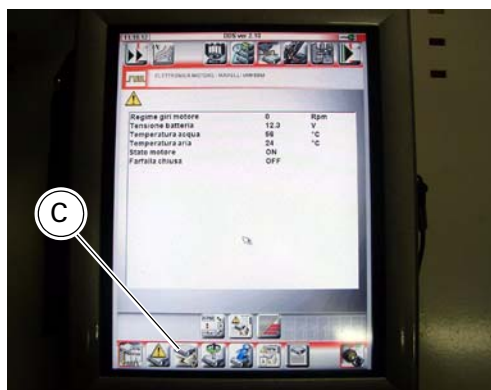


The DDS tester will interrogate the electronic control unit and display the parameters analysed with their relative values.

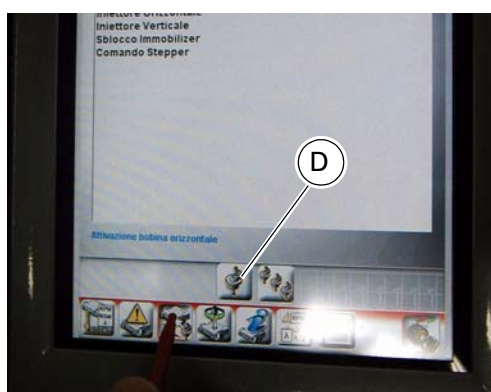
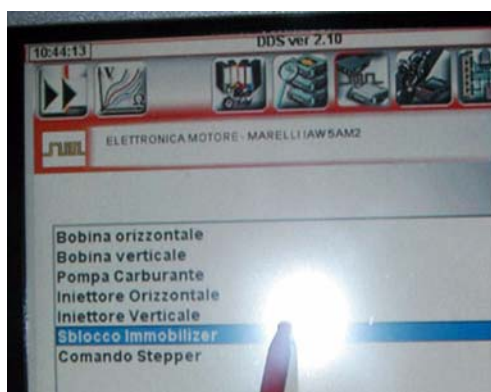


Make the connections with the motorcycle ignition key in the OFF position.

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.



A

B

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G

H

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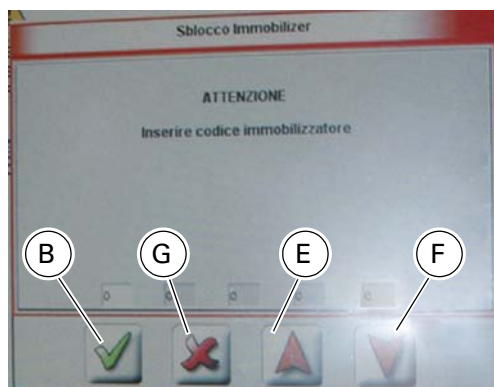
P

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 was completed successfully?" will appear; press "Confirm".

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



Disconnect the tester.

Guided diagnosis



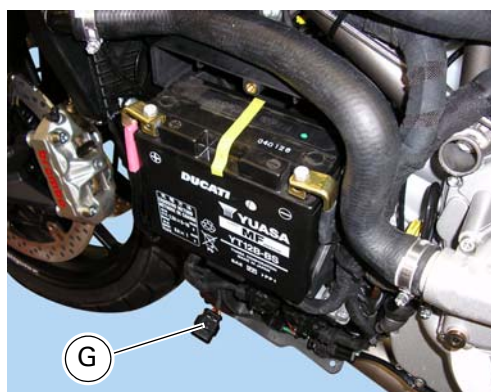
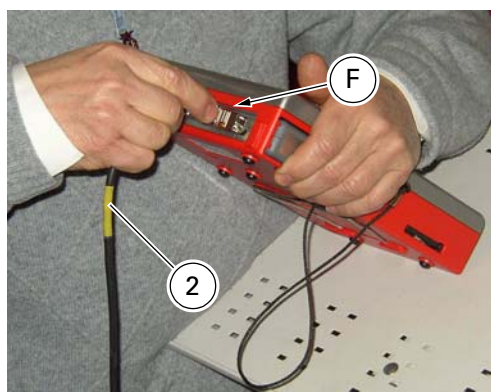
Notes

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

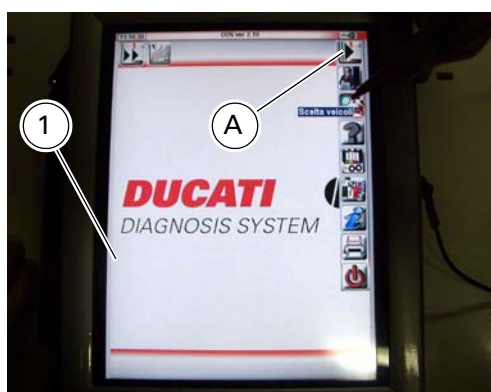
The DDS tester guides the operator step-by-step through the various diagnostic procedures, providing descriptions and documentation for motorcycle components, wiring diagrams for the electronic systems and information on the locations of specific components.

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

Connect the power and diagnostics cable (2) to the diagnostics connector (F) on the tester and to the diagnostics socket (G) on the motorcycle.



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



A

B

C

D

E

F

G

H

L

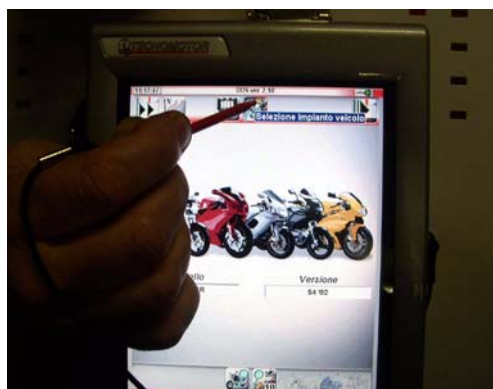
M

N

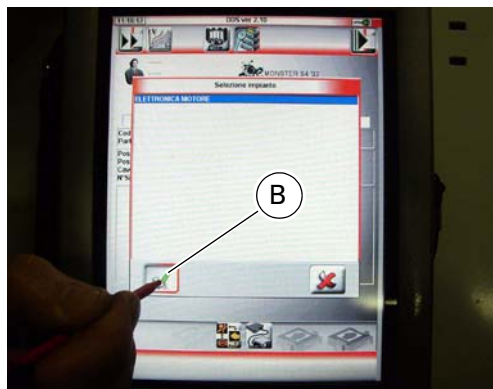
P

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

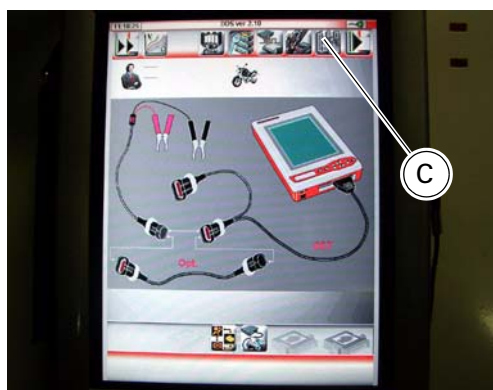
Press the "Select system" icon to display a list of the bike's systems that can be analysed.



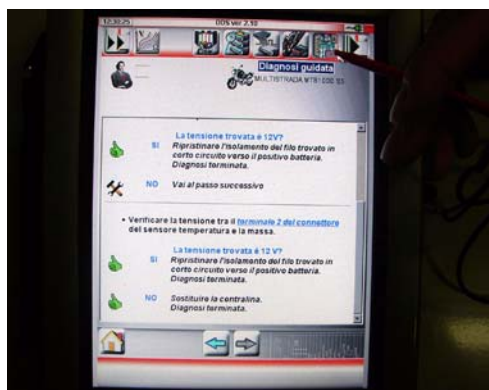
Select "Engine electronics" and press the "Confirm" icon (B).



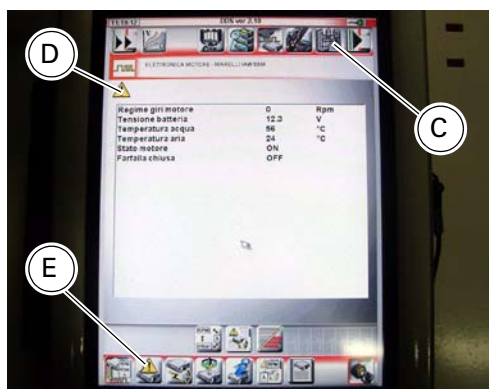
Press the "Guided diagnosis" icon (C) to access the corresponding function.



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 guided diagnostic procedure; press the "Guided Diagnosis" icon.



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

Testing the battery charging system



Notes

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

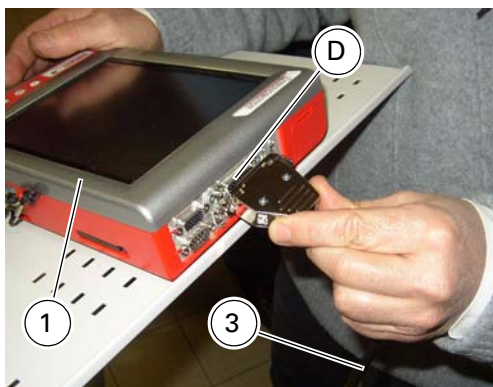
You can determine the engine rpm required for the alternator to produce sufficient current to charge battery, power the injection/ignition system and all the electrical equipment on the motorcycle. When applied to a cable, the ammeter clamp (18) detects the magnetic field generated by the current passing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



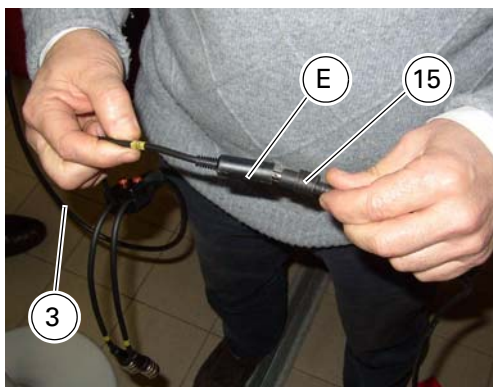
Remove the right-hand fairing (Sect. E 2).

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

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



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

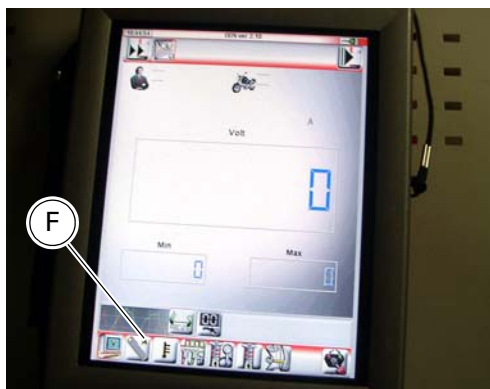
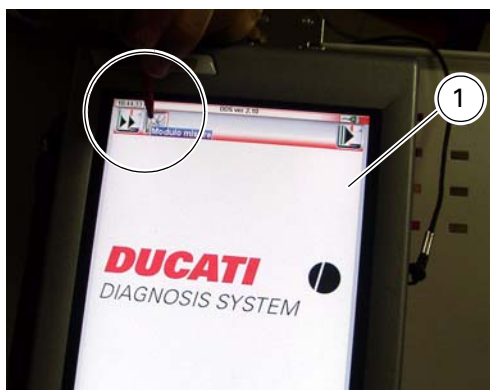


Warning

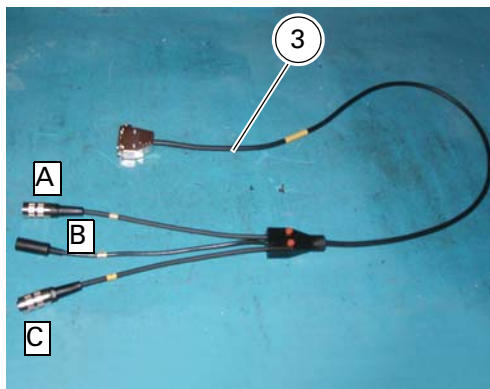
The ammeter clamp must not be connected to wires through which electrical current is flowing.

Apply the ammeter clamp to the battery positive terminal lead with the arrow on the clamp pointing towards the battery positive terminal (+).

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



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



A

B

C

D

E

F

G

H

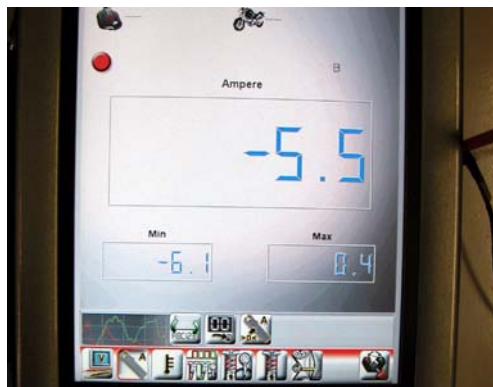
L

M

N

P

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



Important

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

Deactivating the “maintenance” indication on the instrument panel

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

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

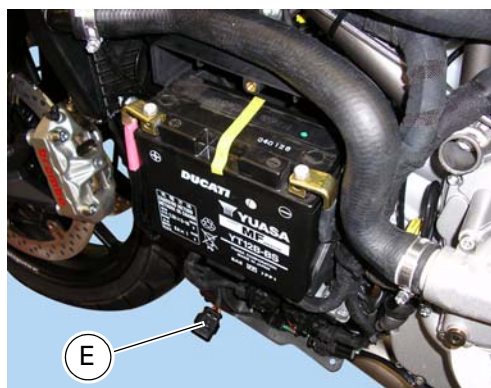
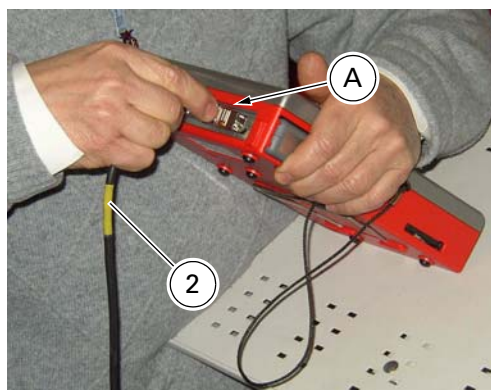


Notes

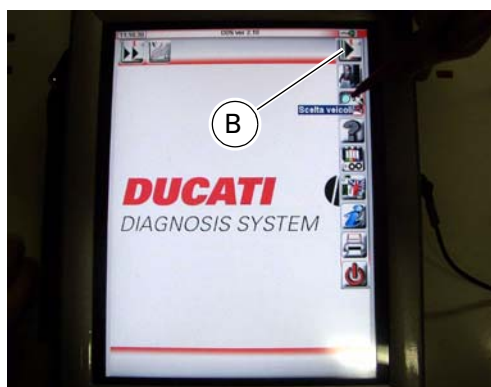
The on-screen icons used during this procedure are explained in a table at the end of this section.

Switch on the DDS tester; see heading “Tester Power Supply”.

Connect the power and diagnostics cable (2) to the diagnostics connector (A) on the tester and to the diagnostics socket (E) on the motorcycle.



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



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

A

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A

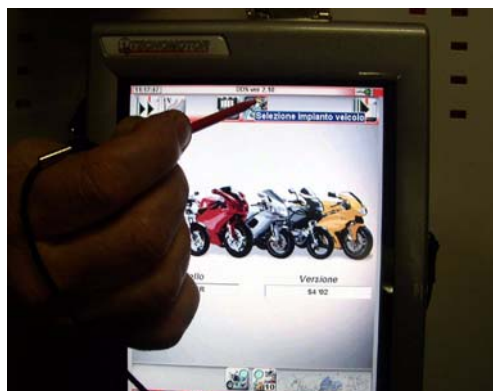


B

C

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

D



E

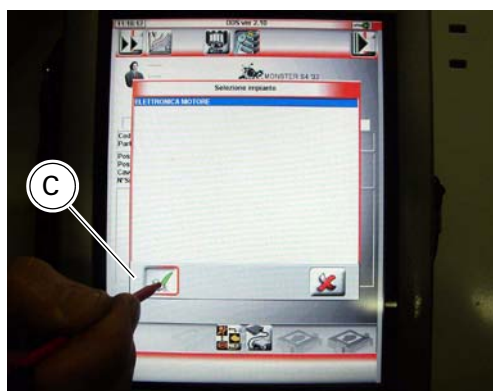
F

Select "Engine electronics".

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

G

H



L

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.

M

N

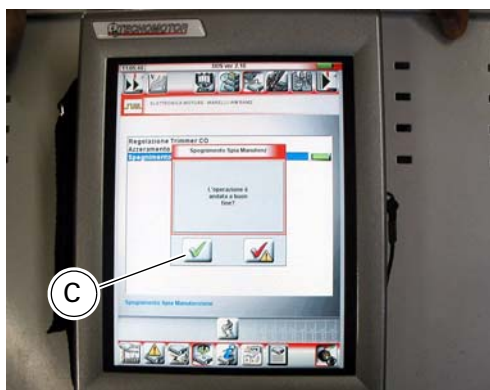
P



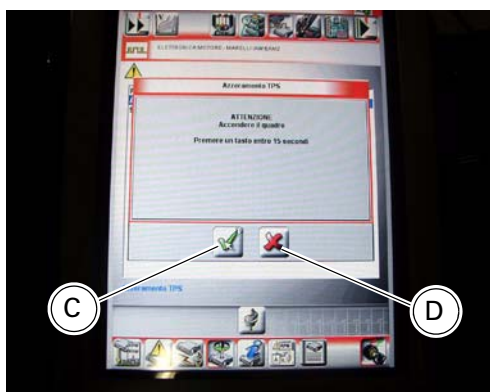
Select the option "Mainten. light OFF" and then press the "Apply" icon.



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 "maintenance" 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.

A

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C

D

E

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G

H

L

M

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P

Icons table

A

Symbol	Designation
--------	-------------



Confirm

B



Exit

C



Measurement module



Belt tension

D



Start/stop

E



Menu 1



Select vehicle

F



Select motorcycle

G



Self-diagnosis



Settings

H



Apply



Cylinder synchronisation

L



Value display

M



Reset



Pressure test

N



Cylinder compression

P



Actuators

Symbol	Designation
	Guided diagnosis
	Select system
	Errors
	Ammeter clamp

A

B

C

D

E

F

G

H

L

M

N

P

Fairings

A

B

C

D

E

F

G

H

L

M

N

P

A	1 - Headlight shell - rear-view mirrors	3
	Removal of the rear-view mirrors	4
	Refitting the rear-view mirrors	5
	Removal of the headlight shell	6
	Refitting the headlight shell	8
B	2 - Fairing panels	11
	Removal of the side fairings	12
	Removal of the front shield	14
	Refitting the front shield	14
	Refitting the side fairings	15
C	3 - Seat - seat cowling and side panels	17
	Removal of the seat	18
	Removal of the side panels and seat cowling	19
D	Refitting the side panels and seat cowling	22
	Refitting the seats	26
	Refitting the pillion seat	27
E	4 - Front mudguard	28
	Removal of the front mudguard	28
	Refitting the front mudguard	29

F

G

H

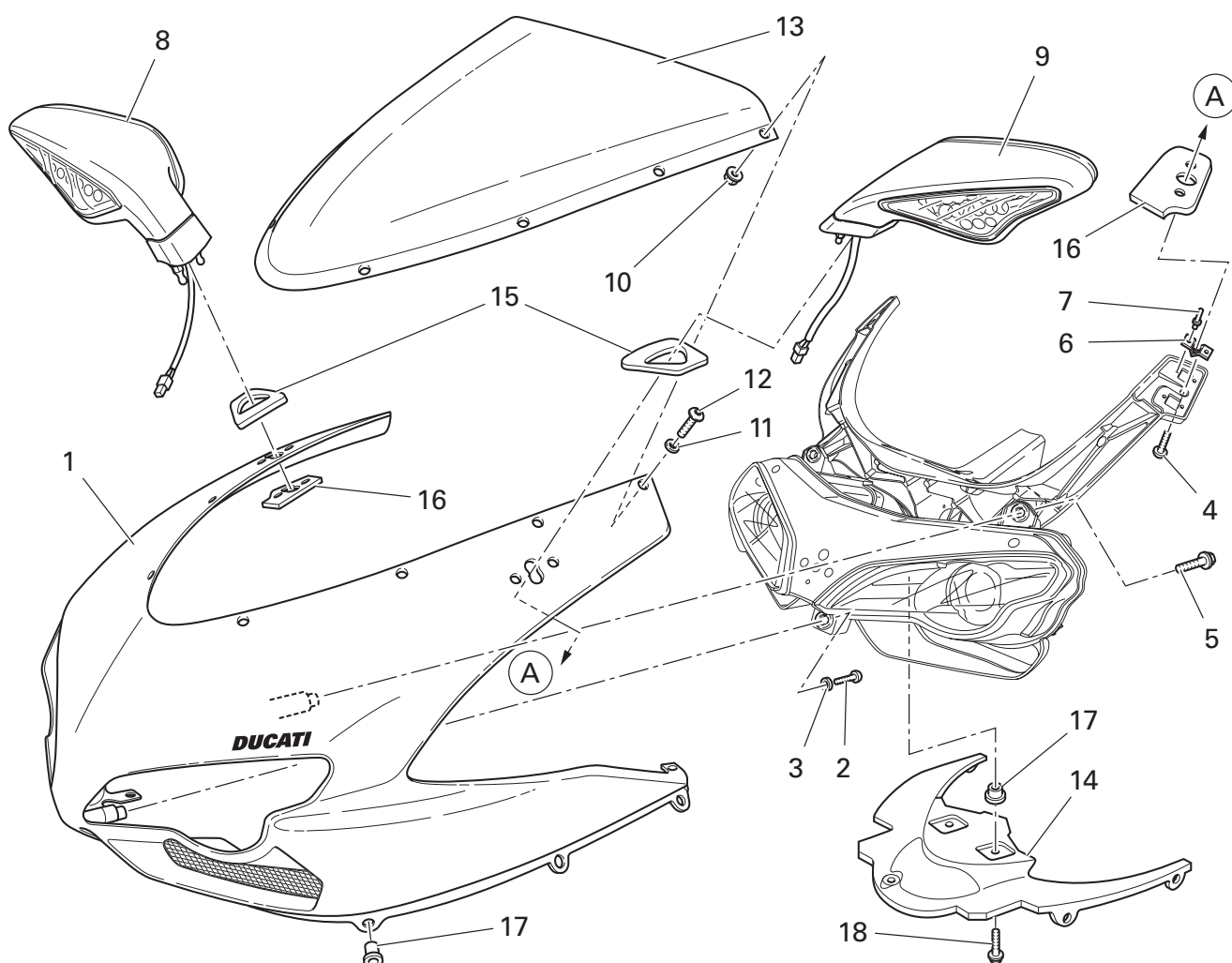
L

M

N

P

1 - Headlight shell - rear-view mirrors



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



Important

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

A

B

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D

E

F

G

H

L

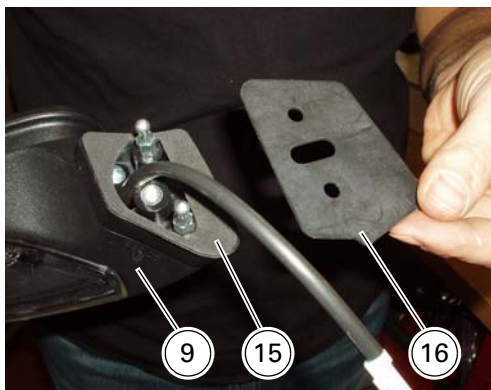
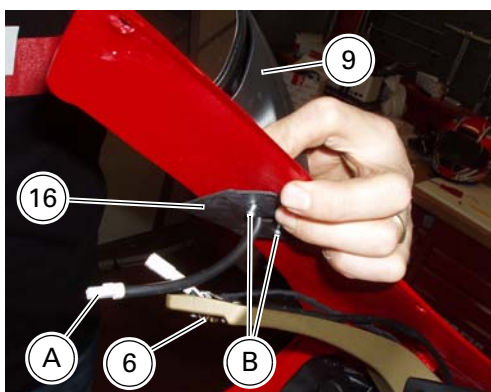
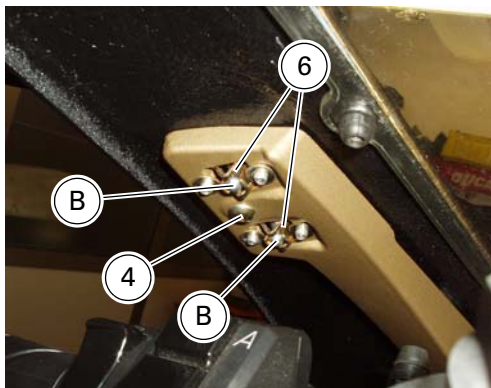
M

N

P

Removal of the rear-view mirrors

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



Refitting the rear-view mirrors

Locate the rear view mirror on the headlight shell, routing the turn indicator wiring through the hole in the headlight shell. Check that the upper gasket (15) is in place on the mirror.

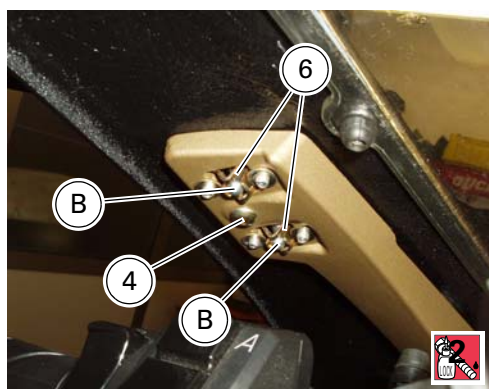
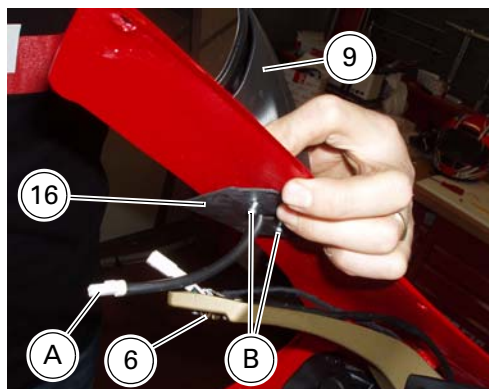
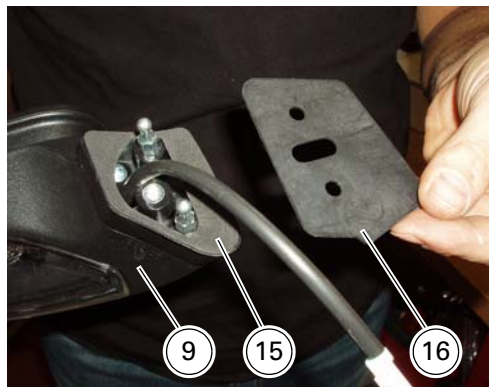
Refit the lower gasket (16).

Engage the pins (B) in the clips (6) on the headlight shell.

Connect the front turn indicator wiring connector (A) to the wiring loom.

Tighten the safety bolt (4) to the specified torque (Sect. C 3), after applying the recommended threadlocker.

Repeat the process to refit the other rear-view mirror.



A

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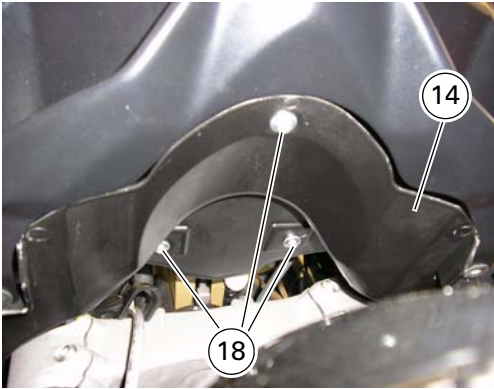
N

P

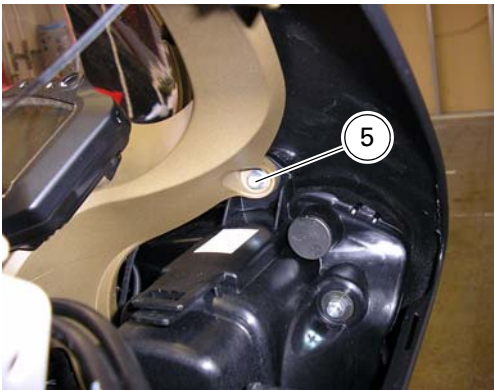
Removal of the headlight shell

Operation	Section reference
Remove the side fairings	E 2

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



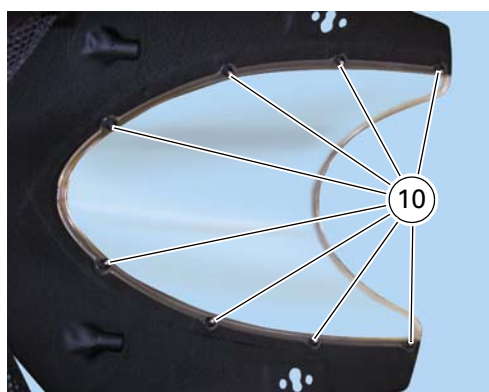
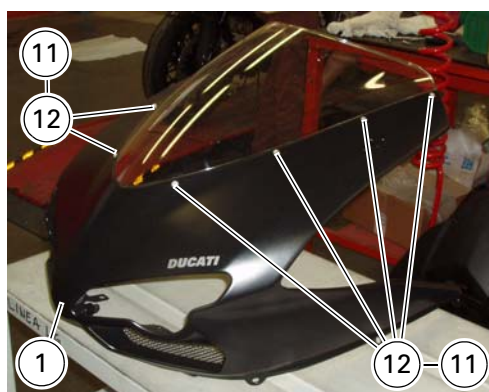
Unscrew the bolts (5) (on both sides of the headlight support frame) and the bolt (2) with washer (3) under the light assembly.



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



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



A

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N

P

Refitting the headlight shell

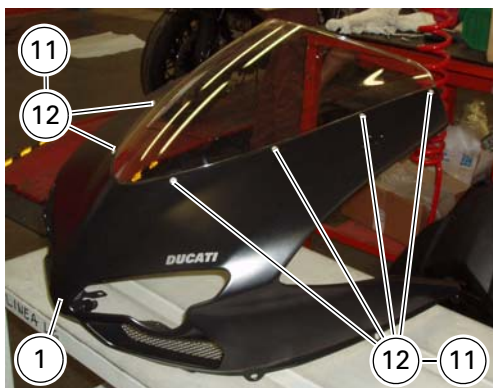
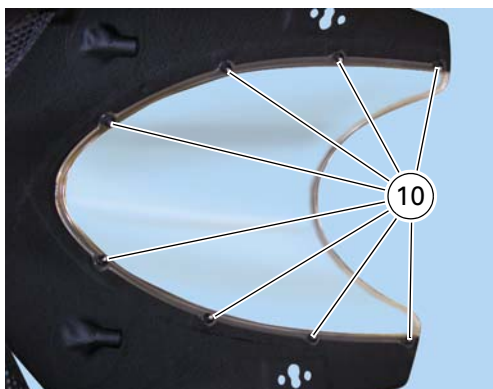


Important

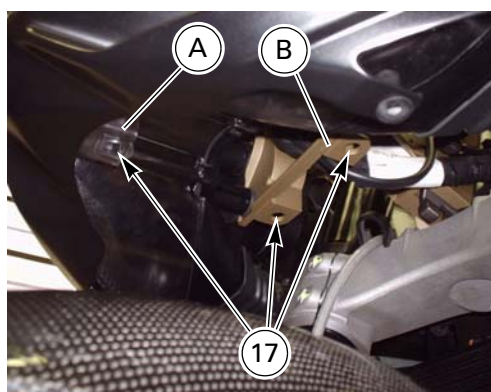
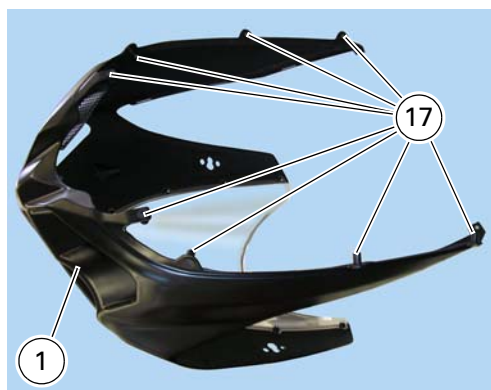
On refitting the headlight shell, always refit the nylon washers (11) in correspondence with the retaining bolts to avoid damaging the painted parts and the Plexiglas windshield.

During reassembly, make sure that the threaded inserts (10) are correctly positioned on the headlight shell.

To prevent the bolts (12) and washers (11) from moving while fitting them, hold the inserts (10) pressed against the headlight shell (1).



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



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



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



A

B

C

D

E

F

G

H

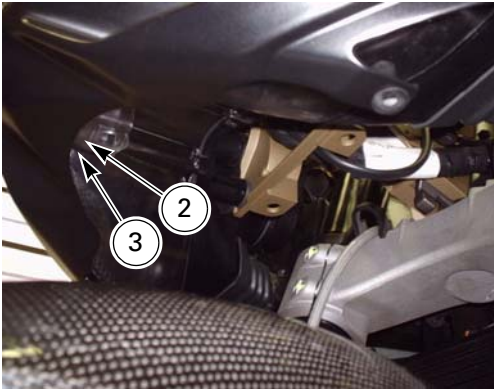
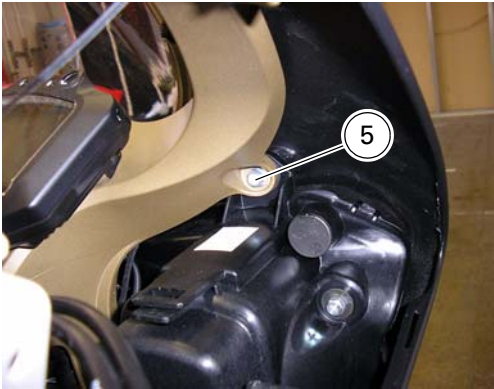
L

M

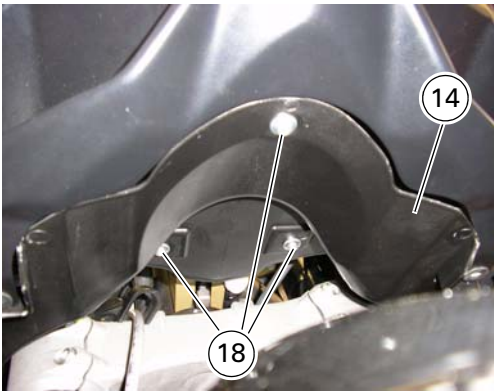
N

P

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



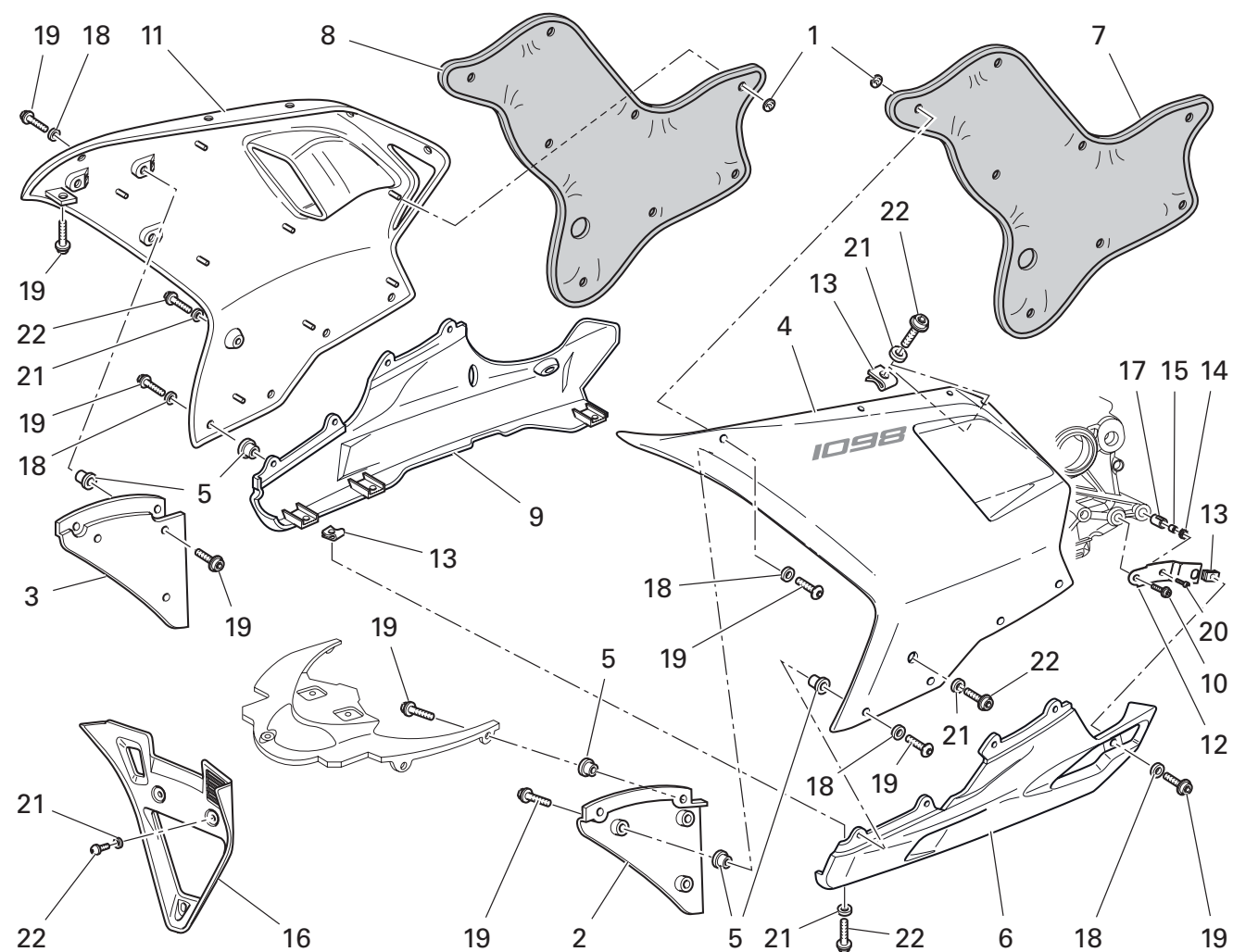
Refit the windshield (14) and tighten the bolts (18) to the specified torque (Sect. C 3).



Refit the rear-view mirrors as described above.

Operation	Section reference
Refit the side fairings	E 2

2 - Fairing panels



- 1 Clip
- 2 Panel (left)
- 3 Panel (right)
- 4 Left upper fairing
- 5 Threaded insert
- 6 Left lower fairing
- 7 Left side panel
- 8 Right side panel
- 9 Right lower fairing
- 10 Screw
- 11 Right upper fairing

- 12 Bracket
- 13 Clip
- 14 Washer
- 15 Bush
- 16 Front air scoop
- 17 Bush
- 18 Nylon washer
- 19 Screw
- 20 Screw
- 21 Nylon washer

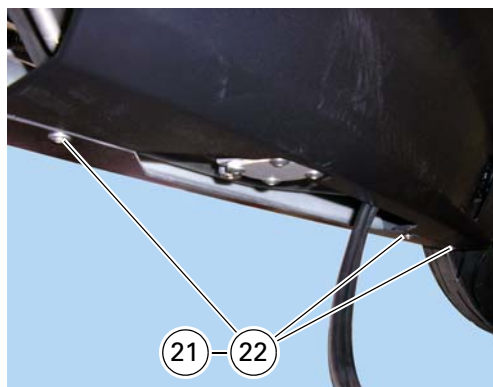


Important

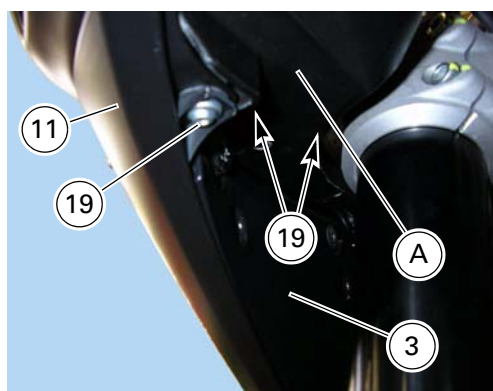
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the side fairings

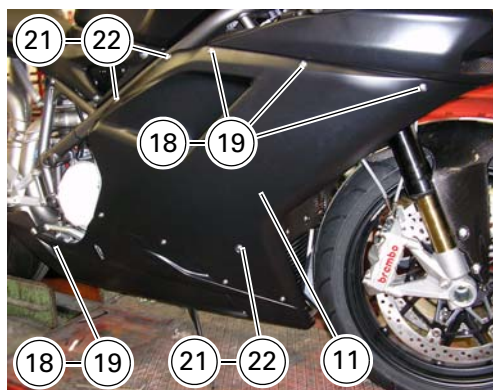
Unscrew the screws (22) securing the bottom of the fairing panels, recovering the washers (21).



Unscrew the inner screw (19) securing the front of the right upper fairing (11). Unscrew the inner screws (19) securing the splashguard (A) to the inner panel (3).

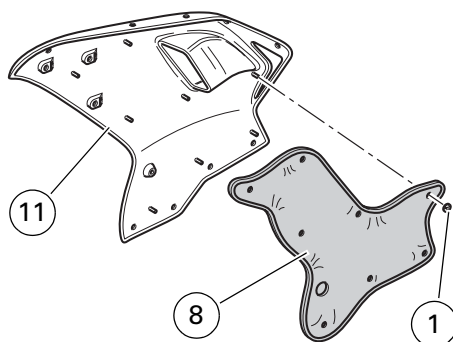


Unscrew the screws (22) and (19) securing the right upper fairing (11) to the bike, recovering the washers (21) and (18).



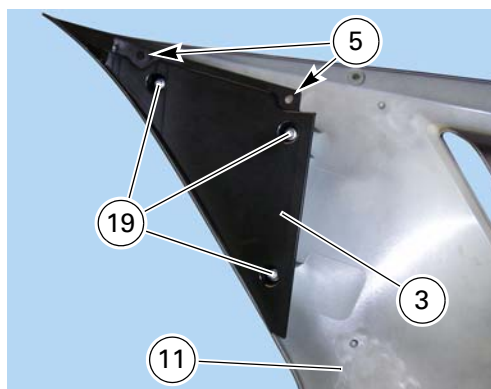
Remove the right side fairing assembly from the motorcycle.

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

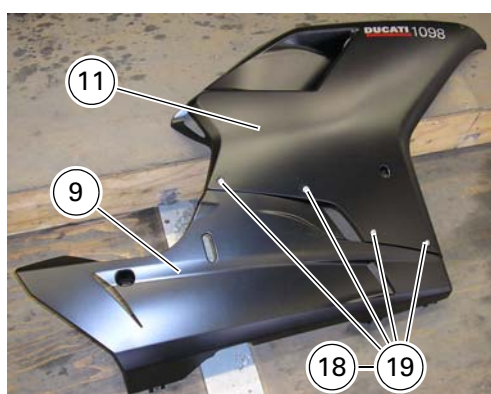


Disassembly of the fairing

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

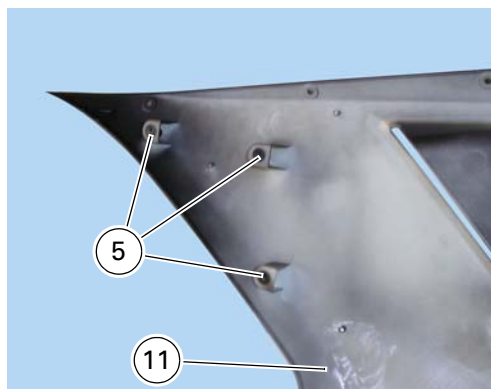


Undo the screws (19) securing the upper fairing (11) to the lower (9), recovering the washers (18).

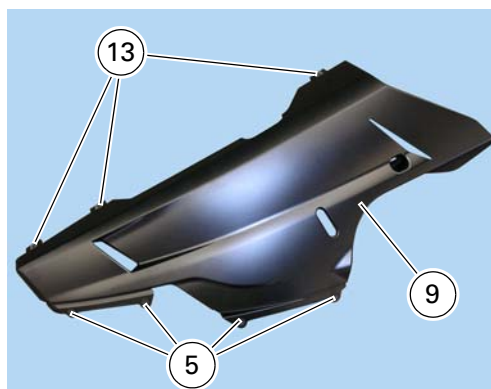


Repeat the above steps to disassemble the left-hand side fairing.

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



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



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

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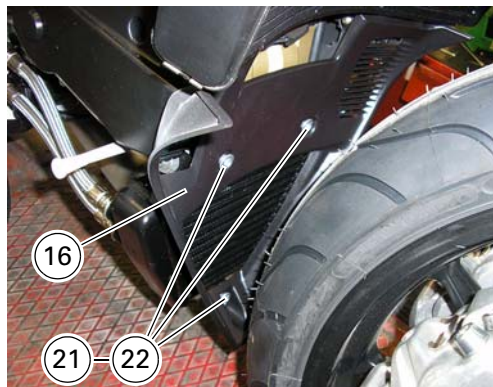
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Removal of the front shield

After removing the side fairings as described above, unscrew the screws (22) securing the front shield (16) to the oil cooler support bracket.

Remove the front shield (16) from its seat and recover the washers (21).



Refitting the front shield

When refitting the shield, tighten the screws (22) to the specified torque (Sect. C 3).



Refitting the side fairings



Warning

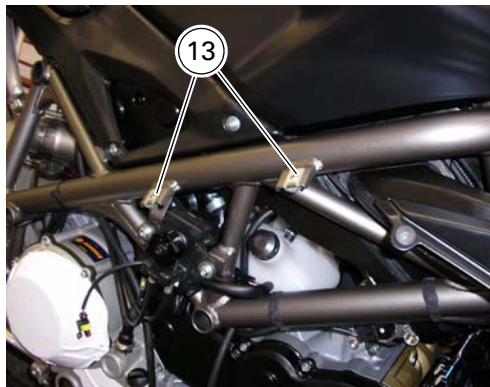
Failure to replace or incorrect refitting of any of the components removed could cause parts of the fairing to come loose when riding and the consequent loss of control of the motorcycle.



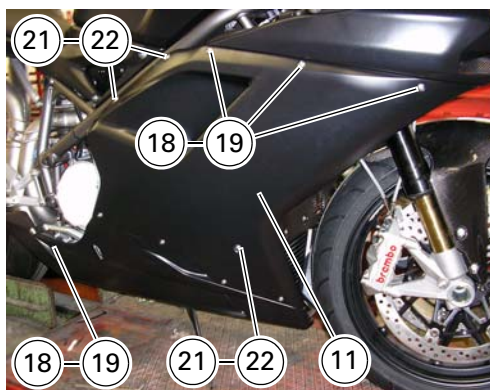
Important

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

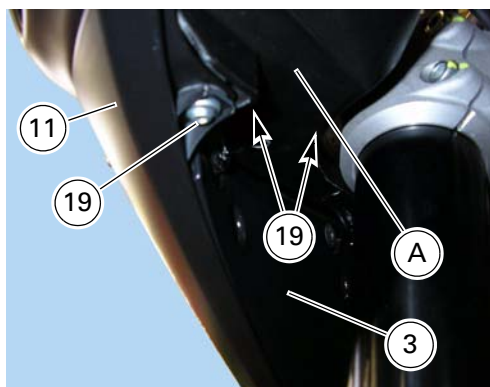
Make sure that the clips (13) are fitted to the frame on both sides of the motorcycle.



Fit the screws (22) and (19) securing the right upper fairing (11) to the bike, interposing the washers (21) and (18).



Fit the inner screws (19) securing the splashguard (A) to the inner panel (3). Fit the inner screw (19) securing the front of the right upper fairing (11).



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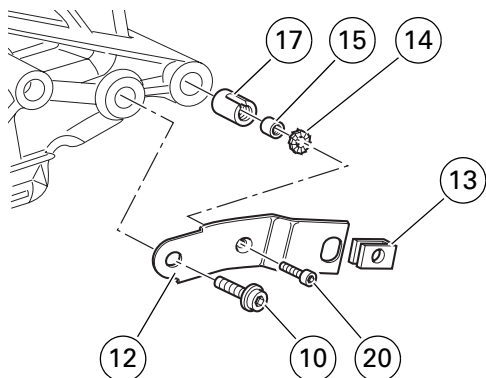
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Left fairing mounting bracket

If the bracket (12) was removed, refit, in order, bush (17), bush (15), washer (14), bracket (12) and secure then with the screws (20) and (10). Tighten the screws (20) and (10) to the specified torque (Sect. C 3). make sure that the clip (13) is fitted.

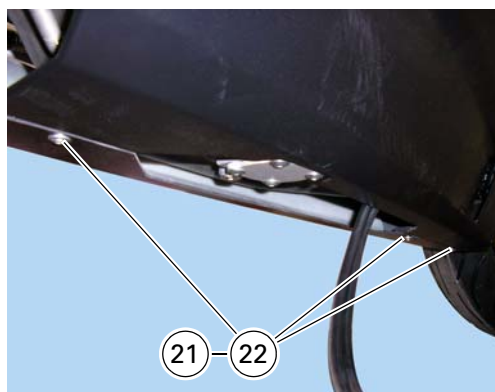


In the same way, refit the left fairing (4), taking care when inserting the sidestand through the aperture provided in the fairing panel (6).

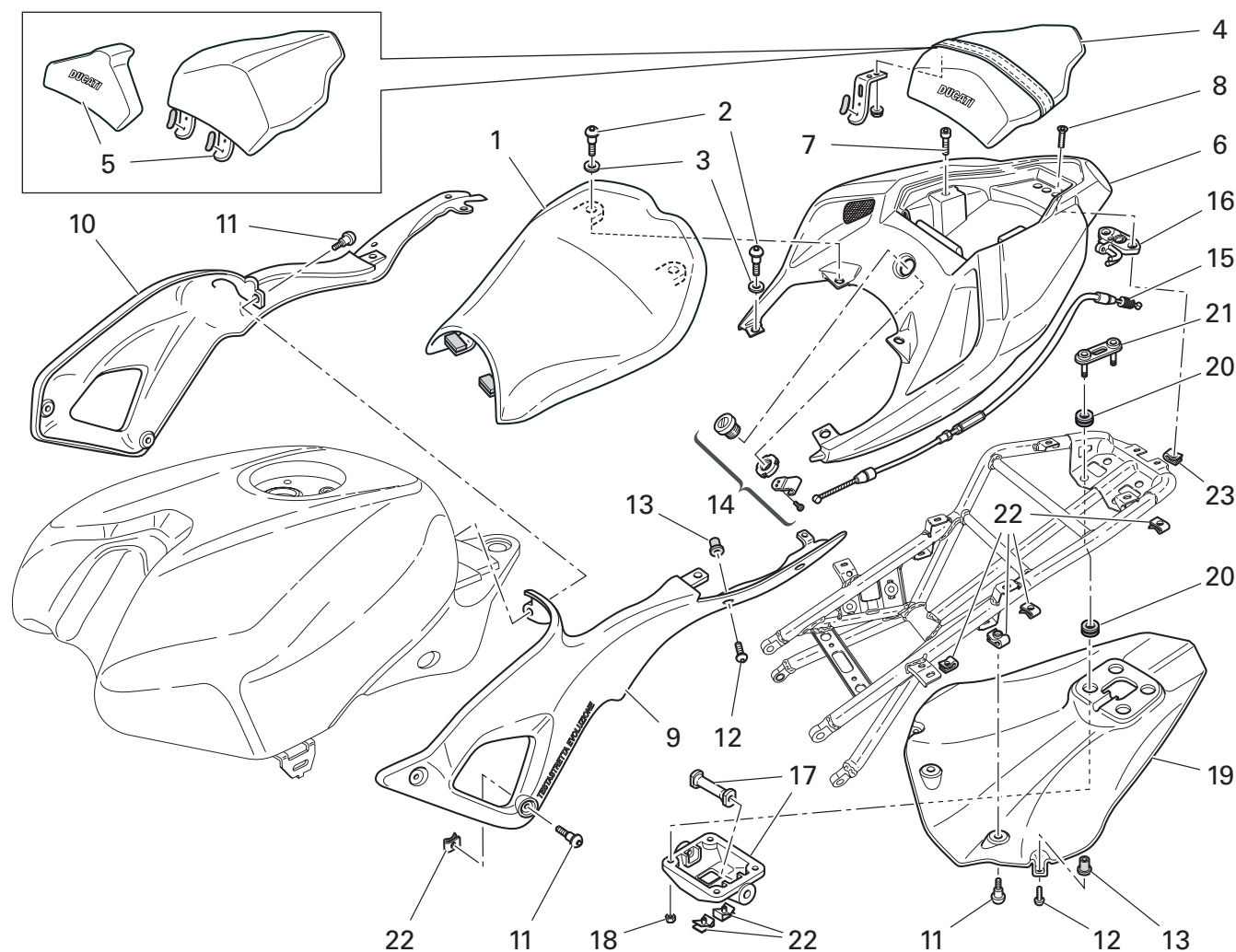
Fit the left fairing, attaching it to the front shield and to the right fairing at the bottom.

Fit the screws (22) securing the bottom of the fairing panels, interposing the washers (21).

Tighten all the fairing retaining screws mentioned above to the specified torque (Sect. C 3).



3 - Seat - seat cowling and side panels



- 1 Seat
- 2 Bolt
- 3 Washer
- 4 Passenger seat
- 5 Seat cover
- 6 Dual seat cowling
- 7 Bolt
- 8 Bolt
- 9 Left side panel
- 10 Right side panel
- 11 Bolt
- 12 Bolt

- 13 Threaded insert
- 14 Seat lock
- 15 Control cable
- 16 Seat catch
- 17 Support
- 18 Nut
- 19 Seat cowling heat shield
- 20 Rubber mounting
- 21 Flange
- 22 M5 clip
- 23 M6 clip



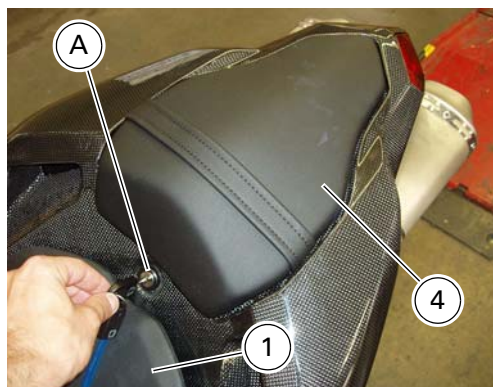
Important

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

Removal of the seat

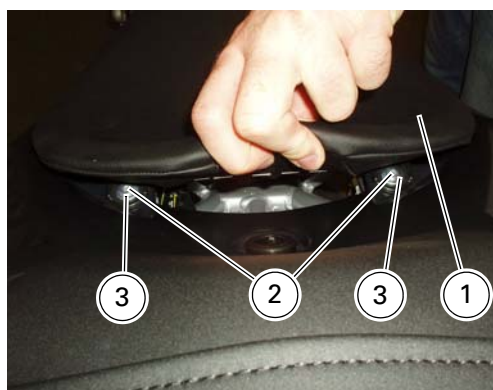
Removal of the pillion seat

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



Removal of the rider seat

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

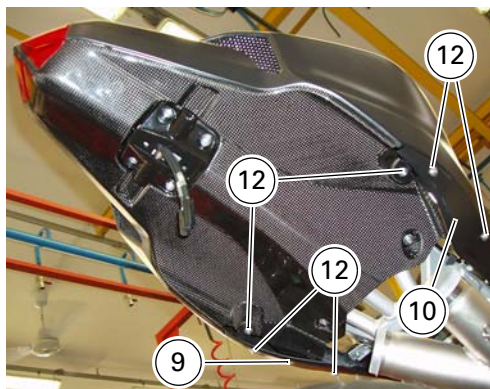


Removal of the side panels and seat cowling

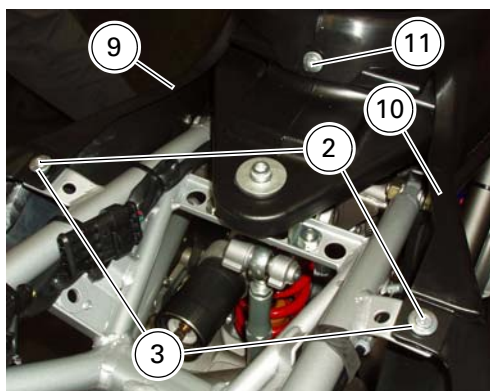
Removal of the side panels

In order to remove the side panels, you first need to remove the seats as described previously.

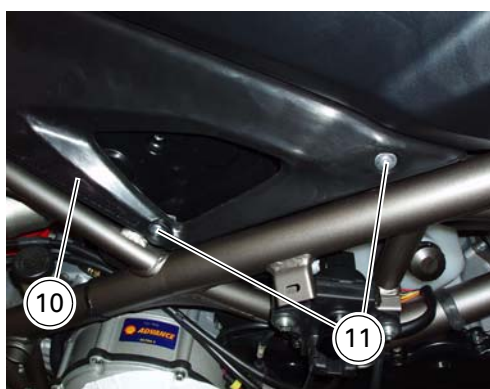
Unscrew the two screws (12) securing the rear of the right (10) and left (9) side panels to the rear subframe. Unscrew the four lateral rear retaining screws (12).



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



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



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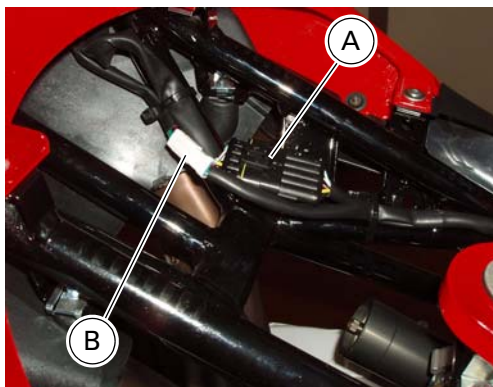
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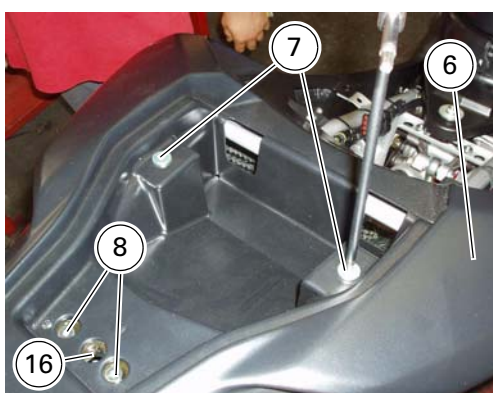
P

Removal of the seat cowling

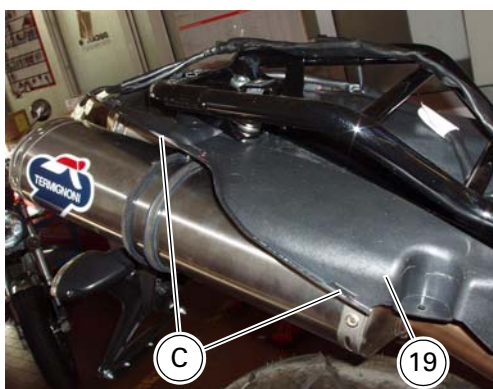
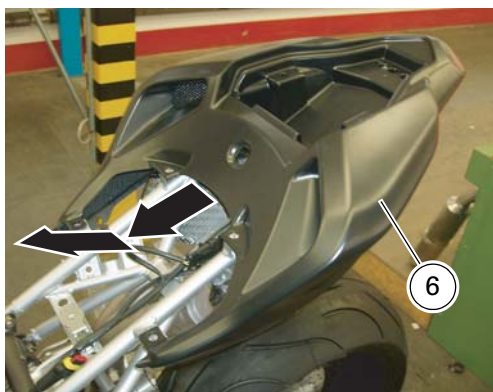
In order to remove the seat cowling, you first need to remove the seats and side panels as described previously. Disconnect the wiring connectors (A) of the rear wiring loom and the connector (B) of the data acquisition wiring.



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



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

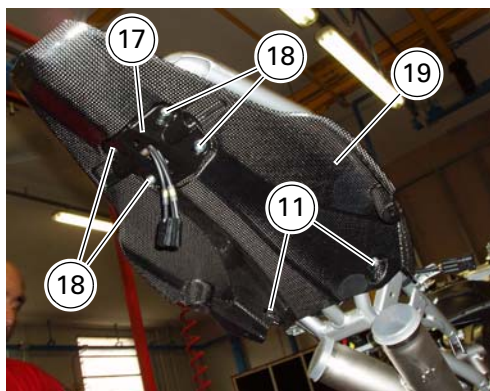


Removal of the seat cowling heat shield

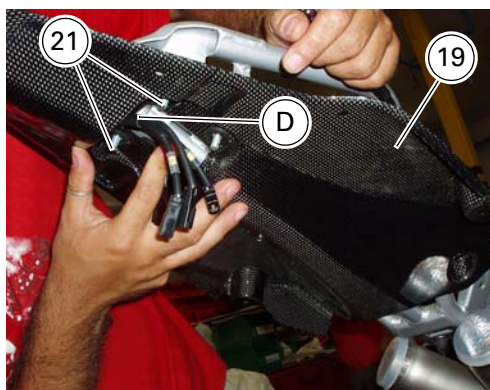
Remove the exhaust silencers and the relative clamps as indicated in Sect. L 8.

In order to remove the seat cowling heat shield, you first need to remove the seats, side panels and seat cowling as described previously.

Unscrew the lower front bolts (11) securing the heat shield (19). Undo the retaining nuts (18) and remove the support (17).



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



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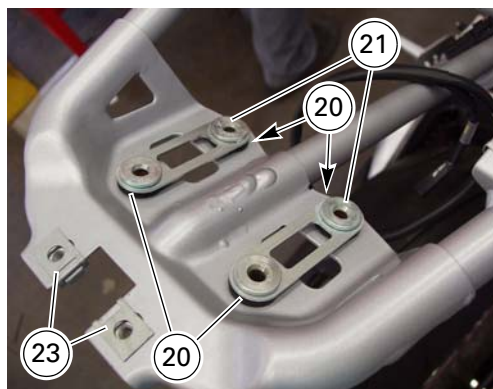
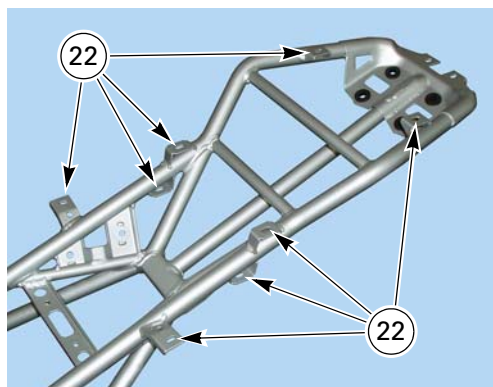
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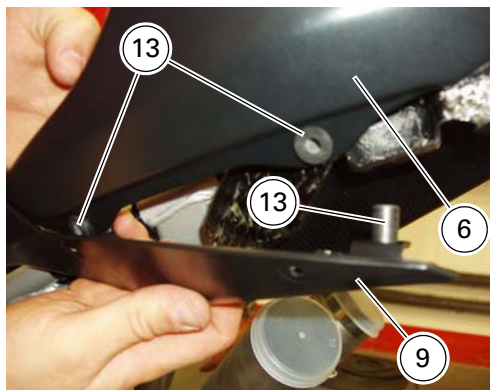
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Refitting the side panels and seat cowl

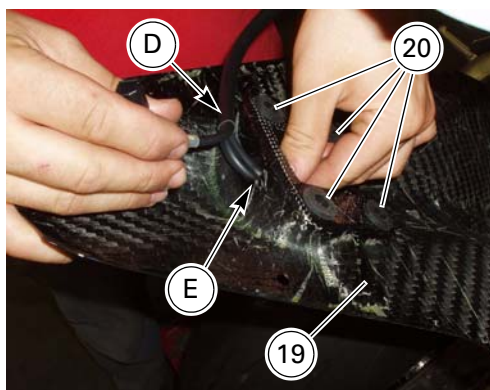
Make sure that the M5 clips (22), M6 clips (23), rubber mountings (20) and the flanges (21) are all fitted to the bike.



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

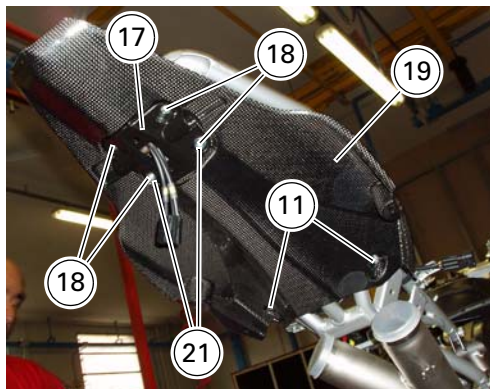


Check that the rubber mountings (20) are present on the heat shield (19). Offer the shield (19) up to the subframe and insert the wiring (D) in the aperture (E).



Refitting the seat cowl heat shield

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



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

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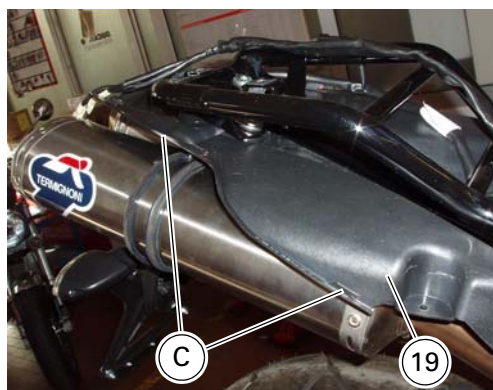
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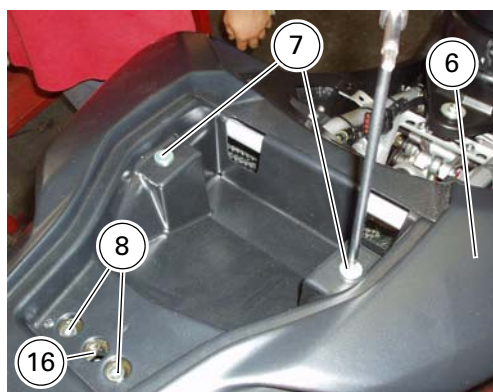
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Refitting the seat cowling

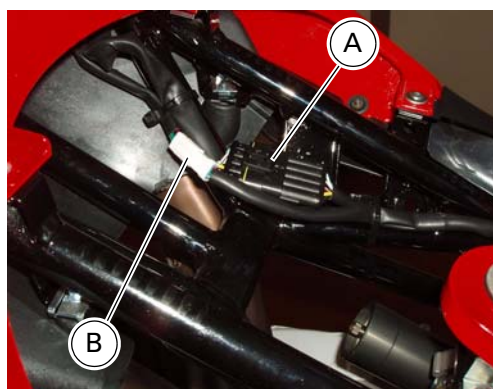
Refit the seat cowling (6) to the heat shield (19), pushing the cowling towards the rear of the bike so that it engages the catches (C) on the shield (19).



Refit the two upper bolts (7) securing the seat cowling (6). Refit the two bolts (8) securing the catch for the lock (16). Tighten the bolts (7) and (8) to the specified torque (Sect. C 3).

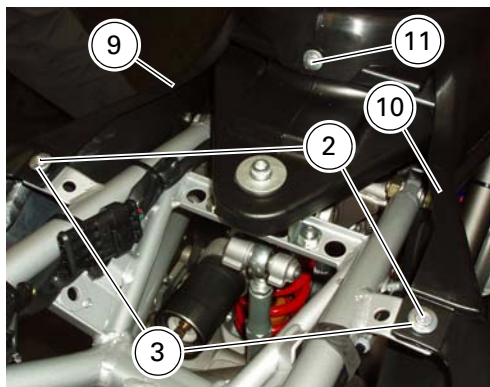


Reconnect the wiring connectors (A) of the rear wiring loom and the connector (B) of the data acquisition wiring.

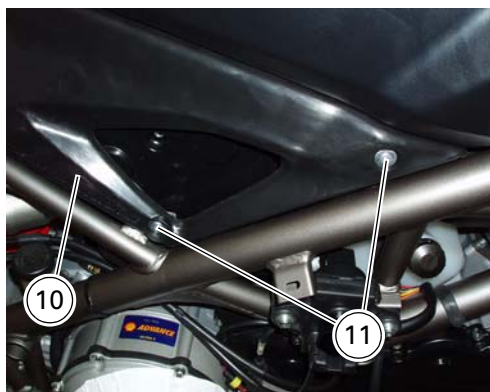


Refitting the side panels

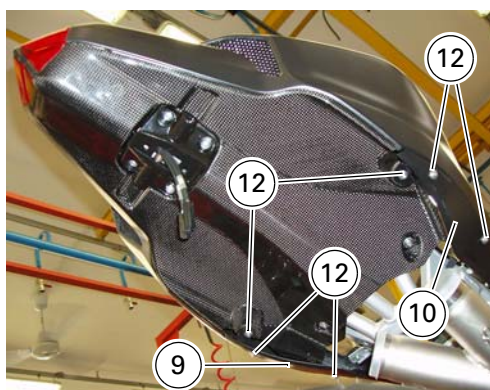
Position the left side panel (9) on the bike first and then the right (10) and fit the screw (11) that connects the two side panels together and to the fuel tank. Fit the washers (3) on the screws (2) and secure the central parts of the side panels to the rear subframe.



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



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



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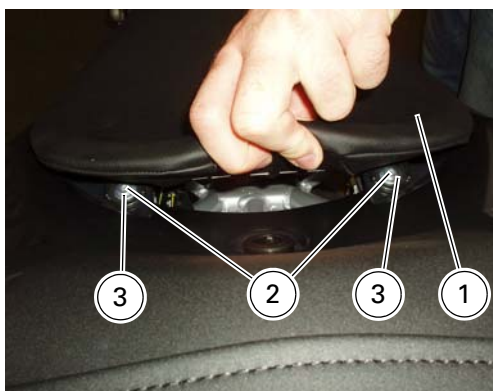
Refitting the seats

Refitting the rider seat

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

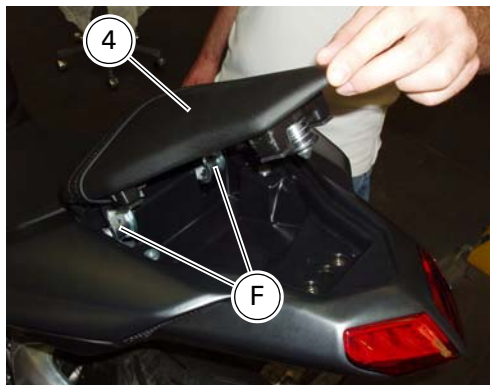


Fit the washers (3) on the screws (2) and fit them in the rear slots of the seat (1) to secure it to the rear subframe. Tighten the screws (2) to the specified torque (Sect. C 3).



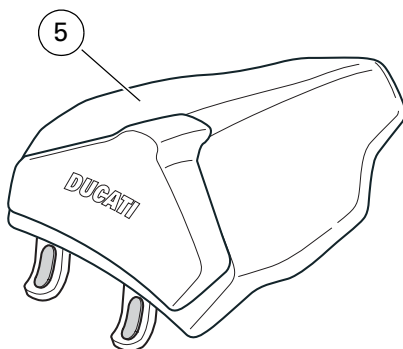
Refitting the pillion seat

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



Notes

The motorcycle can be converted to a single-seat configuration by installing the seat cover (5), which is fitted in the same way as the pillion seat (4).



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4 - Front mudguard

Removal of the front mudguard

Disconnect the brake hose (A) from the clip (1).

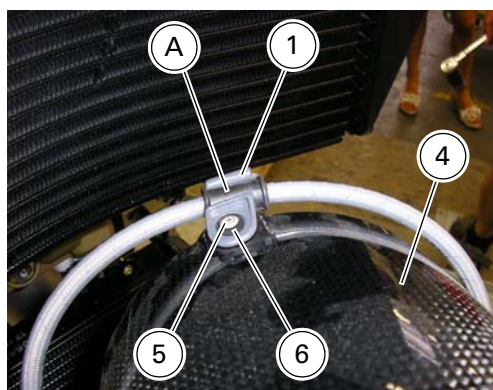
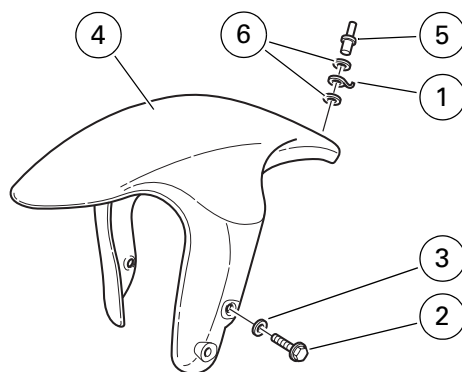
Remove the retaining bolts (2) and recover the nylon washers (3).

Remove the front mudguard (4).



Notes

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



Refitting the front mudguard



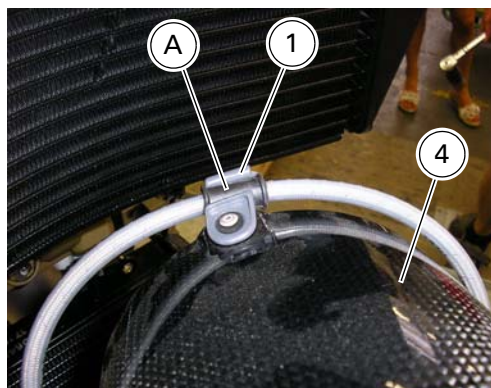
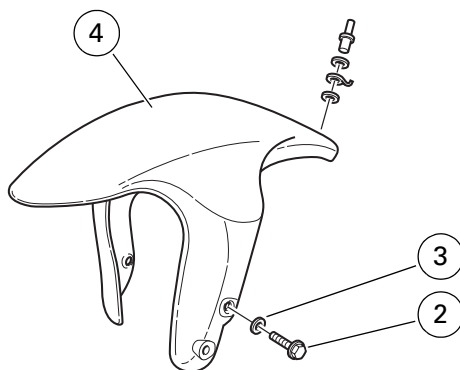
Warning

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

Position the front mudguard (4) and refit the retaining bolts (2) with the washers (3).

Locate the front brake hose grommet (A) in the mudguard clip (1).

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



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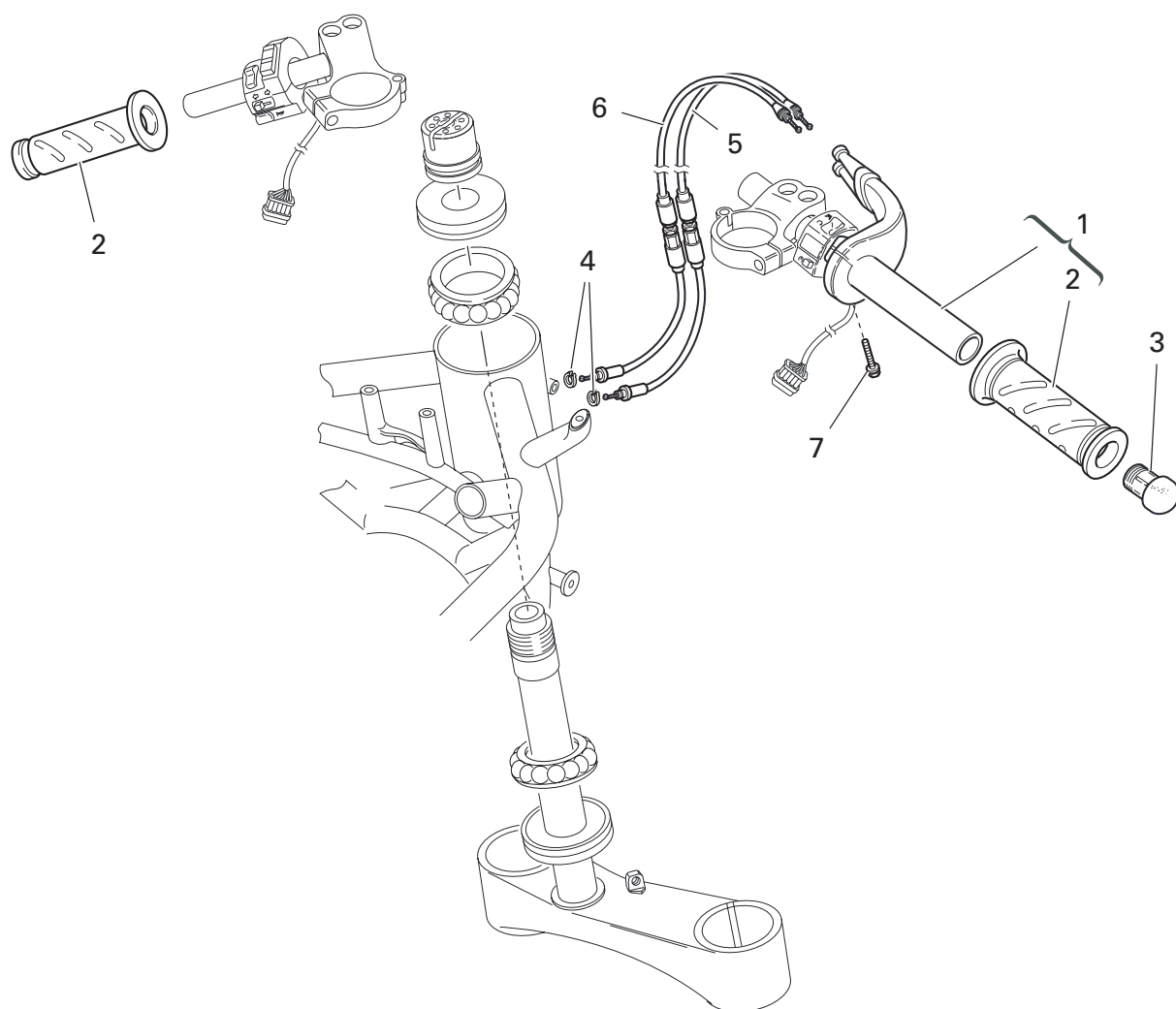
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Controls - Devices

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A	1 - Throttle and choke controls	3
	Adjusting the throttle cable	4
	Removal of the throttle cable	4
	Refitting the throttle twistgrip	5
B	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	13
C	3 - Front brake control	16
	Removal of the front brake master cylinder	17
	Refitting the front brake master cylinder	18
D	4 - Rear brake control	19
	Removal of the complete rear brake control	20
	Disassembly of the rear brake master control	21
	Refitting the rear brake control	22
E	5 - Gearchange control	23
	Removal of the complete gearchange control	24
	Disassembly of the gearchange control	25
	Refitting the gearchange control	26
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1 - Throttle and choke controls



- 1 Throttle twistgrip
- 2 Handlebar grips
- 3 Plug
- 4 Circlip
- 5 Throttle opening cable
- 6 Throttle closing cable
- 7 Bolt



Important

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

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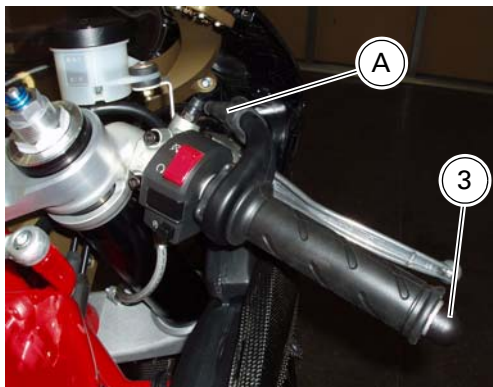
Adjusting the throttle cable

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

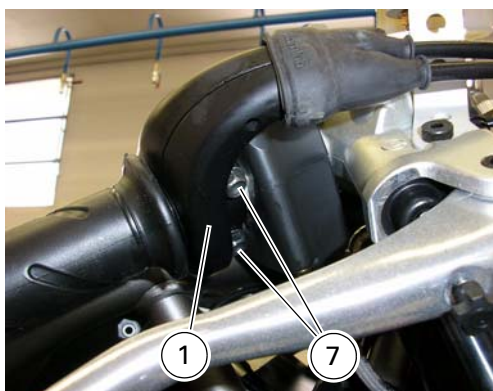
Removal of the throttle cable

Remove the end plug (3) from the handlebar.

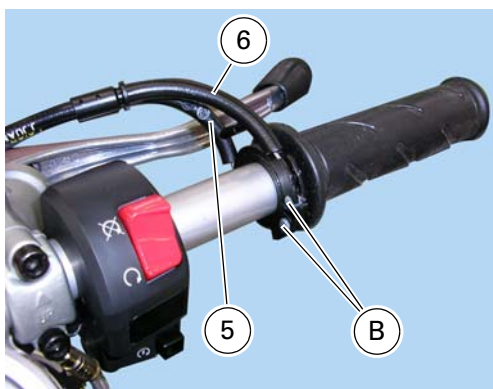
Peel back the rubber sleeve (A) protecting the throttle control cables.



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



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

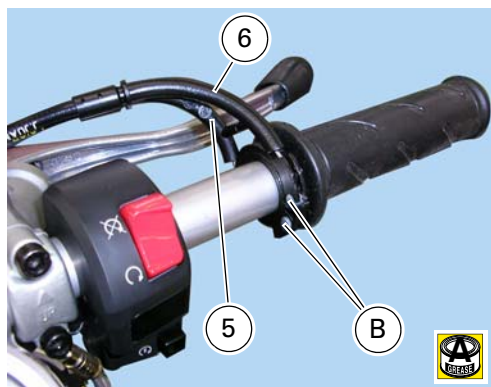


Notes

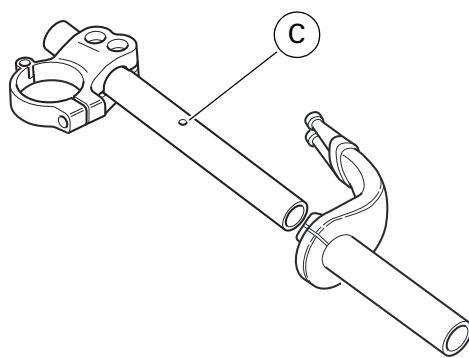
To renew the throttle cables, disconnect them from the throttle body as described in Sect. L 6. Replacement throttle cables are supplied complete with adjusters.

Refitting the throttle twistgrip

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



To refit the throttle control components, reverse the removal procedure, making sure that the twistgrip housings locate in the reference hole (C) in the handlebar.



Notes

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

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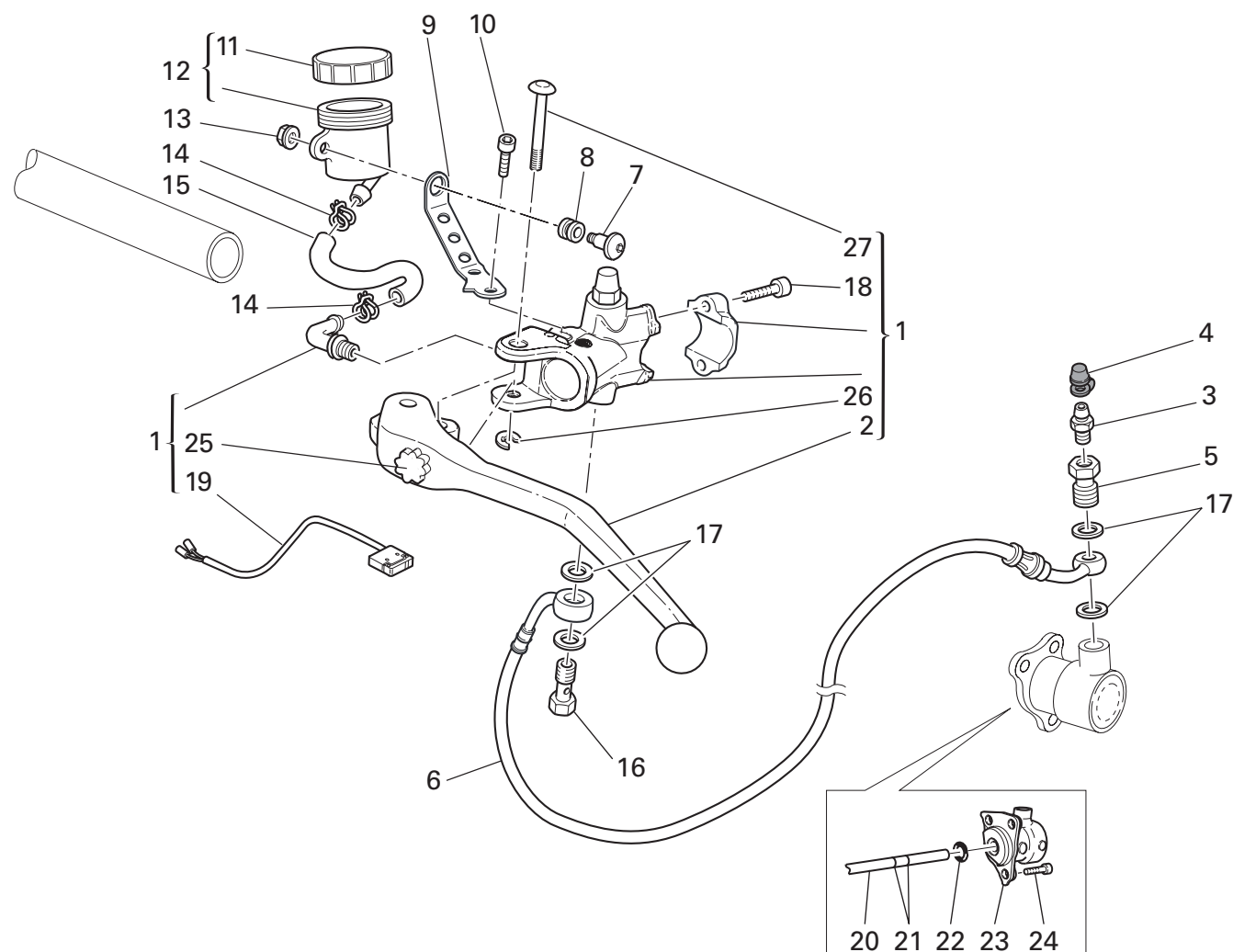
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Throttle cable routing



2 - Hydraulic clutch control



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

- 15 Hose
- 16 Banjo bolt
- 17 Sealing washer
- 18 Bolt
- 19 Microswitch
- 20 Clutch pushrod
- 21 O-ring
- 22 O-ring
- 23 Clutch slave cylinder
- 24 Bolt
- 25 Adjuster screw
- 26 Retaining ring
- 27 Special bolt

● Important

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

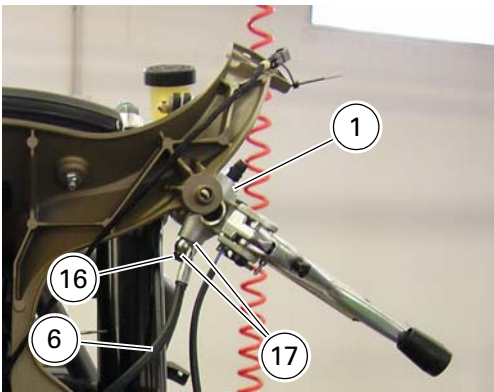
Removal of the clutch master cylinder assembly

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

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

Operation	Section reference
Drain the clutch system	D 4

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



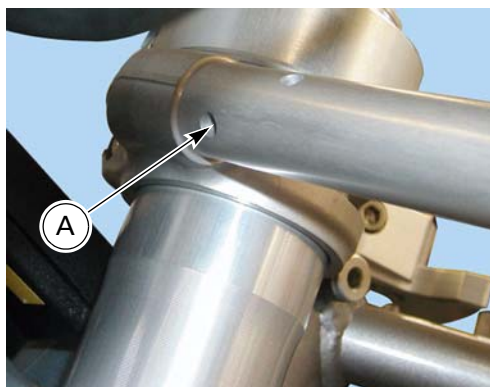
Unscrew the two clamp bolts (18) securing the clutch master cylinder assembly to the handlebar.



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

Refitting the clutch master cylinder assembly

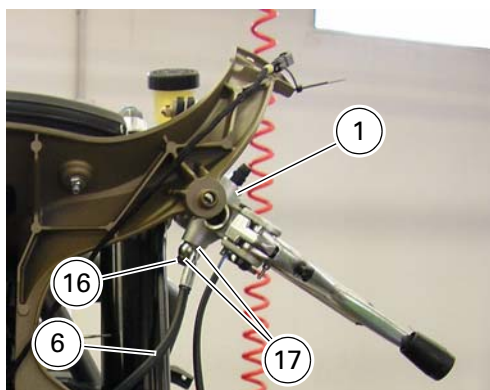
Fit the clutch master cylinder (1), locating the pin on the cylinder body in the hole (A) in the handlebar.



Tighten the retaining bolts (18) to the specified torque (Sect. C 3), in the sequence 1-2-1.



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



Warning

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

A

B

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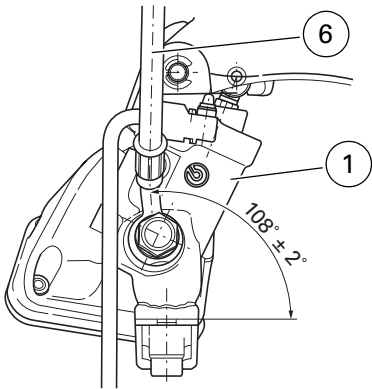
L

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P

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



Operation	Section reference
Fill the clutch system with fluid	D 4

Removal of the clutch slave cylinder



Warning

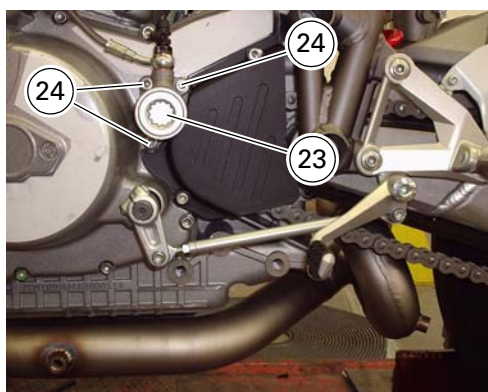
The clutch slave cylinder manufacturer advises against servicing the internal components of the slave cylinder (23) due to the safety-critical nature of the unit.

Incorrect overhaul of this critical safety component can endanger the rider and passenger.

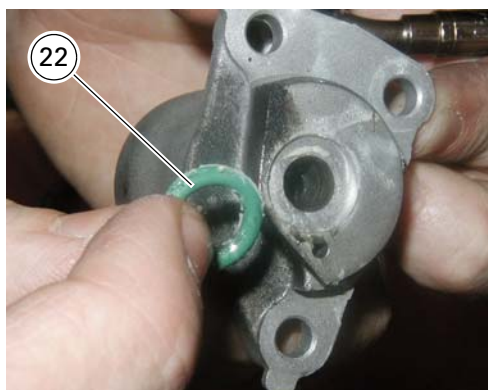
The only components that should be renewed are the complete clutch slave unit, the bleed valve, the O-ring seal and the clutch pushrod assembly.

Operation	Section reference
Drain the clutch system	D 4
Remove left side fairing	E 2

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

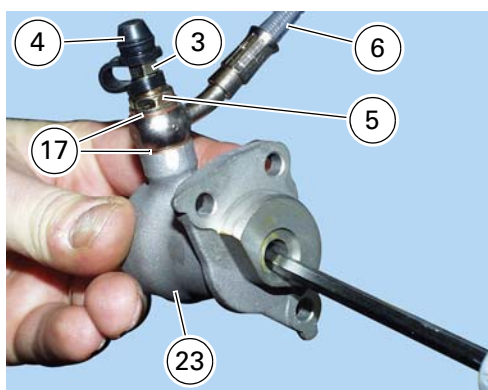


Remove the clutch slave cylinder from the crankcase, taking care to recover the internal O-ring (22).

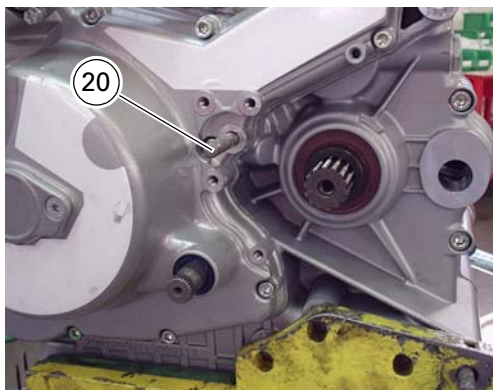


Remove the dust cap (4) and the bleed valve (3) and unscrew the banjo bolt (5), taking care to recover the sealing washers (17): the unit (23) is now disconnected from hose (6).

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



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



A

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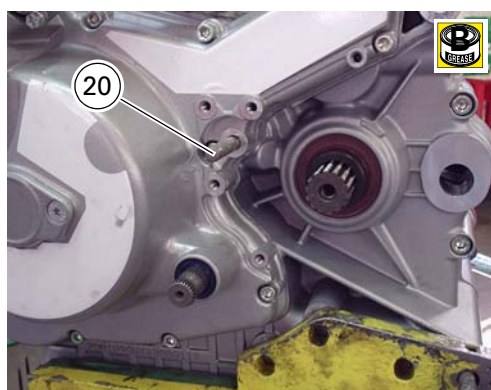
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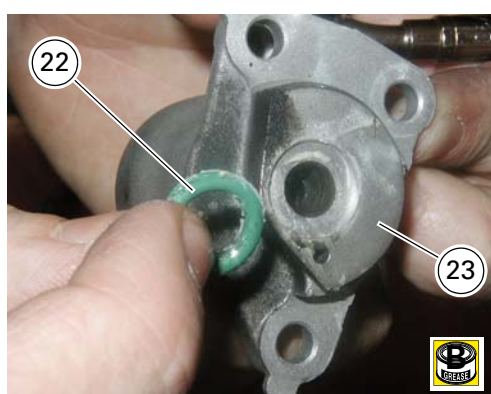
P

Refitting the clutch slave cylinder

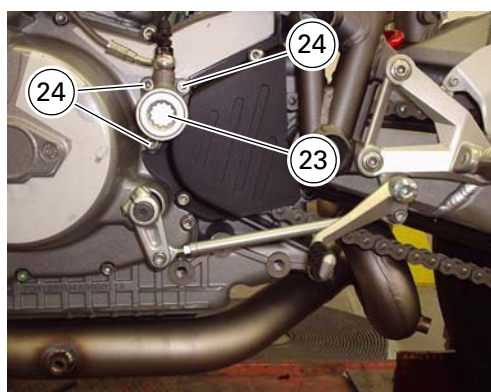
Grease and refit the clutch pushrod (20) with two O-rings (21).



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



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



A

B

C

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A

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

 Warning

If the clutch hose end fitting is incorrectly positioned, the hose may interfere with moving parts and lead to clutch faults.

B

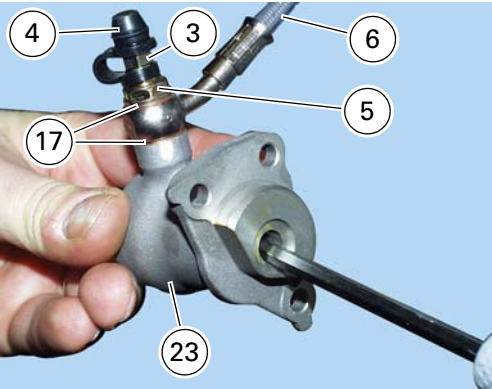
Locate the two sealing washers (17) and tighten the banjo bolt (5) to the specified torque (Sect. C 3).

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

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

C

D



E

Operation	Section reference
Fill the clutch system	D 4
Refit the left side fairing	E 2

F

G

H

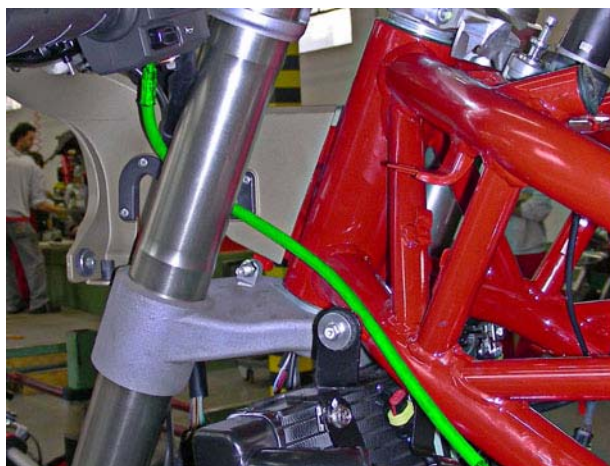
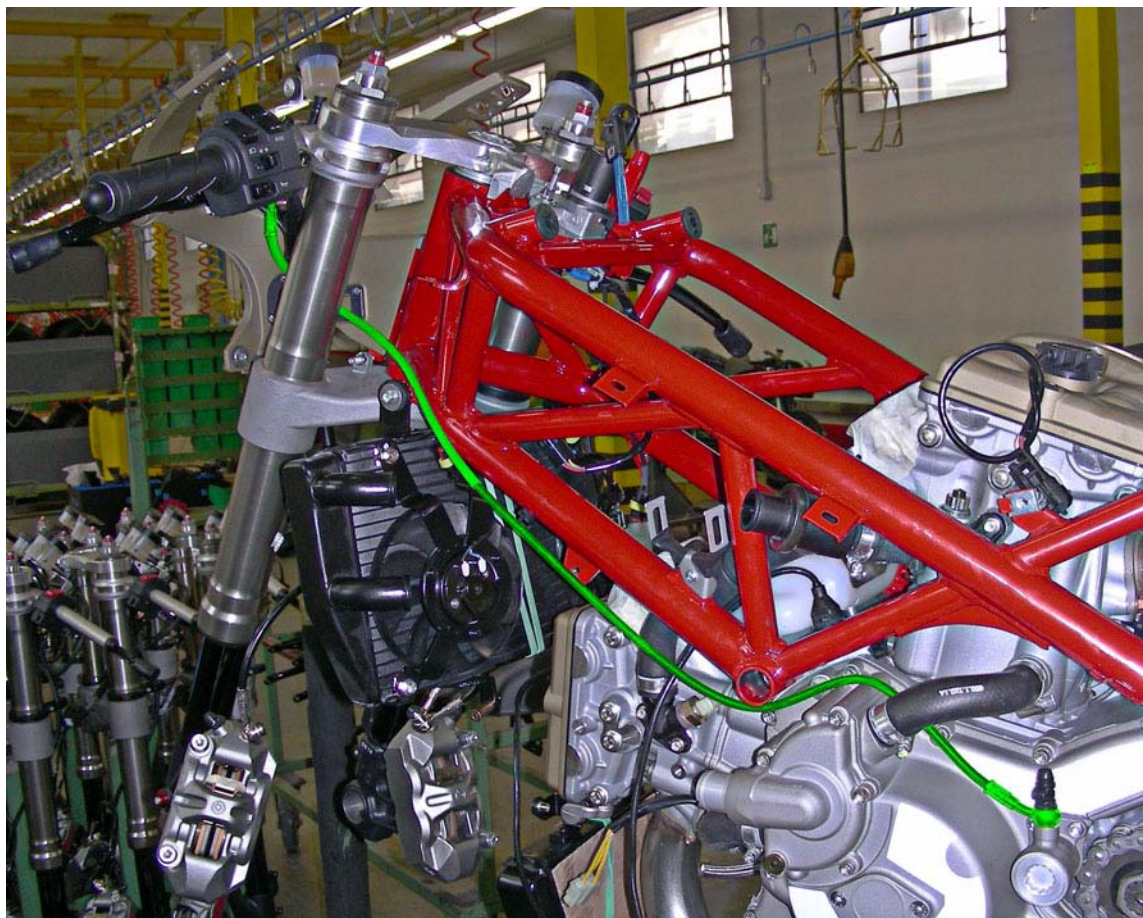
L

M

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Routing the clutch hose



A

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C

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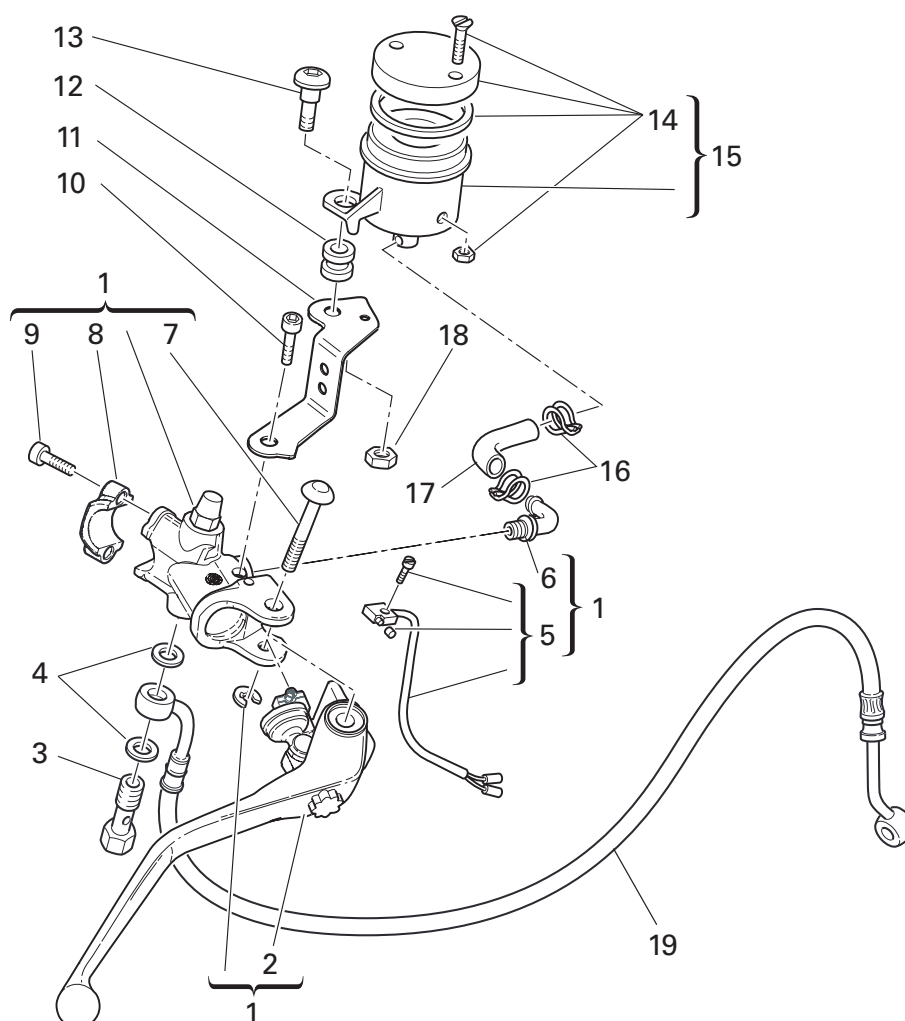
L

M

N

P

3 - Front brake control



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



Important

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

Removal of the front brake master cylinder

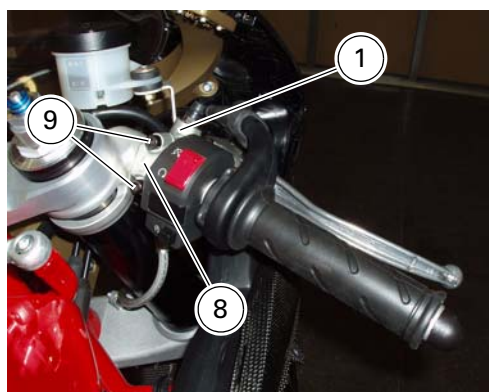


Warning

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

Operation	Section reference
Drain the braking system	D 4
Disconnect the brake hose from the master cylinder unit	G 3

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



For disassembly of components of the master cylinder unit (1) refer to the exploded view at the beginning of this chapter. When refitting the hose, fit the end fitting (3) with the sealing washers (4) and tighten the fitting to the prescribed torque (Sect. C 3).



A

B

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Refitting the front brake master cylinder

A

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

B

C

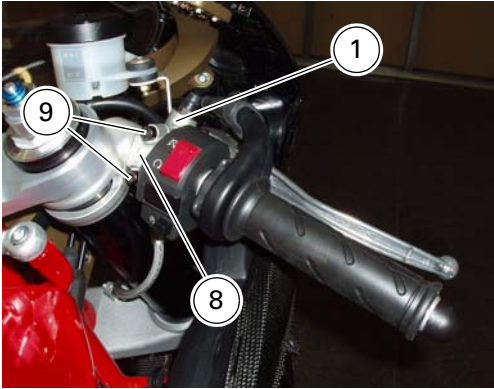
D

 Warning

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

E

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



F

Operation	Section reference
Reconnect the brake hose to the master cylinder	G 3
Fill the brake circuit	D 4

G

H

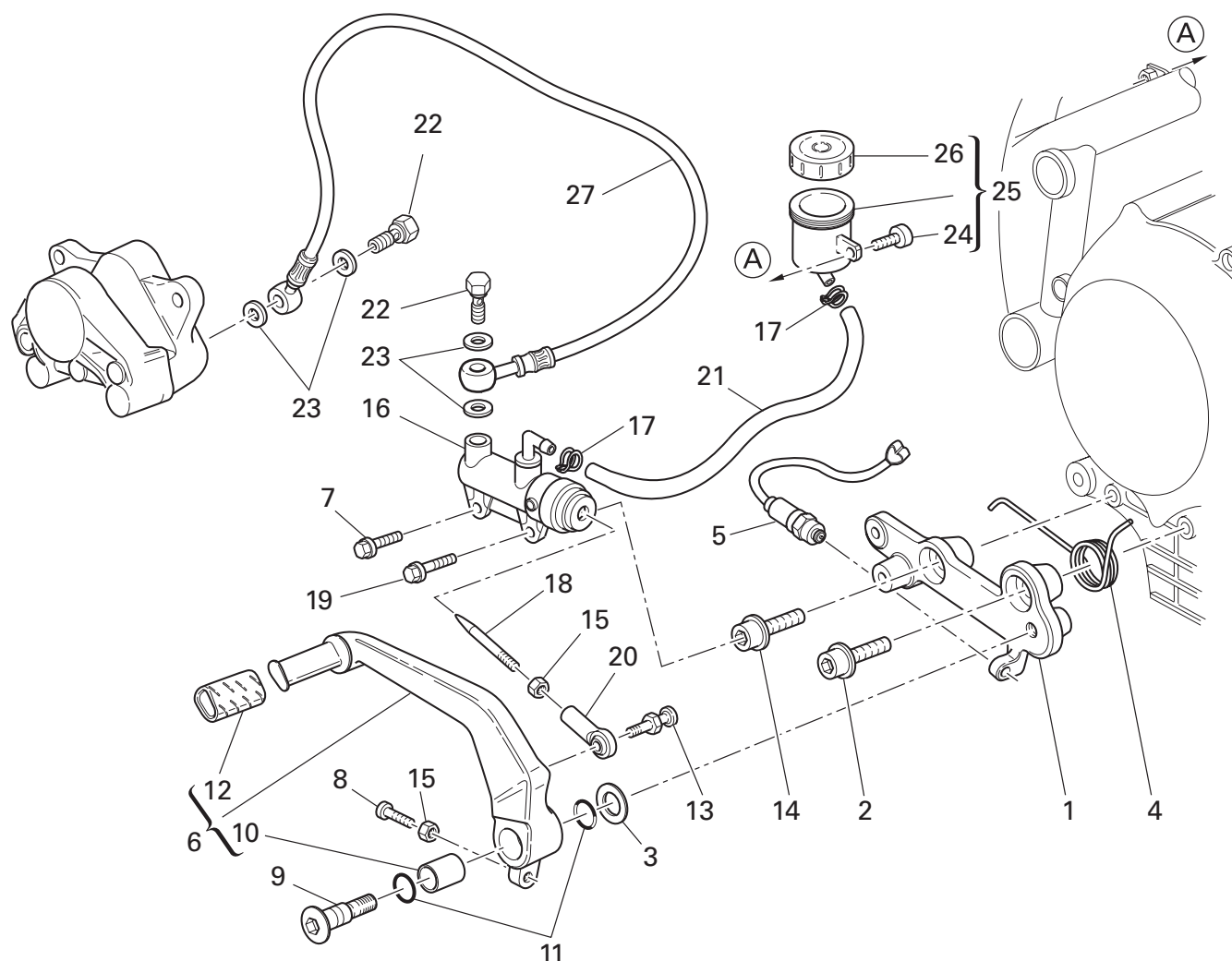
L

M

N

P

4 - Rear brake control



- 1 Support
- 2 Bolt
- 3 Washer
- 4 Spring
- 5 Switch
- 6 Brake lever pedal
- 7 Bolt
- 8 Adjuster screw
- 9 Pedal pivot bolt
- 10 Bush
- 11 O-ring
- 12 Pedal rubber
- 13 Pivot bolt
- 14 Banjo bolt

- 15 Nut
- 16 Rear brake master cylinder
- 17 Clamp
- 18 Pushrod
- 19 Bolt
- 20 Ball joint
- 21 Hose
- 22 Banjo bolt
- 23 Sealing washer, thickness 1
- 24 Bolt
- 25 Fluid reservoir assembly
- 26 Plug
- 27 Rear brake hose

● Important

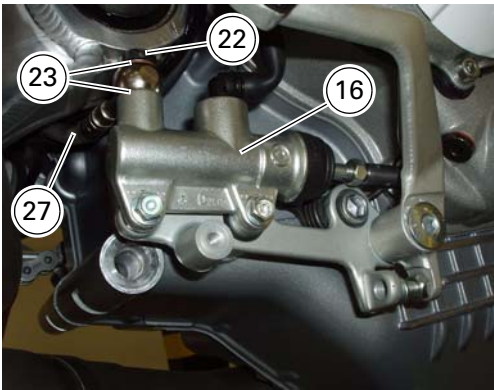
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the complete rear brake control

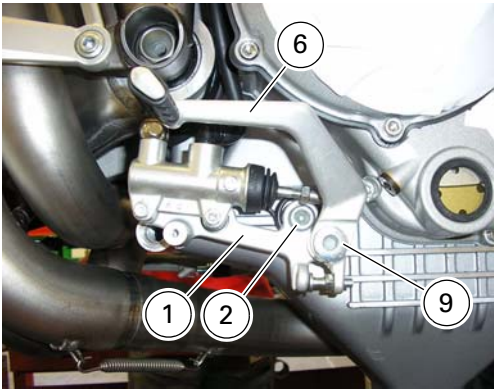
Operation	Section reference
Drain the braking system	D 4
Remove the right-hand fairing	E 2

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

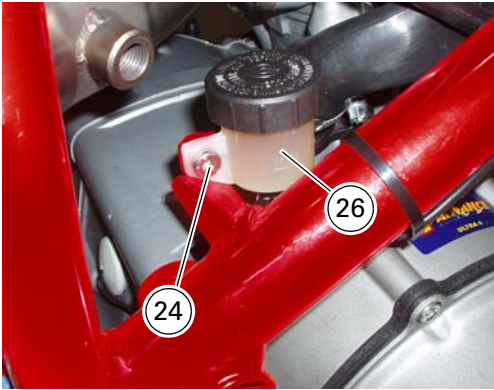
Maintenance operations on these units are limited to renewal of the following parts: control lever, fluid reservoir assembly and relative fasteners and master cylinder fasteners.
Disconnect the rear brake light switch (5) from main wiring (Sect. P 1).
Unscrew the banjo bolt (22) from the master cylinder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



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



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



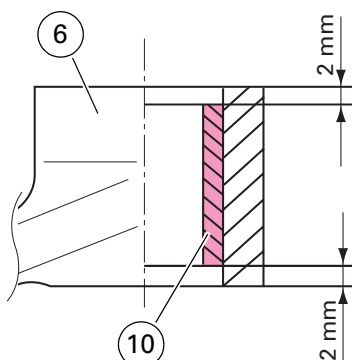
Remove the complete rear brake control.

Disassembly of the rear brake master control

The brake master cylinder is supplied only as a complete unit; internal components cannot be replaced.

To disassemble the external parts of master cylinder assembly, refer to the exploded view at the beginning of this chapter.

If the bush (10) inside the brake pedal (6) needs to be renewed, drive the replacement bush into place using a press. The bush must be seated 2 mm below the outer face of the pedal.



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



Warning

After working on the rear brake control, check the operation of the brake pedal as described in Sect. D 4.

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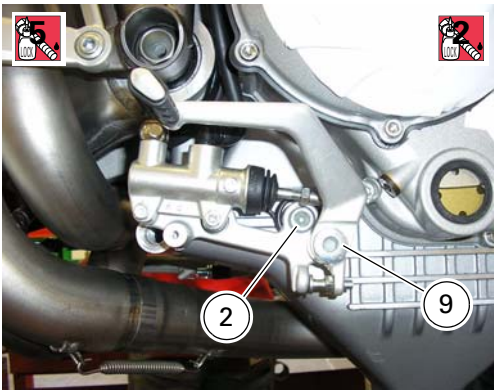
M

N

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Refitting the rear brake control

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



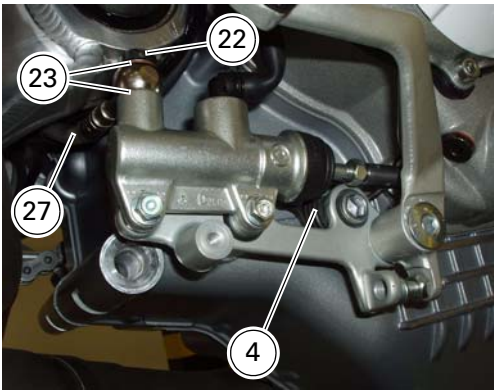
● Important

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

👁 Notes

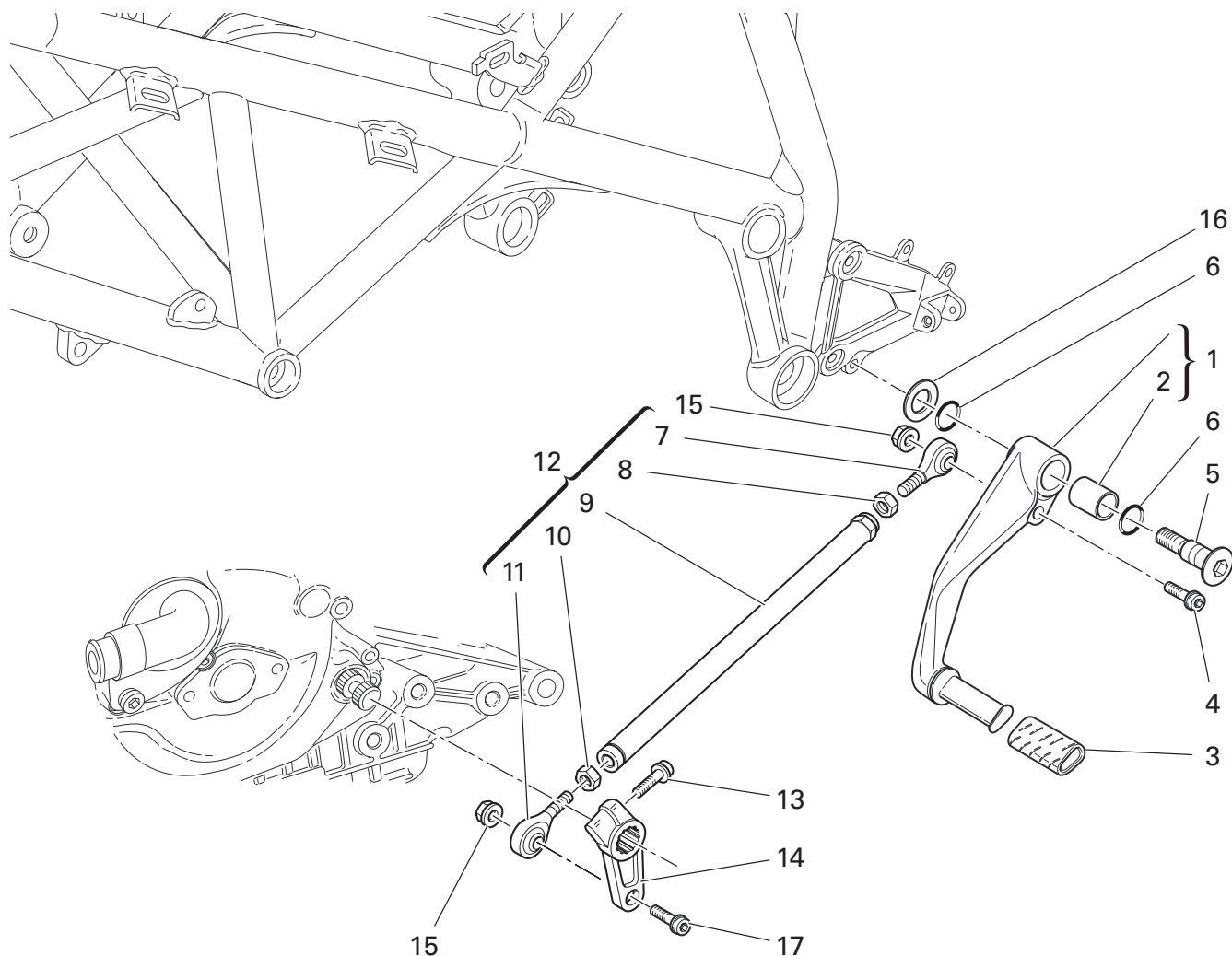
If the master cylinder-caliper hose (27) and the master cylinder-reservoir hose (21) are to be renewed, take care to position the hose unions on the master cylinder correctly.

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



Operation	Section reference
Fill the brake circuit	D 4
Refit the right-hand fairing	E 2

5 - Gearchange control



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



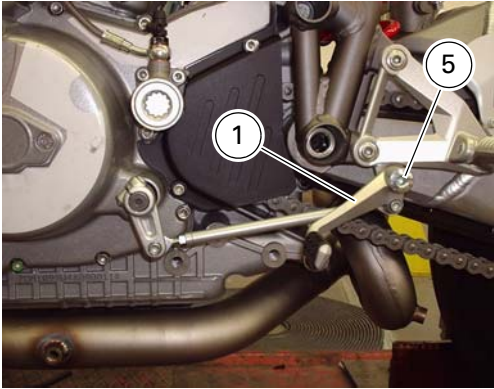
Important

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

Removal of the complete gearchange control

Operation	Section reference
Remove the left-hand fairing	E 2

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

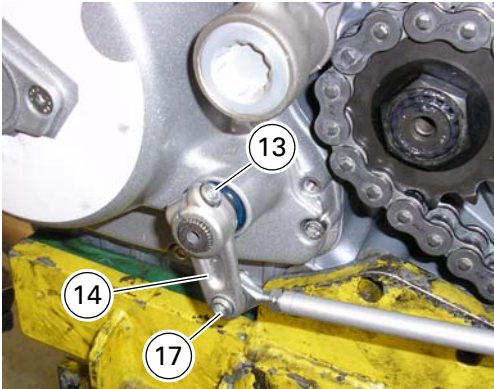


Unscrew and remove the bolt (13) securing the lever to the gearbox shaft. Withdraw the lever (14) complete with the gearchange control assembly.

 Notes

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

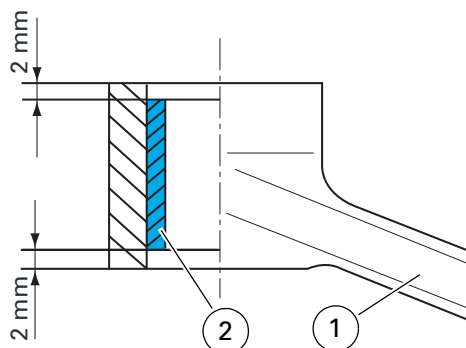
To remove the lever (14) from the gearchange assembly, unscrew the bolt (17), recover the nut (15), and then slide off the lever (14).



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



Warning

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

To adjust the position of the gearchange pedal, follow the instructions given in Sect. D 4.

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Refitting the gearchange control

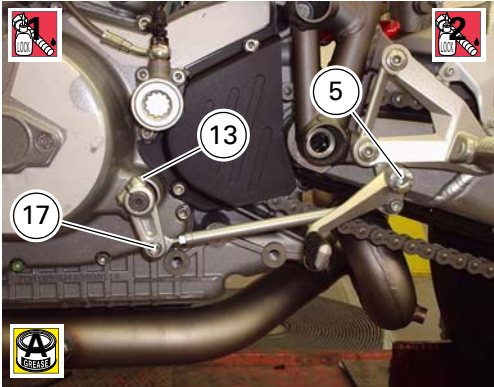
A

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

B

C

D



Operation	Section reference
Refit the left-hand fairing	E 2

E

F

G

H

L

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P

Wheels - Suspensions - Brakes

A

B

C

D

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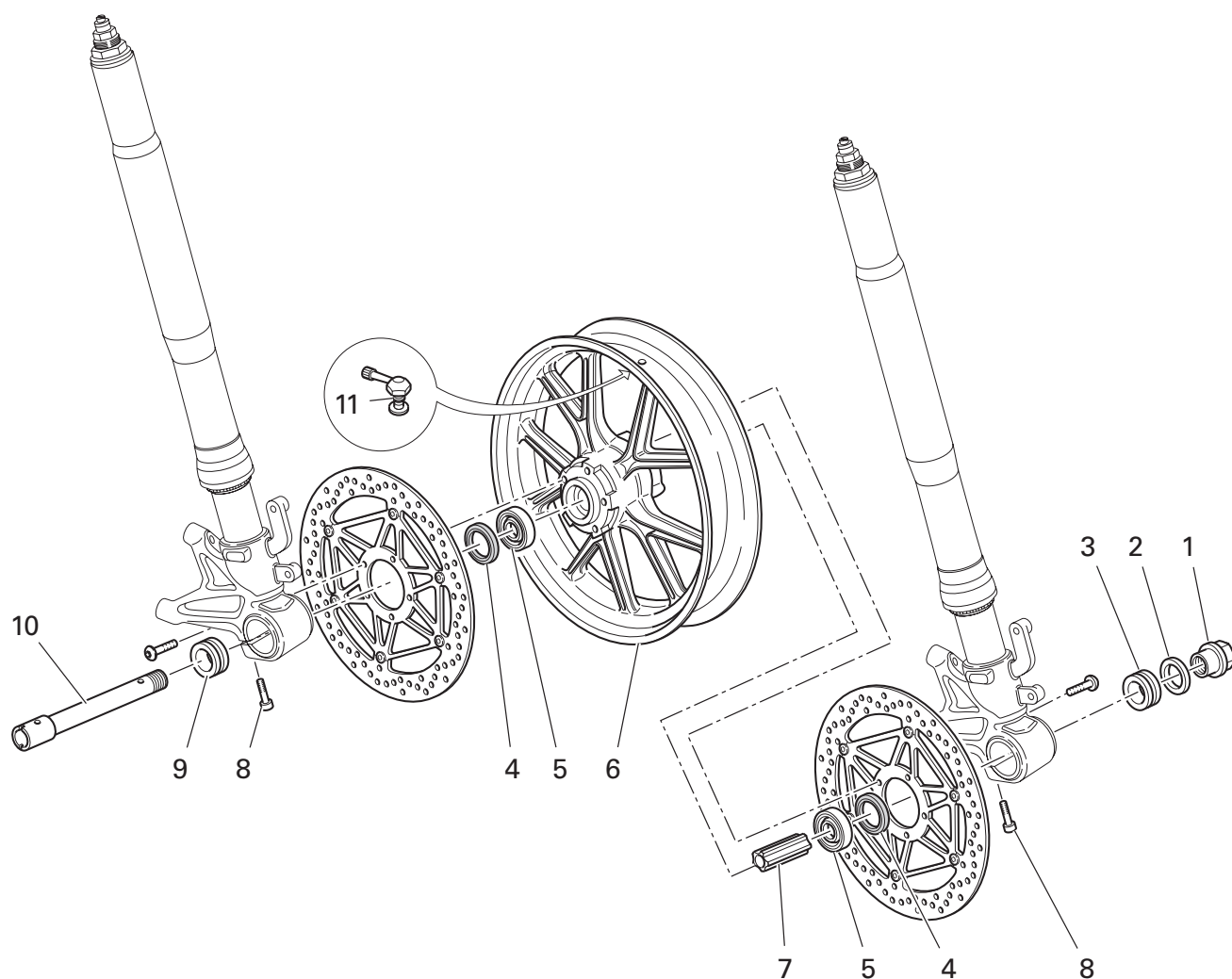
M

N

P

A	1 - Front wheel	3
	Removal of the front wheel	4
	Overhauling the front wheel	6
	Refitting the front wheel	9
B	2 - Front fork (1098)	11
	Removal of the front forks	12
	Overhauling the front forks	13
	Refitting the front forks	20
C	3 - Hydraulic front brake	22
	Maintenance operations	23
	Removal of the front brake system	24
	Refitting the brake discs	26
	Overhauling the front brake components	27
D	Refitting the front brake system	28
	4 - Rear wheel	30
	Removal of the rear wheel	31
E	Overhauling the rear wheel	32
	Refitting the rear wheel	33
	5 - Rear swingarm	34
	Removal of the rear eccentric hub	35
F	Removal of the rear eccentric hub	37
	Removal of the swingarm	39
	Inspecting the swingarm pivot shaft	41
	Overhauling the rear swingarm	42
	Refitting the swingarm	46
G	6 - Hydraulic rear brake	48
	Removal of the rear brake caliper	49
	Removal of the rear brake disc	50
	Refitting the rear brake caliper	51
H	7 - Rear suspension	52
	Rear suspension system	53
	Removal of the rear shock absorber	54
L	Overhauling the rear shock absorber	55
	Removal of the rear suspension rocker arm	56
	Overhauling the rear suspension rocker arm	57
	Disassembly and overhaul of the shock absorber tie-rod	58
	Refitting the rear suspension	59
M	8 - Final drive	61
	Inspecting the final drive	62
	Removal of the front sprocket	63
N	Refitting the front sprocket	65
	Renewal of the rear sprocket	67
	Refitting the rear sprocket	68
	Washing the chain	69
P	Lubricating the chain	69

1 - Front wheel



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



Important

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

A

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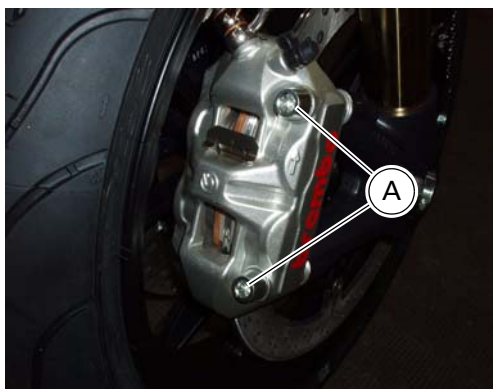
M

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P

Removal of the front wheel

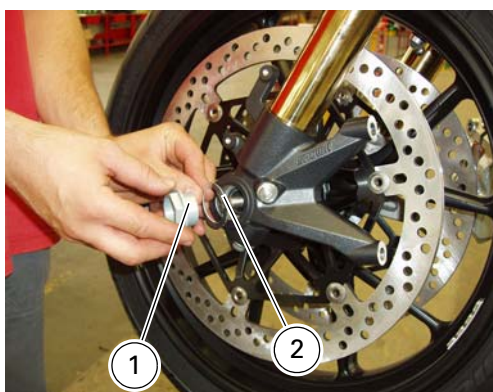
A Remove the front brake calipers complete with hoses by undoing the bolts (A).



Warning

Do not operate the brake lever when the calipers are removed. This could cause the brake pistons to be expelled from their bores.

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



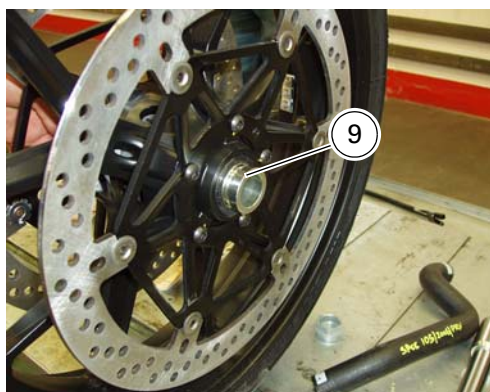
Loosen the axle clamp bolts (8) on the ends of the fork legs.



Working from the left side, use a plastic mallet to drive the wheel axle (10) out from the opposite side.



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



A

B

C

D

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Overhauling the front wheel

A

Wheel bearings

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

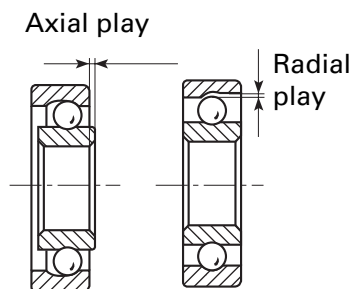
B

Turn the inner race.

Check the amount of radial and axial play. Excessive play will cause vibration and make the bike unstable; in this case the bearings must be renewed.

C

D



E

To remove the bearings (5) and the seals (4) from the wheel hub, proceed as follows.

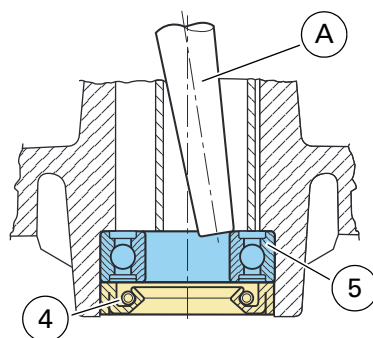
Position a drift (A) against the inner race of the bearing (5).

Tap with a hammer to drive out the bearing (5) and the oil seal (4).

Apply the drift at different points to keep the bearing square during removal.

F

G



H



Important

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

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

L

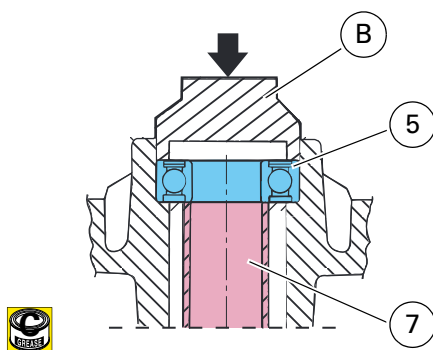
M

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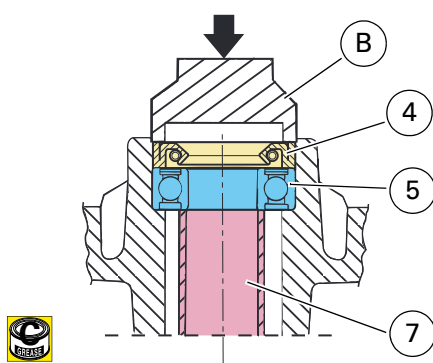
Grease the bearing seat and then push the new bearing into its seat.

Using a tubular drift (B) that only bears on the outer race of the bearing, drive the bearing (5) fully into its seat.



Use the same method to install the oil seals (4).

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



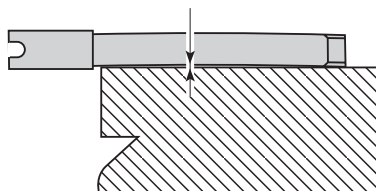
Notes

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

Inspecting the wheel axle

Check the wheel axle for straightness.

Roll the axle on a flat reference surface and measure maximum runout using a feeler gauge (see Sect. C 1.1).



A

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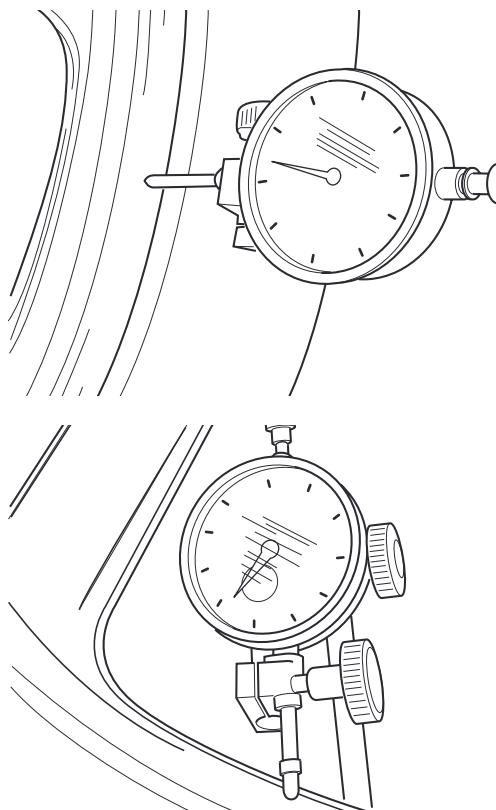
Overhauling the wheel

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

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

Insert the axle in the wheel and mount it on two fixed reference blocks.

Using a dial gauge, measure rim runout and out-of-round relative to the axis of the axle (see Sect. C 1.1).



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

Refitting the front wheel

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

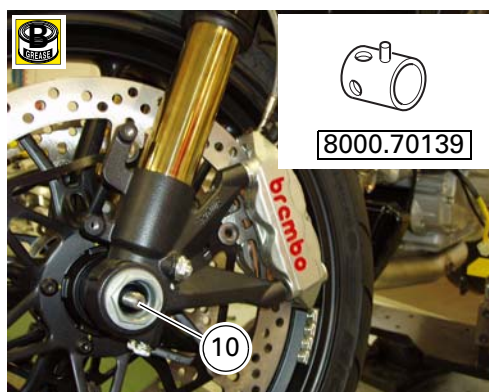


Install the complete wheel between the fork legs.

Lubricate the shank and thread of the wheel axle (10).

Fit the special tool part no. **8000.70139** to 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).



Refit the front brake calipers as described in Sect. G 3.

Check that the brake discs turn freely inside the calipers.

A

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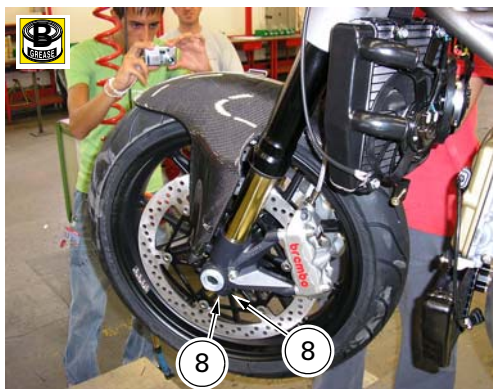
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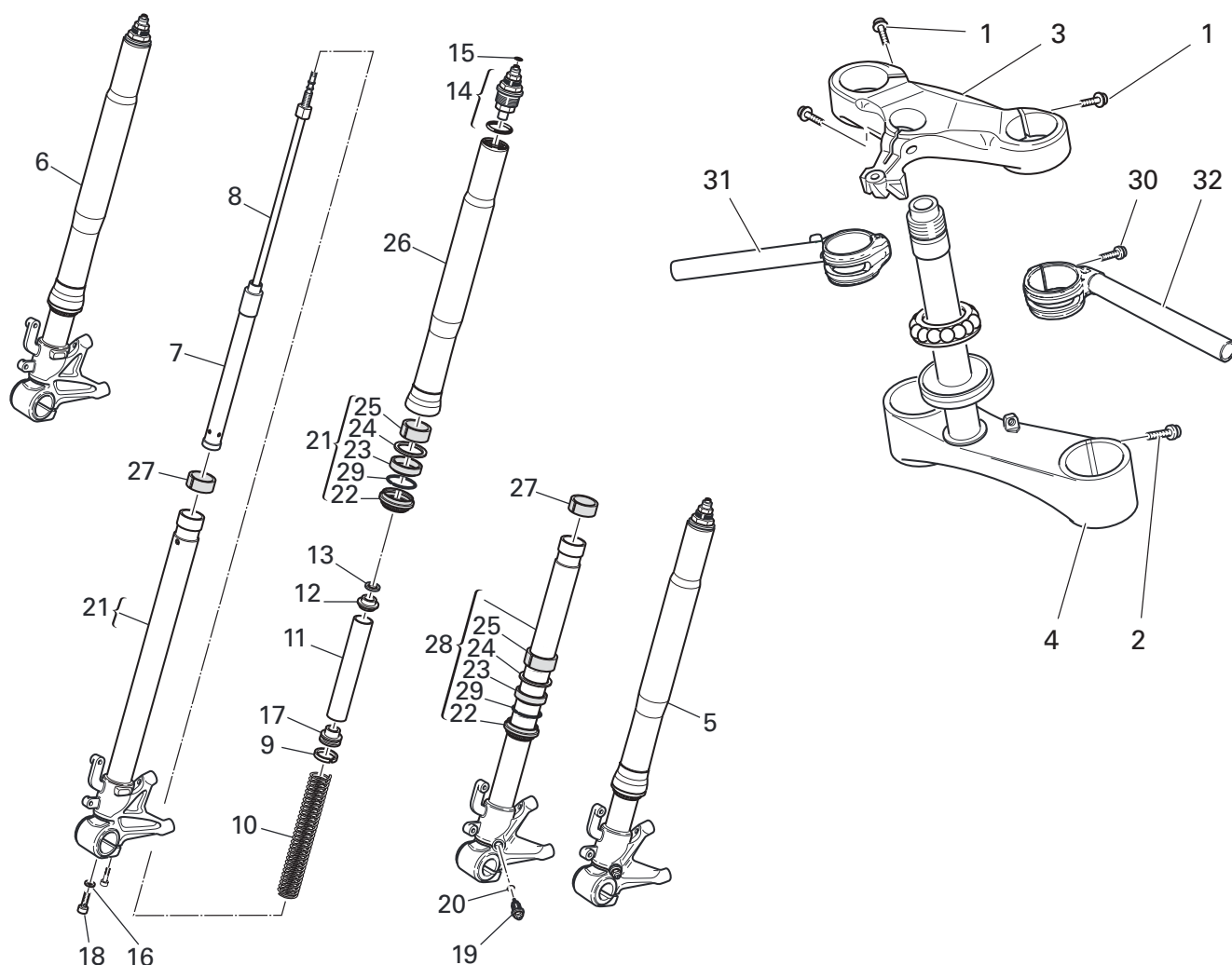
Before tightening the axle clamp bolts (8), lower the bike to the ground and press up and down on the handlebars to load the suspension so the fork legs will become properly seated onto the wheel axle.

Lubricate the bolts (8).

Tighten the bolts (8) to the specified torque (Sect. C 3), in the sequence 1-2-1.



2 - Front fork (1098)



- | | |
|---------------------------|------------------------------|
| 1 Bolt | 17 Dust cap |
| 2 Bolt | 18 Bolt |
| 3 Top yoke | 19 Adjuster screw |
| 4 Bottom yoke | 20 Special washer |
| 5 Left fork leg assembly | 21 Right inner tube assembly |
| 6 Right fork leg assembly | 22 Dust cap |
| 7 Locating ring | 23 Oil seal |
| 8 Damper assembly | 24 Retaining ring |
| 9 Oil seal | 25 Bush |
| 10 Spring | 26 Outer tube |
| 11 Upper spacer | 27 Bush |
| 12 Spacer | 28 Left inner tube assembly |
| 13 Washer | 29 Ring |
| 14 Top cap assembly | 30 Bolt |
| 15 Circlip | 31 Left handlebar |
| 16 Washer | 32 Right handlebar |



Important

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

A

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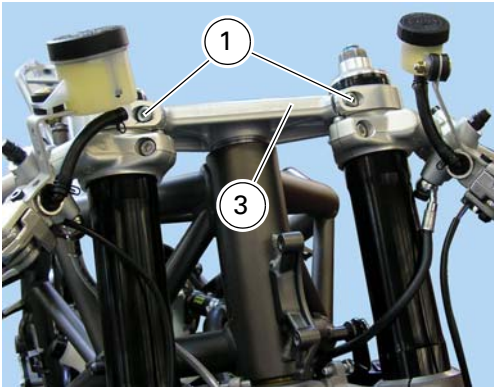
Removal of the front forks

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

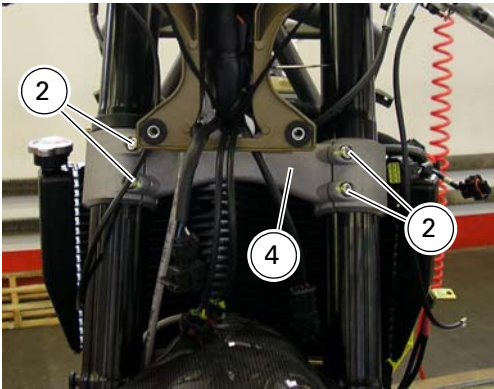
Operation	Section reference
Removal of the front brake calipers	G 3
Removal of the front mudguard	E 4
Removal of the front wheel	G 1
Removal of the headlight shell	E 1

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

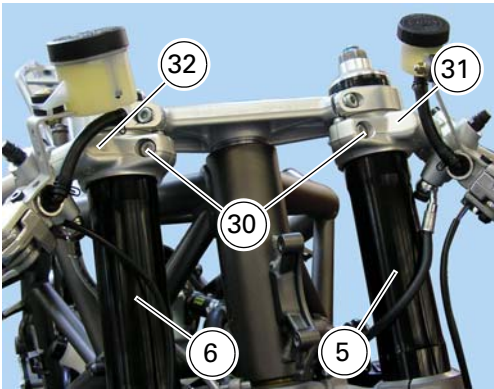
Loosen the clamp bolts (1) holding the fork legs to the top yoke (3).



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



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

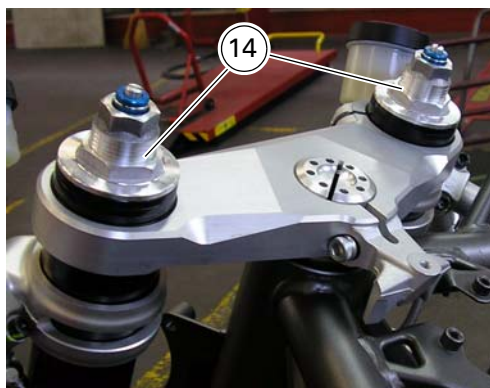


Overhauling the front forks



Notes

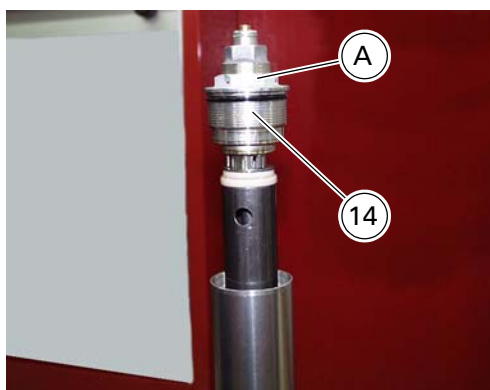
It is advisable to loosen the top cap (14) when the fork is still fitted to the motorcycle.



Notes

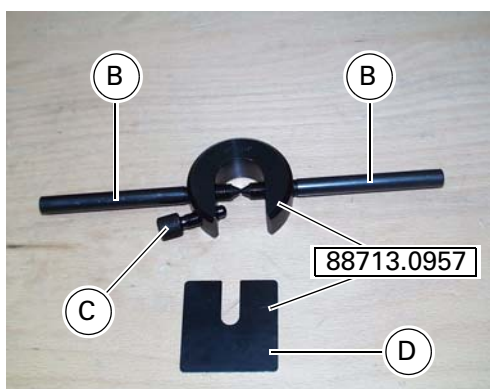
The special tools required for front fork overhaul are listed in Sect. C 4.

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



Disassembly of the front fork

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



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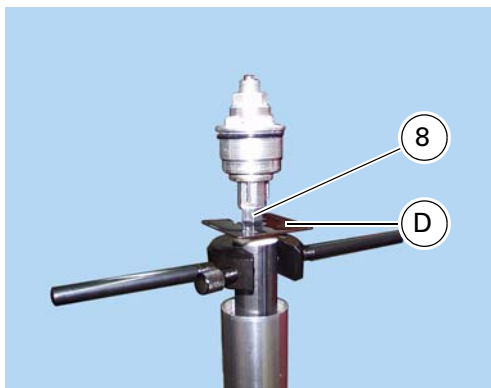
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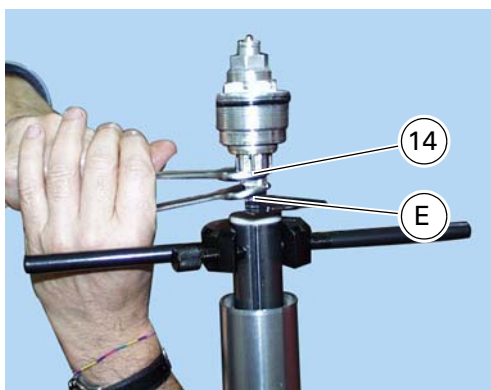
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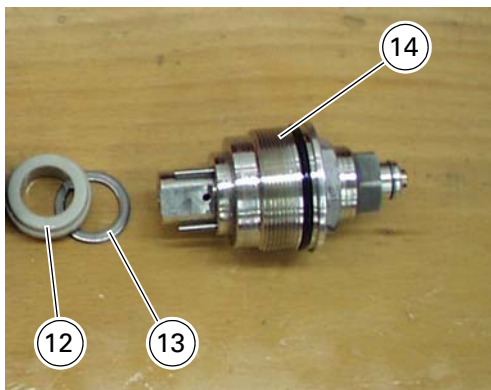
Push the tool downwards to compress the spring and then slide the spacer (D) under the damper lock nut (8).



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



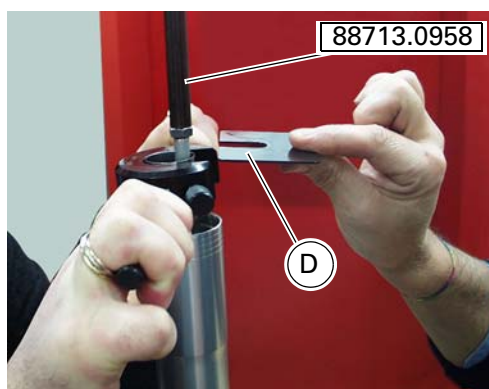
Remove top cap assembly (14) complete with the collar (12) and the washer (13).



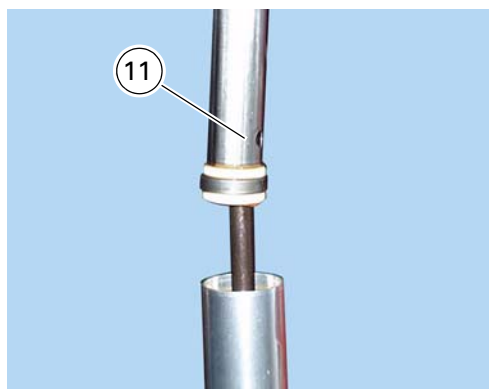
Fit the service tool part no. **88713.0958** and screw it onto the damper rod.



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



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

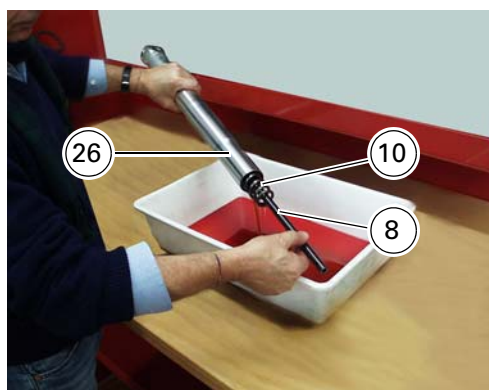


Remove the spring (10) and pump the outer tube (26) and the damper (8) to expel the oil from the fork.



Warning

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



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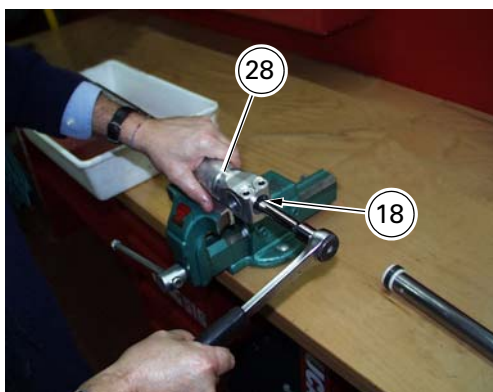
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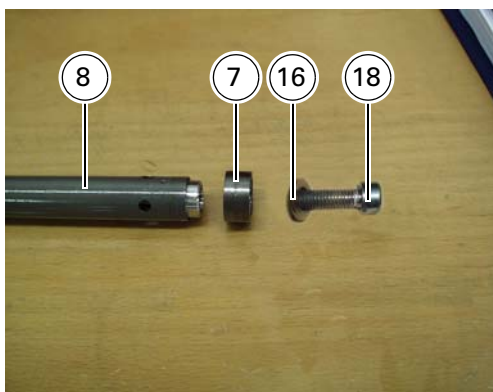
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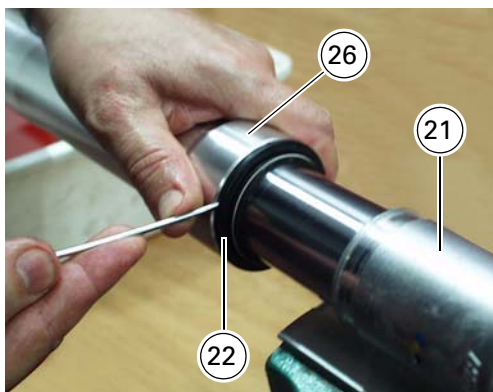
Clamp the inner tube (28) in a vice with soft-faced jaws.
Unscrew the screw (18).



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



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



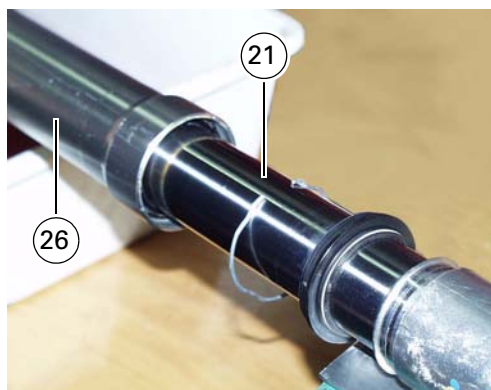
Remove the circlip (29).





Important

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

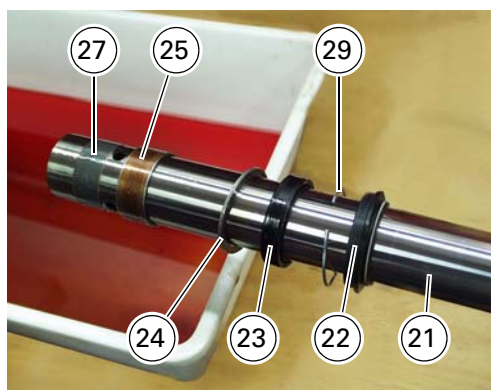


To separate the outer tube (26) from the inner tube (21), pull the inner tube sharply outwards repeatedly to gradually displace the bottom bush (25).

Insert a screwdriver in the slit in the top bush (27) and open it up sufficiently to slide the bush off the inner tube.

Remove the following parts from the inner tube (21):

- bottom bush (25)
- ring (24)
- oil seal (23)
- circlip (29)
- dust seal (22)



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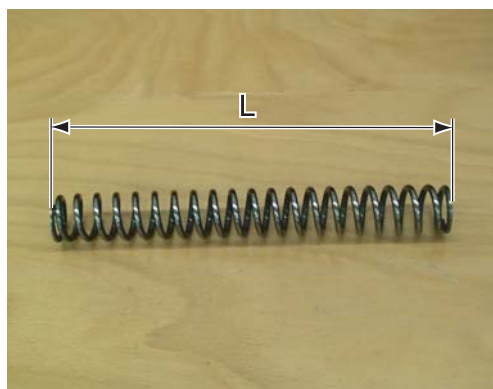
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Inspection of the adjustable front fork

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



Service limit:

270 mm.

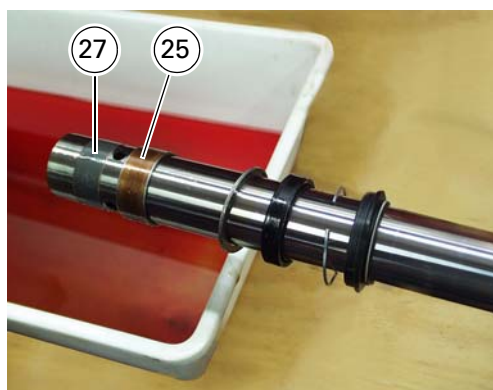
Renew the spring if the length is not within the specified limit.

Inspect the outer surfaces of both fork inner tubes and the internal surfaces of both outer tubes. They must be free from scoring, steps, or dents.

Check that outer tubes are straight:

maximum permissible error **0.10 mm**.

Whenever the inner tube is removed from the outer tube it is good practice to renew the bushes (25) and (27).



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

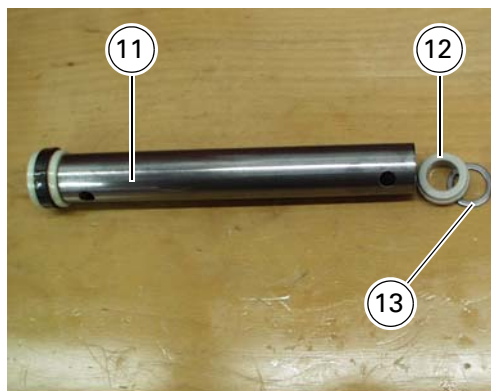


Notes

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

Fit the following components:

- spring (10),
- upper spacer (11),
- spacer (12),
- washer (13).



Fit the service tool part no. **88713.0957** (previously used for removal) into the lateral hole of upper spacer (11).

Push the tool down and position the spacer (D) under the lock nut of damper (8).

Remove the tool part no. **88713.0958**.

Screw the top cap (14) onto the damper (8).

Using a hex wrench, hold the rebound damping adjuster (E) and tighten the top cap to **30 to 40 Nm**.

Remove the spacer (D) by pushing the service tool (C, part no. **88713.0957**) downwards.

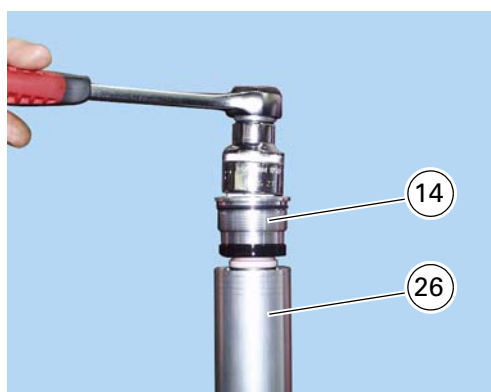
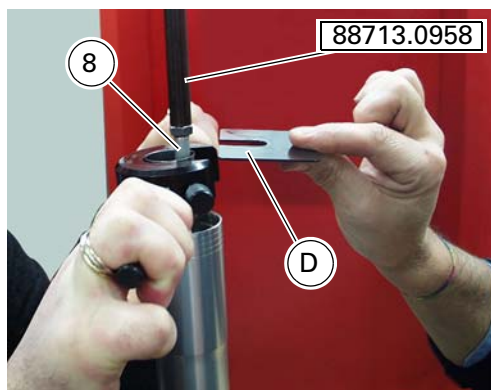


Warning

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

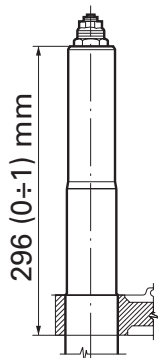
Lift the outer tube (26) and tighten the top cap (14) to a torque of **30 to 40 Nm**.

Set the adjusters according to riding requirements.

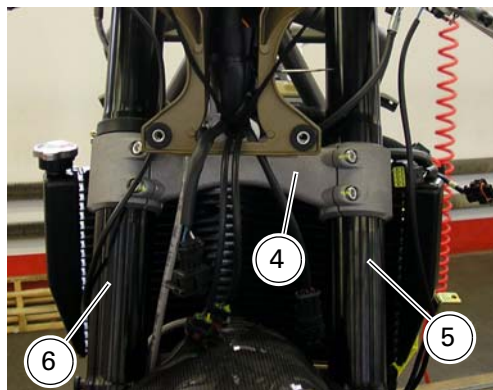
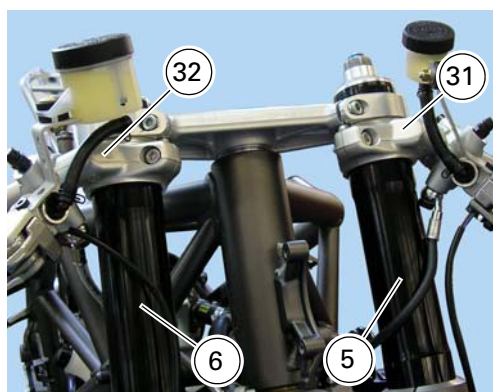


Refitting the front forks

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

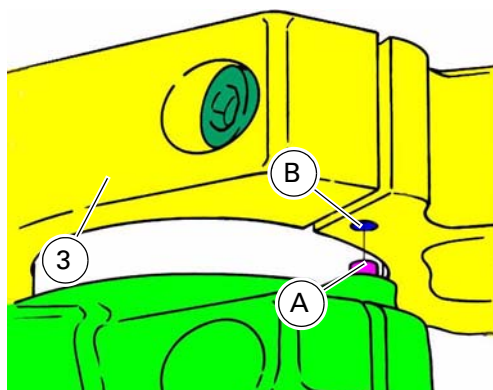


Locate the fork legs (5) and (6) in the bottom yoke (4) and then fit the handlebars (31) and (32).



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

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



Tighten to the specified torque (Sect. C 3) the clamp bolts (2) and (1) securing the legs to the bottom yoke (4) and to the top yoke (3) in the sequence 1-2-1.

Tighten the handlebar clamp bolts (30) to the specified torque (Sect. C 3).



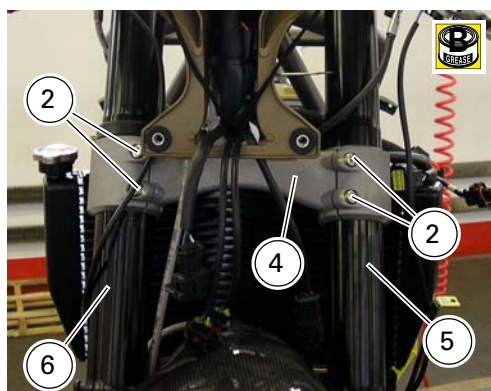
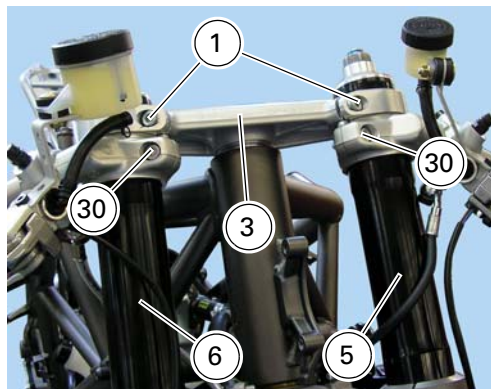
Important

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



Warning

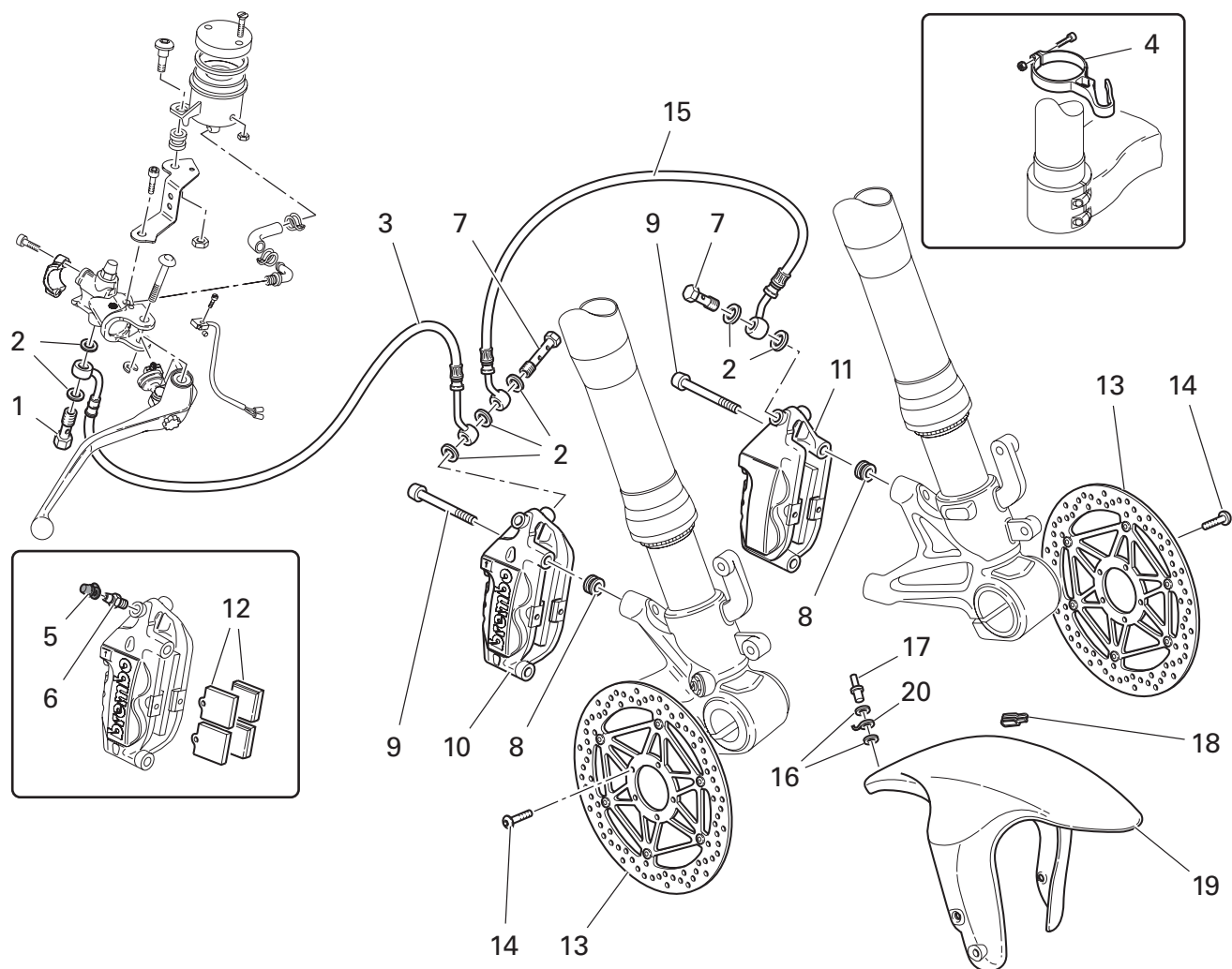
Do not use the motorcycle without the front mudguard fitted to avoid the risk of the brake pipes fouling the wheel on braking.



Refit any parts removed from the frame:

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

3 - Hydraulic front brake



- 1 Banjo bolt
- 2 Sealing washer
- 3 Calipers-master cylinder hose
- 4 Clamp
- 5 Dust cap
- 6 Bleed valve
- 7 Banjo bolt
- 8 Spacer
- 9 Bolt
- 10 Right brake caliper

- 11 Left brake caliper
- 12 Set of 4 brake pads
- 13 Brake disc
- 14 Bolt
- 15 Front brake hose
- 16 Washer
- 17 Rivet
- 18 Grommet
- 19 Mudguard
- 20 Clip

● Important

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

Maintenance operations



Warning

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

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

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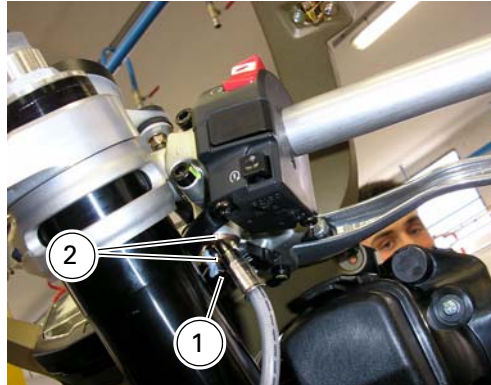
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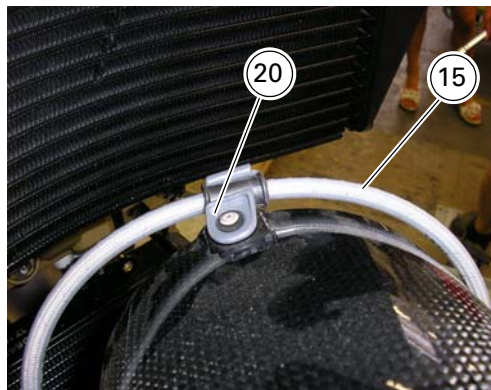
Removal of the front brake system

Operation	Section reference
Drain the braking system	D 4

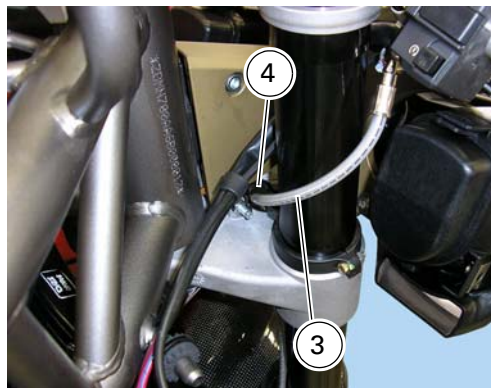
Unscrew the banjo bolt (2) securing the brake hose to the master cylinder and recover the sealing washers (1).



Remove the hose (15) from the grommet (18) on the mudguard and release the hose (3) from the clip (20).



Withdraw the hose (3) from the clamp (4) on the bottom yoke.



Warning

If the clamp (4) is damaged while removing the front brake hose, it must be replaced (Sect. E 4).

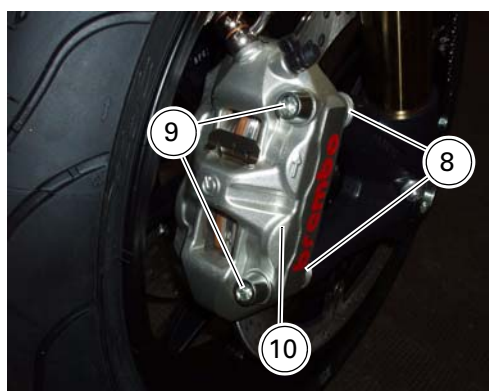
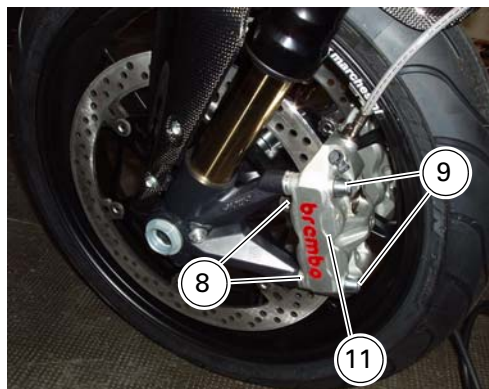
In the absence of the restraint provided by the clamp, the brake hose could come into contact with the tyre during braking and thus lead to accidents.

Remove the brake master cylinder (Sect. F 3).

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

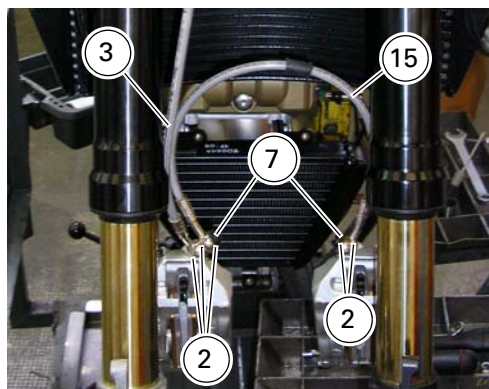
Repeat the operation for the right brake caliper (10).

Recover the spacers (8).



Unscrew the banjo bolts (7) from both calipers and recover the sealing washers (2).

Detach the front brake calipers from the hose (3) and (15).



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Refitting the brake discs

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

Remove the front wheel (Sect. G 1).

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



Overhauling the front brake components



Important

Critical safety components. The brake caliper manufacturer advises against any servicing of the internal components of calipers. Incorrect overhaul of this safety-critical component can endanger rider safety.

Operations should be limited to renewal of the pads, fasteners and the bleed valve assembly.

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

The brake disc must be clean without any signs of rust, oil, grease or dirt and no deep scoring.

For brake disc wear inspection, adhere to the service limits given in Sect. C 1.1.

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Refitting the front brake system

Before refitting the brake disc to the wheel, clean all contact surfaces thoroughly and smear a medium strength threadlocker on the threads of retaining screws (14).

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



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

Refit the wheel to the motorcycle (Sect. G 1).

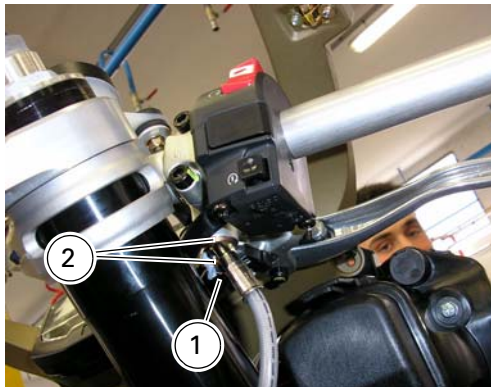


Notes

When refitting the brake system, pay particular attention to the positioning of the hose connection fittings on the master cylinder (Sect. F 3) and the caliper.

When reconnecting the brake hose to the caliper or master cylinder, make sure to install the sealing washers (2) either side of the hose end fitting.

After positioning the fitting correctly, tighten down the banjo bolt (1) to the specified torque (Sect. C 3).

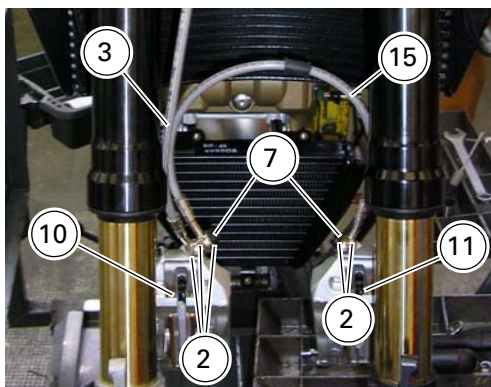


Reconnect the hoses (3) and (15) to the front brake calipers (10) and (11) and tighten the screws (7) to their specified torque (Sect. C 3).



Notes

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

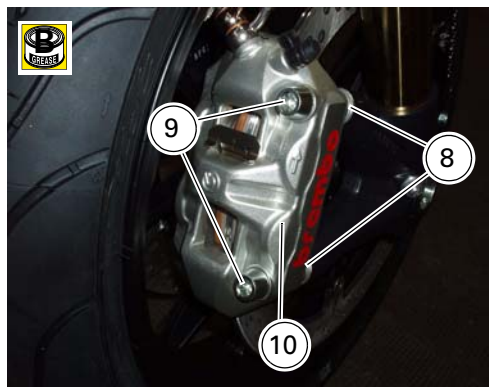


Fit the right caliper (10) over the disc.

Locate the hose (3) in the grommet (18).

Apply the recommended grease to the bolts (9).

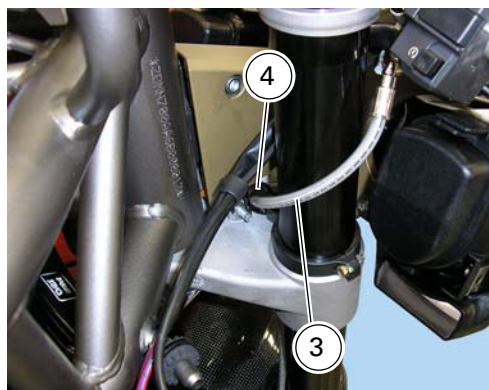
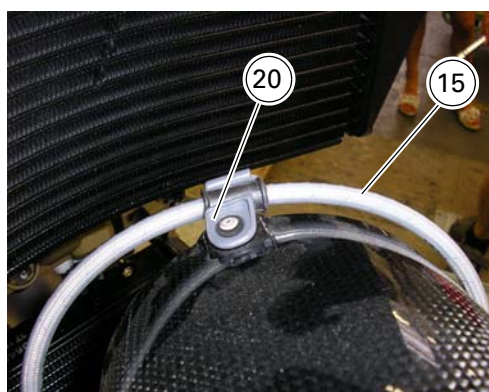
Hand tighten the bolts (9) with their spacers (8) to secure the calipers to the fork legs.



Repeat the procedure to refit the other brake caliper.

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

Insert the front brake hose (3) in the clip (20) located on the front mudguard and in the clamp on the bottom yoke (4).



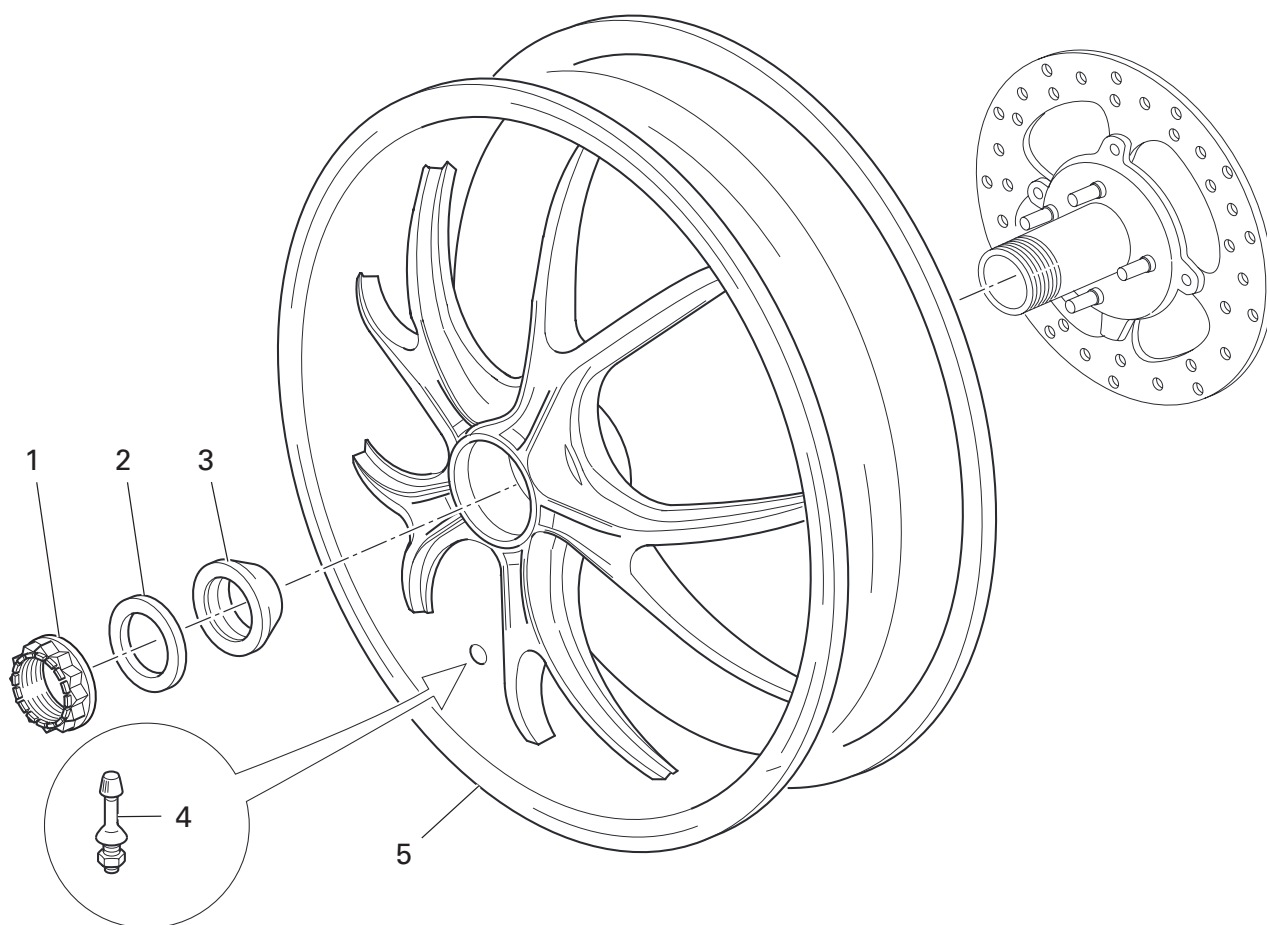
Operation

Section reference

Fill the brake circuit

D 4

4 - Rear wheel



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

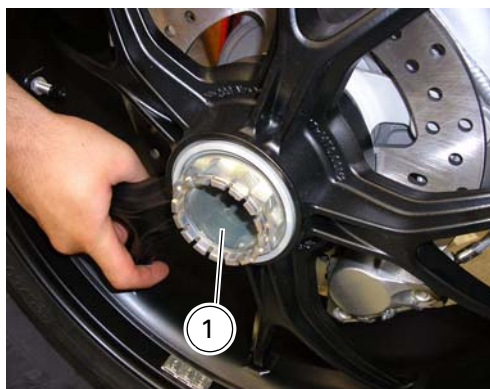


Important

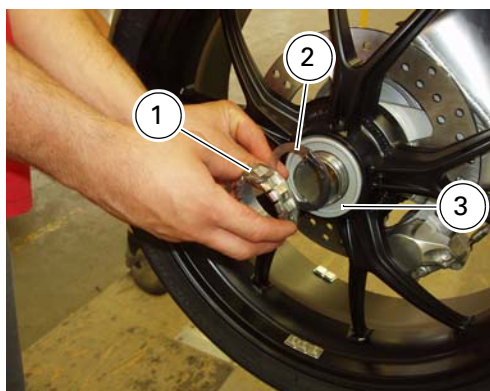
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Removal of the rear wheel

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



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



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Overhauling the rear wheel

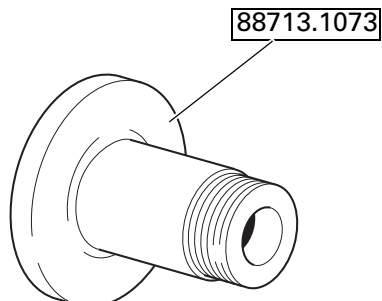
Proceed with inspection of the rear wheel.

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



Notes

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



Overhauling the wheel

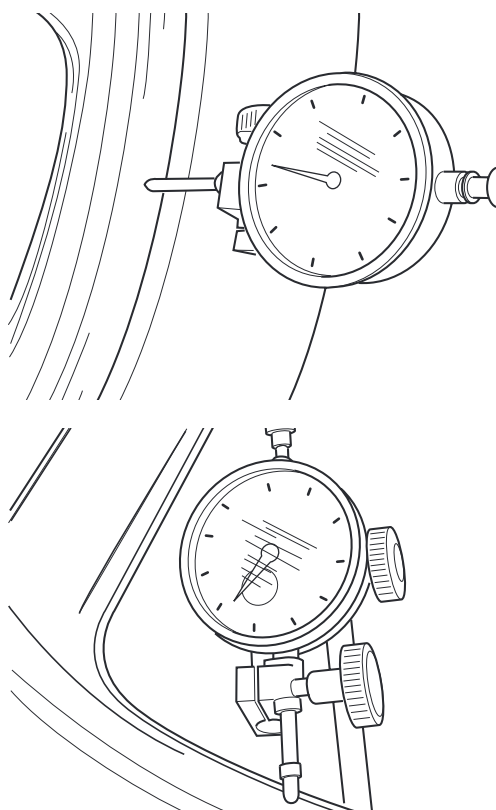
Inspect the wheel as follows:

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

Install the wheel on the service tool part no. **88713.1073** using the original fasteners.

Using a dial gauge, measure rim runout and out-of-round relative to the wheel axle (see Sect. C 1.1).

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

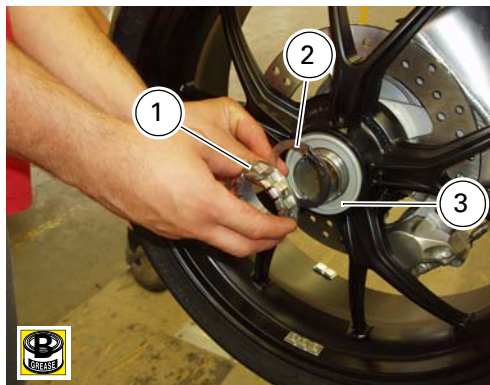


Refitting the rear wheel

Clean the mating surfaces and grease the threaded end of the stub axle with the recommended grease.

Fit the wheel, aligning it with the stub axle and the driving pins.

Fit the tapered bush (3) and the washer (2), and hand tighten the wheel nut (1).



Tighten the wheel nut to the specified torque (Sect. C 3). Check that the hole in the nut is aligned with one of the holes in the stub axle.

If not, tighten the nut slightly until the holes are aligned.

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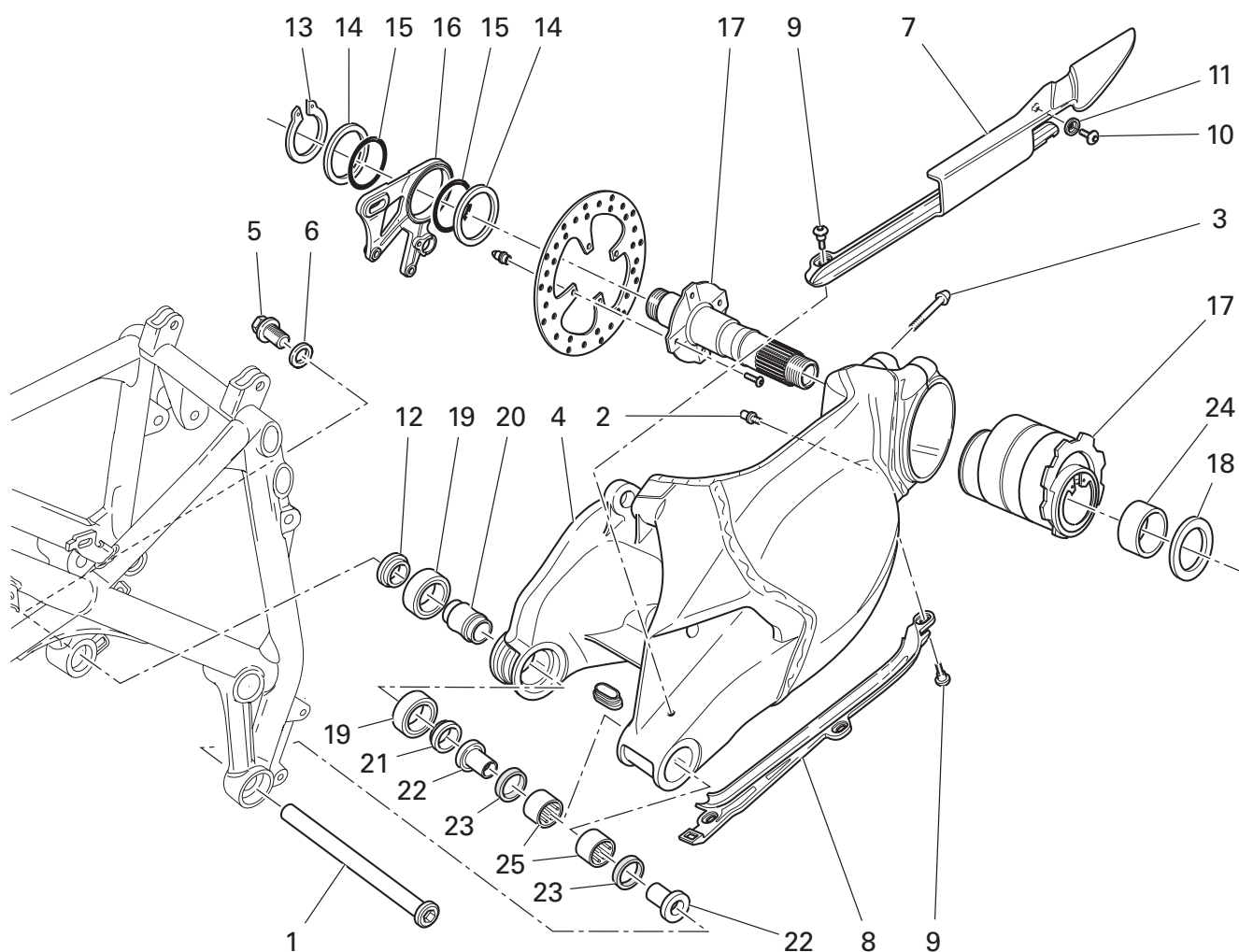
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5 - Rear swingarm



1 Swingarm pivot shaft

2 Pin

3 Bolt

4 Rear swingarm

5 Nut

6 Washer

7 Upper drive chain slider

8 Lower drive chain slider

9 Bolt

10 Bolt

11 Washer

12 Left spacer

13 Circlip

14 Washer

15 O-ring

16 Caliper mounting bracket

17 Eccentric hub

18 Spacer

19 Bearing

20 Spacer

21 Right spacer

22 Bush

23 Oil seal

24 Inner ring

25 Roller bearing



Important

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

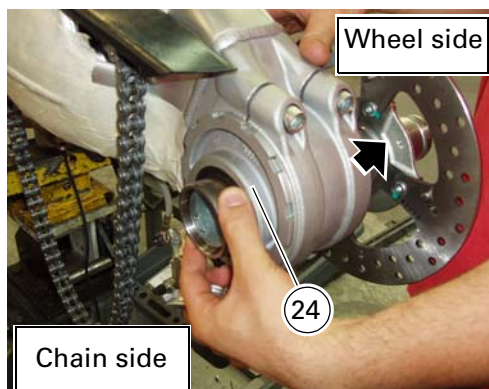
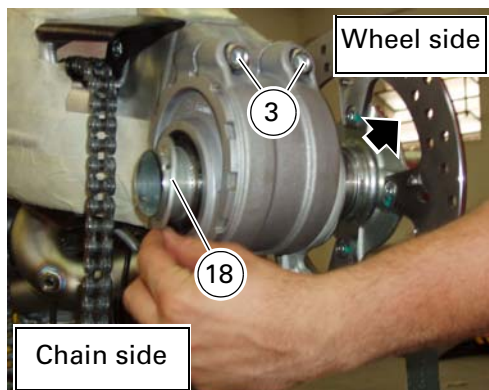
Removal of the rear eccentric hub

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

Operation	Section reference
Remove the rear wheel	G 4
Remove the rear sprocket	G 8
Remove the rear brake caliper	G 6

Slacken off the bolts (3).

Withdraw the spacer (18) and the inner ring (24) on the chain side and withdraw the stub axle complete with brake disc from the opposite side.



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



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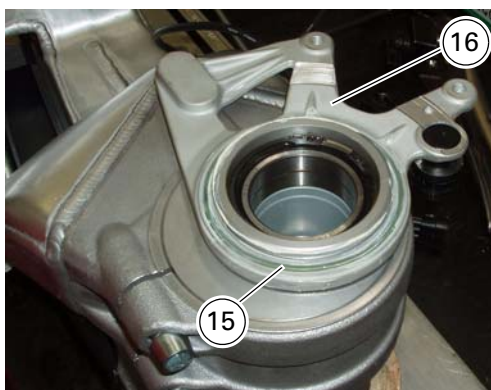
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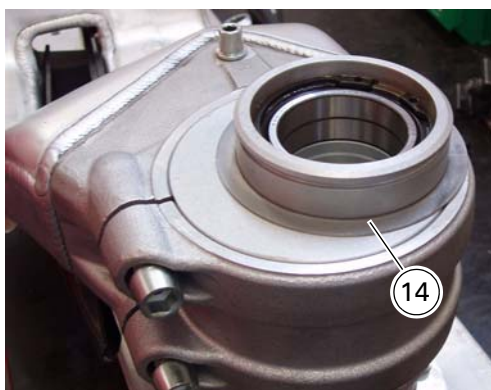
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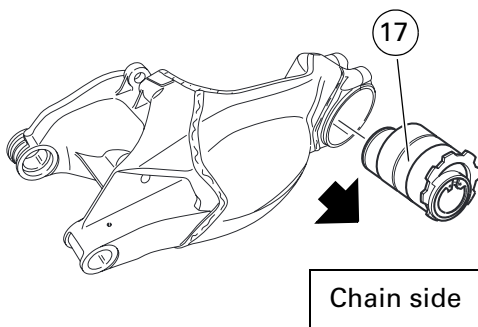
Remove the washer (14), the caliper mounting bracket (16) with the O-rings (15).



Remove the other washer (14).



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



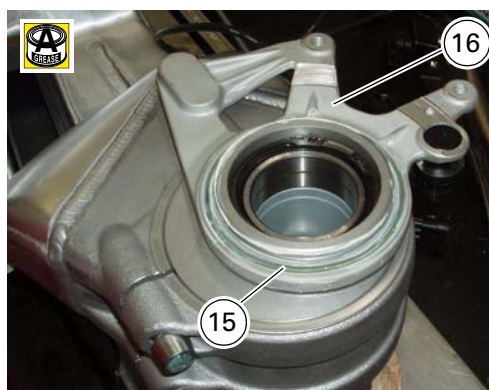
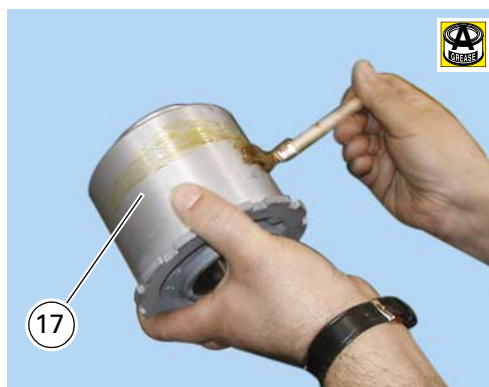
Notes

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

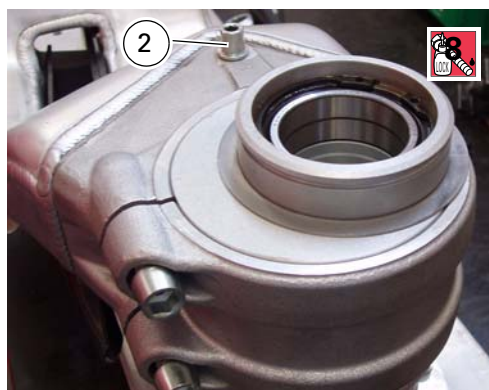
Removal of the rear eccentric hub

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 (17) of the caliper mounting bracket (16) on which the rings (15), also greased, will be located.



If the caliper bracket locating pin (2) was removed, apply the recommended threadlocker on reassembly.



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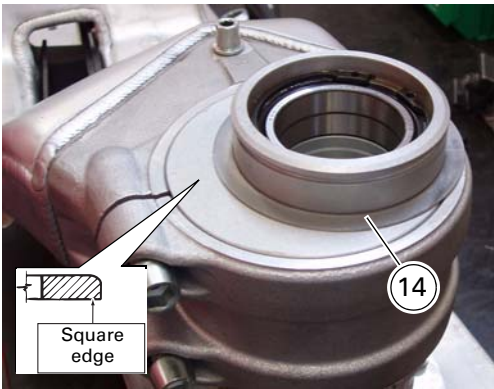
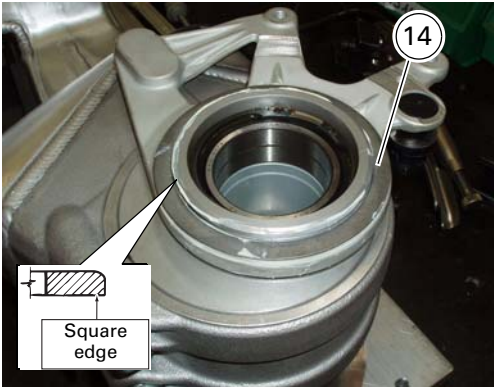
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Refit the washers (14) with their square edges facing the eccentric hub.



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



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

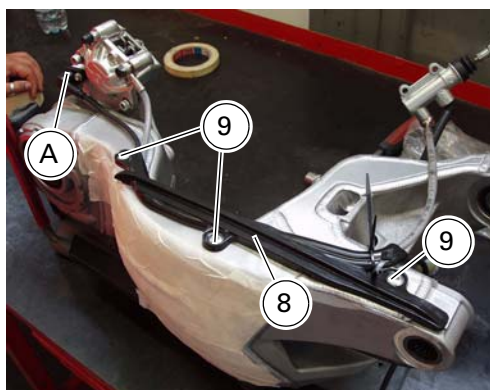
Tension the drive chain as indicated in the paragraph "Adjusting the chain tension" in Sect. D 4.

Removal of the swingarm

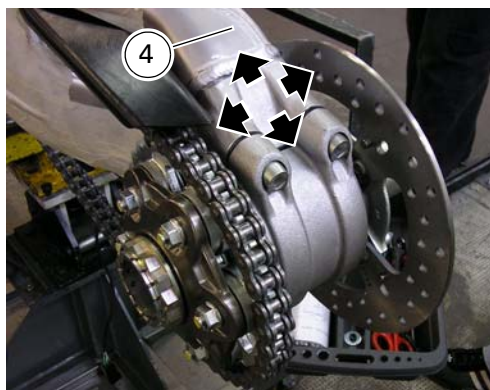
Before removing the parts in question, you must first remove the following parts:

Operation	Section reference
Remove the rear wheel	G 4
Remove the rear sprocket	G 8
Remove the rear brake caliper	G 6
Remove the shock absorber and tie-rod from the swingarm	G 7

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



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



Any abnormal movement is sign of worn bearings that could cause instability when riding.
Refer to the indications for checking swingarm bearing play in Sect. N 9.2.
Once the play in the swingarm bearings has been checked, the swingarm (4) may be removed from the motorcycle.

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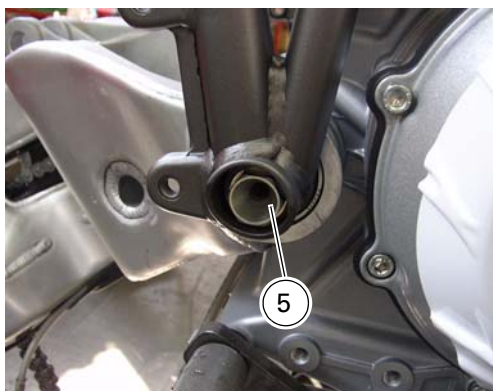
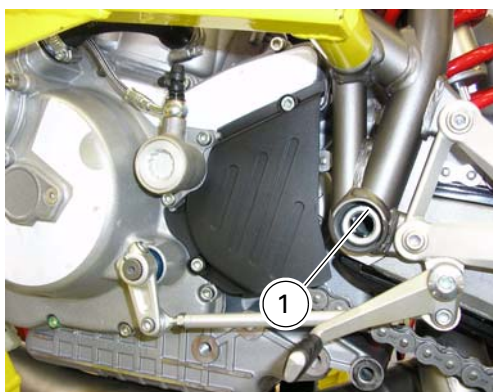
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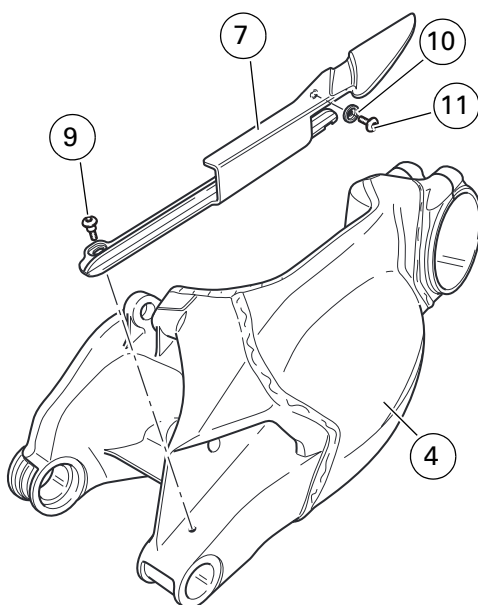
Restrain the swingarm pivot shaft (1) on the left side of the motorcycle while undoing the bolt (5) on the opposite side: recover the washer (6).



Use the drift **88713.1074** to drive out the swingarm pivot shaft.

Remove the swingarm (4) assembly from the frame.

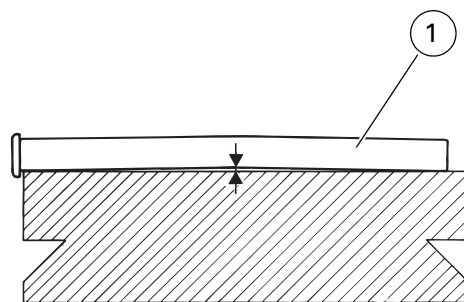
Detach the upper chain slider (7) from the swingarm (4) by unscrewing the bolts (9) and (10), recovering the washer (11).



Inspecting the swingarm pivot shaft

Before refitting the swingarm pivot shaft (1), check it carefully for distortion.

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



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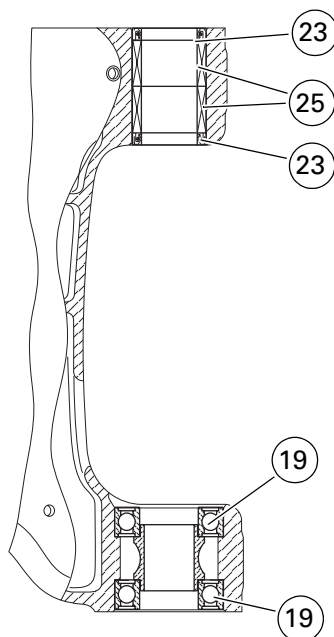
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Overhauling the rear swingarm

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



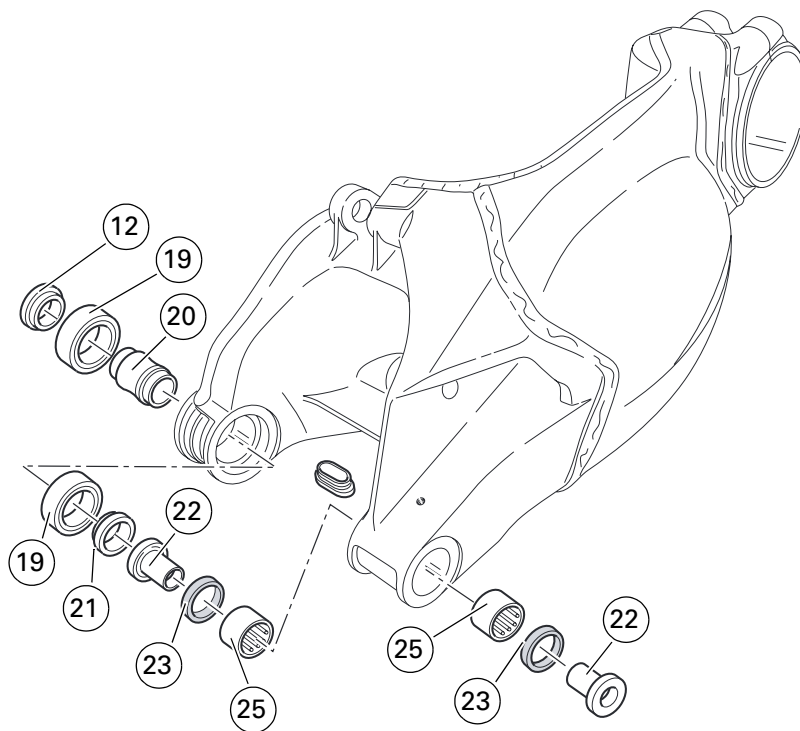
To change the bearings, proceed as follows.

From the right-hand side of the swingarm, remove the spacers (21) and (12) and the two bushes (22) from the left-hand side. Remove the ball bearings (19), seal rings (23) and roller bearings (25) with a suitable punch and press. Support the swingarm and take care not to damage the bearing bores.



Important

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



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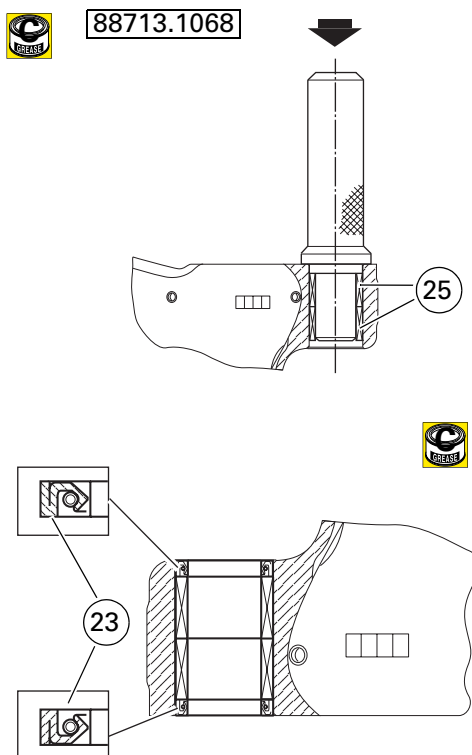
P

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

Fit the new roller bearings (25) on to service tool part no. **88713.1068** and, working from the outer side, install them in their bores on the left side of the swingarm.

Drive them in until the tool is fully inserted into the swingarm.

Use the same tool to fit the new seal rings (23), positioned as shown in the sectional view, so that they seat against the newly installed roller bearings.



To install the ball bearing races (19) you will need tool part no. **88713.2409**, composed of:

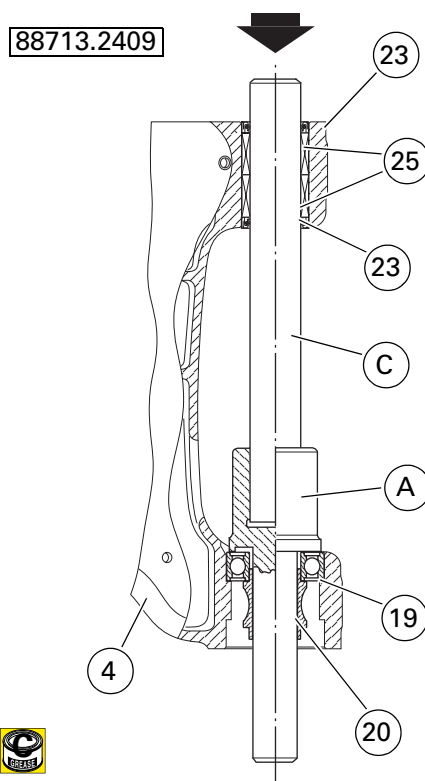
- (A) – drift for internal bearings;
- (A) – drift for external bearings;
- (C) – guide pin.

Fit a new bearing (19) with the internal spacer (20) onto the drift (A) and position it on the interior of the right-hand side support of the swingarm.

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

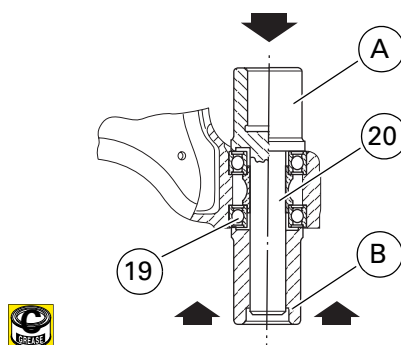
Drive the bearing (19) fully into the swingarm.

Fit the other new bearing (19) at the outer end of tool (A).



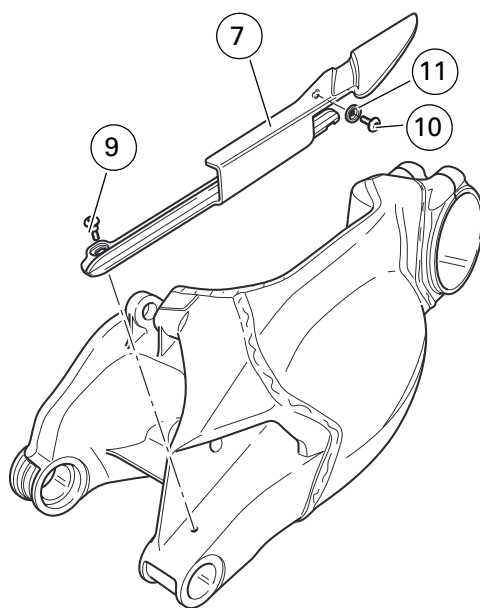
Using tool (A) as a stop, use tool (B) to drive the external bearing up against spacer (20): remove the tools.

Before reinstalling the swingarm (4), grease the ball bearings (19), roller bearings (25) and seal rings (23) with the recommended grease.



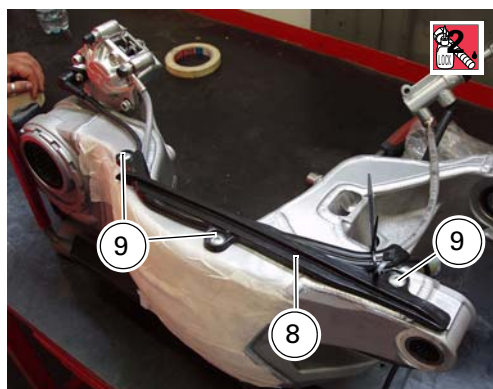
Refitting the swingarm

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



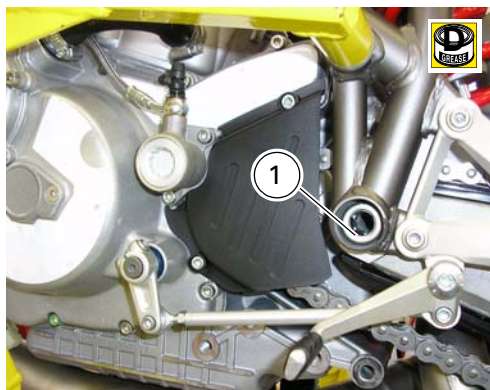
Refit the rear brake hose and speed sensor to the swingarm (4), securing them with the lower chain slider (8) and tightening the bolts (9).

Apply the recommended threadlocker to the bolts (9) and (10) and tighten to the specified torque (Sect. C 3).



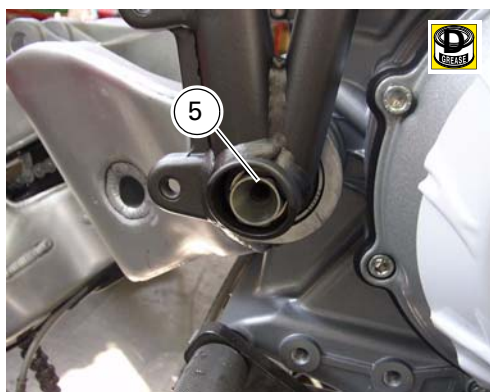
Locate the swingarm (4) on the frame.

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



On the opposite side of the bike, secure the swingarm pivot shaft (1) with the nut (5) after applying the recommended grease, interposing the washers (6).

Tighten the wheel nut (5) to the specified torque (Sect. C 3).



Connect the speed sensor to the main wiring loom.

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

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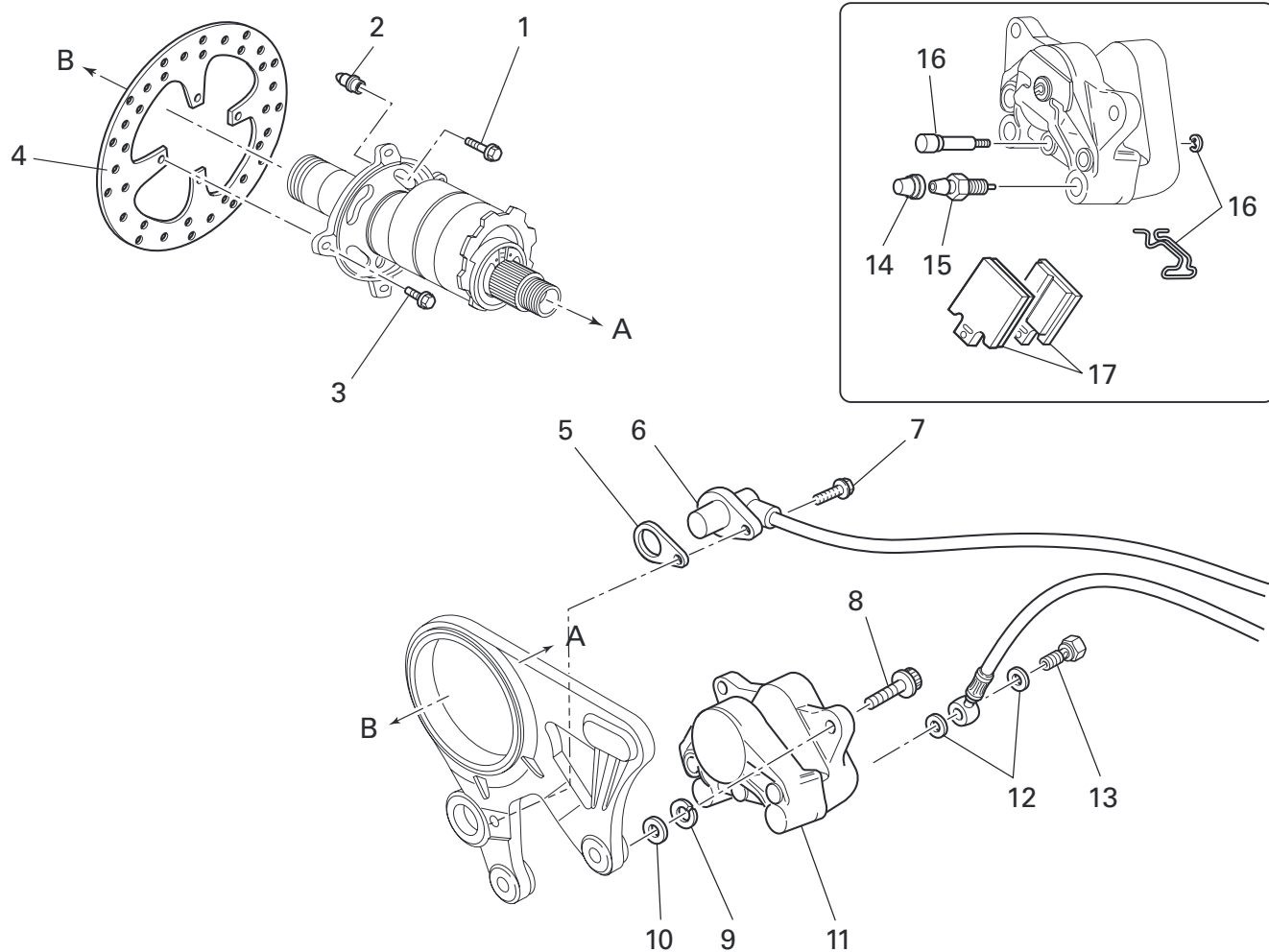
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6 - Hydraulic rear brake



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



Important

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

Removal of the rear brake caliper



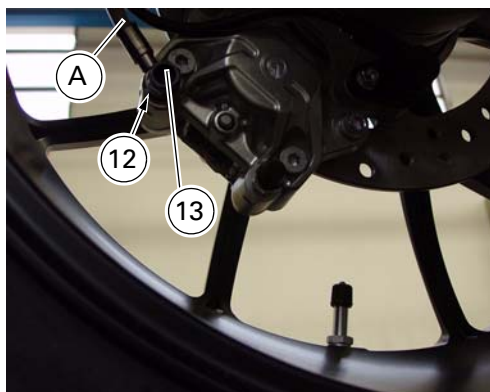
Important

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

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

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

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



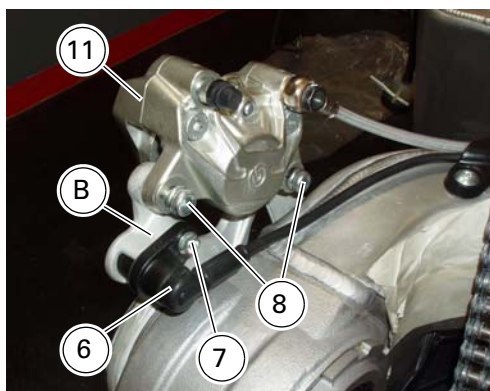
Unscrew the two bolts (8) securing the rear brake caliper (11) to the caliper mounting bracket, taking care to recover the washers (9) and (10), and remove the caliper (11).

If it is necessary to remove the caliper mounting bracket (B), refer to Sect. G 5.



Notes

See "Checking brake pad wear and changing brake pads" in Sect. D 4 for instructions on how to change the brake pads. To remove the speed sensor (6), unscrew the bolt (7) securing it to the caliper mounting bracket, taking care to recover the spacers (5).



Only the following parts should be renewed:

Caliper: Pads, fasteners and bleed valve assembly.

Master cylinder: control pedal, bleed valve assembly, reservoir and its components (Sect. F 4).

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

Removal of the rear brake disc

A Remove the rear eccentric hub (Sect. G 5).

Unscrew and remove the four bolts (3) securing the brake disc to the stub axle and remove the rear brake disc (4).

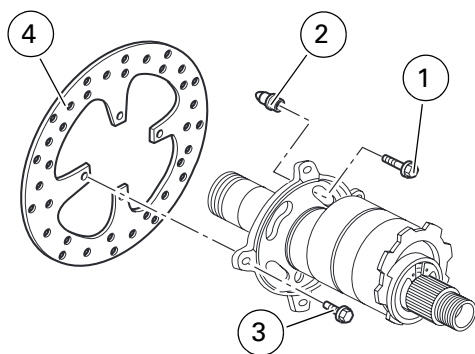
If they are to be renewed, unscrew the bolts (1) from the hub and remove the locating pins (2).

The disc must be perfectly clean with no signs of rust, oil or grease deposits or other contaminants and must be free of any deep scoring.

B Refer to Sect. C 1.1 for the brake disc wear tolerance limits.

Proceed with the refitting of the rear brake disc (4), tightening the bolts (3) to the specified torque (Sect. C 3) in the sequence 1-2-3-4.

Refit the rear eccentric hub as described in Sect. G 5.



Refitting the rear brake caliper

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



Warning

An incorrectly positioned hose can affect brake operation and foul moving parts. Position the hose as shown in the figure. Remember to fit the copper faced sealing washers (12) to the either of the hose end fitting the brake hose to the caliper (11). After positioning the fitting correctly, tighten the banjo bolt (13) to the specified torque (Sect. C 3). If removed, locate the speed sensor (6) on the caliper mounting bracket (B) with the spacer (5) and tighten the bolt (7) to the specified torque (Sect. C 3).



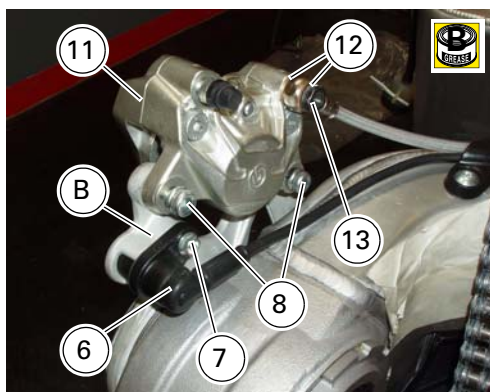
Notes

The gap between the sensor (6) and the brake disc bolt must be between **0.6** and **2.2** mm.

If the caliper mounting bracket (B) was removed, see Sect. G 5 for refitting instructions.

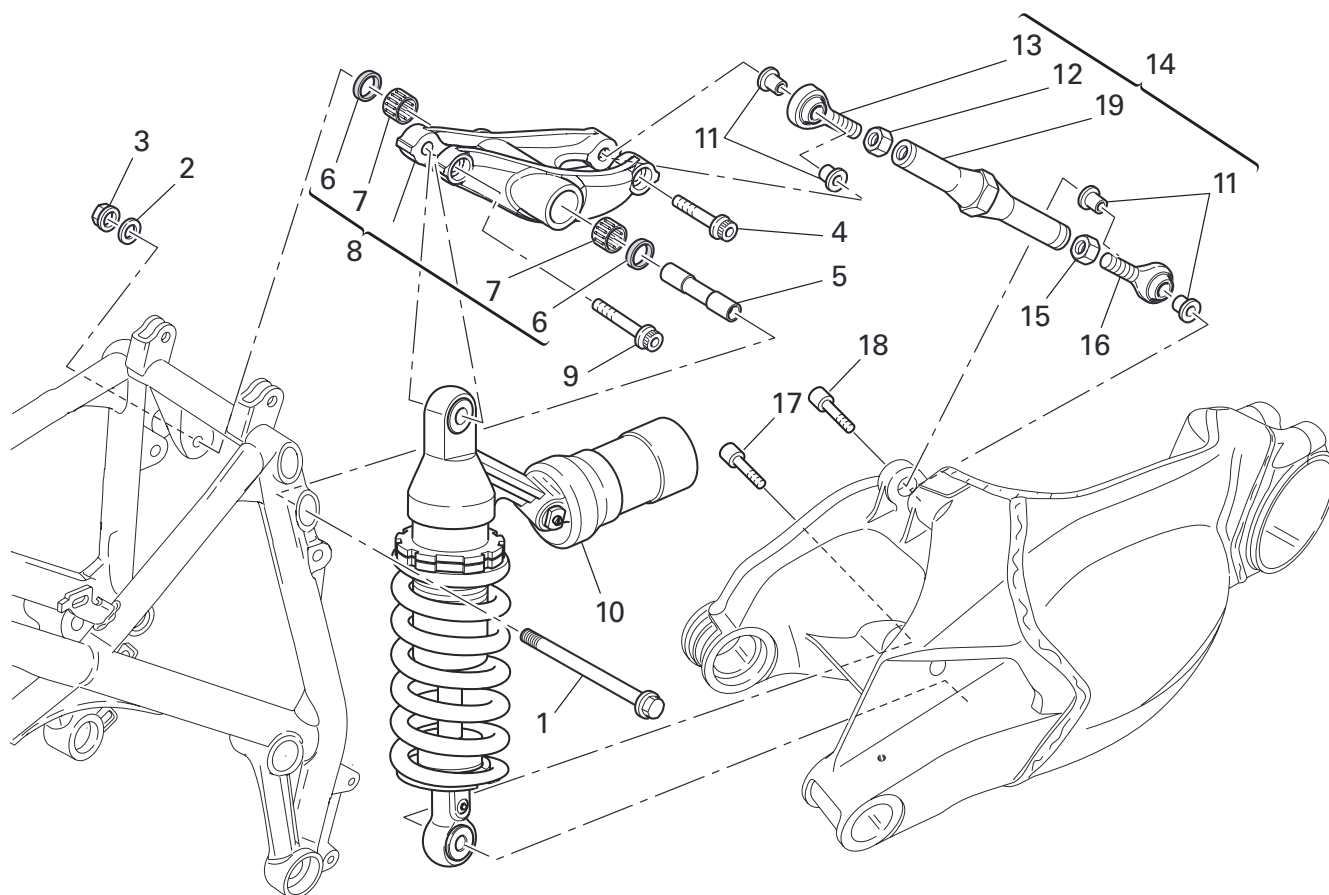
Fit the rear brake caliper (11) over the brake disc, aligning it with the holes in caliper mounting bracket (B).

Apply grease to the bolts (8) and tighten to the specified torque (Sect. C 3) interposing the washers (9) and (10) between the bolts and the caliper mounting bracket (B).



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

7 - Rear suspension



- 1 Bolt
- 2 Washer
- 3 Nut
- 4 Bolt
- 5 Spacer
- 6 Oil seal
- 7 Roller bearing
- 8 Rocker arm assembly
- 9 Bolt
- 10 Shock absorber
- 11 Collar
- 12 Nut
- 13 Ball joint
- 14 Tie-rod
- 15 Nut
- 16 Ball joint
- 17 Bolt
- 18 Bolt
- 19 Tie-rod central shaft

 Important

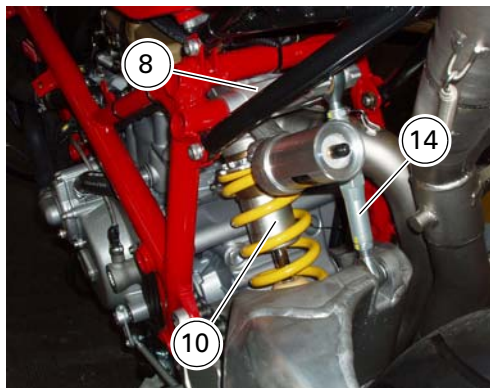
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Rear suspension system

The rear suspension uses a fully adjustable progressive hydraulic monoshock (10). The system consists of an upper rocker arm (8) and an adjustable tie-rod (14), which is fixed to the single-sided swingarm.

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

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



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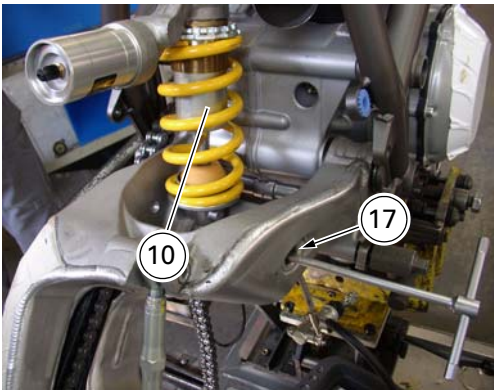
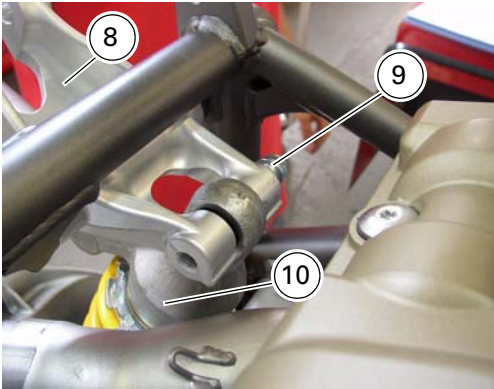
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Removal of the rear shock absorber

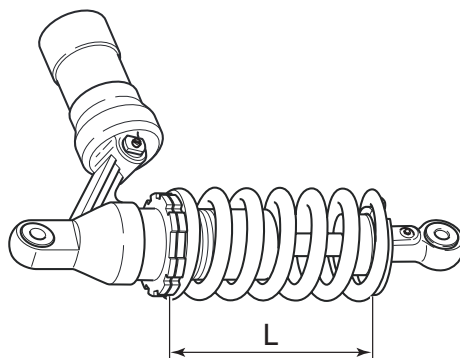
Operation	Section reference
Remove the seat cowling	E 3
Remove the rear wheel	G 4

To remove the rear shock absorber (10) from the swingarm and from the rocker arm (14), remove the upper (9) and lower (17) mounting bolts.



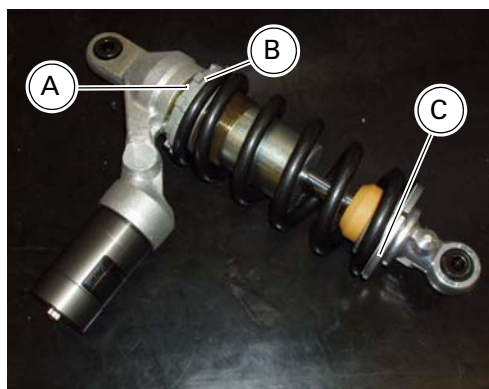
Overhauling the rear shock absorber

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



Removal of the rear shock absorber

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



Inspect the shock absorber for signs of oil leaks and other problems. Renew the shock absorber if necessary.

Refitting the rear shock absorber

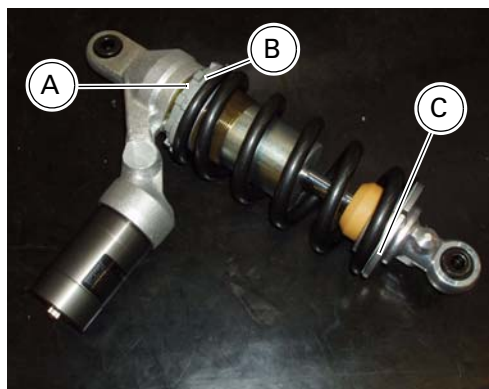
Fit the spring into its seat in the shock absorber with the tapered end towards the lower mounting. Fit the spring retaining ring (C). Screw in the spring adjuster nut (B) to obtain the previously measured length (L).



Notes

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

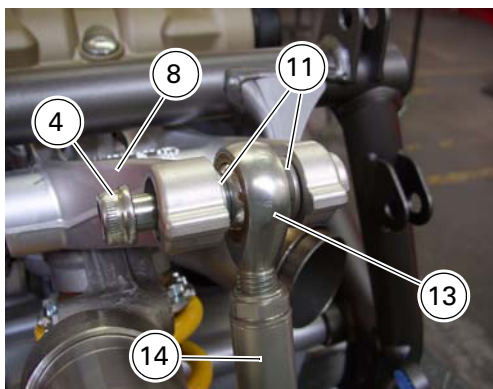
Tighten down the lock nut (A) against the adjuster (B).



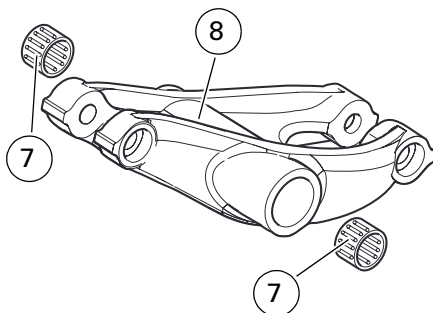
Removal of the rear suspension rocker arm

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

Separate the tie-rod (14) and the rocker arm (8) by unscrewing the bolt (4) and recover the collars (11) from either side of the ball joint (13).



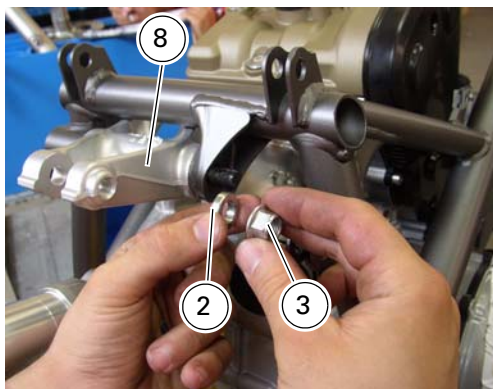
Before removing the rocker arm (8) from the frame, check the play of its internal needle roller bearings (7).



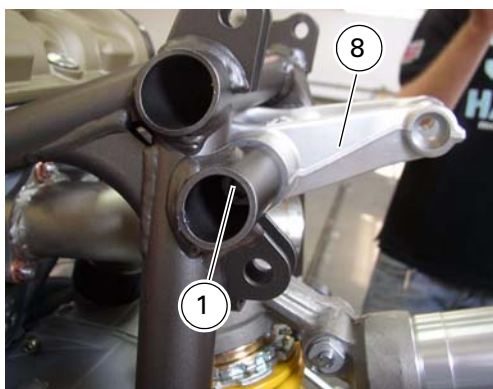
Grasp the rear end of the rocker arm and try to move it in all four directions.

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

To remove the rocker arm (8) from the frame, unscrew the nut (3) and withdraw the washer (2).



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



Overhauling the rear suspension rocker arm

Disassembly of the rear suspension rocker arm

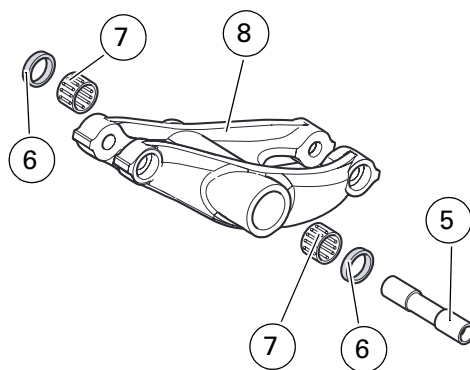
The rocker arm movement is obtained by needle roller bearings (7) rotating on an internal spacer (5). Two seals (6) on the outer sides of the bearings keep the lubricant inside the cages.

First remove the inner spacer (5), then remove the oil seals (6) and the needle roller bearings (7) using a suitable drift.



Important

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



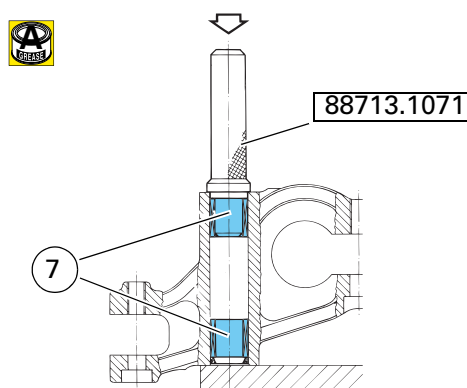
Reassembly of the rear suspension rocker arm

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



Important

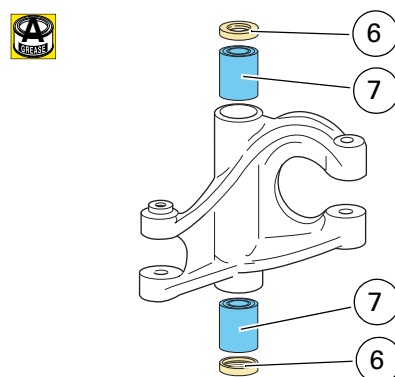
Make sure that the bearings are installed perfectly square in the hole. Avoid jamming. Use a press, if necessary.



Fit a new oil seal (7) on the installation tool, with the metal side facing outwards, and drive it in so that it seats against the previously installed bearings.

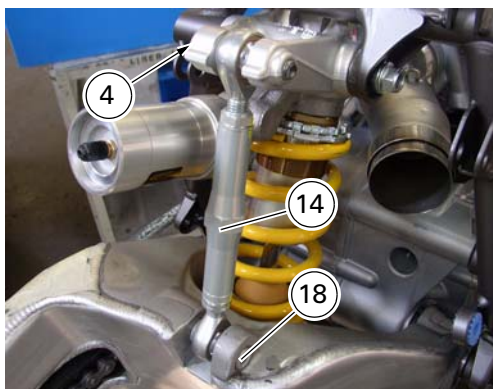
Repeat the above procedure for the other roller bearing (7) and the other oil seal (6).

Lubricate the bearings and oil seals with the recommended grease and insert the inner spacer (6).

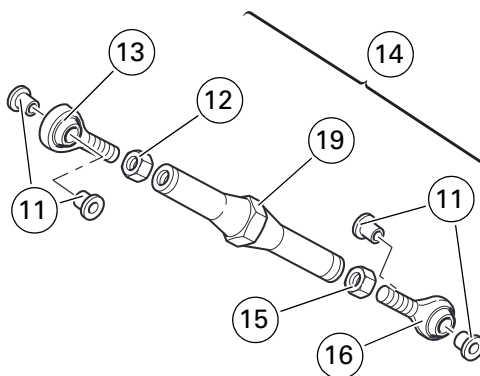


Disassembly and overhaul of the shock absorber tie-rod

A Unscrew and remove the upper bolt (4) and lower bolt (18).
Remove the tie-rod assembly (14).

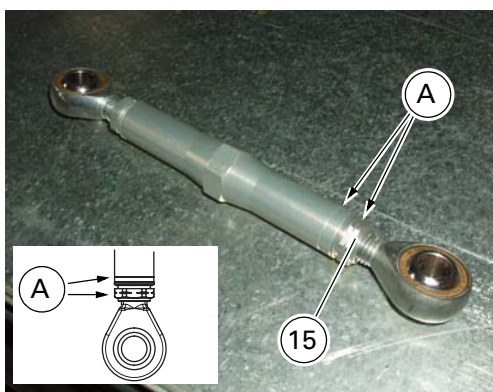


D The tie-rod (14) is comprised of a central shaft (19), two nuts (12) and (15), and two ball joints (13) and (16). Two mounting collars (11) are located at the sides of each ball joint.



G After removing the collars (11), check the amount of play in the ball joint by turning the internal ring by hand: change the ball joint if it has excessive play.

On reassembly, note that the **nut (15)** marked (A) **has a left-hand thread**: this nut is to be fitted to the end of the rod (19) also marked (A).



M The centre-to-centre distance between the two ball joints should be **285 mm**.

Altering this distance will affect the rear ride height of the motorcycle.

Tighten the nuts (12) and (15) on the rod to the specified torque (Sect. C 3) while holding the rod against rotation with a wrench on the central flats.

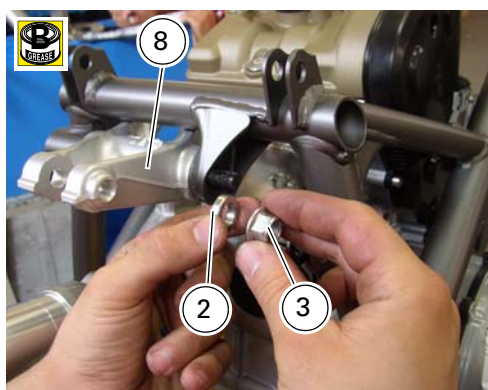
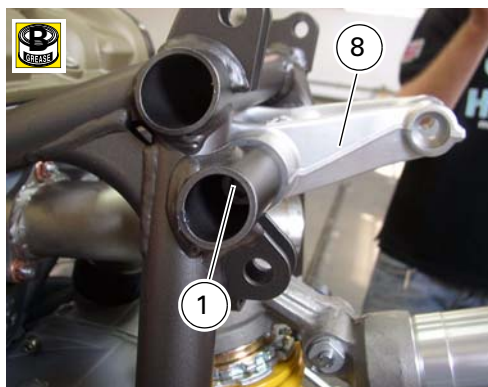
Refitting the rear suspension

Lubricate the shank and thread of the bolt (1) and the underside of the head of the nut (3) with the recommended grease. Insert the rocker arm assembly (8) between the frame supports, as shown in the figure.

Drive the bolt (1) fully home in the frame.

Fit the nut (3) and washer (2) on the opposite side.

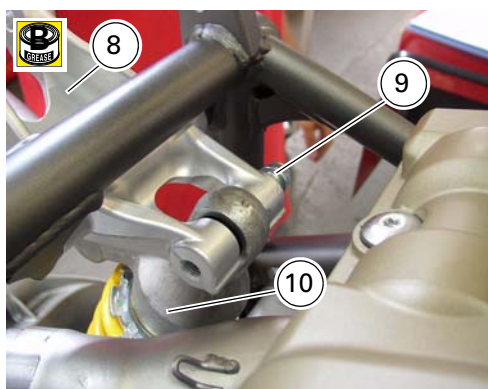
Restrain the nut (3) and tighten the bolt (1) to the specified torque (Sect. C 3).



Grease the thread and the underside of the head of the upper shock absorber bolt (9) and insert it in the rocker arm.

Position the shock absorber (10) with the reservoir at the top.

Align the upper mounting of the shock absorber with the front hole in the rocker arm and lower mounting with the slot in the swingarm.



A

B

C

D

E

F

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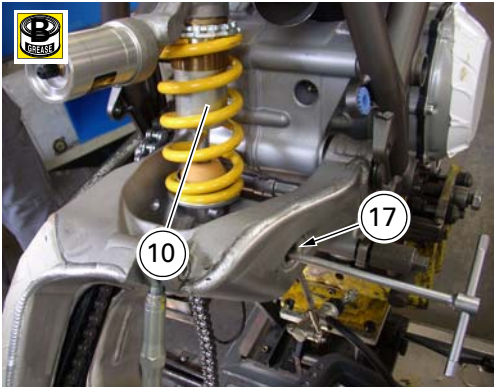
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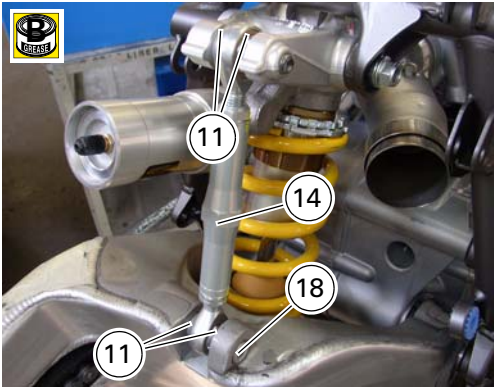
N

P

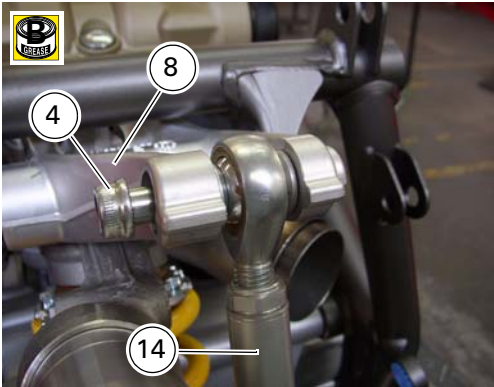
Grease the thread and underside of the head of the lower mounting bolt (17), and tighten it to the specified torque (Sect. C 3).



Install the collars (11) on both the ball joints end fittings.
Install the lower end of the tie-rod (14) on the swingarm.
Grease the thread, underside and sliding surface of the lower pivot bolt (18) and insert it in the swingarm from the right-hand side. Tighten the bolt (18) to the specified torque (Sect. C 3).

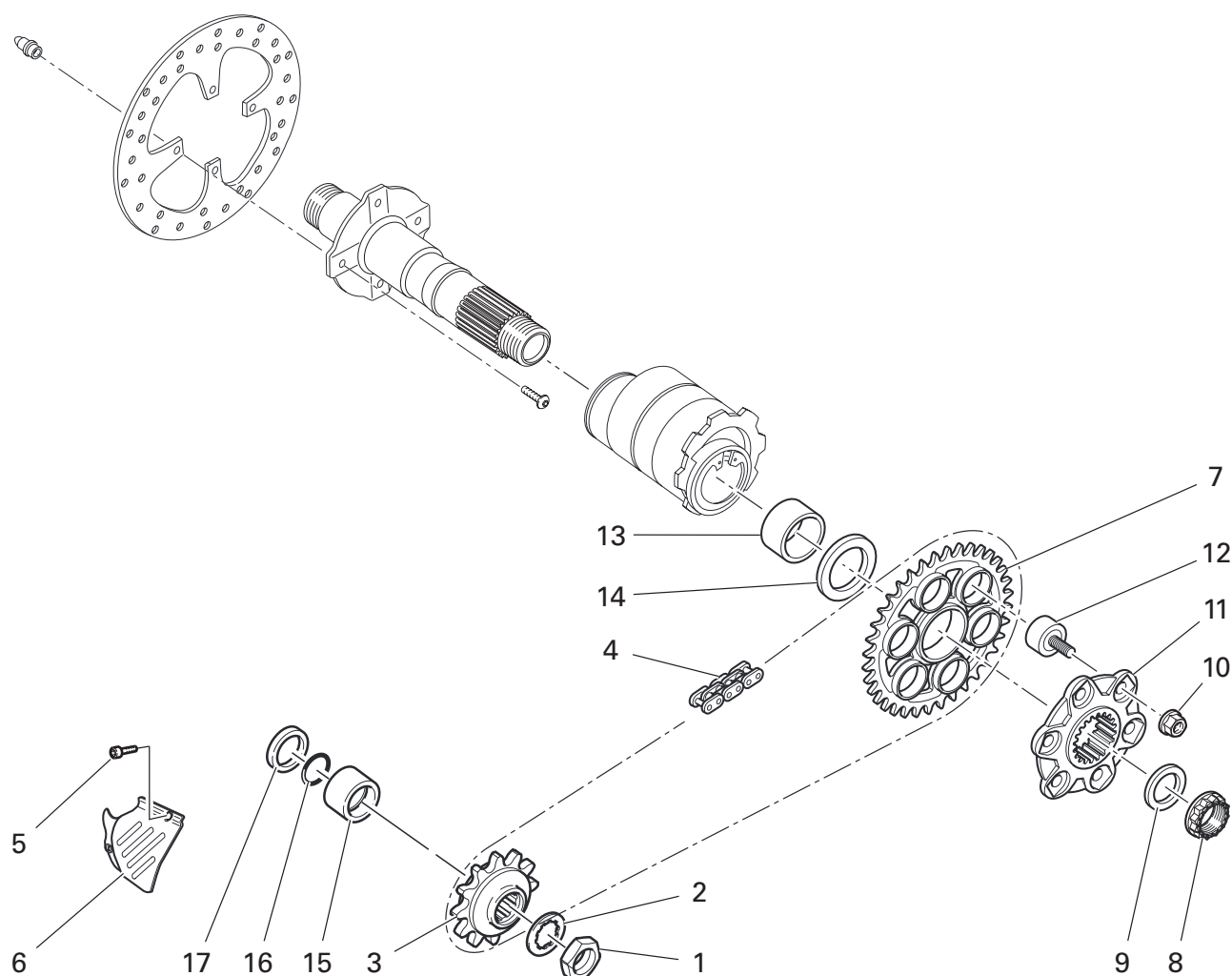


Grease the thread and the underside of the head of the upper tie-rod bolt (4) and insert it in the rocker arm.
Fit the upper end of the tie-rod to the rocker arm and tighten the bolt (4) to its specified torque (Sect. C 3).



Operation	Section reference
Refit the rear wheel	G 4
Refit the seat cowling	E 3

8 - Final drive



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



Important

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

A

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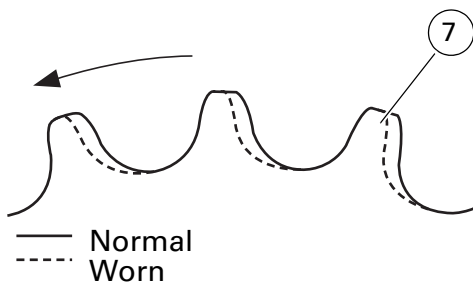
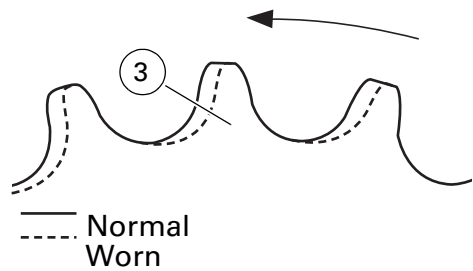
M

N

P

Inspecting the final drive

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

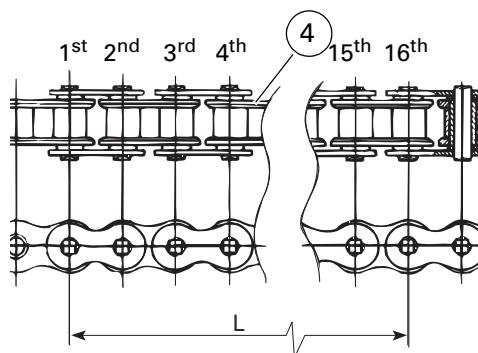


To check the amount of wear on the chain (4), keep the chain taut and measure **16** links. If the length (L) is greater than **256.5** mm, the chain should be renewed.



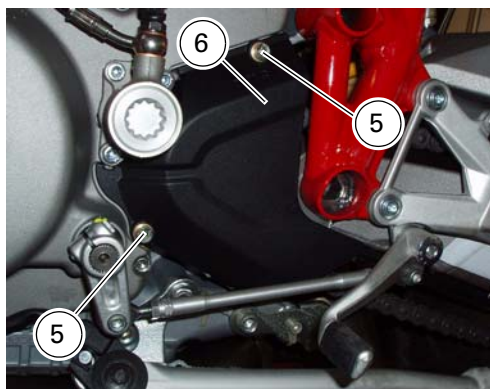
Important

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



Removal of the front sprocket

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



Remove the chain with the service tool part no. **88713.1344**.

The tool is composed of a holder (A), punch (B), body (C) and two wrenches (D) and (E).

Fit the link to be opened into the holder (A).

Fit a punch (B) into the body (C) and manually unscrew the bolt until the punch no longer protrudes.

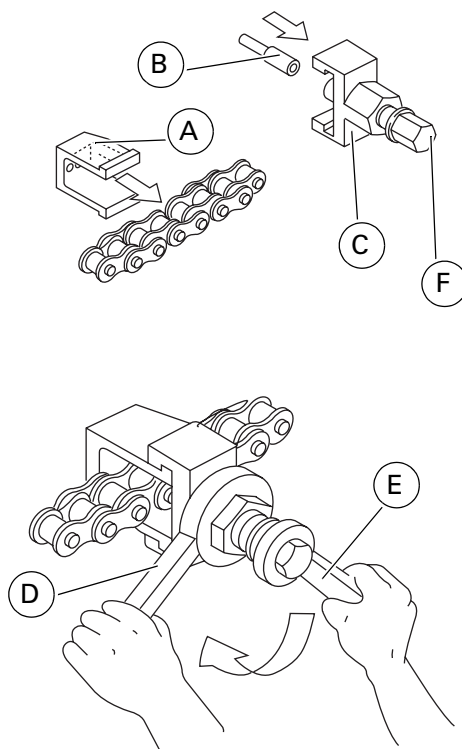
Fit the holder (A) and link into the body (C).

Manually turn the bolt (F) on body (C) so that the punch (B) locates against the pin, taking care that they are aligned with each other.

Fit hex wrench (D) into the hexagonal part of the body (C) and wrench (E) onto the bolt.

Turn the bolt (F) clockwise to push out the pin.

88713.1344



Remove the chain.

A

B

C

D

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G

H

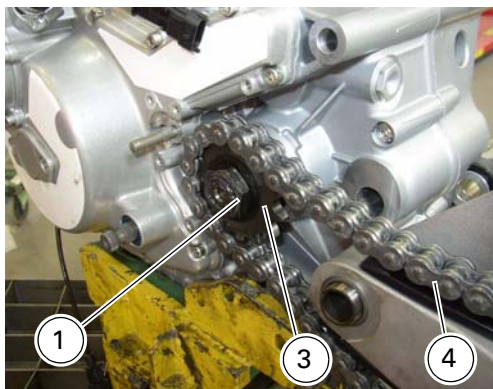
L

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P

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

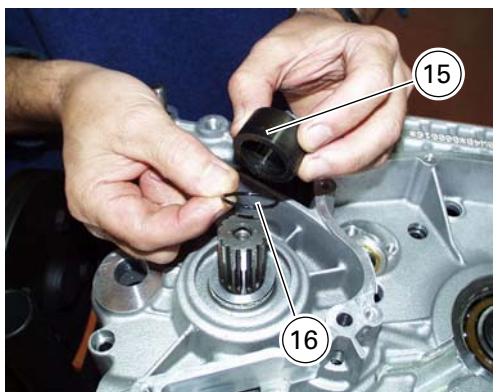


Remove the spacer (15) with the O-ring (16) from the gearbox output shaft.



Important

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



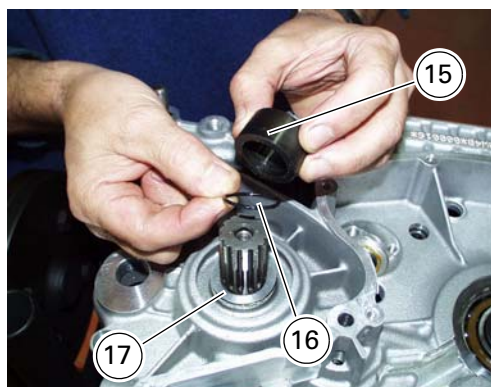
Refitting the front sprocket

Refit the ring (17) (Sect. N 9.2).

Grease the O-ring (16) and install it on the front sprocket spacer (15).

Fit the spacer, from the seal side, on the output shaft and seat it against the inner ring of the bearing.

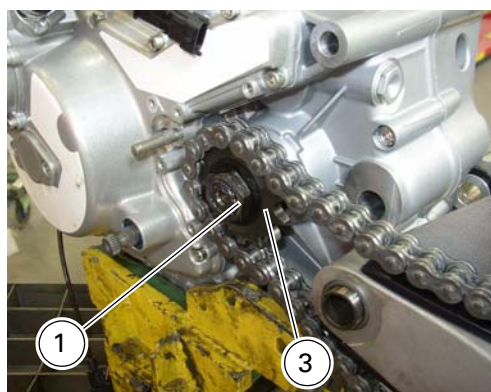
Before fitting the front sprocket, check that the spacer (15) is installed on the gearbox output shaft.



Check that the splines of the gearbox output shaft and the sprocket are in perfect condition.

Fit the front sprocket (3) and install the safety washer (2).

Tighten the nut (1) to the specified torque (Sect. C 3).



A

B

C

D

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N

P

Fit the chain and join it with the service tool part no. **88713.1344**, previously used for split it.

The tool is composed of a holder (A), punch (B), body (C) and two wrenches (D) and (E) and link plate holder (F). Connect the two halves of the chain with the external link and manually fit the plate onto the pins.



Warning

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

Fit the holder (A) onto the external link.

Fit the punch (B) into the body (C) and the plate holder (F).

Fit the body (C) onto the holder (A) which holds the chain in position.

Manually turn the bolt (G) until the plate holder (F) is seated against the plate itself.

Use wrenches (D) and (E) to turn the bolt (G) clockwise until the chain pin is in contact with the holder (F).

Remove the holder (A) from the tool.

Manually turn the bolt (G) until the punch (B) locates against the pin, taking care that they are aligned with each other.

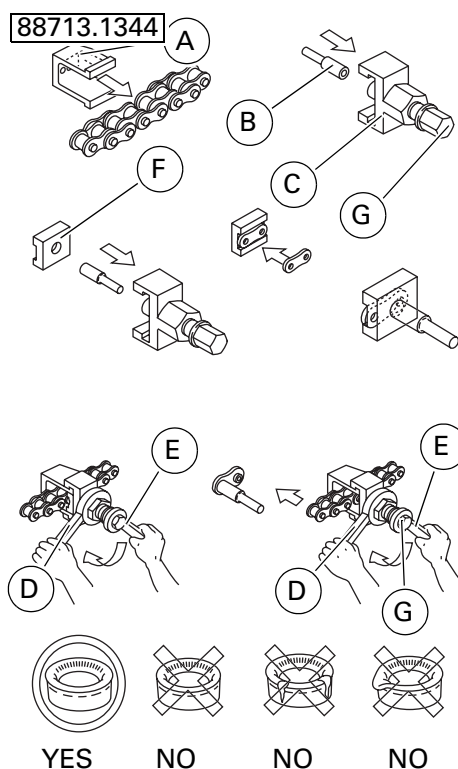
Use wrenches (D) and (E) to turn the bolt clockwise until the punch (B) is seated against the chain plate.

To complete reassembly, repeat the entire procedure with the second pin.



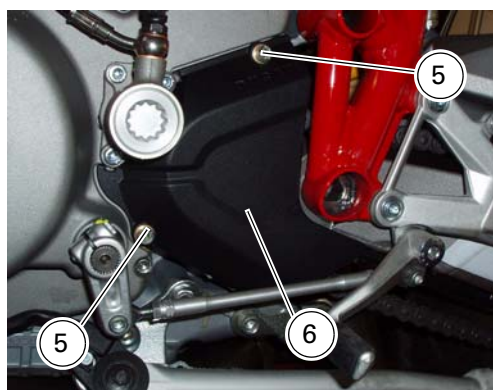
Warning

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



Adjust the chain tension (Sect. D 4).

Fit the sprocket cover (6) and tighten the bolts (5) to the specified torque (Sect. C 3).



Renewal of the rear sprocket

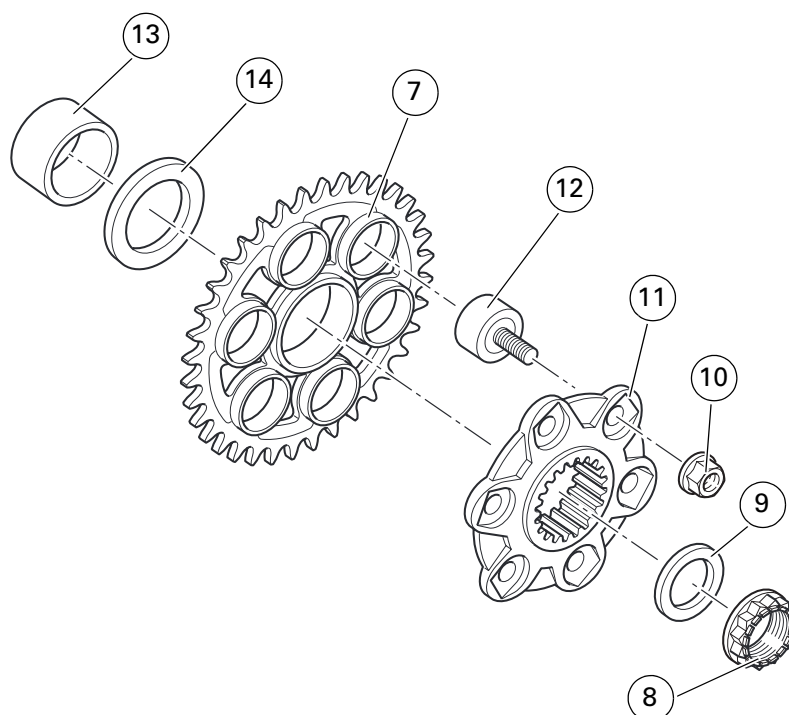
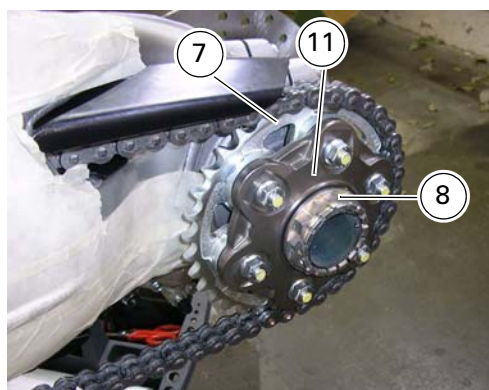
Operation	Section reference
Slacken the chain	D 4
Remove the rear wheel	G 4

Hold the stub axle against rotation and, using a socket wrench, loosen the nut (8).

Fully unscrew the nut (8) and remove the washer (9) and the flange (11) complete with the rear sprocket (7).

Recover the spacer (14).

Using a mallet, tap the sprocket flange (11) with the cush drive bushes (12) off the sprocket (7).



A

B

C

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G

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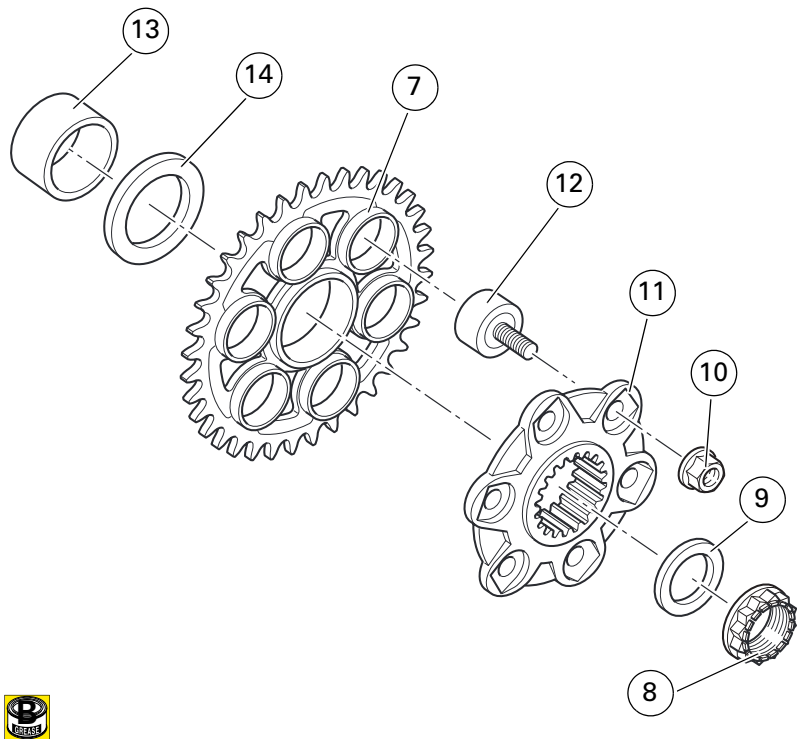
N

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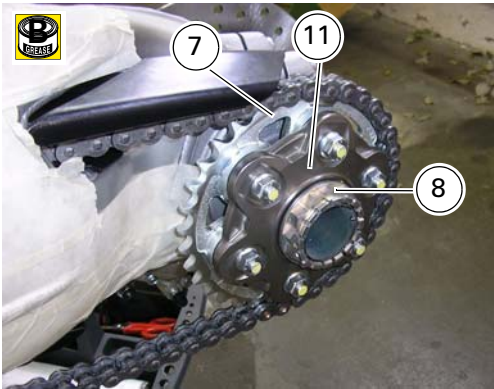
Refitting the rear sprocket

Check the cush drive bushes (12) for signs of wear and, if necessary, remove from the sprocket flange and renew them. Refitting is the reverse of removal.

If it was necessary to remove the cush drive bushes (12), grease all the mating surfaces and the undersides of the retaining nuts (10) of the cush drive bushes (12) with the recommended grease.



Check for wear following the instructions given at the beginning of this section. To refit the nut (8), follow the instructions given for the axle nut in Sect. G 4.



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

Washing the chain

Chains with O-rings must be washed in oil, diesel fuel or paraffin (kerosene).

Do not use petrol, trichloroethylene or other solvents, which could damage the rubber O-rings. For the same reason use only sprays specifically formulated for use with O-ring chains.

Lubricating the chain

Chains with O-rings are lubricated and sealed to protect the O-rings themselves against wear in the pin/bushing area. However, these chains need lubricating at regular intervals to protect metal parts of the chain and the O rings.

Lubrication also serves to keep the O-rings soft and pliable to ensure the maximum sealing efficiency.

Using a brush, apply a thin protective film of high-density gearbox oil along the entire length of the chain both inside and outside (see specifications in Sect. C 2).

A

B

C

D

E

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G

H

L

M

N

P

Frame

A

B

C

D

E

F

G

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M

N

P

A	1 - Handlebars	3
	Removal of the handlebars	4
	Refitting the handlebars	5
B	2 - Steering	6
	Adjusting the steering head bearings	7
	Steering angle adjustment	8
	Removal of the steering head components	9
	Refitting the steering head components	11
C	3 - Steering damper (1098)	14
	Removal of the steering damper	15
	Refitting the steering damper	16
D	4 - Footrest brackets	17
	Removal of the footrests	18
	Refitting the footrests	19
E	5 - Stands	20
	Removal of the sidestand.	21
	Refitting the sidestand	23
F	6 - Frame inspection	24
	Disassembly of structural components and the frame	25
	Checking the frame	29
	Reassembly of structural components and the frame	31
G	7 - Number plate holder	33
	Removal of the number plate holder	34

H

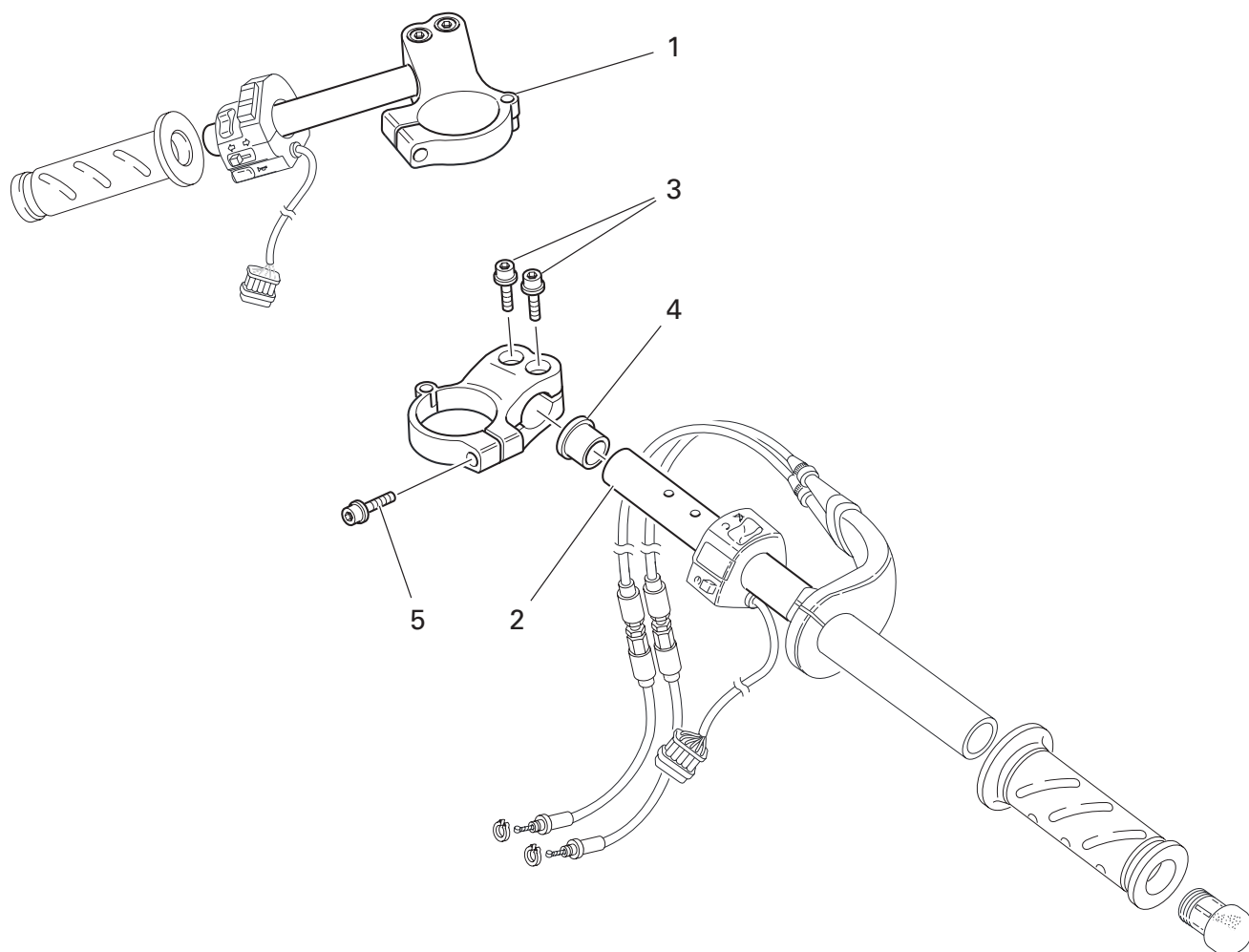
L

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N

P

1 - Handlebars



- 1 Left handlebar
- 2 Right handlebar
- 3 Bolt
- 4 Plug
- 5 Bolt



Important

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

A

B

C

D

E

F

G

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N

P

Removal of the handlebars

A

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

Operation	Section reference
Remove the headlight shell	E 2
Remove the throttle twistgrip	F 1
Remove the right-hand handlebar switch	P 5
Remove the front brake lever	F 3
Remove the top yoke	H 2

B

C

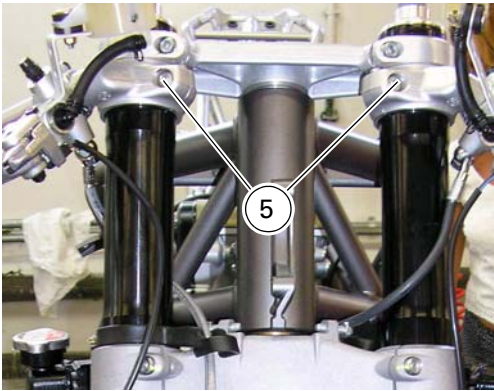
To remove left handlebar, the following parts must be removed first:

Operation	Section reference
Remove the headlight shell	E 2
Remove left-hand handlebar switch	P 5
Remove the clutch lever	F 2
Remove the top yoke	H 2

D

E

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



F

G

H

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

L

M

N

P

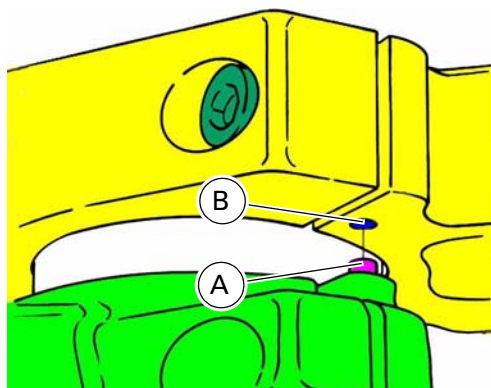
Refitting the handlebars

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



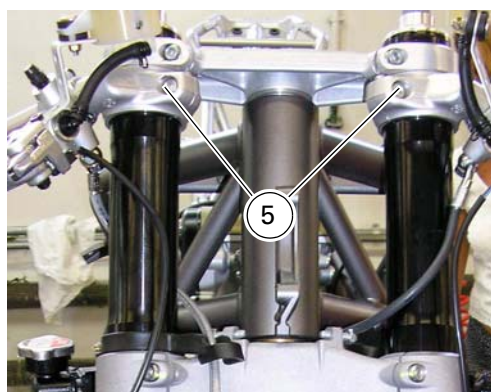
Important

When refitting the handlebars to the fork legs, position them relative to the top yoke by inserting the end of the handlebar pin (A) into the slot (B) in the top yoke.



If the bolts (5) securing the handlebar to the fork leg were removed when removing the handlebars, apply the recommended grease to their threads.

Tighten the bolts (5) to the specified torque (Sect. C 3).



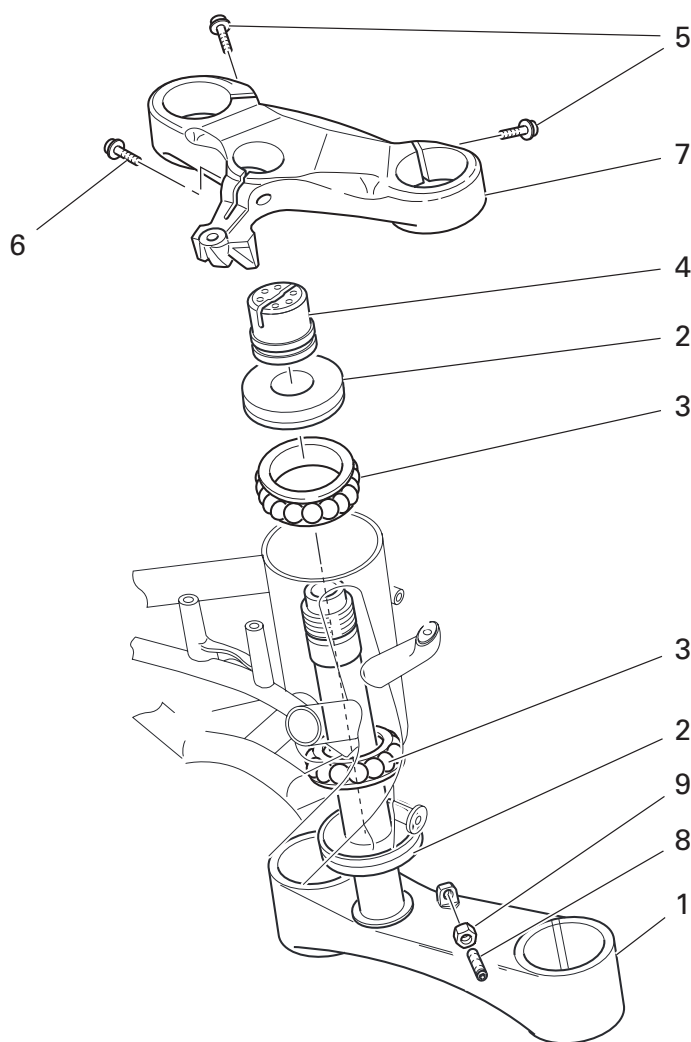
To complete the right-hand handlebar reassembly procedure, install the following parts:

Operation	Section reference
Refit the headlight shell	E 2
Refit the throttle twistgrip	F 1
Refit the right-hand handlebar switch	P 5
Refit the front brake lever	F 3
Refit the top yoke	H 2

To complete the left-hand handlebar reassembly procedure, install the following parts:

Operation	Section reference
Refit the headlight shell	E 2
Refit the left-hand handlebar switch	P 5
Refit the clutch lever	F 2
Refit the top yoke	H 2

2 - Steering



- 1 Bottom yoke
- 2 Oil seal
- 3 Bearing
- 4 Nut
- 5 Bolt
- 6 Bolt
- 7 Top yoke
- 8 Adjuster screw
- 9 Nut



Important

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

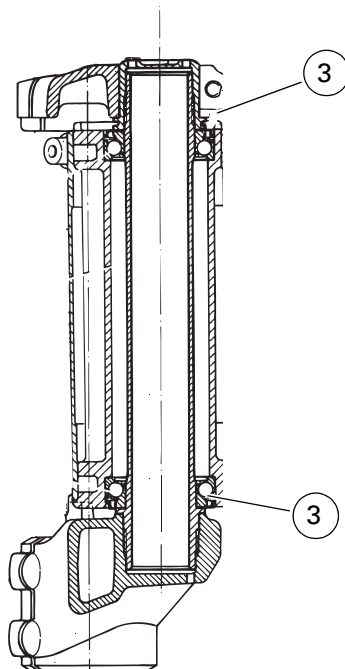
Adjusting the steering head bearings



Notes

See Sect. D 4 for steering bearing play adjustment.

If correct steering bearing play cannot be achieved, check the wear of the steering bearings (3) and if necessary replace them as described in "Removal of the steering head components" in this section.



A

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C

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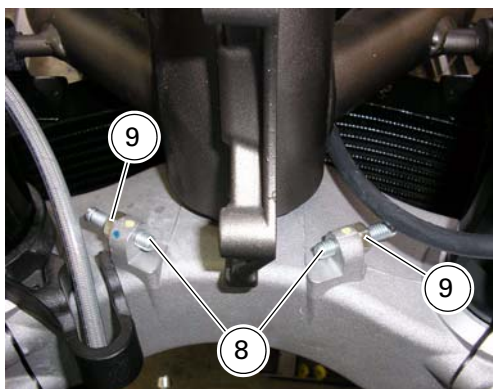
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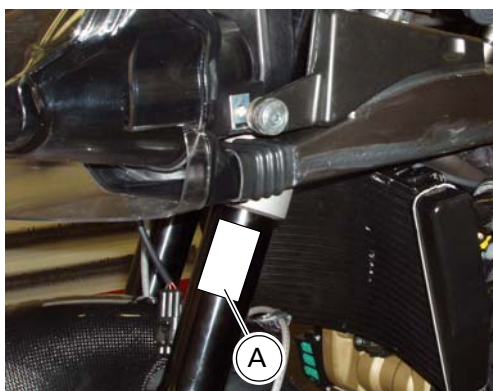
P

Steering angle adjustment

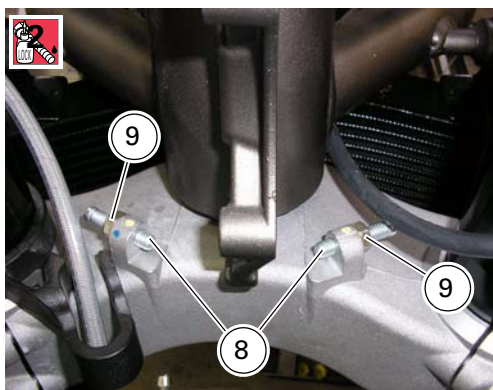
A Loosen the nuts (9).
Loosen the adjuster screws (8) on both sides of the bottom yoke.



D Use a **6 to 6.5 mm** spacer (A) fitted to the fork outer tube, or use a gauge.
Turn the front forks to the right until the spacer (A) is seated against the frame top tube.



G Turn the adjuster screw (8) on the opposite side to bring it into contact with the stop on the steering head.
Apply threadlocker to the thread of nut (9).
Hold the adjuster screw (8) firm and tighten the nut (9).
Turn the forks to the opposite side, and repeat the process to adjust the other screw and tighten the relative nut.



Removal of the steering head components

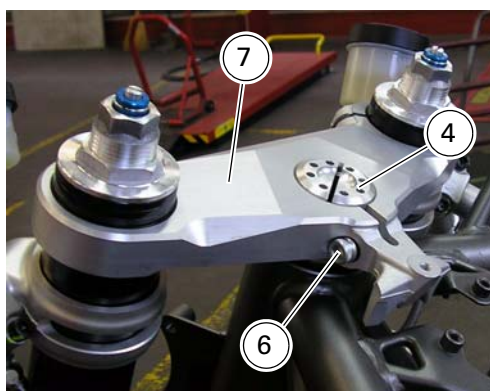
Operation	Section reference
Remove the side fairings	E 2
Remove the headlight shell	E 1
Remove the fork legs	G 2
Remove the steering damper	H 3



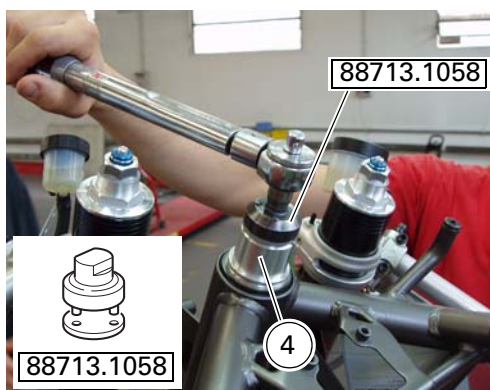
Notes

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

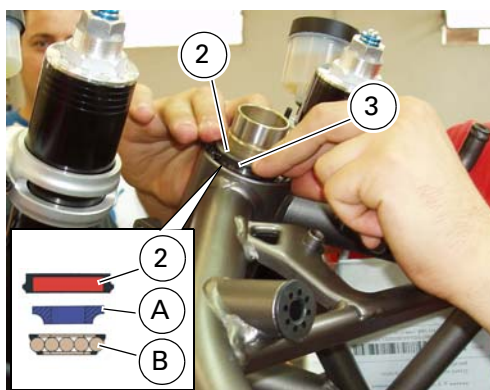
Loosen the bolt (6) securing the top yoke (7) to the steering stem nut (4).
Remove the top yoke (7).



Using tool part no. **88713.1058** loosen the steering stem nut (4) and remove it from the steering stem.



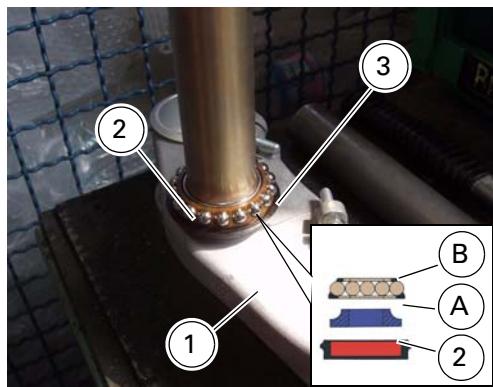
Slide the oil seal (2), the inner race (A) and the ball race (B) of the upper bearing (3) off the steering stem.



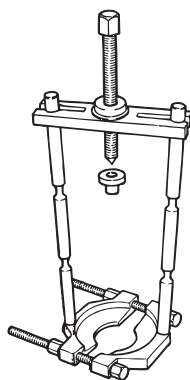
Remove the bottom yoke (1) complete with the steering stem from the frame tube.

Remove the ball race (B) of the lower bearing (3).

The inner race (A) of the lower bearing (3) and the relative oil seal (2) will remain on the steering stem.



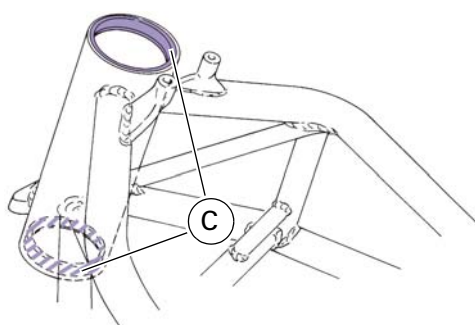
Using a universal puller (of the type shown in the figure) remove the ring (C) from the steering stem, taking care not to damage the seat.



Important

Once removed, the seals (2) and the bearings (3) must not be refitted.

Using a suitable drift, remove the outer bearing races (C) from the steering head. Proceed with extreme care to avoid damaging the seats.



Refitting the steering head components



Important

The steering tube bearings (3) are identical but in no case may their components be swapped around during reassembly.

Clean all contact surfaces and lubricate with the recommended grease.

To fit the outer races (C) of the bearings (3) to the steering head, use the service tool part no. **88713.1062** and proceed as follows:

heat the steering head to **150 °C**;

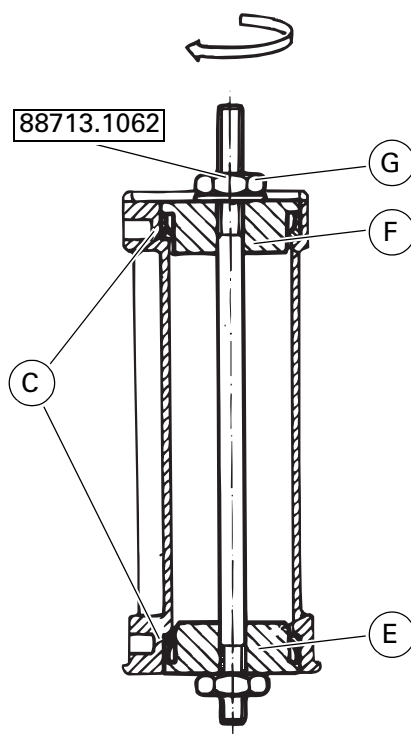
fit the outer races (C) in their seats on the steering head;

fit the fixed bush (E, with threaded hole) of the tool into the lower race;

fit the other movable bush (F) into the upper end of the tool and drive it fully home against the upper bearing race;

tighten the nut (G) and use a wrench to seat the outer rings (E) fully in the steering head;

leave the tool assembled until the steering head has cooled down to ensure that bearings are properly seated.



A

B

C

D

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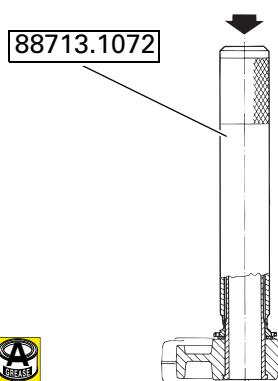
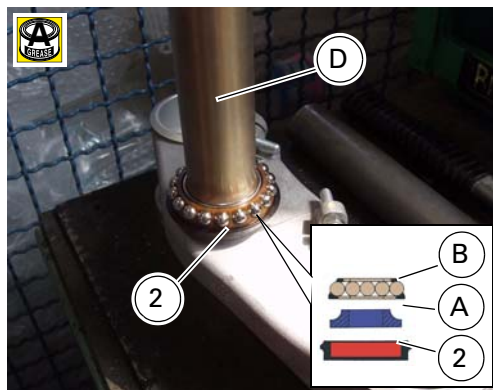
Fit the oil seal (2) (with the rim facing upwards) and inner race (A) of bottom bearing (3) onto the steering stem after heating it for about 10 minutes to **120 °C**.

Fit drift part no. **88713.1072** into steering stem. Keep the inner race (A) pressed against the oil seal (2) manually for at least 10 - 15 seconds.

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

Fit the ball race (B) to the steering stem (D) with the smaller diameter of the cage facing upwards and grease the ball race.

Insert the steering stem in steering head and push it until it becomes axially seated.

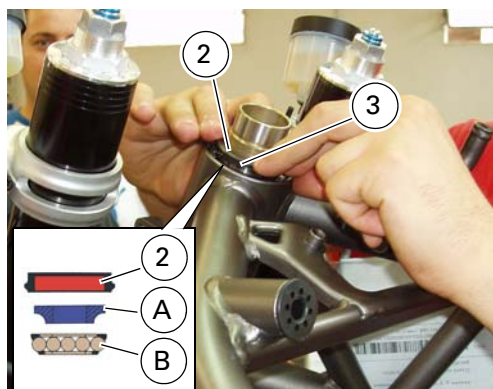


Fit the bottom yoke assembly to frame.

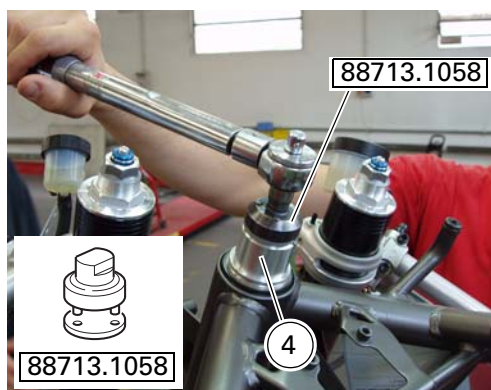
Grease the ball race (B) and fit it to frame top outer race (C).

Fit the inner race (A) of the upper bearing (3) to the steering head, with the larger diameter side of the race facing upwards.

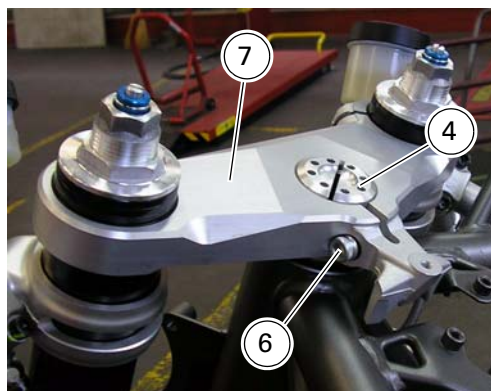
Install the oil seal (2) with the flat side facing upwards.



Tighten the steering stem nut (4) by hand until it seats against the oil seal (2).
Fit service bush part no. **88713.1058** to the steering stem nut (4) and fit the torque wrench to the bush.
Tighten the steering stem nut (4) to the specified torque (Sect. C 3).



Fit the top yoke (7) onto the steering stem nut (4), aligning the fork leg bores with the corresponding bores on the bottom yoke.
Relocate the fork legs as described in Sect. G 3.
Grease the bolt (6).
Tighten the bolt (6) on the top yoke to the specified torque (Sect. C 3).



Operation	Section reference
Refit the fork legs	G 2
Refit the steering damper	H 3
Refit the headlight shell	E 1
Refit the side fairings	E 2

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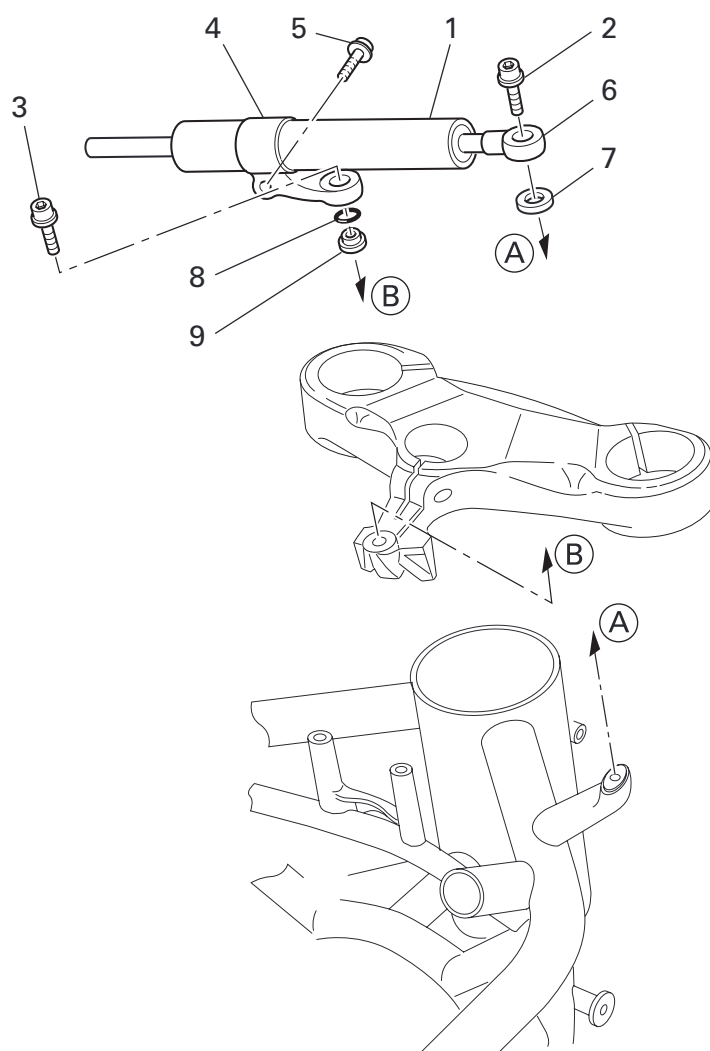
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3 - Steering damper (1098)



- 1 Steering damper
- 2 Bolt
- 3 Bolt
- 4 Mounting clamp
- 5 Bolt
- 6 Ball joint
- 7 Spacer
- 8 O-ring
- 9 Spacer



Important

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

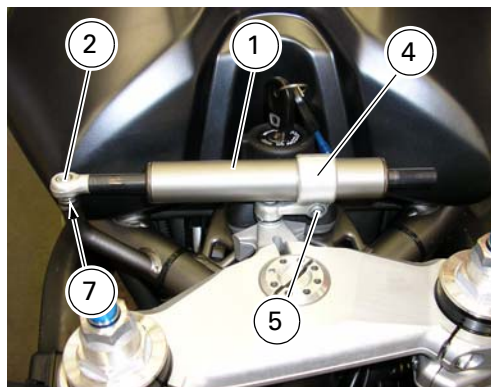
Removal of the steering damper

Unscrew and remove the bolt (2) securing the steering damper rod (1) to the frame.

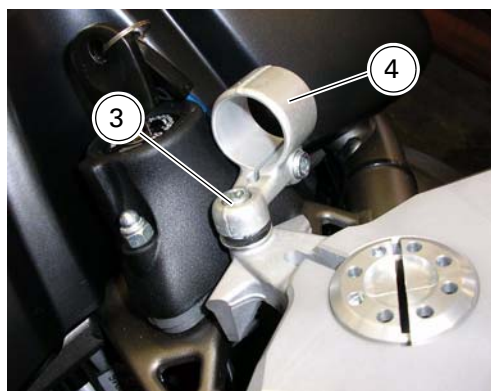
Loosen the bolt (5) securing the steering damper to the mounting clamp (4) on the top yoke.

Remove the steering damper (1) from the mounting clamp (4).

Recover the spacer (7).



Loosen the bolt (3) securing the mounting clamp (4) to the top yoke and remove the clamp, the O-ring (8) and the spacer (9).



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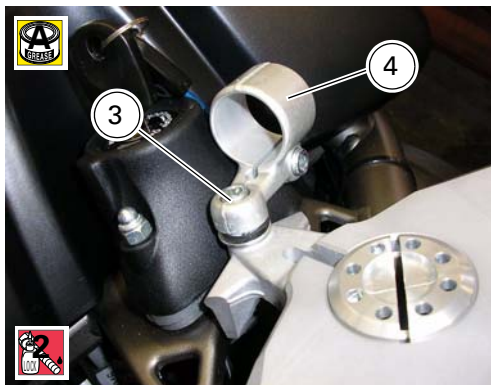
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Refitting the steering damper

A Lubricate the spacer (9) with the O-ring (8) and fit to the seat on the top yoke.
Apply threadlocker to the thread of bolt (3) and insert it in the hole of the mounting clamp (4).
Tighten the bolt (3) on the top yoke to the specified torque (Sect. C 3).



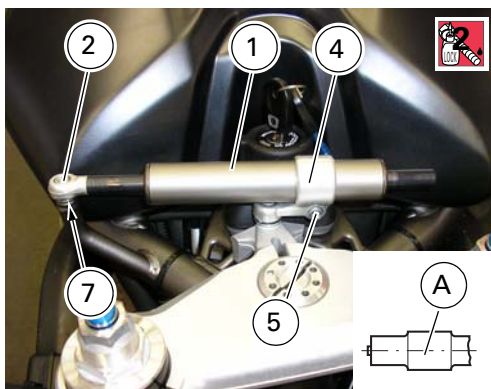
D Insert the steering damper (1) in the mounting clamp (4) so that the part with the largest diameter (A) is located in correspondence with the clamp (4).

Apply threadlocker to the thread and fit the bolt (5) in the mounting clamp.

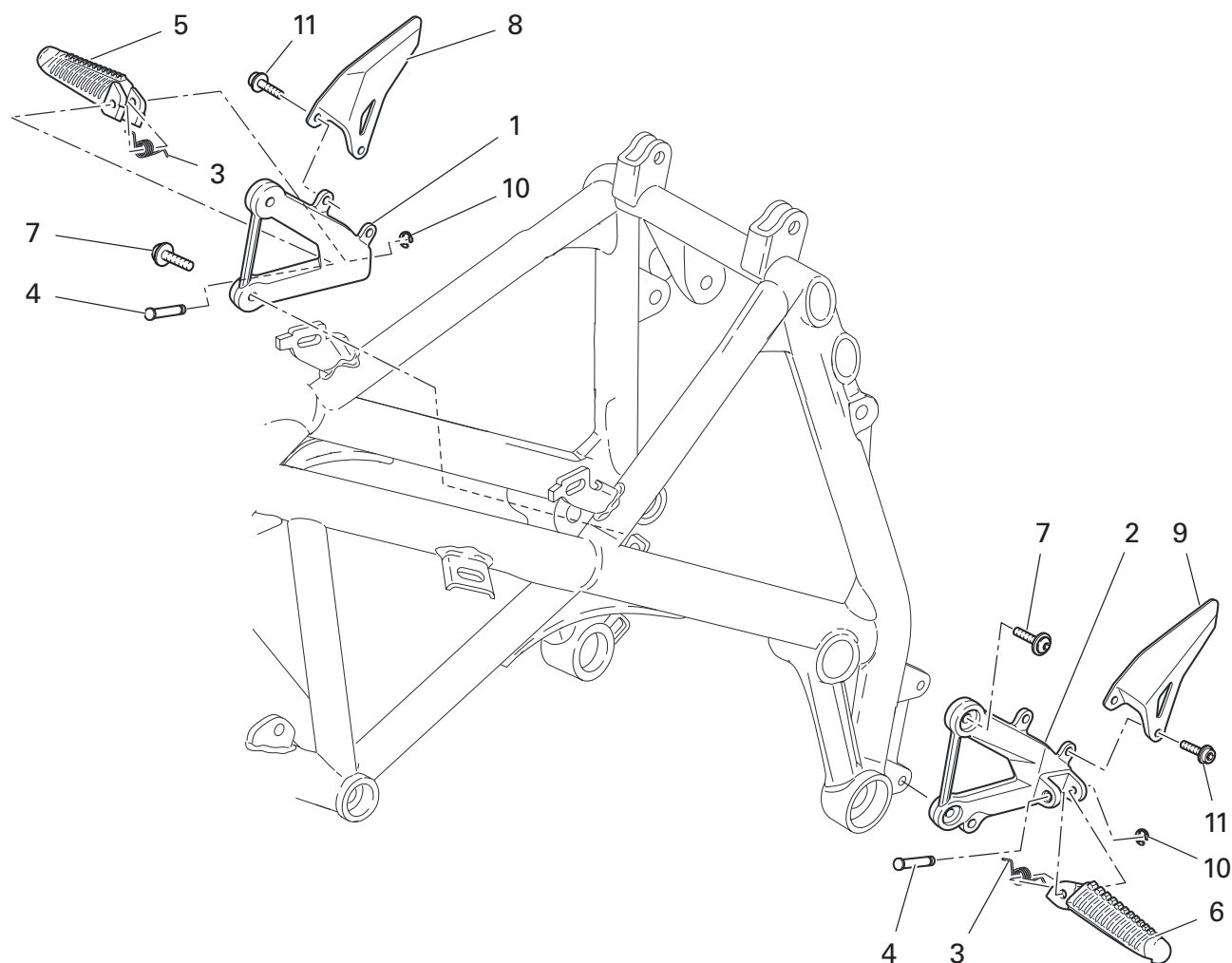
Tighten to the specified torque (Sect. C 3).

Insert the bolt (2) into the damper's ball joint and fit spacer (7) under the bolt's head.

E Apply the recommended threadlocker to the thread of the bolt (2) and tighten it to the specified torque (Sect. C 3) in the threaded hole on the frame.



4 - Footrest brackets



- 1 Right footrest bracket
- 2 Left footrest bracket
- 3 Spring
- 4 Pivot bolt
- 5 Right front footrest
- 6 Left front footrest
- 7 Bolt
- 8 Right heel plate
- 9 Left heel plate
- 10 Circlip
- 11 Bolt



Important

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

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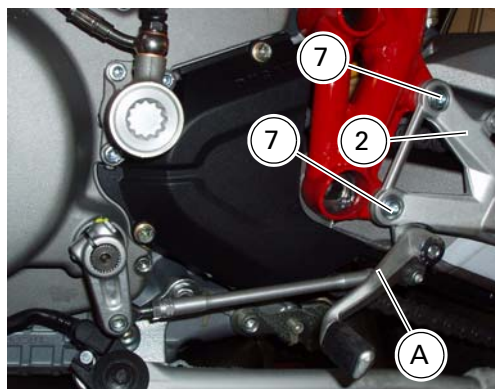
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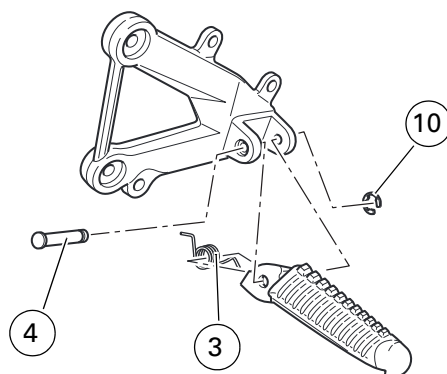
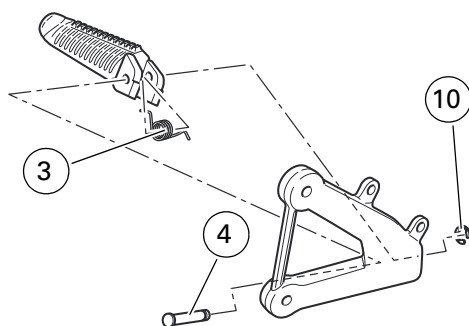
P

Removal of the footrests

The left footrest assembly can be removed after removing gearchange pedal (A) from the bracket (2) (Sect. F 5). Undo the two bolts (7) securing the bracket to the frame and remove the complete footrest and bracket assembly.



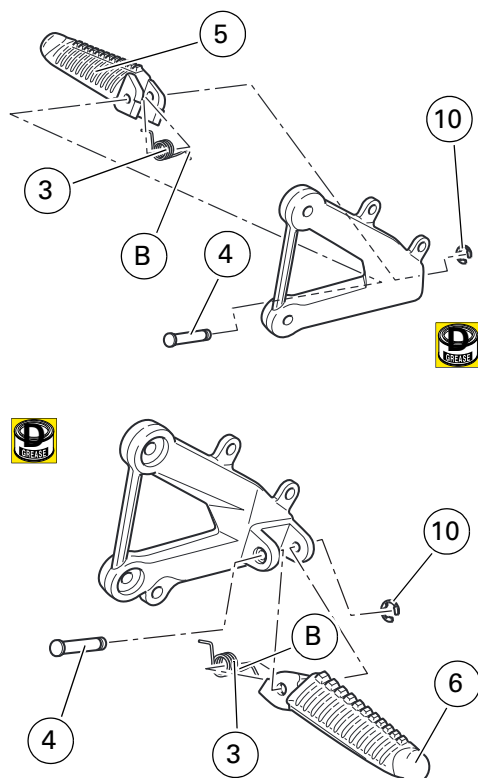
To separate the footrest and the bracket, remove the circlip (10) and withdraw the pin (4) to release the footrest and the spring (3).



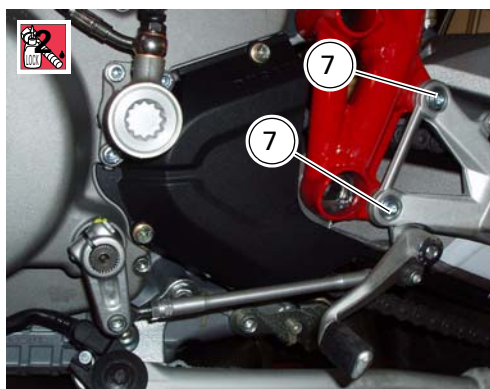
Refitting the footrests

Position the spring (3) between the lugs of the footrest (5) or (6) and fit it to the bracket, inserting the straight end (B) of the spring in the hole in the bracket.

Insert the pin (4) from the front side of the bracket, securing it on the other side with circlip (10).



Fit the entire assembly to the frame, securing it with the bolts (7) coated with the recommended threadlocker. Tighten the bolts (7) to the specified torque (Sect. C 3). Refit the gearchange pedal (Sect. F 5) to the left footrest bracket.



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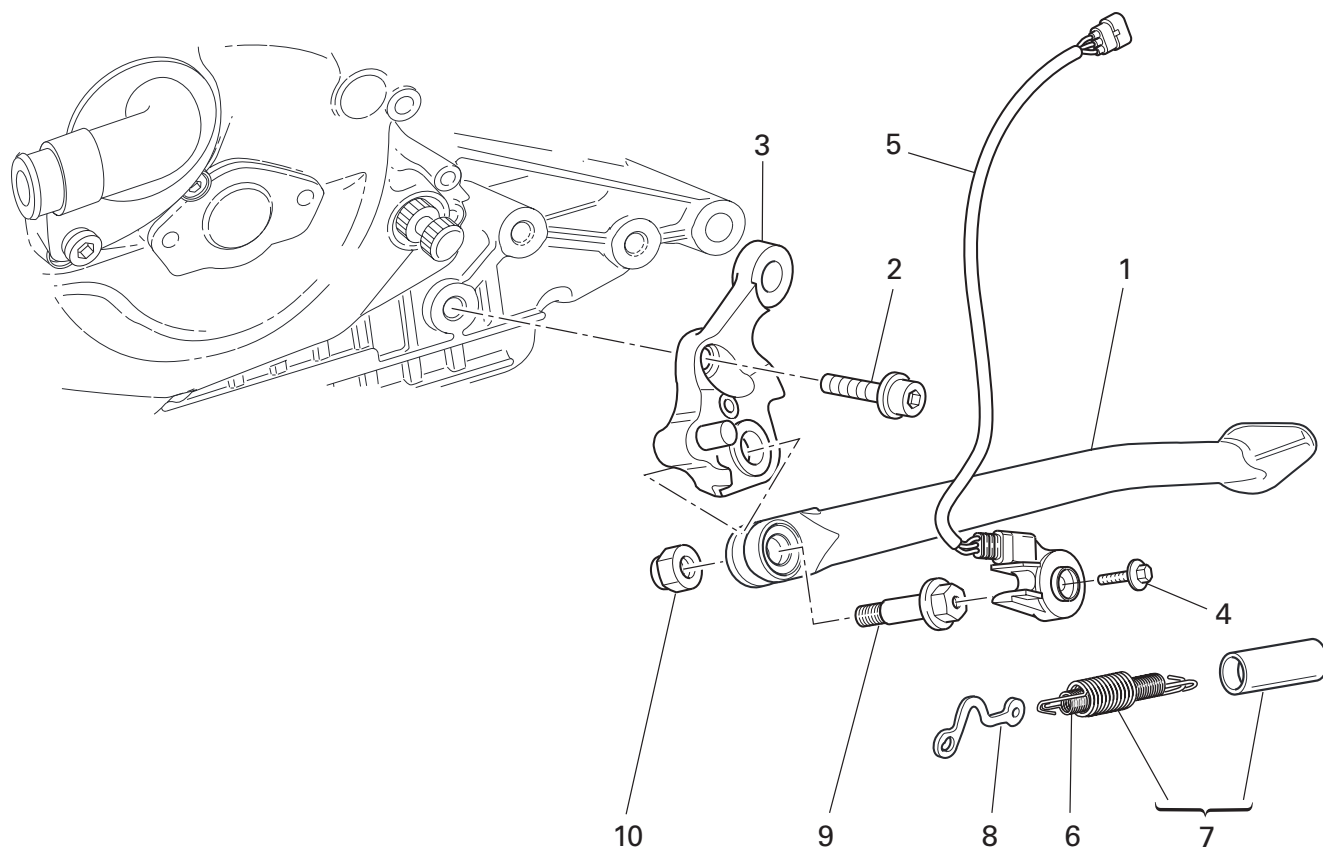
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5 - Stands



- 1 Sidestand
- 2 Bolt
- 3 Bracket
- 4 Bolt
- 5 Switch
- 6 Inner spring
- 7 Spring assembly
- 8 Plate
- 9 Pivot bolt
- 10 Nut



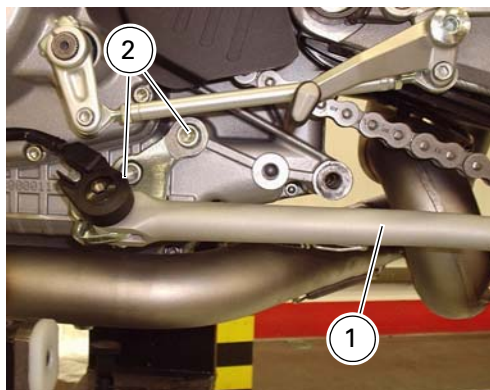
Important

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

Removal of the sidestand.

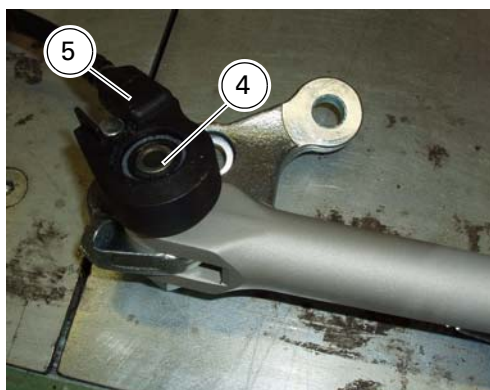
Operation	Section reference
Remove the left-hand side fairing	E 2

Disconnect the wiring connector of the sidestand switch (1) from the main wiring harness.
Unscrew the two bolts (2) securing the sidestand bracket (3) to the engine and remove the complete sidestand assembly.

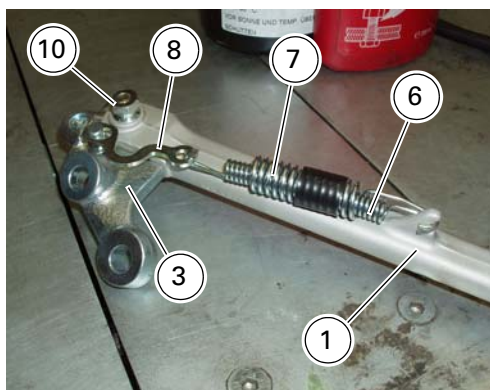


Disassembly of the sidestand.

Unscrew the retaining bolt (4) and remove the sidestand switch (5).



Release the sidestand springs (6) and (7) from the connecting plate (8) located on the sidestand bracket (3), and remove them.
Unscrew the pivot pin (9) securing the sidestand to the support plate and remove the stand leg (1) and nut (10).



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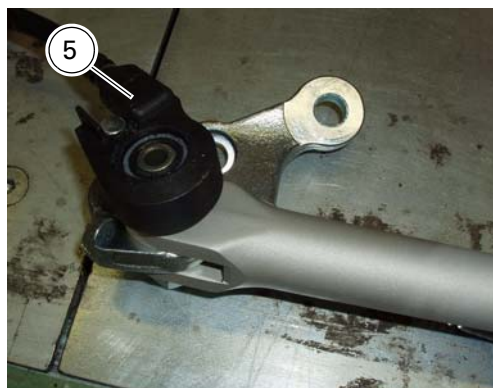
P

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.

See Sect. P 6 for testing the switch (5).

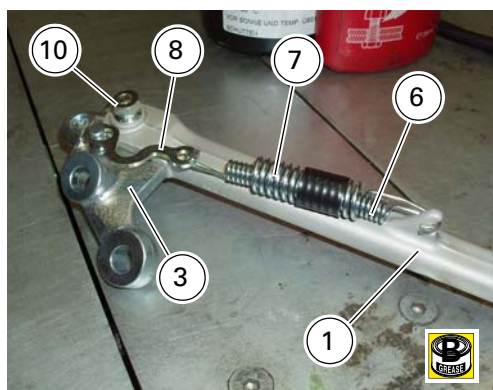


Reassembly of the sidestand

Grease the stand leg (1) and fit it to the plate (3). Secure it with pivot bolt (9) and nut (10).

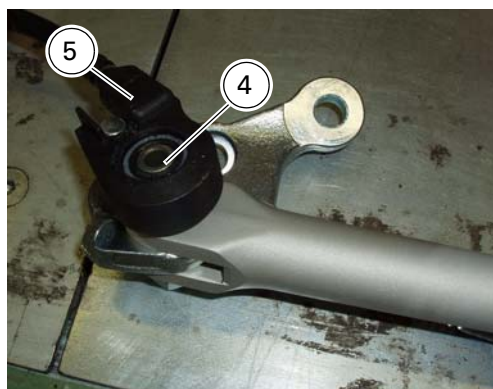
Tighten the pivot bolt (9) to the specified torque (Sect. C 3).

Locate the sidestand return springs (6) and (7) and attach them to the connection plate (8) and to the sidestand leg (1).



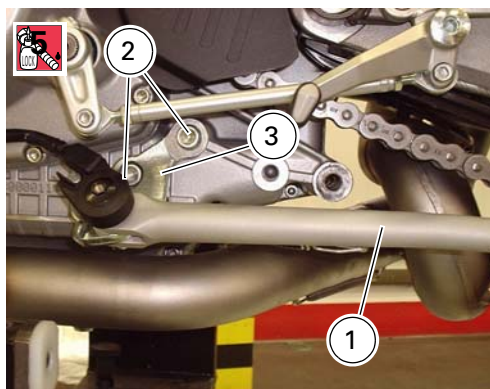
Locate the switch (5) on the bracket against the pivot bolt (9).

Fit the retaining bolt (4) and tighten to the specified torque (Sect. C 3).



Refitting the sidestand

Position the plate (3) on the frame, apply recommended threadlocker to the two bolts (2). Tighten the bolts (2) to the specified torque (Sect. C 3).



Connect the side stand switch connector (A) to the main wiring harness. For correct routing of the sidestand switch wiring, refer to the plates in Sect. P 1.

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

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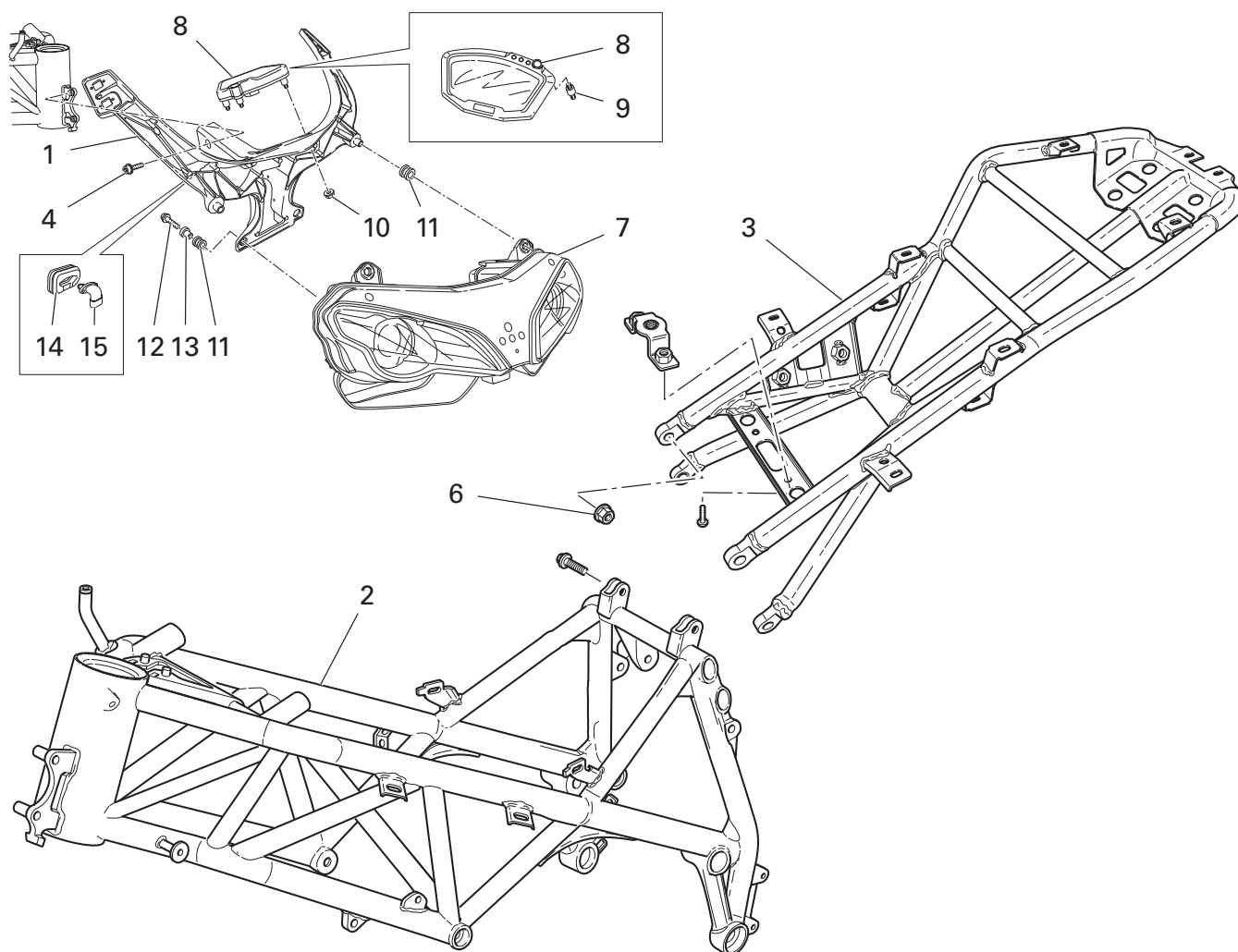
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6 - Frame inspection



- 1 Headlight assembly
- 2 Frame
- 3 Rear subframe
- 4 Bolt
- 5 Bolt
- 6 Nut
- 7 Headlight
- 8 Instrument panel
- 9 Spacer
- 10 Nut
- 11 Rubber mounting
- 12 Bolt
- 13 Spacer
- 14 Rubber mounting
- 15 Air temperature sensor



Important

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

Disassembly of structural components and the frame

Before carrying out dimensional checks on the frame, you must remove all the superstructures fitted, referring to the removal procedures outlined in the sections of this manual.

The structural components of the frame **(2)** are the headlight assembly **(1)** and the rear subframe **(3)**.

Both serve to support motorcycle superstructures and must therefore be in perfect condition.

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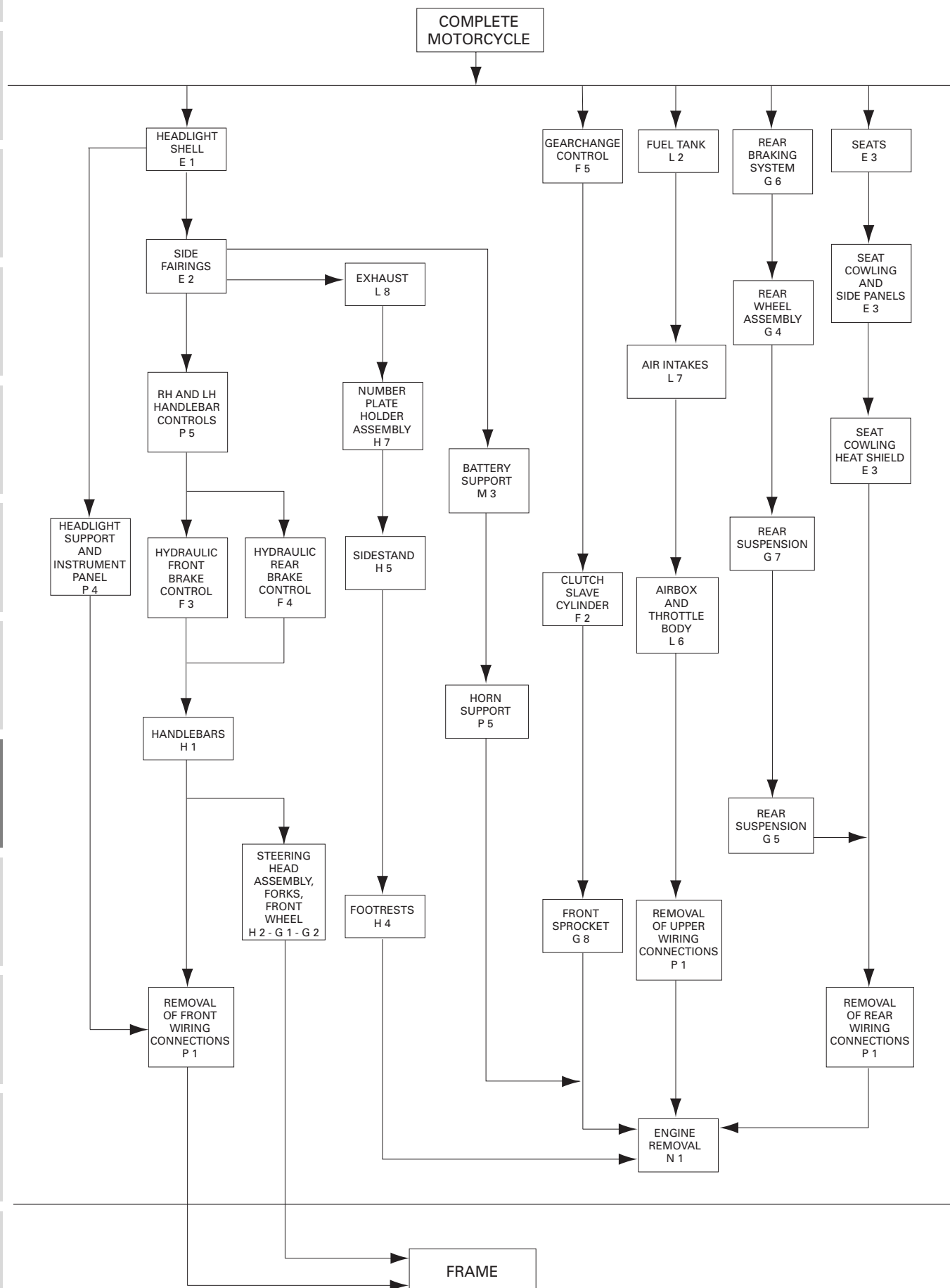
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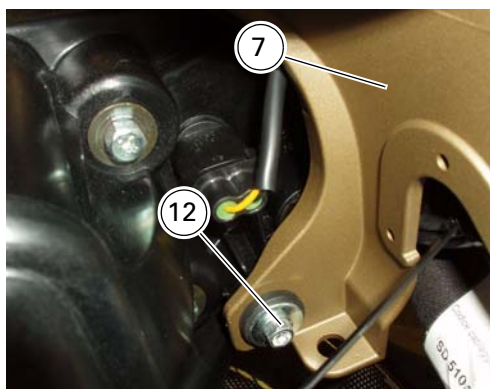
P

The flow chart below illustrates the logical sequence in which the parts are to be removed from the motorcycle and gives a reference to the section of the manual in which the removal procedure is described.

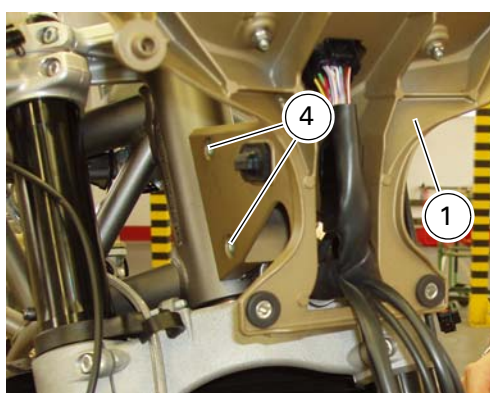


Removal of the headlight assembly

Unscrew the bolts (12) to disconnect the headlight (7).



Disconnect the various wiring connectors and remove all cable ties from the headlight support (Sect. P 1), unscrew the bolts (4). Remove the headlight assembly (1).



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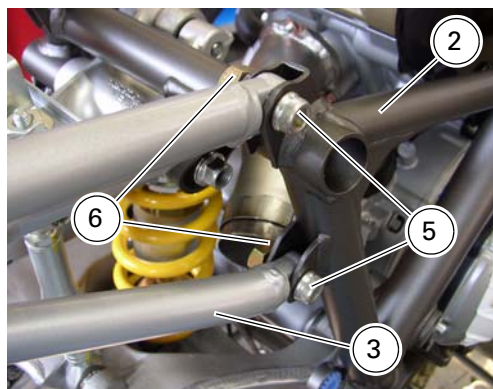
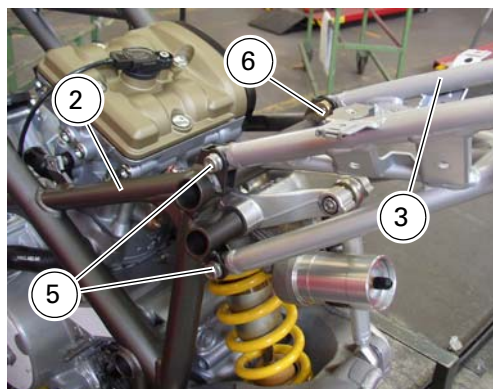
Removal of the rear subframe

Disconnect all the wiring connections of the electrical components mounted on the subframe (Sect. P 1) and remove the silencer (Sect. L 8).

Unscrew the bolts (5) securing the rear subframe (3) to the frame (2).

Separate the rear subframe (3) from the frame (4).

Recover the nuts (6).



Checking the frame

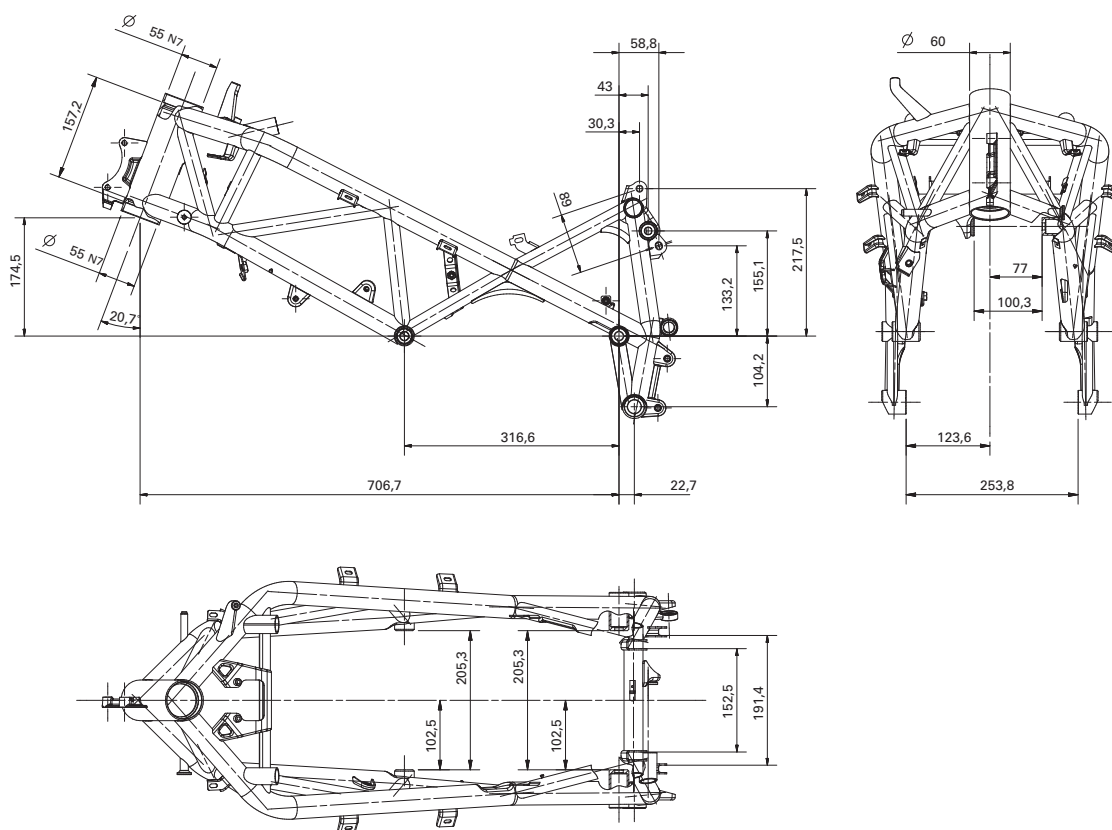
Check the dimensions of the frame against the dimensions shown here to determine whether it needs to be realigned or renewed.



Important

Badly damaged frames must be renewed and not repaired. Any work carried out on the frame can give rise to potential danger, infringing the requirements of EC directives concerning manufacturers' liability and general product safety.

Frame general dimensions (mm)



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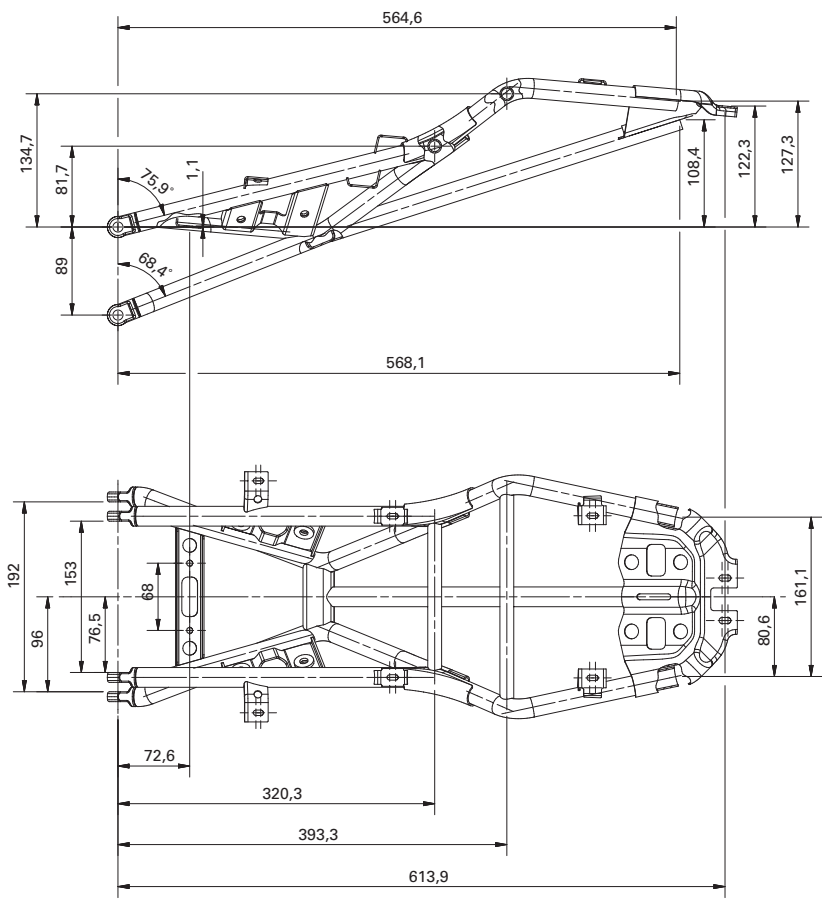
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Rear subframe general dimensions (mm)

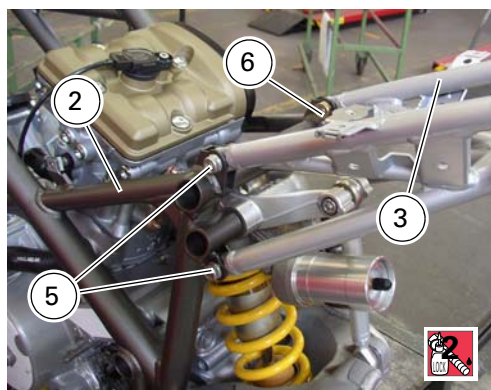
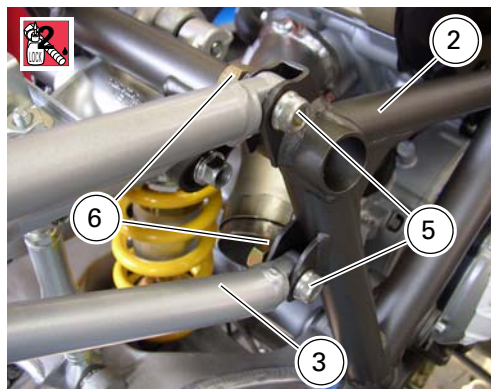


Reassembly of structural components and the frame

Refitting the rear subframe

Locate the rear subframe (3) on the mountings on the frame (2).

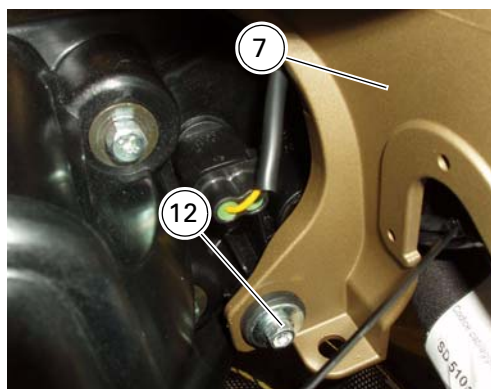
Insert the bolts (5) from the outside and secure on inside with the nuts (6), applying the specified threadlocker. Tighten the bolts (5) to the specified torque (Sect. C 3).



Reconnect the wiring connections (Sect. P 1) and refit the silencer (Sect. L 8).

Refitting the headlight assembly

Fit the headlight (7), fit the retaining bolts (12) and tighten to the specified torque (Sect. C 3).



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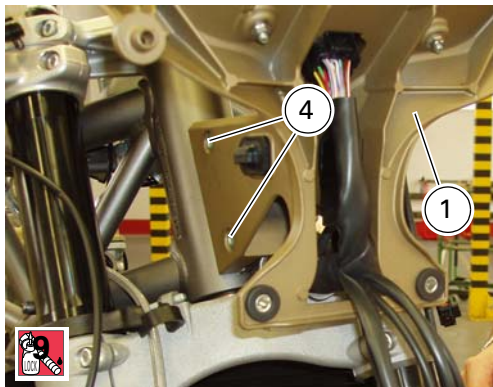
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Install the headlight assembly (1) complete with accessories to the mounting on the front of the steering head, making sure the holes are aligned.

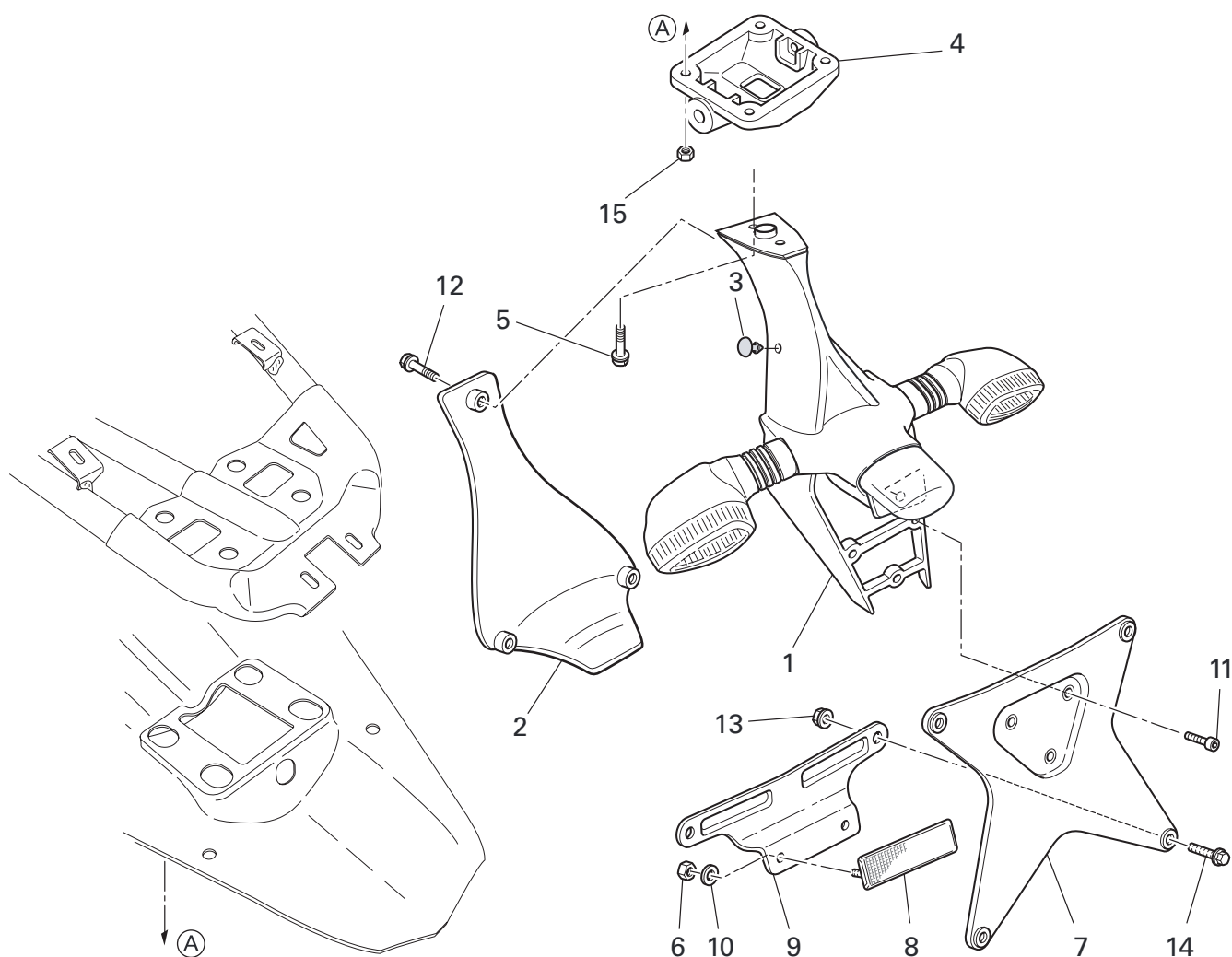
Insert the bolts (4) in the front mounting.

Apply the prescribed threadlocker and tighten the bolts (4) to the specified torque (Sect. C 3).



Reconnect and refit the wiring connectors (Sect. P 1).

7 - Number plate holder



- 1 Number plate holder
- 2 Cover
- 3 Rubber mounting
- 4 Support
- 5 Bolt
- 6 Nut
- 7 Support
- 8 Reflector
- 9 Bracket
- 10 Washer
- 11 Bolt
- 12 Bolt
- 13 Nut
- 14 Bolt
- 15 Nut



Important

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

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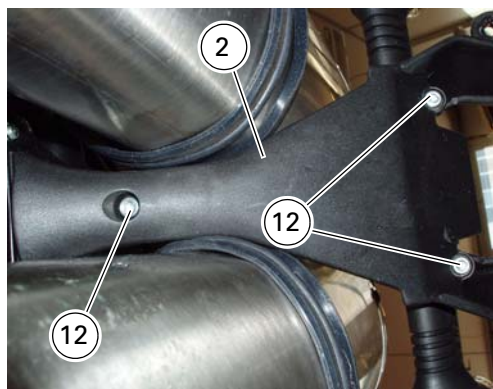
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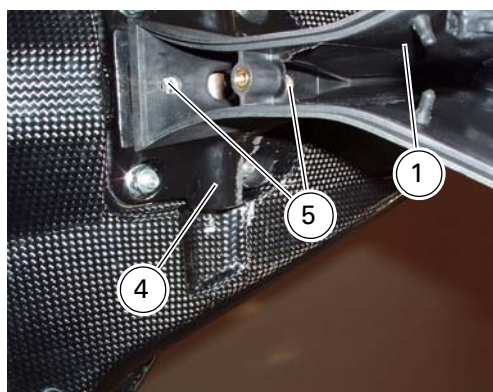
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Removal of the number plate holder

Undo the bolts (12) and remove the number plate holder cover (2).



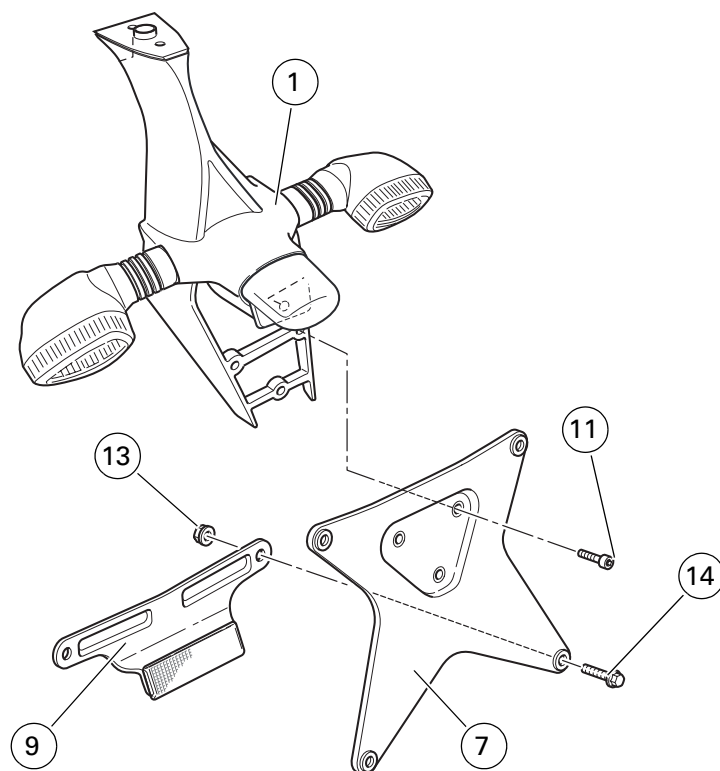
Undo the bolts (5) securing the number plate holder (1) to the frame (4).



Disconnect the rear turn signal connectors from the main wiring loom (Sect. P 1) and remove the number plate holder assembly.



Unscrew the bolts (11) and (14) to remove the number plate support (7) from the number plate (1) and from the bracket (9).



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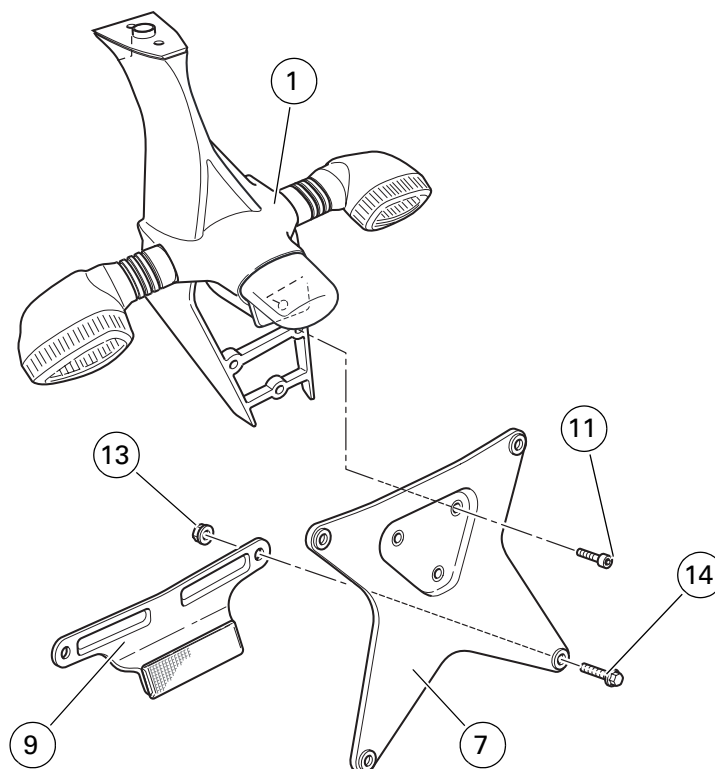
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Refitting the number plate holder

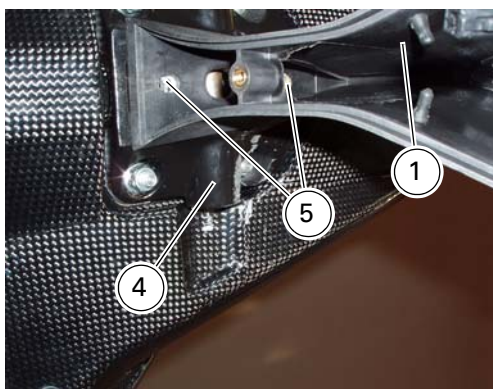
Refit the number plate support (7) to the bracket (9) and to the number plate holder by fitting the bolts (14) and (11).



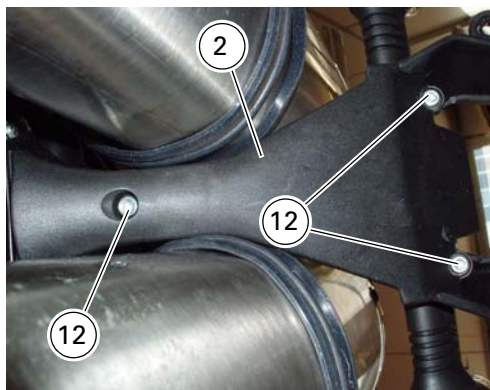
Reconnect the turn signal wiring connectors to the main wiring loom (Sect. P 1).



Refit the number plate holder (1) to the support (4) with the bolts (5).



Refit the number plate holder cover (2) with the bolts (12).



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Fuel / Exhaust System

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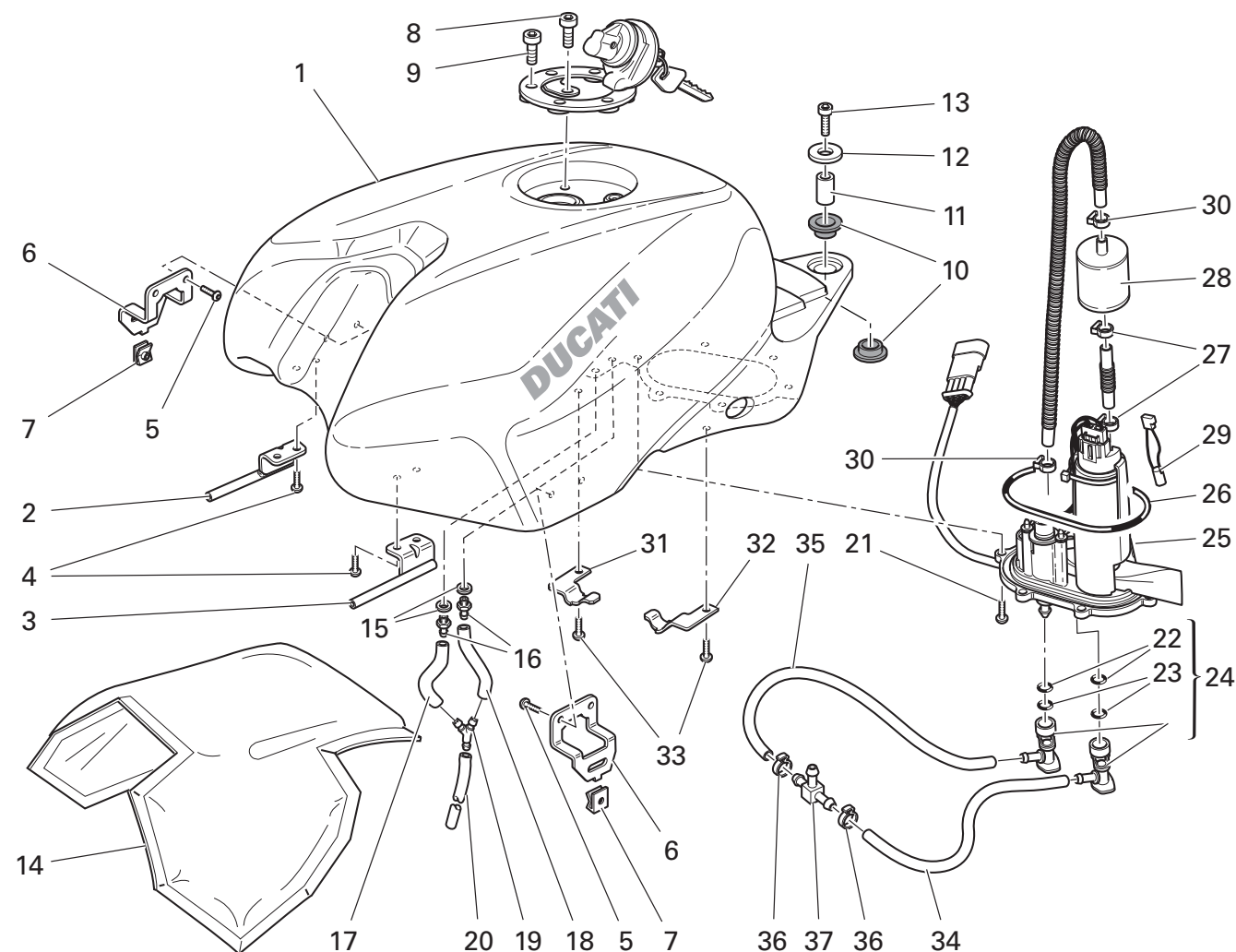
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P

	2 - Fuel tank	3
A	Removal of the fuel tank	4
	Removal of the fuel filler cap assembly	6
	Refitting the fuel filler cap assembly	7
B	Renewal of the fuel tank flange	8
	Refitting the fuel tank flange	9
	Refitting the fuel tank	10
	6 - Airbox - Throttle Body	14
C	Removal of the throttle body	15
	Refitting the airbox and throttle body	23
	7 - Air intake	29
D	Removal of the air filters	30
	Refitting the air filters	31
	8 - Exhaust system	32
E	Removal of the exhaust system	33
	Refitting the exhaust system	37
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2 - Fuel tank



- | | |
|------------------------------------|--------------------------|
| 1 Fuel tank | 20 Hose |
| 2 Front fuel tank mounting (right) | 21 Bolt |
| 3 Front fuel tank mounting (left) | 22 O-ring |
| 4 Bolt | 23 O-ring |
| 5 Bolt | 24 Quick-release fitting |
| 6 Support | 25 Flange |
| 7 Quick-release fastener | 26 O-ring |
| 8 Bolt | 27 Collar |
| 9 Bolt | 28 Filter |
| 10 Rubber mounting | 29 Thermistor |
| 11 Spacer | 30 Collar |
| 12 Washer | 31 Bracket |
| 13 Bolt | 32 Bracket |
| 14 Panel | 33 Bolt |
| 15 Seal | 34 Hose |
| 16 Union | 35 Hose |
| 17 Hose | 36 Clamp |
| 18 Hose | 37 T-fitting |
| 19 Union | |

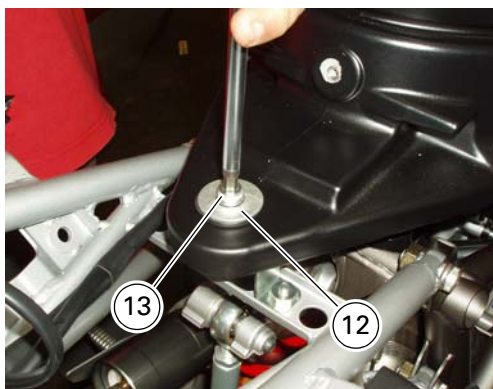


Important

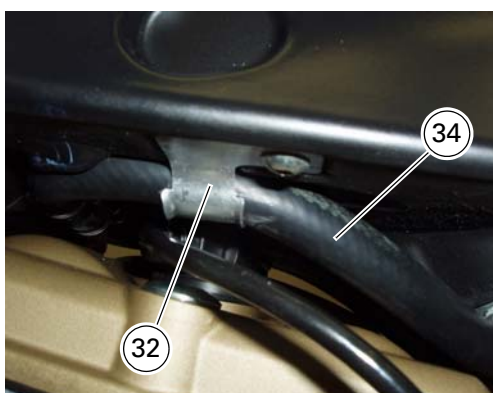
Bold reference numbers in this section identify parts not shown in the figures next to the text. Refer to the exploded view diagram.

Removal of the fuel tank

Remove the seat and the side panels (Sect. E 3, Removal of the seat - Removal of the side panels and seat cowling).
Remove the bolt (13) and recover the washer (12).



Detach the hoses (34) and (35) from respectively plates (32) and (31).



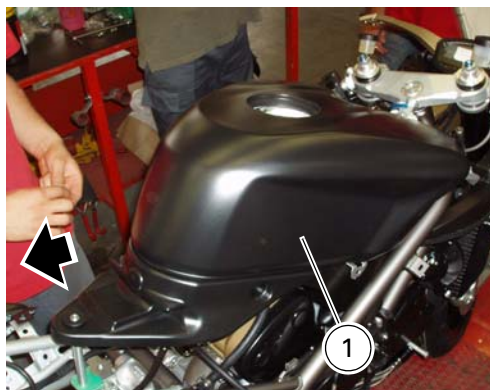
Raise the fuel tank and disconnect the fuel level sensor (A) from the main wiring loom.



Disconnect the quick-release fittings (24) from the flange.



Withdraw the fuel tank (1) towards the rear of the motorcycle to disengage the front catches from the frame.



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Removal of the fuel filler cap assembly

A Open the filler cap.

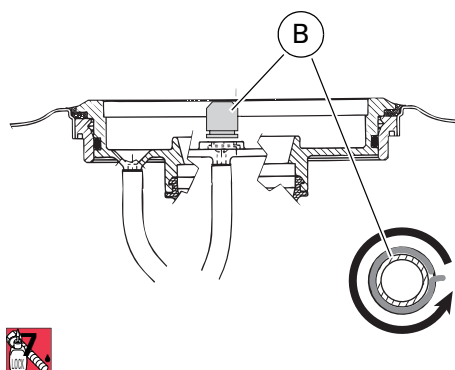
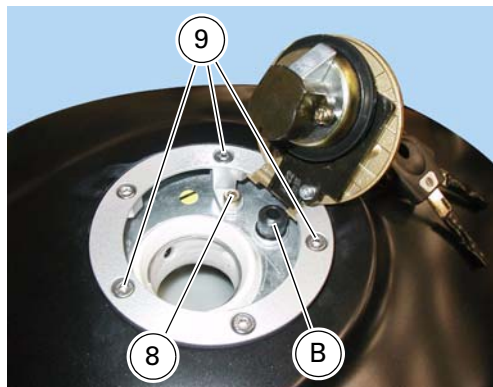
Unscrew the outer bolts (9) securing the ring nut to the filler cap recess.

Unscrew the anti-theft screw (8) on the inside.

Remove the complete filler cap assembly.

The rubber breather nozzle (B) is located inside the filler cap. If the nozzle (B) is to be renewed, apply a uniform film of speed bonder around the groove.

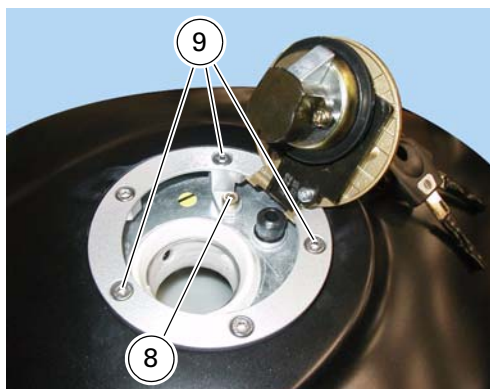
Fit the nozzle making sure that it is properly seated in the recess groove.



Refitting the fuel filler cap assembly

Grease the new O-ring and its groove in the fuel tank.

Refit the filler cap assembly in its seat in the tank and tighten the bolts (8) and (9) to the specified torque (Sect. C 3).



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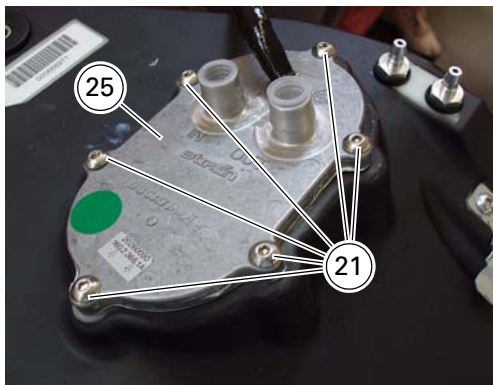
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Renewal of the fuel tank flange

Unscrew the six bolts (21) securing the fuel tank flange. Remove three of the bolts, leaving three in position in order to help lift the flange.

Remove the flange (25) from the fuel tank.



Recover the O-ring (A).

Using the appropriate tool, undo the clips (B) next to the fuel filter (C).

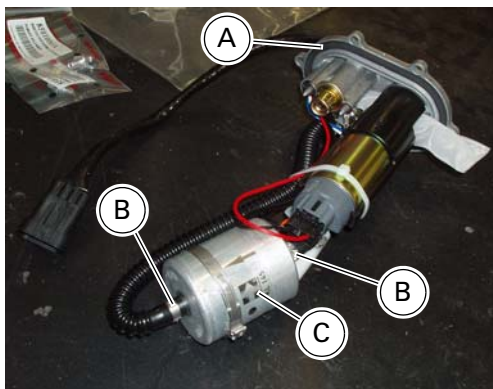
Remove the old filter from the connecting hoses and fit a new filter.

Before reassembly, carefully remove any deposits or scale from all parts.

Important
When installing the new filter, position it with the arrow punched on the external housing pointing towards the flange.

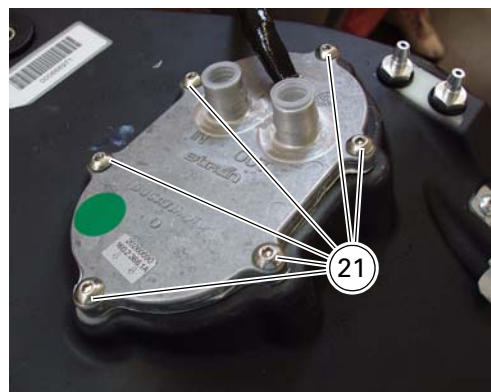
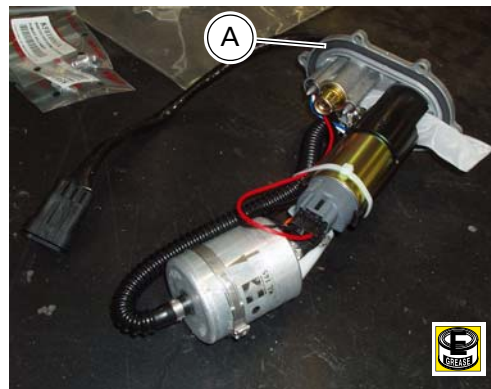
Notes

The flange is supplied as a spare part complete with the fuel pump and pressure regulator: in the event of any malfunction of these components it will be necessary to renew the complete flange assembly.



Refitting the fuel tank flange

Grease the O-ring and locate the flange and refit by reversing the steps of the removal procedure. Tighten the bolts (21) to the specified torque (Sect. C 3).



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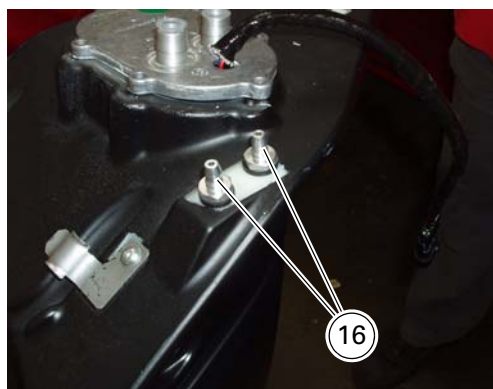
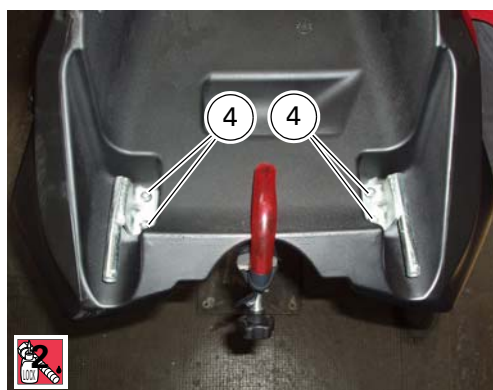
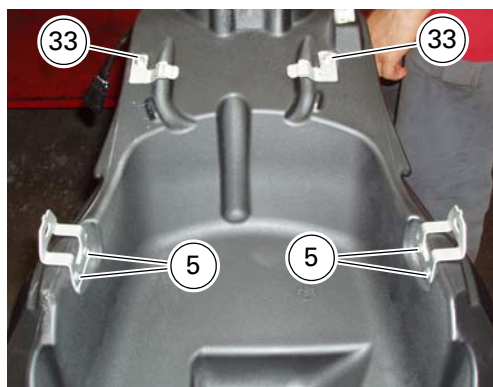
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Refitting the fuel tank

If the fuel tank has been disassembled into its component parts, reposition all the parts as shown in the exploded view. In particular:
apply the recommended threadlocker to the bolts (4);
tighten the bolts (4), (5) and (33) and the unions (16) to the specified torque (Sect. C 3, Frame torque settings).



Reposition the fuel tank (1), inserting the front catches in the corresponding locations on the frame.



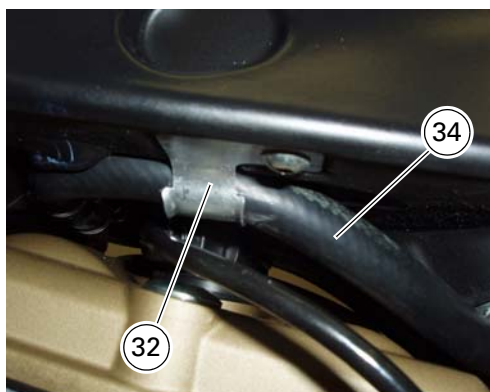
Connect the quick-release fittings (24) to the flange.



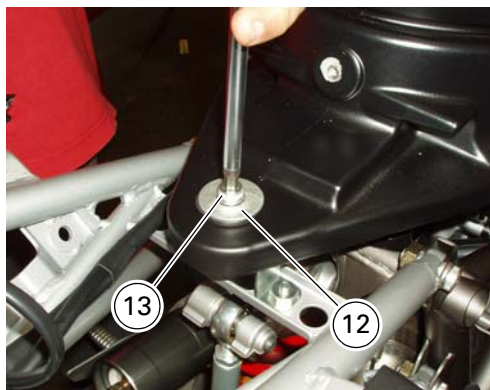
Connect the wiring connector (A) to the main wiring loom.



Insert the hoses (34) and (35) in respectively plates (32) and (31).



Secure the tank to the frame with the bolt (13) and the washer (12).
Tighten the bolt (13) to the specified torque (Sect. C 3, Frame torque settings).



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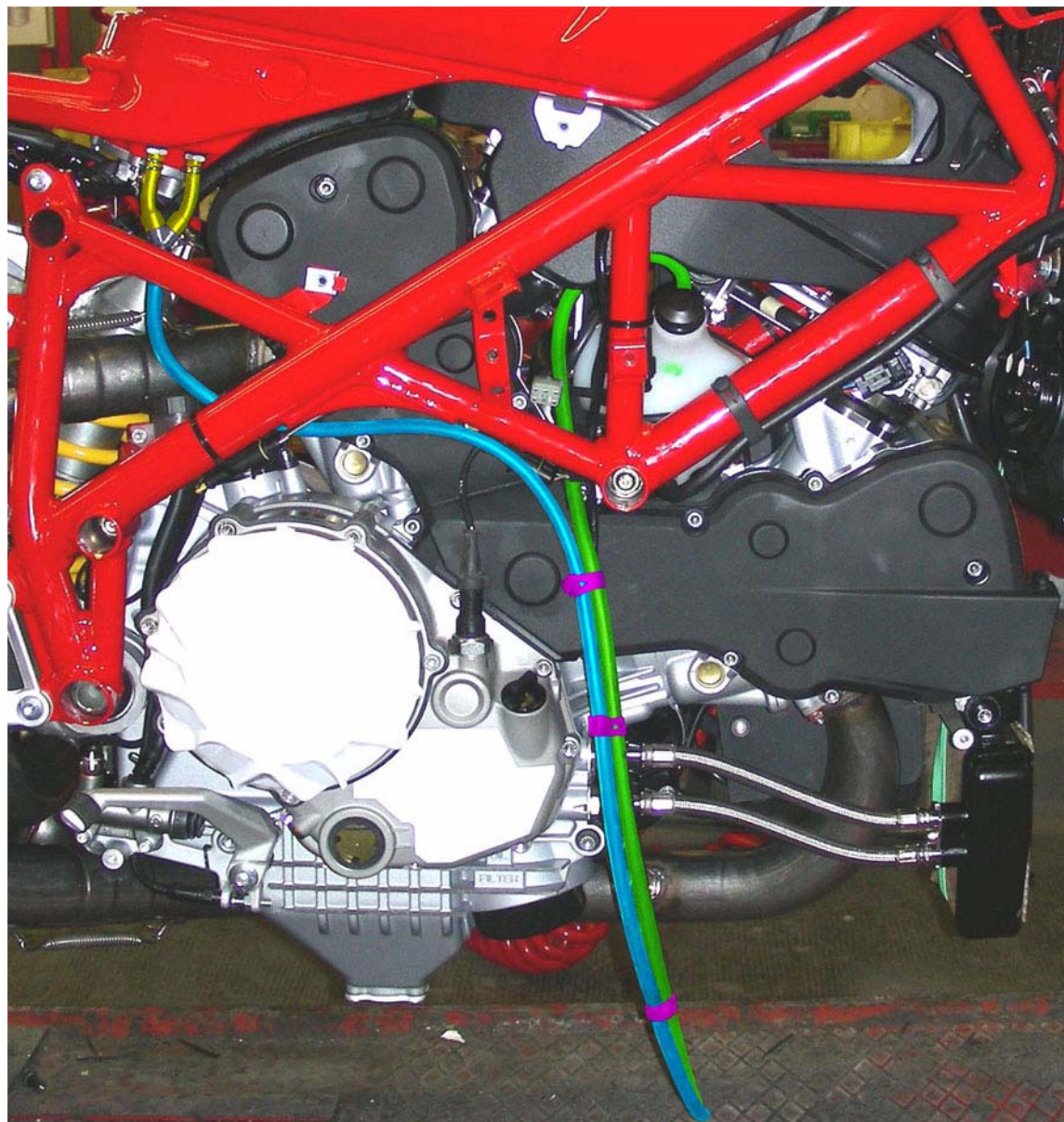
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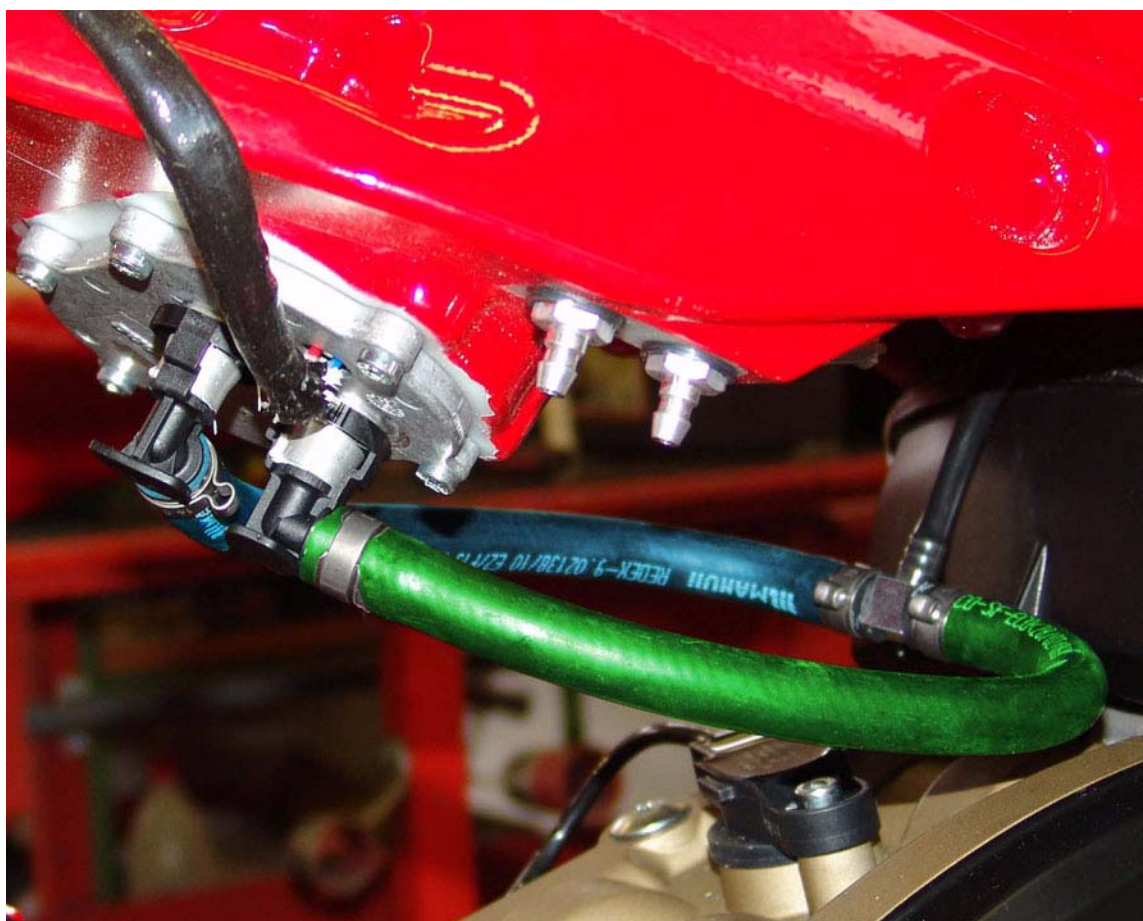
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Positioning of the fuel tank breather and drain hoses and the water overflow hose and expansion tank.



Positioning of the fuel pipes



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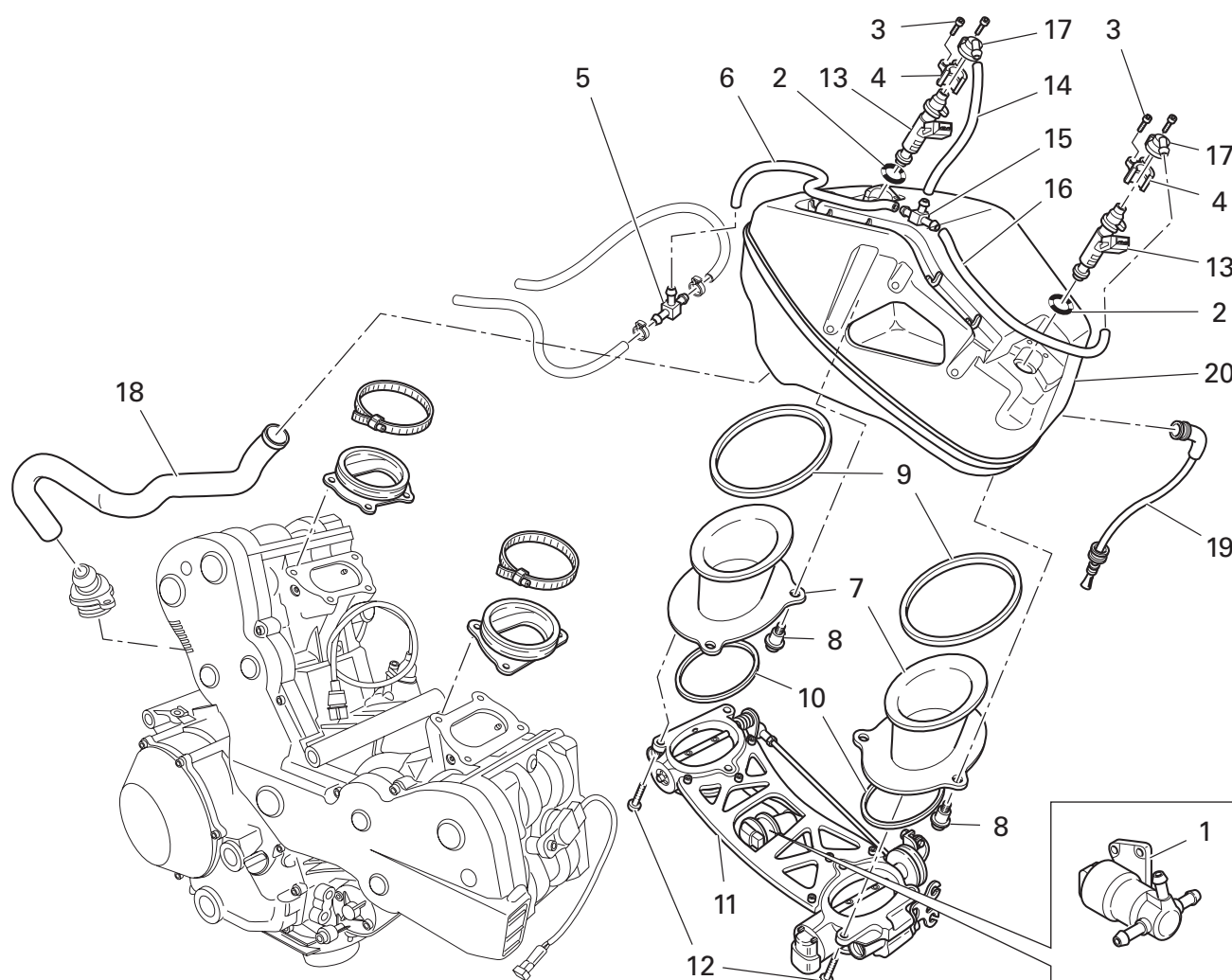
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6 - Airbox - Throttle Body



- 1 Stepper motor
- 2 O-ring
- 3 Bolt
- 4 Fuel injector support
- 5 Union
- 6 Hose
- 7 Air intake funnel
- 8 Special screw
- 9 Seal
- 10 Seal

- 11 Throttle body assembly
- 12 Bolt
- 13 Injector
- 14 Hose (vertical)
- 15 Union
- 16 Hose (horizontal)
- 17 Fuel injector cap
- 18 Drain hose
- 19 Hose
- 20 Airbox

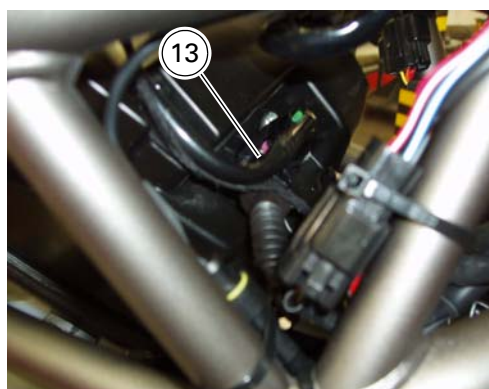
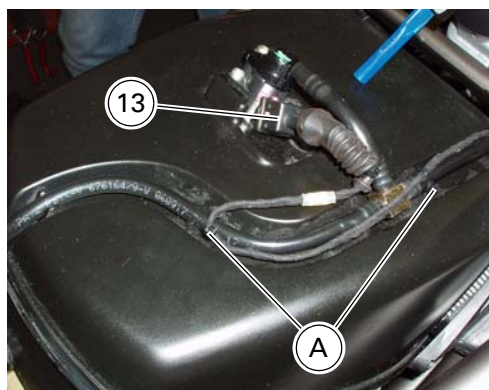
 Important

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

Removal of the throttle body

Operation	Section reference
Remove the side fairings	E 2
Remove the headlight shell	E 1
Remove the fuel tank	L 2
Remove the air scoops	L 7
Disconnect the throttle cable	F 1

Disconnect the fuel injectors (13) from the main wiring harness.
Remove the retaining clips (A).



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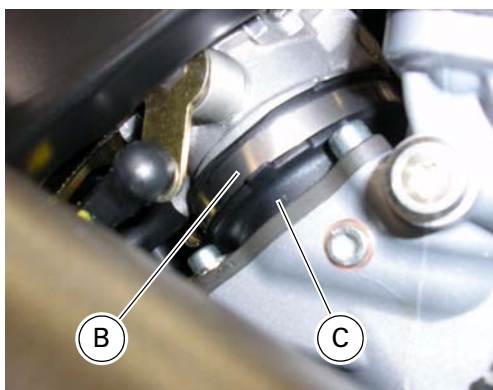
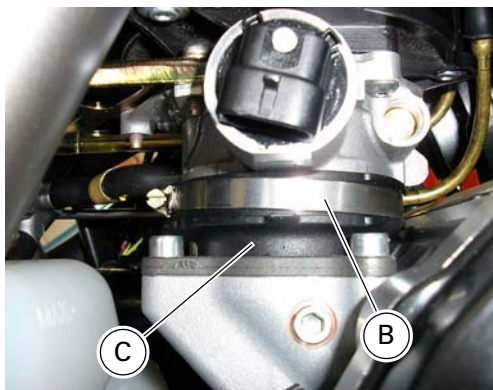
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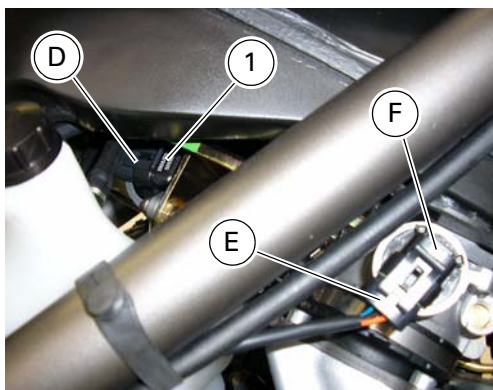
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Loosen the clamps (B) securing the throttle body to the intake manifolds (C).



Disconnect the connector (D) connecting the main wiring loom to the stepper motor (1).
Disconnect the wiring connector (E) connecting the main wiring loom to the throttle position sensor (F).



Slacken off the clamp (G) dsecuring the hose (18) to the blow-by valve.

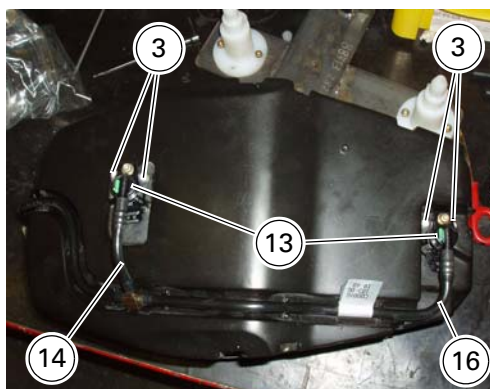


Withdraw the airbox (20) complete with the throttle body (11) and the fuel injectors (13).



Removal of the fuel injectors

Undo the screws (3) to remove the fuel injectors (13) complete with hoses (14) and (16) from the airbox.



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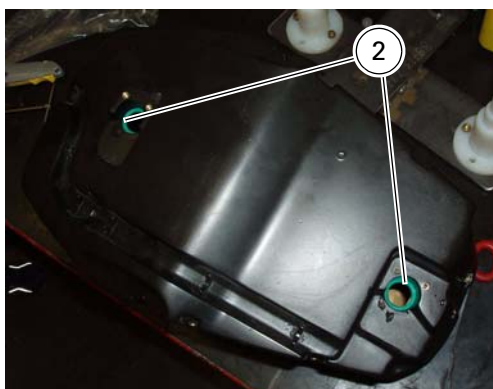
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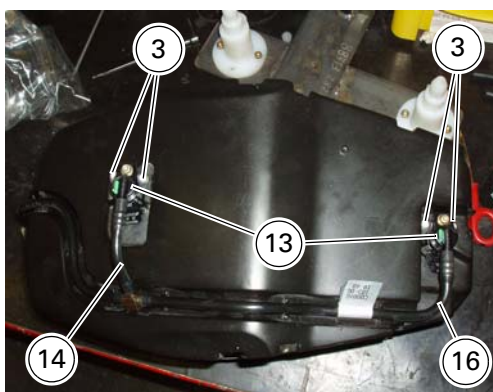
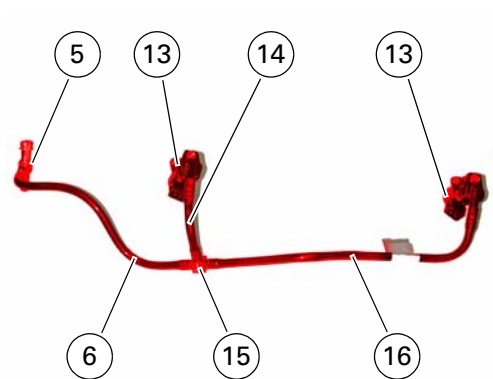
Refitting the injectors

Check that the injector O-ring seals (2) are present.



Position the hoses and unions (5), (6), (14), (15) and (16) with the fuel injectors (13) on the airbox (20) in the corresponding yellow clips.

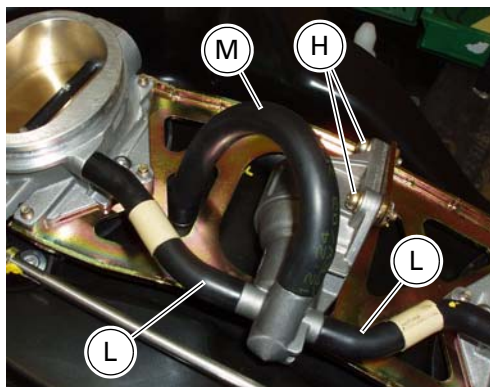
Tighten the bolt (3) to the specified torque (Sect. C 3, Frame torque settings).



Removal of the stepper motor

The stepper motor is installed in the central part of the throttle body:

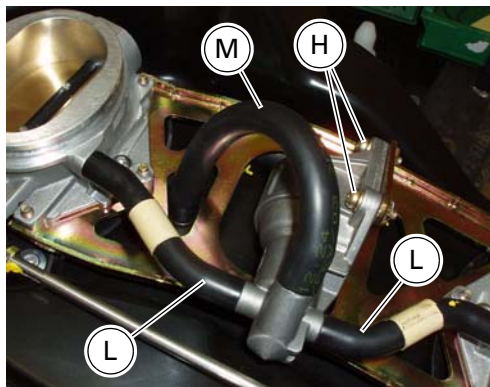
to remove it, unscrew the two screws (H) and disconnect the hoses (L) and (M) from the airbox. Refer to Sect. M 3 for details of stepper motor operation.



Refitting the stepper motor

Reconnect the hoses (L) on the throttle body and the hose (M) to the airbox.

Locate the stepper motor with its support on the throttle body, inserting the bolts (H). Tighten the bolts (H).



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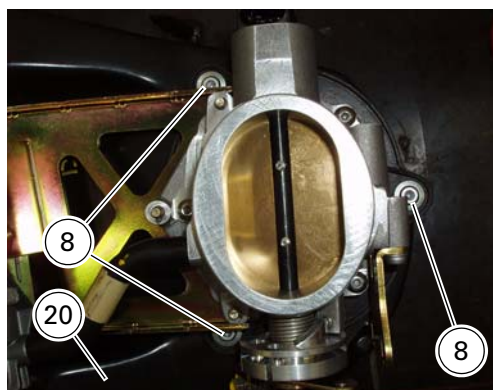
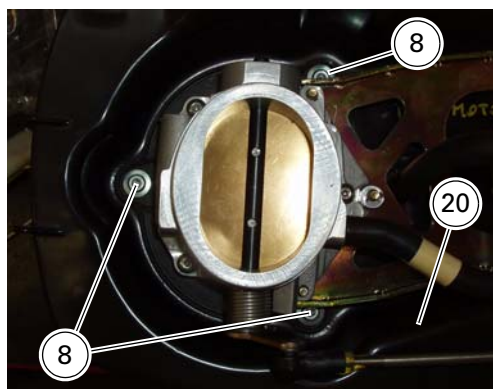
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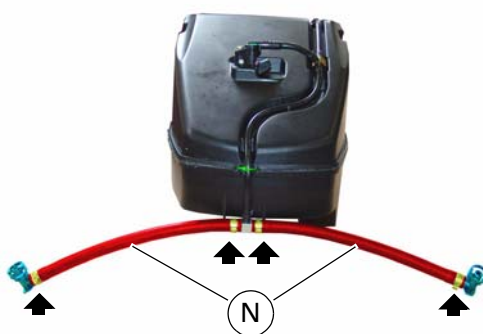
Disassembly of the airbox – throttle body

Unscrew the six bolts (8) and remove the throttle body (11) from the airbox (20).

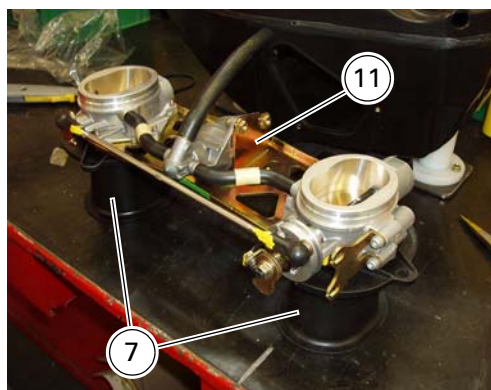


Reassembly of the airbox – throttle body

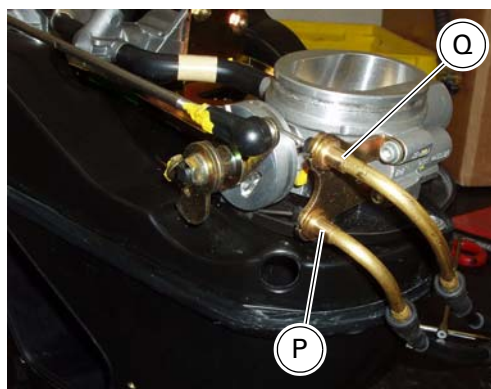
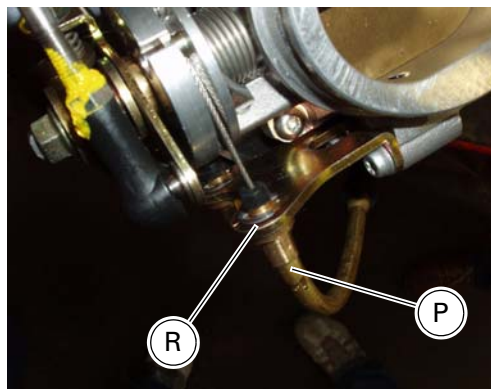
If removed, refit the fuel hoses (N) with relative quick-release fittings and hose clamps to the airbox as shown.



If removed, refit the air intake funnels (7) to the throttle body (11) and tighten the bolts (12) to the specified torque (Sect. C 3, Frame torque settings).



If removed, refit the throttle cables to the throttle body as indicated: insert the throttle opening cable (P) and the throttle closing cable (Q) in the throttle body plate, as shown in the figure. Secure the throttle cables with two circlips (R).



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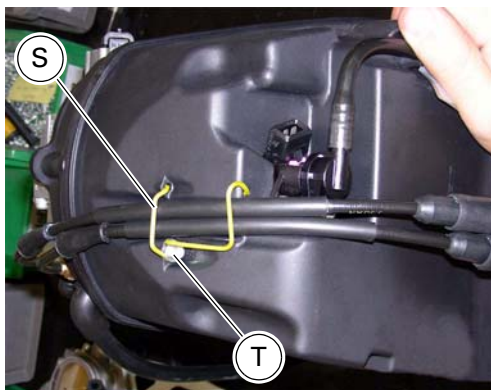
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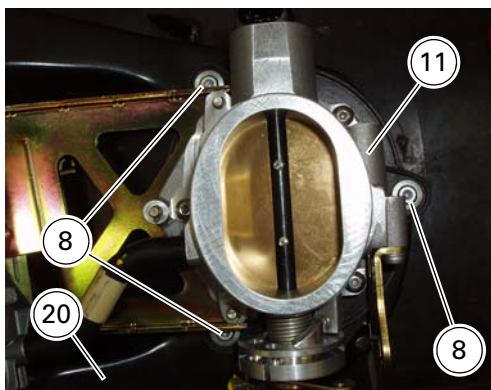
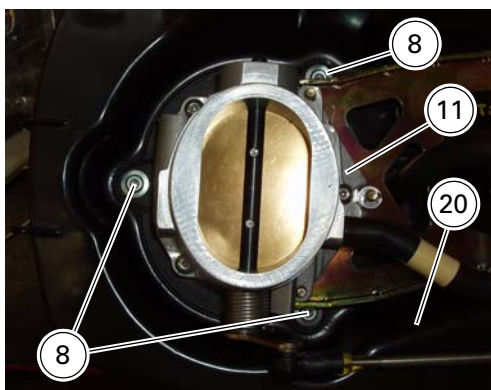
P

If removed, refit the throttle cable stop (S) tightening the screws (T).



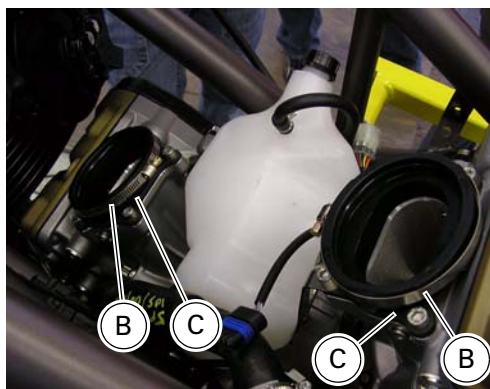
Refit the throttle body (11) to the airbox (20).

Tighten the six screws (8) to the specified torque (Sect. C 3, Frame torque settings).



Refitting the airbox and throttle body

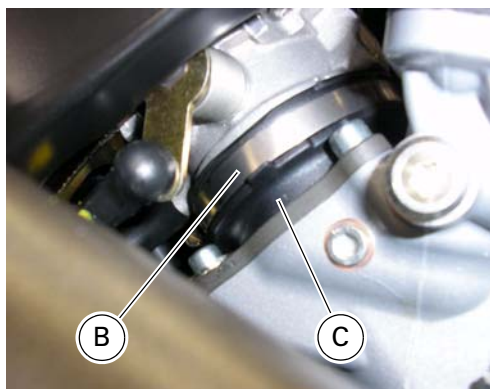
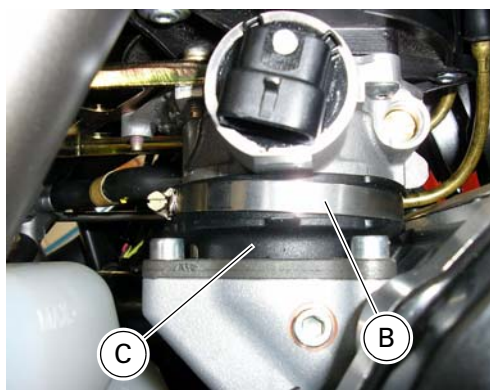
Locate the hose clamps (B) in their seats on the air intakes (C).



Position the airbox (20) and the throttle body (11) on the motorcycle.



Tighten the hose clamps (B) to the specified torque (Sect. C 3).



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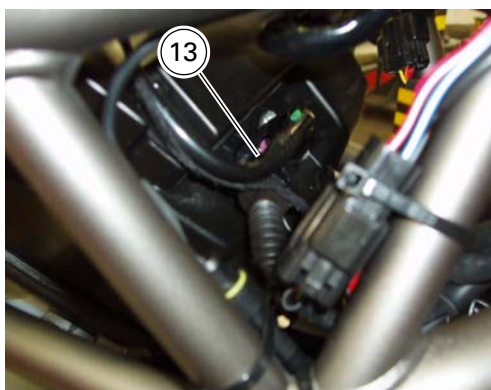
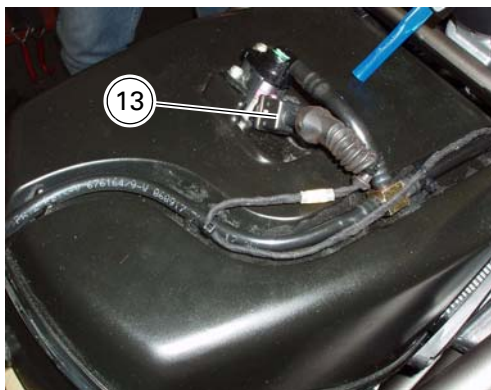
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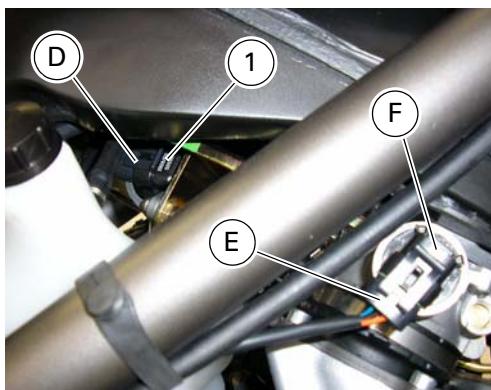
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Reconnect the wiring connectors connecting the injectors (13) to the main wiring loom.



Connect the wiring connector (D) on the main wiring loom to the stepper motor (1).
Connect the wiring connector (E) to connect the main wiring loom to the throttle position sensor (F).



Reconnect the hose (18) to the blow-by valve and tighten the clamp (G).



Important

If the throttle body is renewed, carry out the procedure to reset the TPS (Sect. D 5).

Operation	Section reference
Connect the throttle cable	F 1
Refit the air intake funnels	L 7
Refit the fuel tank	L 2
Refit the headlight shell	E 1
Refit the fairings	E 2

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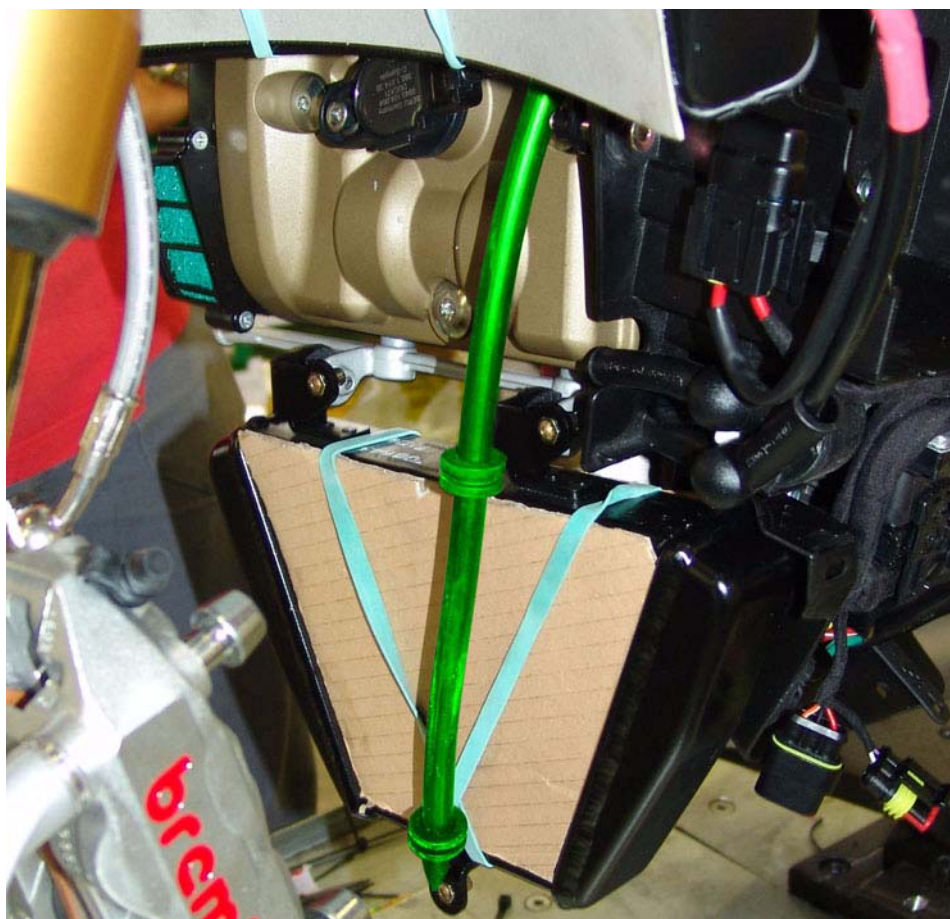
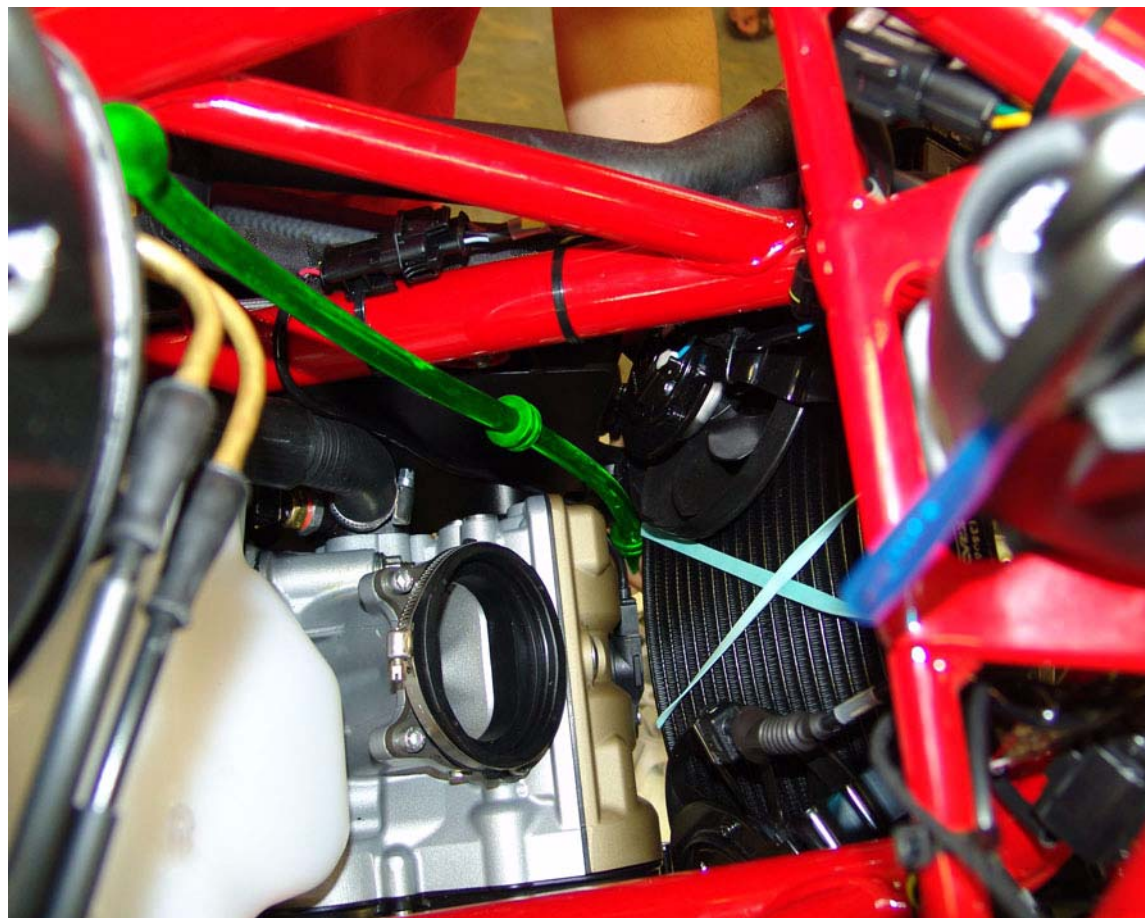
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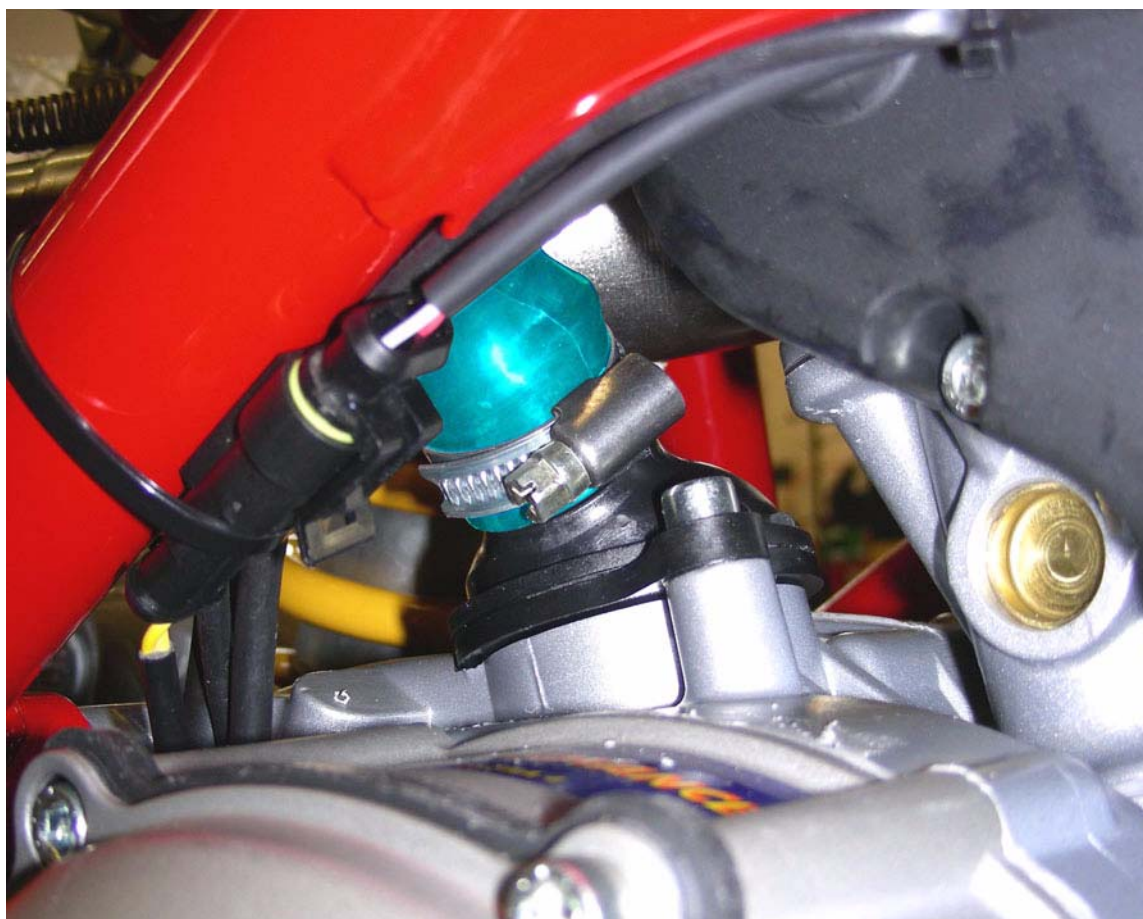
N

P

Positioning of the airbox drain hose



Positioning of the blow-by hose



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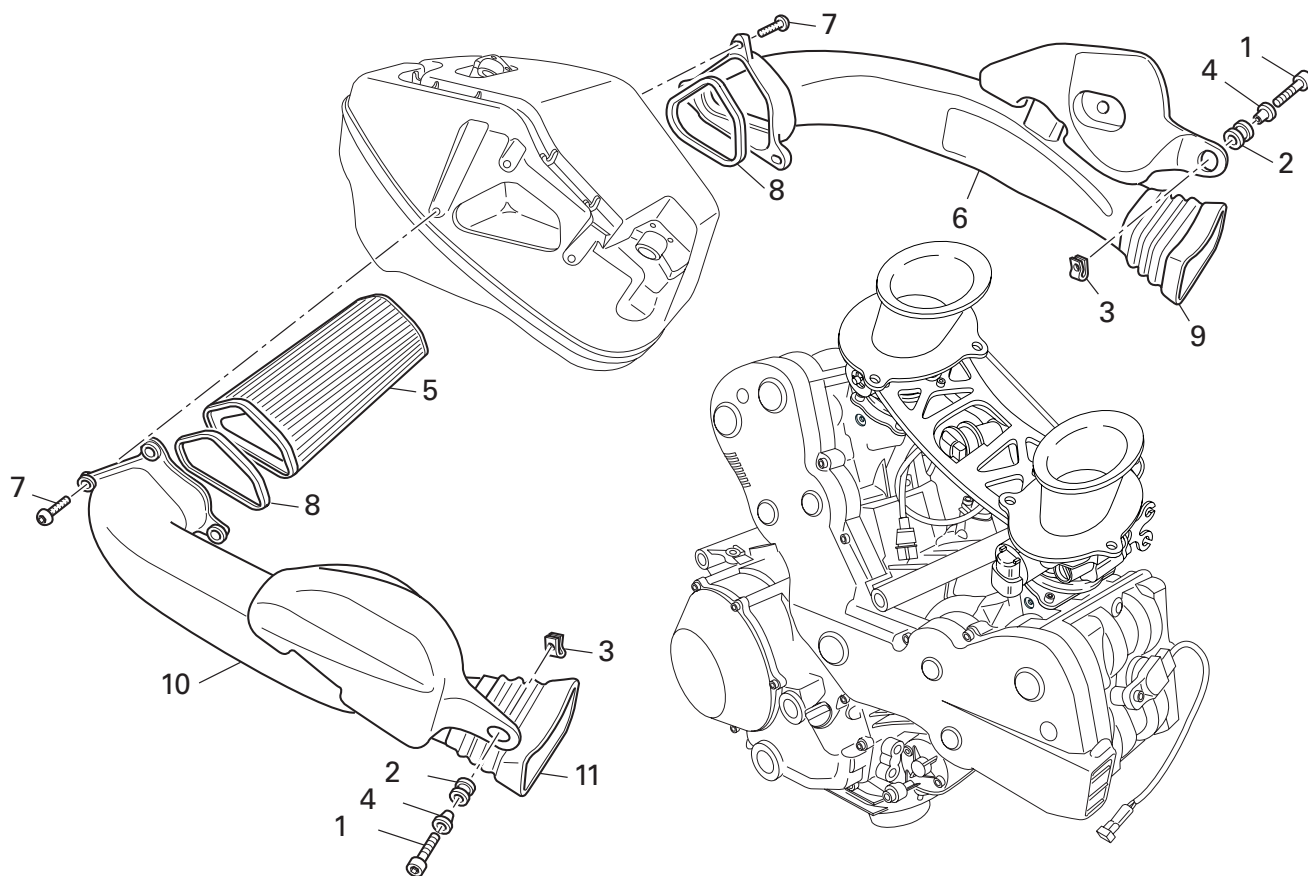
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Positioning throttle cables



7 - Air intake



- 1 Bolt
- 2 Rubber grommet
- 3 Quick-release fastener
- 4 Spacer
- 5 Air filter
- 6 Left air scoop
- 7 Bolt
- 8 Seal
- 9 Left intake hose
- 10 Right air scoop
- 11 Right intake hose



Important

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

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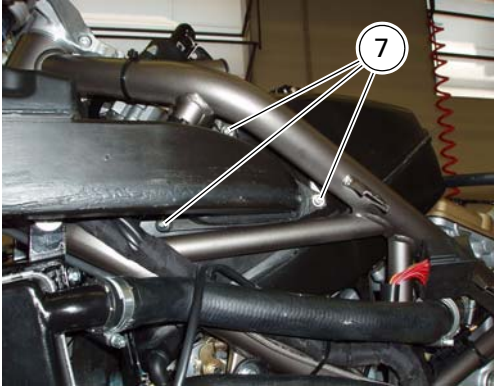
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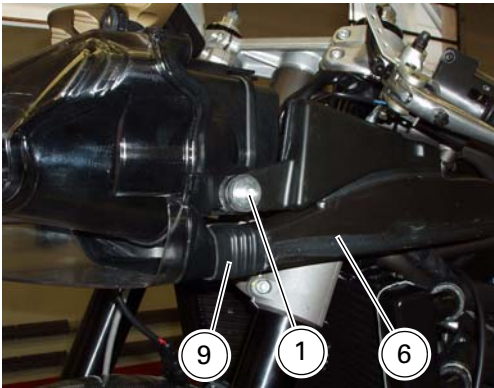
Removal of the air filters

Operation	Section reference
Remove the side fairings	E 2
Remove the headlight shell	E 1

Undo the bolts (7) securing the air scoops to the airbox.

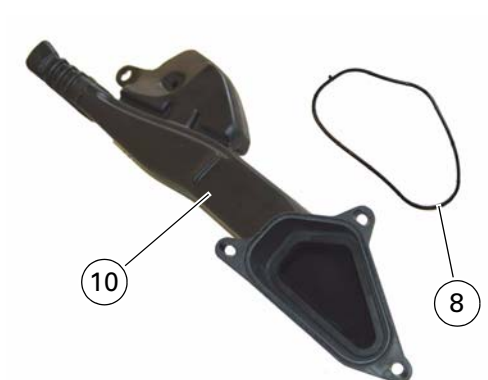


Unscrew the bolts (1) securing the air scoops to the headlight assembly and withdraw the intake hoses (9) and (11) with the air scoops (6) and (10) from the headlight assembly.

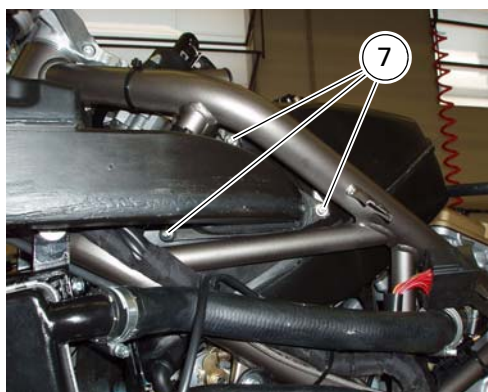
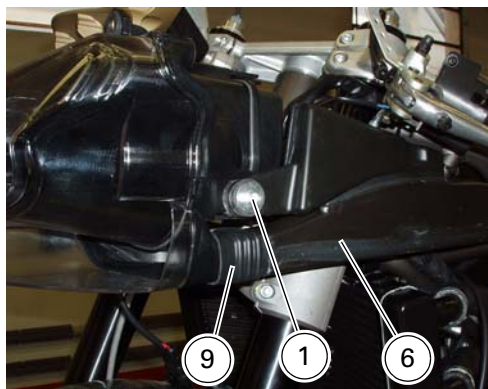


Refitting the air filters

If removed, refit the seals (8) to the air scoops (6) and (10), positioning the locating nib in the relative notch on the air scoop.

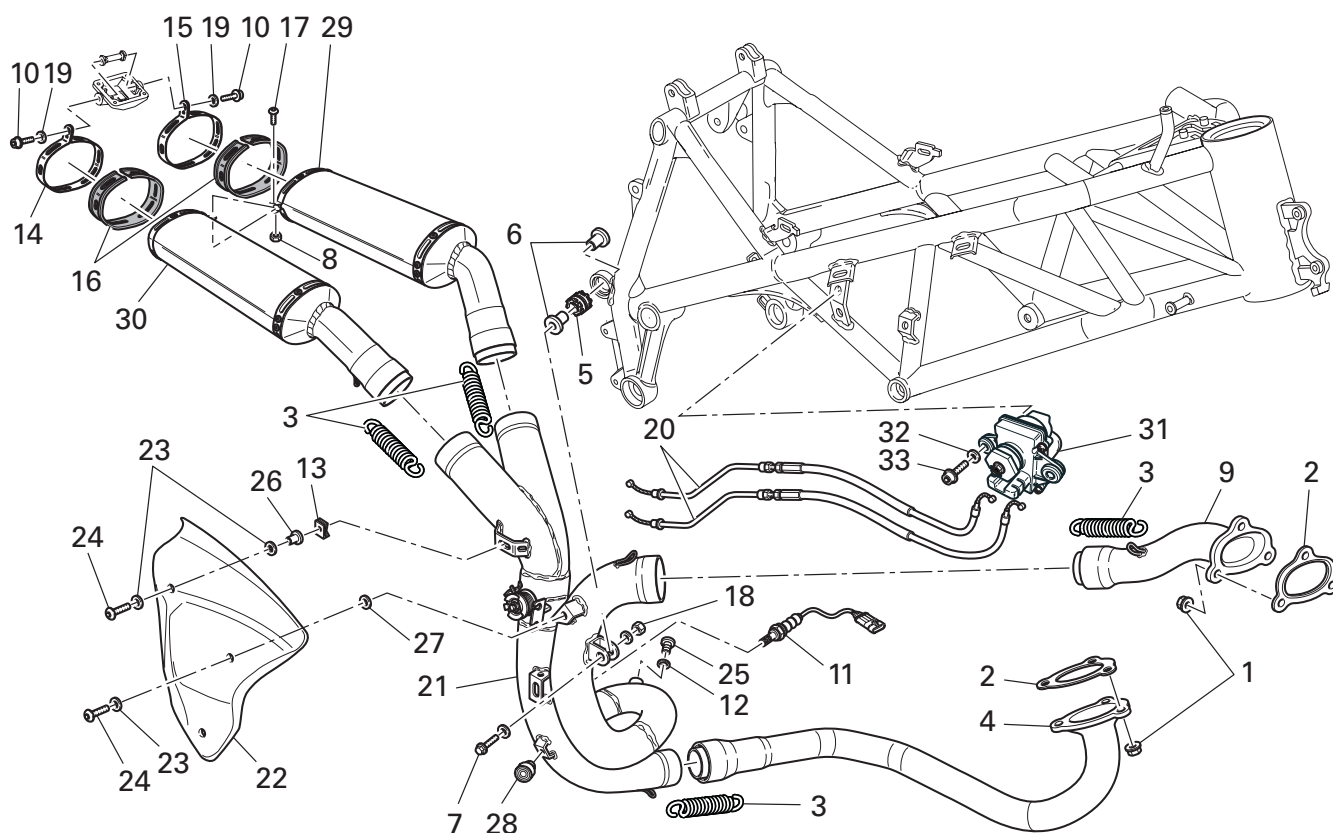


Reposition the hoses (9) and (11) with the air scoops (6) and (10) on the headlight assembly. Insert the bolts (1) securing the air scoops to the headlight assembly and the bolts (7) securing the air scoops to the airbox. Tighten the bolts (1) and (7) to the specified torque (Sect. C 3, Frame torque settings).



Operation	Section reference
Refit the headlight shell	E 1
Refit the fairings	E 2

8 - Exhaust system



- 1 Nut
- 2 Exhaust gasket
- 3 Spring
- 4 Horizontal cylinder head exhaust pipe
- 5 Rubber mounting
- 6 Spacer
- 7 Bolt
- 8 Nut
- 9 Exhaust manifold
- 10 Bolt
- 11 Lambda sensor
- 12 Seal
- 13 Quick-release fastener
- 14 Right-hand clamp
- 15 Left-hand clamp
- 16 Clamp rubber
- 17 Bolt

- 18 Nut
- 19 Washer
- 20 Cables assembly
- 21 Vertical cylinder head exhaust pipe
- 22 Heat shield
- 23 Washer
- 24 Bolt
- 25 Plug
- 26 Spacer
- 27 Washer
- 28 Rubber
- 29 Left-hand silencer
- 30 Right-hand silencer
- 31 Exhaust valve motor
- 32 Washer
- 33 Bolt

● Important

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

Removal of the exhaust system

Operation	Section reference
Remove the side fairings	E 2

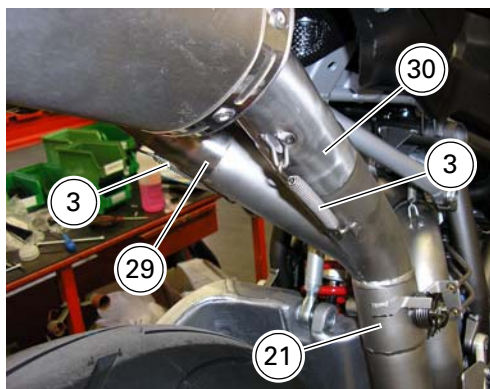
Unscrew the bolts (10) and recover the seals (19).



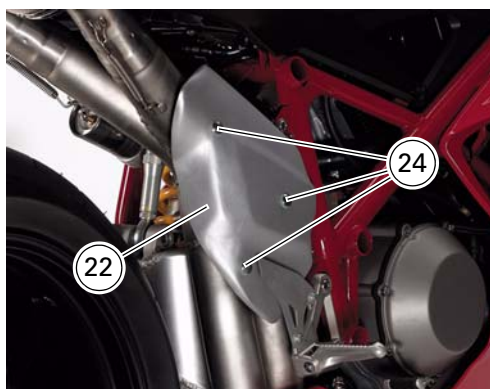
Unscrew the bolt (17) and the nut (8).



Remove the springs (3) and slide the silencers (29) and (30) from the vertical cylinder head exhaust pipe (21).



Unscrew the bolts (24) to remove the heat shield (22).



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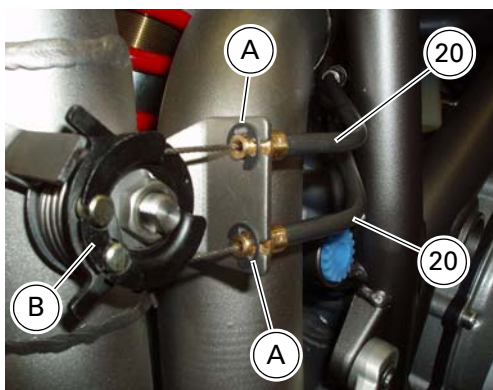
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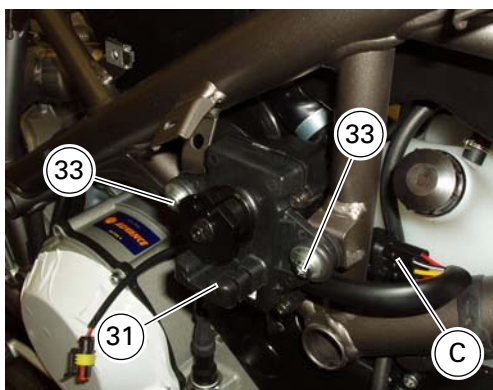
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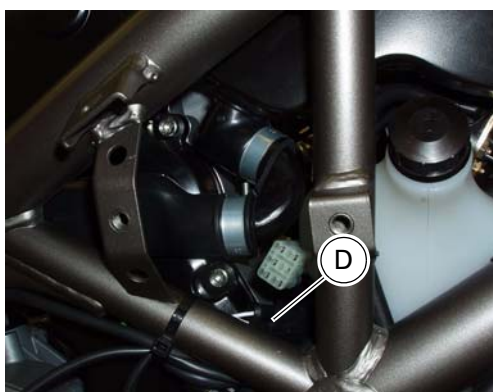
Remove the circlips (A) from the cables assembly (20) for the exhaust valve motor (B).
Remove the cables (20) from the exhaust valve (B).



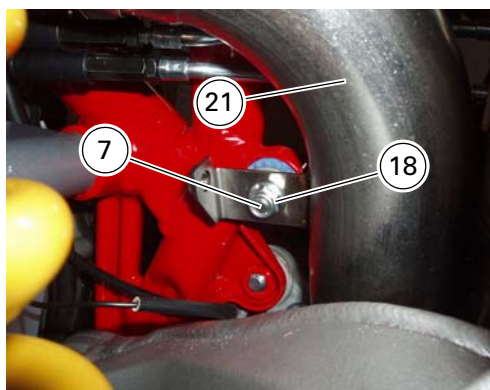
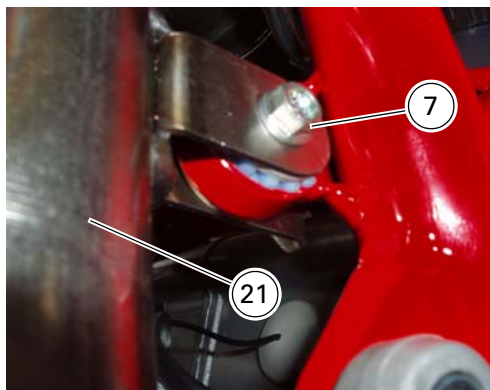
Unscrew the bolts (33) to remove the exhaust valve motor (31) from the frame and disconnect the wiring (C) from the motor (31).



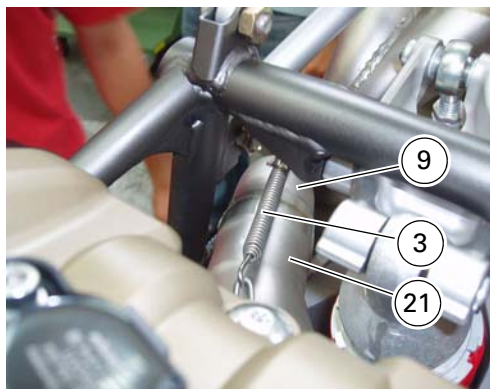
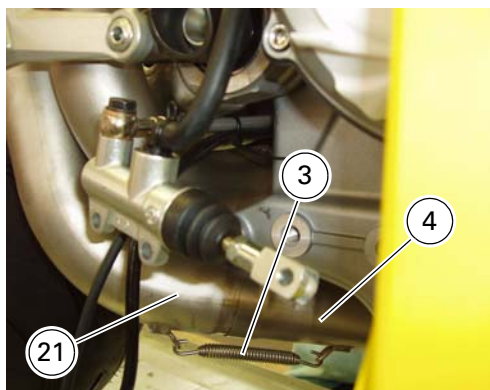
Disconnect the lambda sensor (11) from the wiring (D).



Unscrew the bolt (7) and the nut (18) securing the pipe (21) to the frame.



Remove the springs (3) and withdraw the vertical cylinder head exhaust pipe (21) from the horizontal cylinder head exhaust pipe (4) and the exhaust manifold (9).



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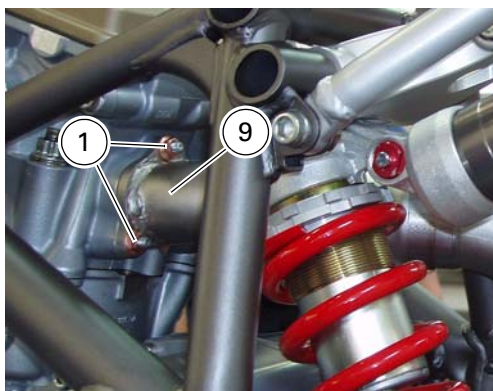
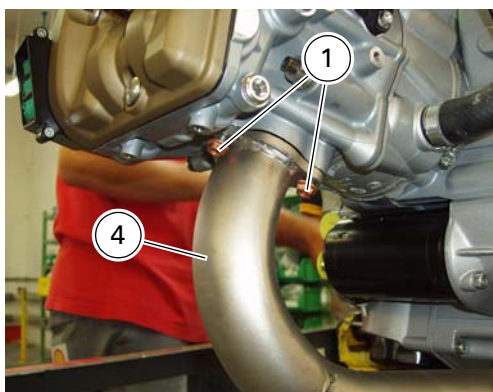
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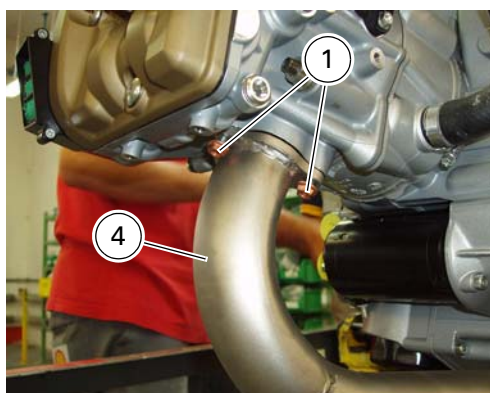
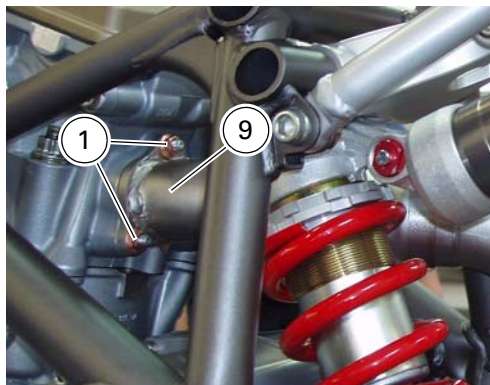
Unscrew the bolts (1) and remove the exhaust manifold (9) from the vertical cylinder head exhaust pipe and the horizontal cylinder head exhaust pipe (4) from the horizontal cylinder head.



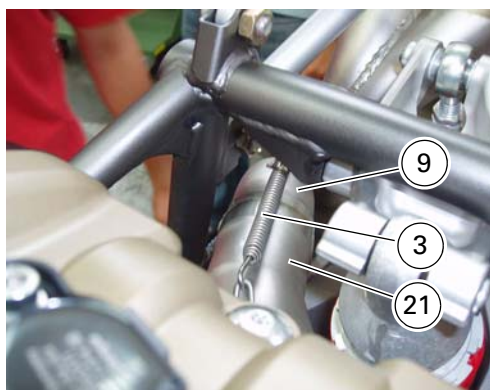
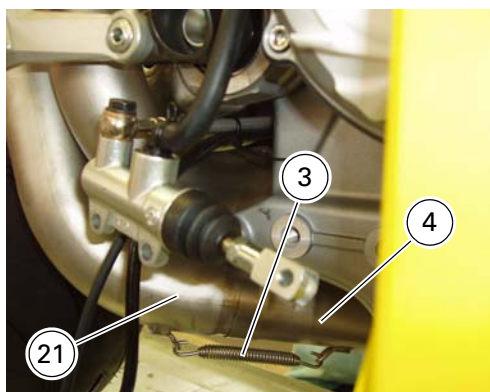
Refitting the exhaust system

Position the exhaust manifold (9) on the vertical cylinder head and the horizontal head exhaust pipe (4) on the horizontal cylinder head along with the gaskets (2).

Tighten the nuts (1) to the specified torque (Sect. C 3, Frame torque settings).



Connect the vertical cylinder head exhaust pipe (21) to the horizontal cylinder head exhaust pipe (4) and to the exhaust manifold (9) with the springs (3).



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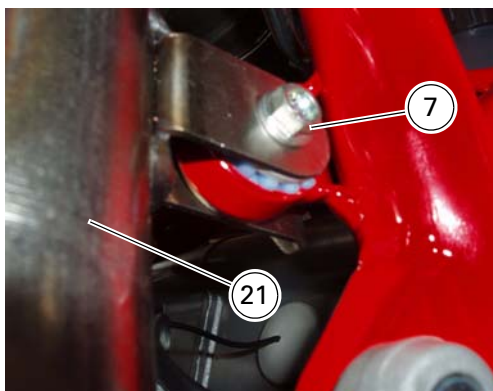
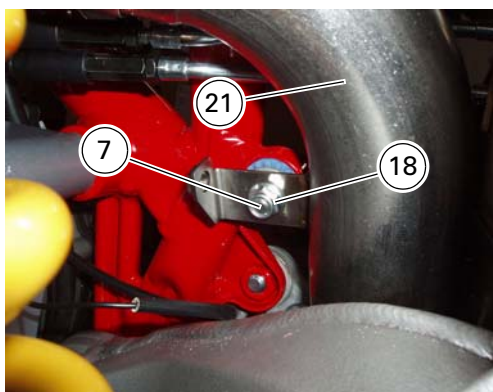
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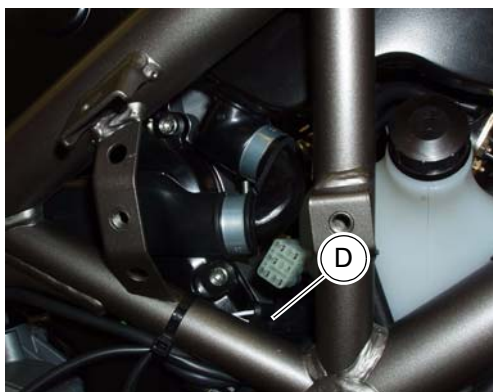
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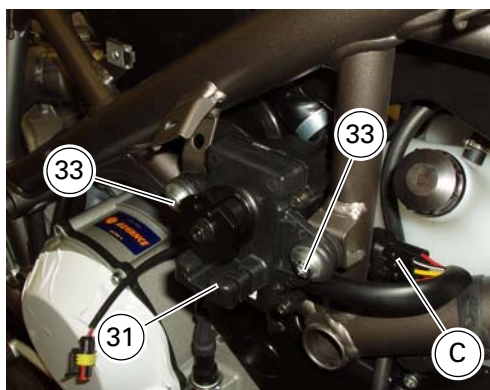
Secure the vertical head exhaust pipe (21) to the frame with the bolt (7) and nut (18) and tighten the bolt (7) to the specified torque (Sect. C 3, Frame torque settings).



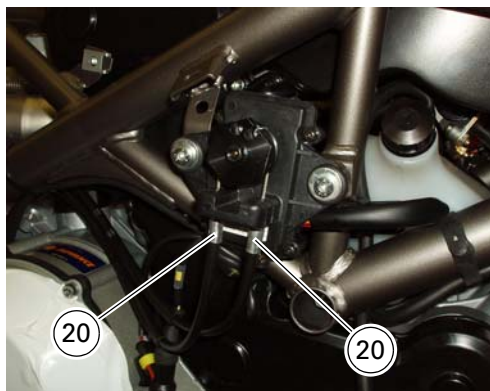
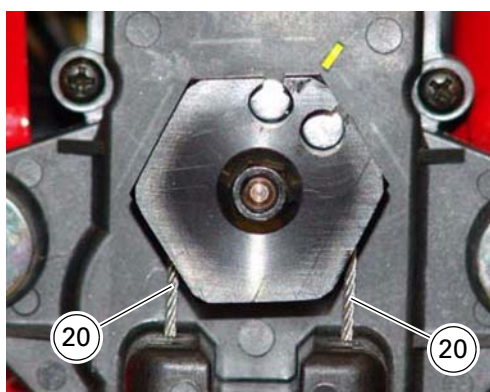
Connect the lambda sensor (11) to the wiring (D).



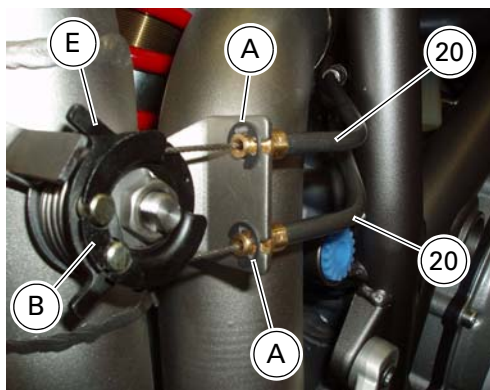
Locate the motor (31) on the frame and tighten the bolts (33) to the specified torque (Sect. C 3, Frame torque settings). Connect the motor to the wiring (C).



If the cables (20) have been removed from the motor, position them so that the top corner of the pulley race (located between the two cable end fittings) is aligned with the notch.



Position the cables (20) on the exhaust valve (B).
The travel stop (E) of the exhaust valve pulley must be seated against the blade of the exhaust valve (B).
Secure the cables with two circlips (A).
Refer to the figures at the end of the chapter for correct routing of the cables (20).
The cables must have no free play.



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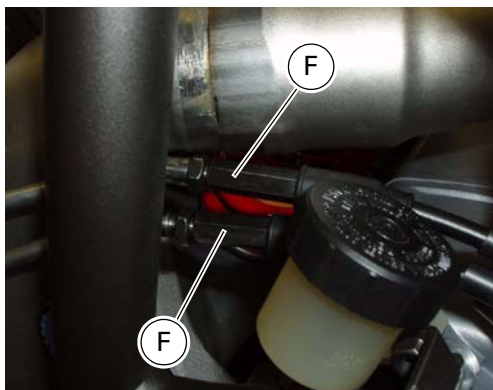
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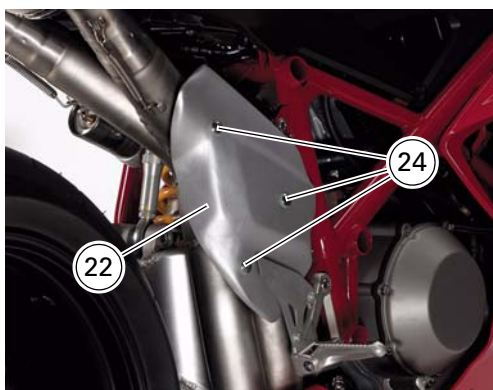
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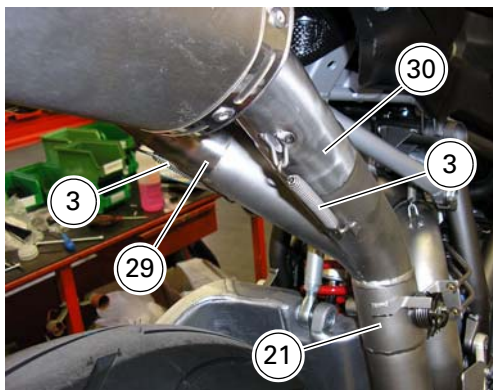
To adjust the cables, turn the adjusters (F).



Refit the heat shield (22) and tighten the bolts (24) to the specified torque (Sect. C 3, Frame torque settings).



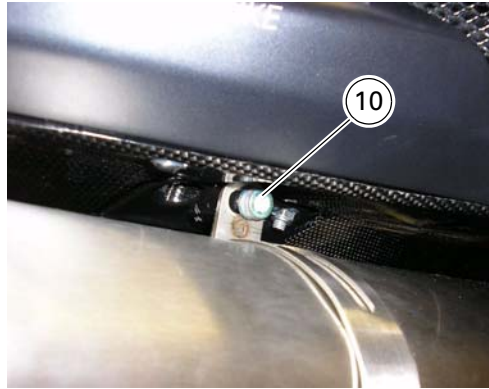
Connect the silencers (29) and (30) to the pipe (21) and locate the springs (3).



Refit the bolt (17) with the nut (8) and tighten to the specified torque (Sect. C 3, Frame torque settings).



Insert the bolts (10) with washers (19) and tighten the bolts (10) to the specified torque (Sect. C 3, Frame torque settings).



Operation	Section reference
Refit the fairings	E 2

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P

Positioning the control cables of the exhaust valve motor



Injection - ignition system

A

B

C

D

E

F

G

H

L

M

N

P

2 - Fuel injection-ignition system

3

3 - System components

4

Electronic Control Unit (ECU)

4

Removal of the battery support

6

Refitting the battery support

9

Electric injector

14

Air pressure sensor

15

Coolant temperature sensor

16

Air temperature sensor

17

Ignition coils

18

Throttle Position Sensor (TPS)

21

Rpm/timing sensor

22

Injection relay

23

CAN Line

24

2 - Fuel injection-ignition system

The electrical components of the fuel injection-ignition system are listed below: The reference next to each component is that shown in the diagram in Sect. P 1.

- 2 Ignition switch
- 3 Left cooling fan
- 4 Right cooling fan
- 5 Starter motor
- 6 Starter contactor
- 7 Battery
- 8 Regulator fuse
- 9 Regulator
- 15 Fuel tank
- 16 Stepper motor
- 17 Injection relay
- 18 Self-diagnosis
- 19 Horizontal cylinder coil
- 20 Vertical cylinder coil
- 21 Horizontal cylinder spark plug
- 22 Vertical cylinder spark plug
- 23 Horizontal cylinder injector
- 24 Vertical cylinder injector
- 25 Throttle position sensor
- 26 Rpm/timing sensor
- 27 Coolant temperature sensor
- 28 Speed sensor
- 29 Side stand
- 31 Neutral switch
- 32 Oil pressure switch
- 34 ECU
- 35 Fuses
- 40 Air temperature sensor

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3 - System components

Electronic Control Unit (ECU)

The engine ECU (1) is an electronic digital microprocessor-based unit.



It controls both the injectors and the coils, thus controlling fuel injection and ignition in accordance with the engine operating conditions detected by the following sensors:

- Absolute pressure sensor (measures atmospheric pressure)
- Air temperature sensor (measures intake air temperature)
- Engine temperature sensor for coolant temperature
- Timing/rpm sensor for engine rotation speed and cylinder timing relative to TDC
- Throttle position sensor (measures the throttle opening angle)

The ECU also monitors battery voltage so that it can adjust injector opening time and ignition coil charging time accordingly.

The ECU determines the following values:

- Fuel amount delivered to each cylinder with a sequential non-parallel control
- Closing time of injectors and therefore injection timing relative to the end of the induction stroke for each cylinder
- Ignition advance

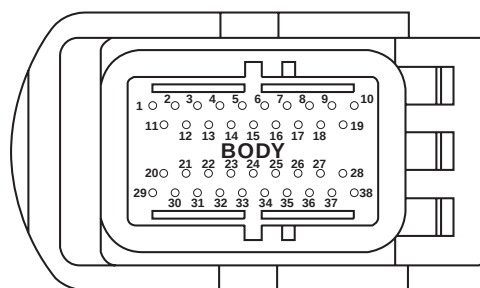


Important

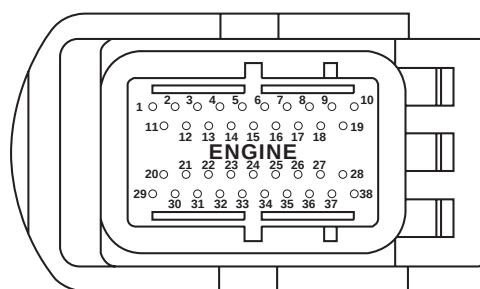
The maps, which include ignition advance values, injection times, crankshaft angle for injector closing and all correction curves as a function of temperature and atmospheric pressure values, are stored in the Flash Eprom of the ECU. The above values are preset by the Manufacturer after testing the motorcycle under different riding conditions. These settings cannot be changed.

CO content can be adjusted using software on the "DDS" tester, which should be connected to the ECU diagnostic socket. For this procedure, refer to Sect. D 5.

There are two kinds of ECU connector, one with a grey terminal block (Body), and one with a black terminal block (Engine).



Grey



Black



Warning

If the ECU has been renewed, it will be necessary to reset the throttle position sensor (TPS) (Sect. D 5).



Notes

For removal/refitting of the ECU, refer to "Removal of the battery support" and "Refitting the battery support" in this section.

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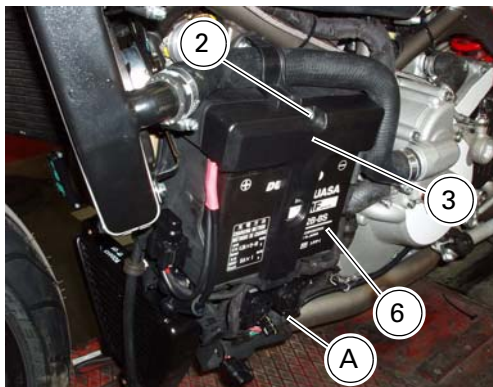
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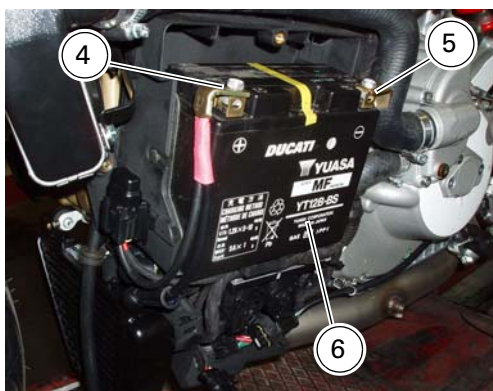
Removal of the battery support

To remove the battery support, you first need to remove the left-hand side fairing (Sect. E 2) and disconnect the sidestand wiring connector (A) from the main wiring loom (Sect. P 1).

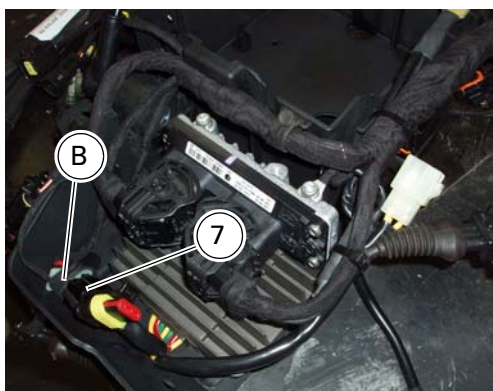
Unscrew the bolt (2) and remove the battery retaining bracket (3).



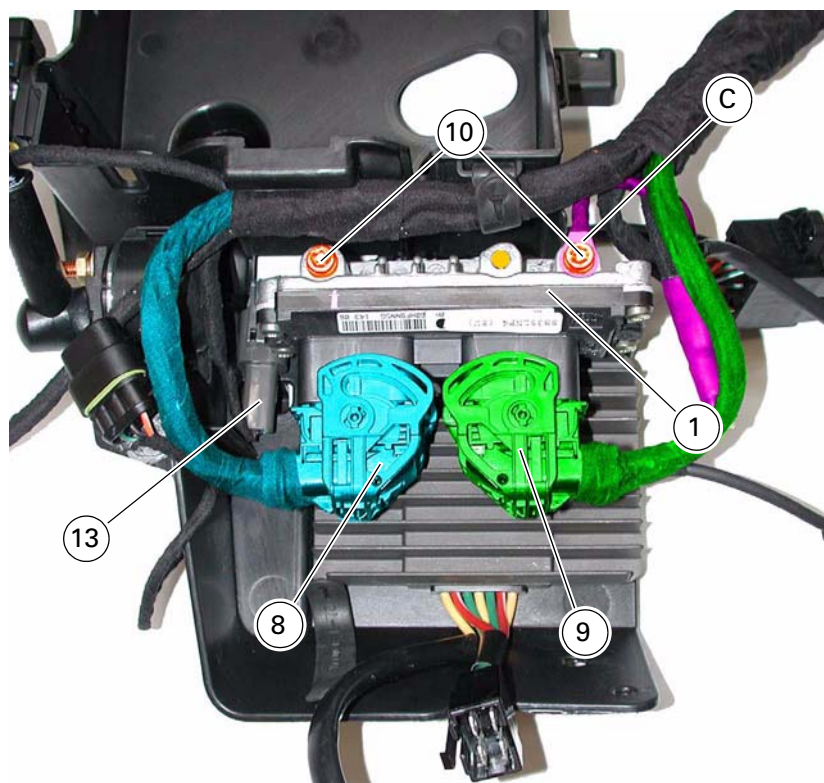
Disconnect the battery terminal clamps (5) and (4). Always disconnect the negative terminal clamp (5) first. Remove the battery (6).



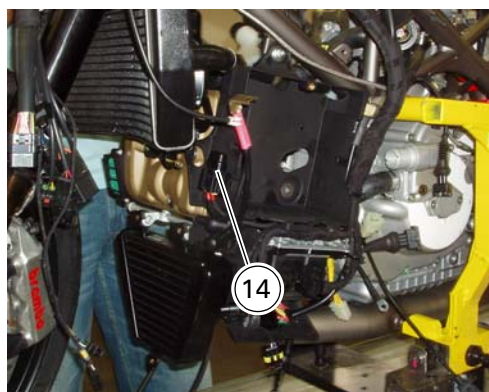
Remove the clamp (B) and disconnect the regulator wiring connector (7) from the wiring loom.



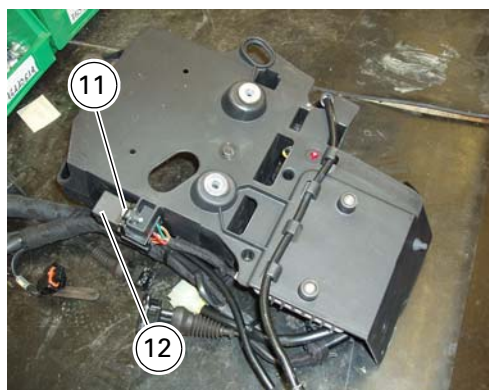
Disconnect the two wiring connectors (8) and (9) from the ECU.
Undo the screws (10) and remove the ECU (1), freeing from the ECU earth lead (C).
Detach the wiring connector of the contactor (13) with the fixing device from the battery support.
To remove the contactor, proceed as described in Sect. P 2.



Remove the regulator fuse (14) from the battery support, withdrawing through the holes provided.



Undo the screw (11) and remove the injection and fans relay (12).



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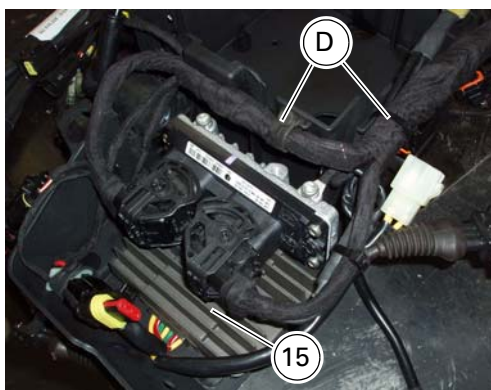
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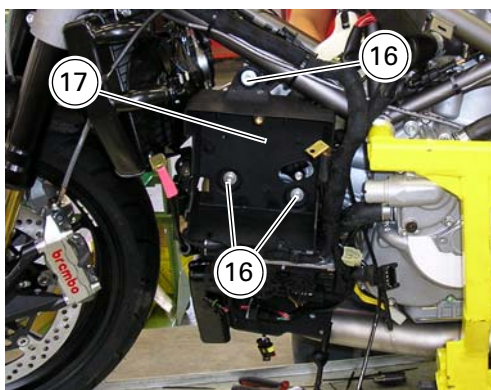
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Release the wiring from any cable ties (D).

To remove the rectifier (15), proceed as described in Sect. P 2.

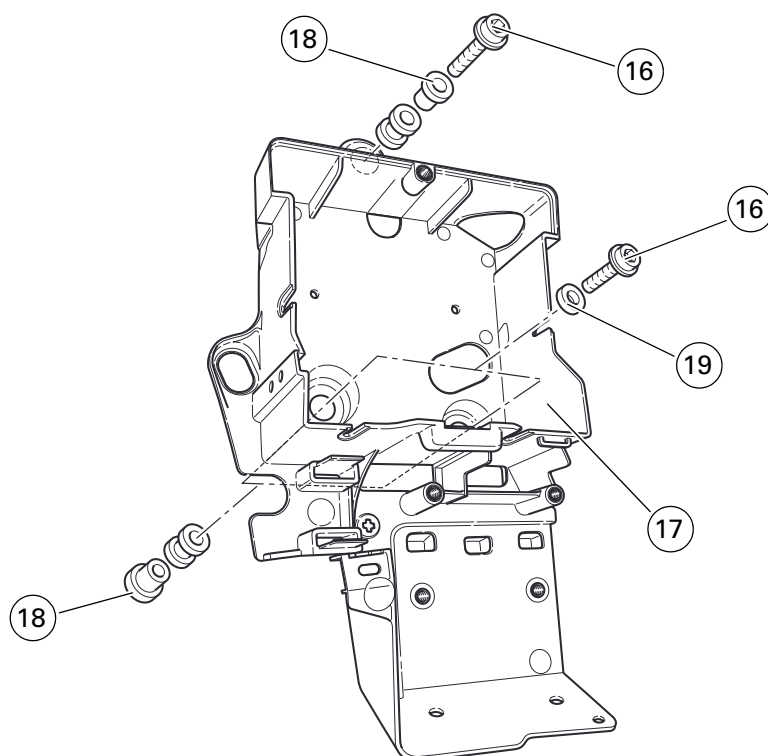


Undo the bolts (16) securing the battery support (17) to the frame.



Recover the spacers (18) and the washer (19).

Remove the battery support from the motorcycle.



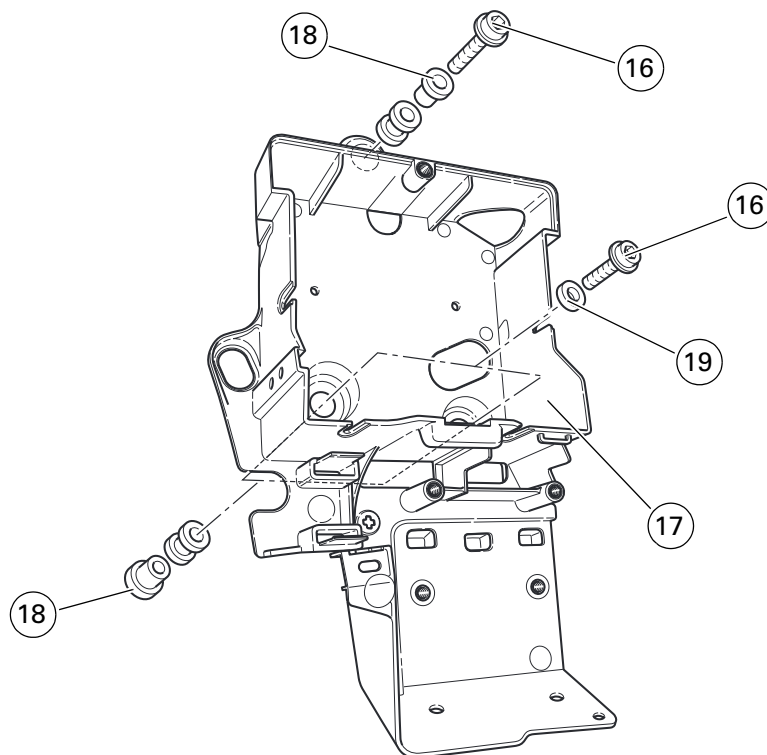
Refitting the battery support

Check the condition of all rubber components and replace them if necessary.
Insert the small diameter side of the spacers (18) into their rubbers.

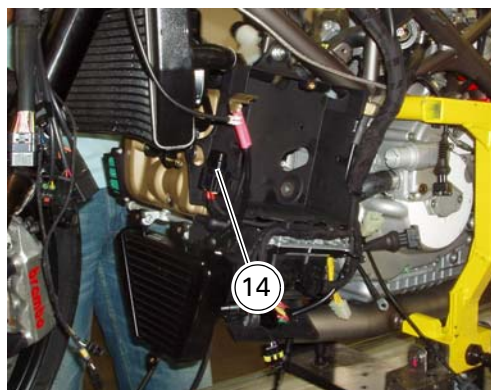


Notes

If the regulator/rectifier and the contactor were removed, refit following instructions in Sect. P 2.



Fit the regulator fuse (14) inserting through the holes in the battery support.



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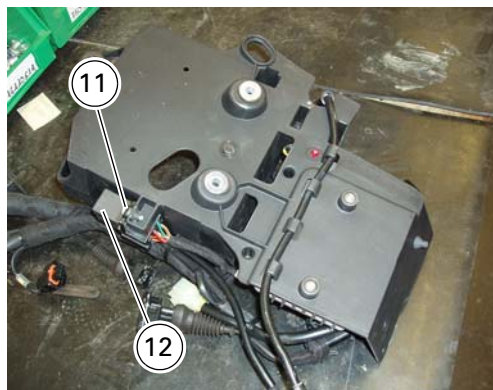
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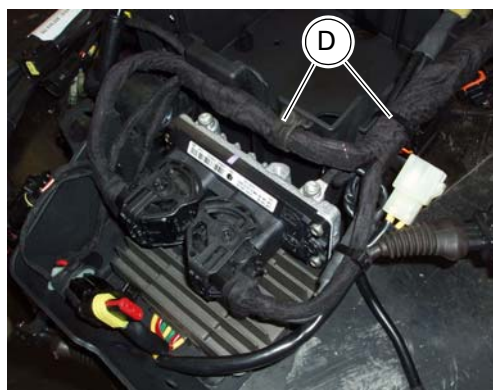
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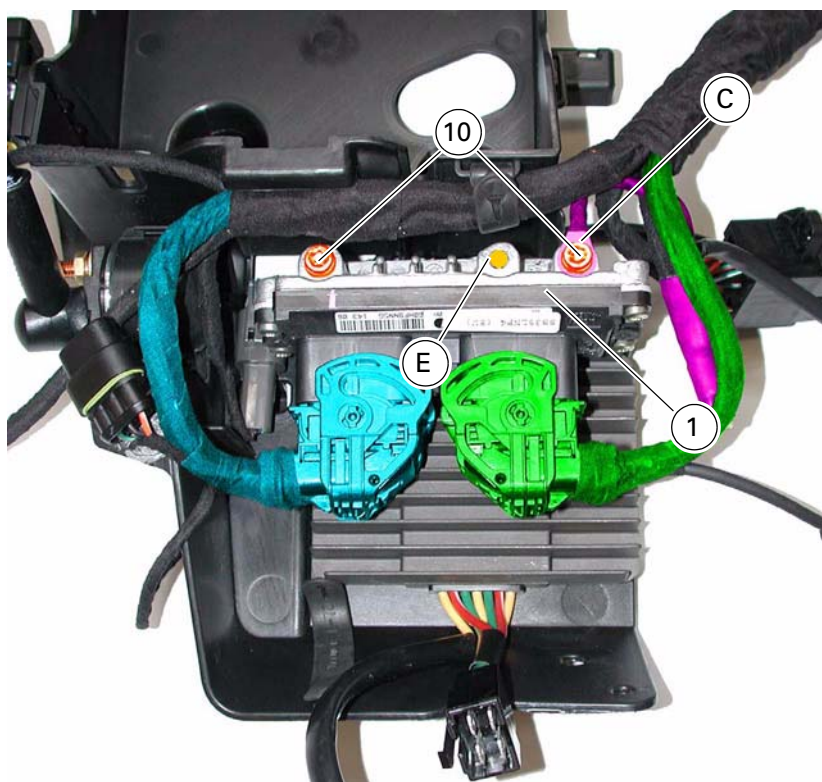
Refit the injection and fans relay e (12), insert the screws (11) and tighten to the specified torque (Sect. C 3).



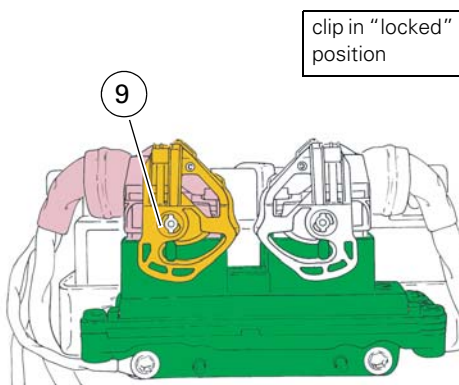
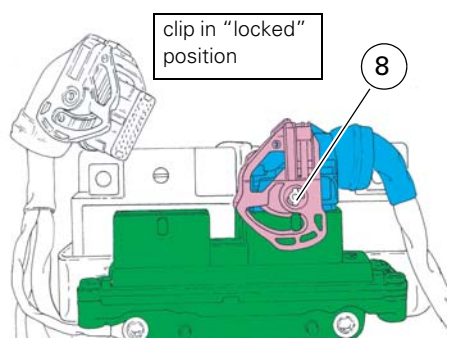
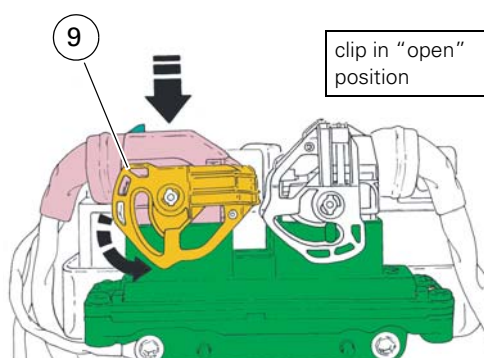
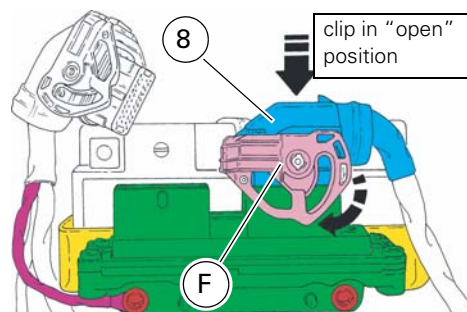
Fasten the main branch of the wiring loom to the battery support with the relative clips (D).



Position the ECU so that the threaded hole (E) is facing upwards; insert the retaining screws (10) with the ECU earth connector (C) under the right-hand screw, and tighten to the specified torque (Sect. C 3).



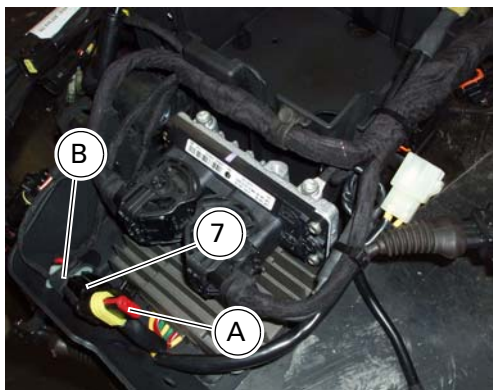
Make sure the clip (A) for the connector (8) is in its "open" position (as shown in the diagram).
 Push the connector firmly into the ECU.
 Rotate the clip (F) to secure the connector (clip in "locked" position).
 Repeat the procedure for the other connector (9).
 Make sure the connector clip is in the "open" position.
 Push the connector firmly into the control unit.
 Rotate the clip to secure the connector (clip in "locked" position).



Important

If the ECU is renewed, it will be necessary to reset the TPS to zero using the DDS tester (Sect. D 5).

Connect the regulator wiring connector (7) and secure with the wiring clip (B) along with the sidestand wiring connector (A).



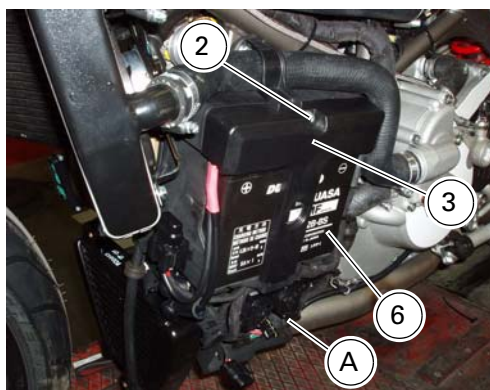
Fasten the main branch of the wiring loom to the battery support as shown in the illustration.



If it has been removed, refit the rubber mat (20) in its seat, locating the pins in the holes (C) on the battery support.



Refit the battery in the support and refit the support to the motorcycle by reversing the removal operations. Reconnect the sidestand wiring (A) to the main wiring loom (Sect. P 1) and refit the left-hand fairing (Sect. E 2).



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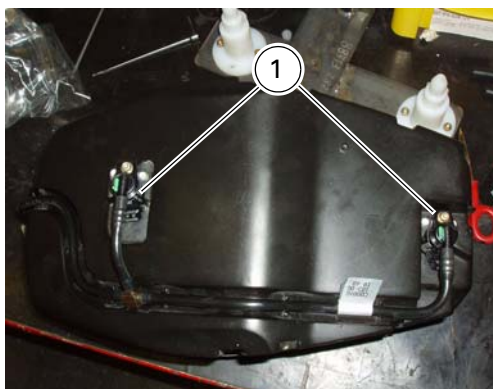
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Electric injector

The injectors (1) deliver the correct quantity of fuel required for optimal engine operation.



The ECU controls injector opening by feeding current to the coil of an electromagnet which creates a magnetic field to attract the armature, thereby generating fuel spray. If we take the physical characteristics of the fuel to be constant (viscosity, density), as well as the injector delivery and pressure head (controlled by the fuel pressure regulator), the amount of fuel injected depends on the duration for which the injector is open.

This time is determined by the ECU in accordance with the engine operating conditions.

In this way correct fuel delivery is ensured.

For the removal and refitting of the injectors, refer to Sect. L 6.



Notes

To test the operation of the injectors, use the DDS tester and follow the instructions given under the heading "Guided diagnosis", Sect. D 5.

The fuel output must be even and the jet should be fully atomised, without droplets.

Do not leave the engine stopped for a long time with the fuel circuit full.

The fuel could clog the injectors and render them inoperable.

Periodically, after lengthy periods without running the engine, we recommend adding TUNAP 231 to the fuel in the tank to help clean critical sections of the fuel circuit.



Notes

Electric injectors are only supplied as part of the "Injectors and pipes" kit, and must not be replaced individually.

Air pressure sensor

This sensor is integrated in the instrument panel and indicates the atmospheric air pressure. This information is sent to the ECU by a serial line (CAN line), and is used to correct the calibrations stored in the Flash Eprom.



Notes

To test the operation of this component, use the DDS tester and follow the instructions given under the heading "Guided diagnosis", Sect. D 5.

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Coolant temperature sensor

This sensor is mounted to the horizontal cylinder head coolant outlet union and measures the coolant temperature. This information is sent to the ECU and used to correct the calibrations stored in the Flash Eeprom so as to ensure optimal ignition and fuel supply at all times. The same information is sent to the instrument panel via the CAN line for the coolant temperature display. It comprises a housing containing an NTC thermistor (NTC means that the thermistor resistance decreases as the temperature increases).

Notes

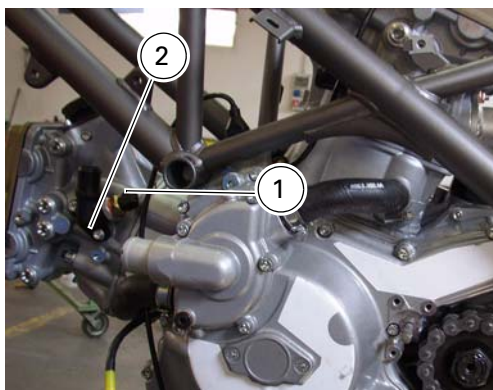
To test the operation of the coolant temperature sensor, use the DDS tester and follow the instructions given under the heading "Guided diagnosis", Sect. D 5.

Removal of the coolant temperature sensor

To remove the coolant temperature sensor, first remove the LH side fairing (Sect. E 2) and the battery support (as explained in this section).

Disconnect the wiring connector.

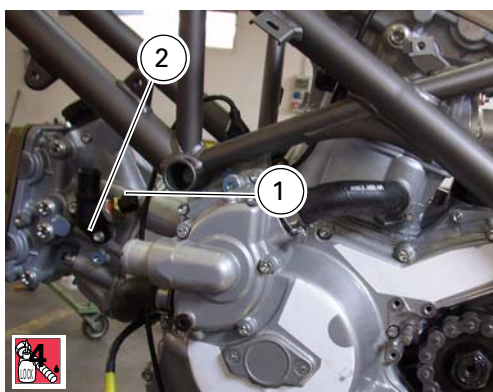
Unscrew the sensor (1) from the coolant outlet (2) (see Positioning of wiring on the motorcycle, Sect. P 1).



Refitting the coolant temperature sensor

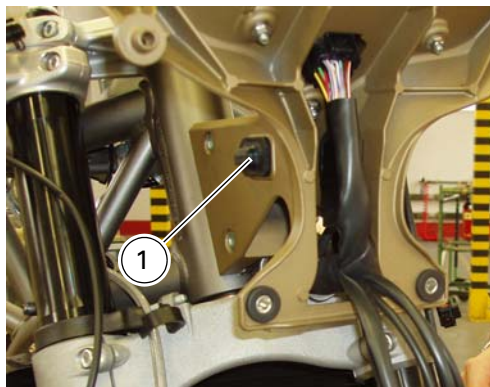
Refit by reversing the removal operations, securing the sensor to the coolant outlet union with the specified torque (Sect. C 3) and applying the recommended threadlocker.

Refit the LH side fairing (Sect. E 2).



Air temperature sensor

The sensor (1) is located on the right-hand side of the instrument panel and measures the external air temperature: the temperature signal is sent to the ECU integrated in the instrument panel for display and sent over the CAN line to the engine ECU which uses it to make mapping corrections.



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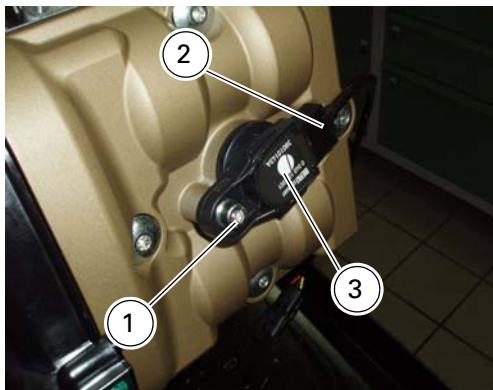
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Ignition coils

- A** Remove the seat cowling and the fuel tank (Sect. E 3).
Undo the nut (1) securing the coil to the cylinder head.
Remove the connector (2) and extract the coils (3) from the spark plugs on both cylinder heads.
Clean the area around the spark plug bores with a compressed air jet before removing the spark plugs themselves.
Remove the spark plugs, making sure that dirt does not fall into the combustion chambers.



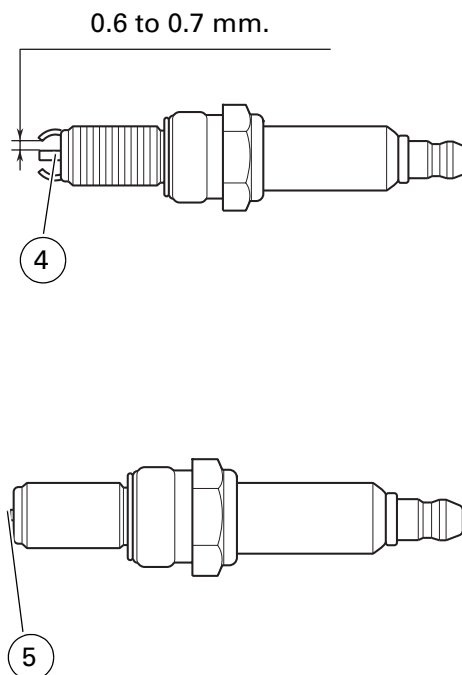
Spark plugs

Check the colour of the ceramic insulation around the central electrode:

an even, light brown colour indicates the engine is in good condition and running at the right temperature.

The motorcycle may be fitted with either plugs with earth electrodes (4) or plugs without earth electrodes (5).

On spark plugs with earth electrodes, check the central electrode for wear and the gap between the electrodes, which should be: **0.6** to **0.7** mm.



Important

Check the gap between the central and side electrodes. If the gap is not as specified or if the spark plug is soiled with heavy sooty deposits, renew it.

Refit the spark plug in the cylinder head, first tightening it down fully by hand.

Tighten to the specified torque (Sect. C 3).



Notes

For the positioning of the HT leads, see Sect. P 1.

Refit the fuel tank/seat cowling assembly (Sect. E 3).



Important

Do not use spark plugs with inadequate thermal rating or incorrect thread length.

The spark plug must be securely installed.

If a spark plug is loose, it can overheat and damage the engine.

Spark plug type

Make: **NGK**

Type: **MAR10A-J**

Checking the coils

A

The coils used on this model are known as “cigar” coils.

They are similar in appearance to a spark plug cap. They transform the low voltage from the ECU into high voltage for the spark plugs.

To test the coils, proceed as follows:

B

Measure the resistance between the two pins (1-15).

The resistance should be $650\text{ m}\Omega \pm 50$; if not, replace the coil.



Notes

To check the coils for faults, use the DDS tester and follow the instructions given under the heading “Guided diagnosis”, Sect. D 5.

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Throttle Position Sensor (TPS)

The TPS is powered by the ECU to which it sends a signal indicating the throttle position. This information is the indirect measure of the engine load and is used by the ECU as one of the main parameters for determining the fuel flow rate and spark advance.



Notes

To check this component, use the DDS tester following the instructions given in the paragraph “Guided diagnosis” (Sect. D 5).

It is not possible to change the throttle position sensor as a single component. In the event of a fault with this component, it will be necessary to replace the entire throttle body assembly (Sect. L 6) and then reset the TPS (Sect. D 5).

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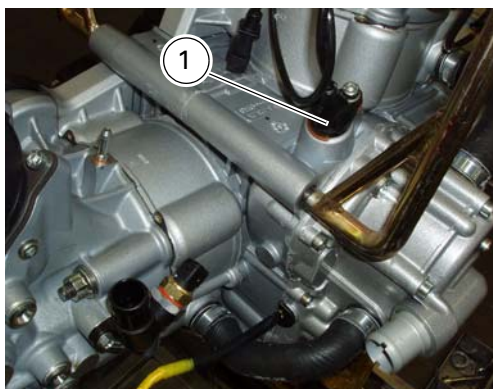
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Rpm/timing sensor

This sensor (1) is of the inductive type: it faces the timing gear and is capable of reading the 46 teeth and the 2-tooth gap.



The signal from the pickup on the timing driveshaft driving 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 under the heading "Guided diagnosis", Sect. D 5.

For instructions on how to renew the sensor and check the air gap, see the chapter "Flywheel/alternator" (Sect. N 8).

Injection relay

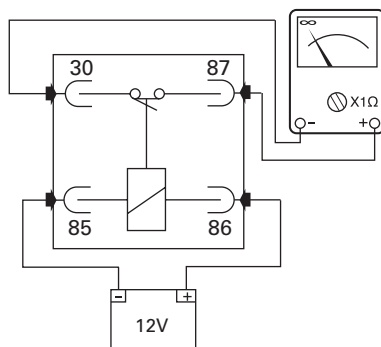
The relay (1) is positioned next to the battery and fixed to the battery support.



To remove the relay (1), first remove the battery support as described previously in this section.

Disconnect the relay from the electrical system and apply **12 V** (battery voltage) between contacts (86) and (85) (small contacts): you should hear a click that confirms that the internal electromagnet has switched.

Connect a multimeter to contacts (30) and (87) (big contacts) to check for electrical continuity (see Sect. P 9 concerning operation of the multimeter). The resistance reading should be near zero and, if present, the continuity sound signal should be emitted. If this does not occur, the part must be renewed.



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CAN Line

A

This model utilises a CAN line (Controller Area Network) which has made it possible to greatly simplify the layout of the electrical system and consequently reduce its overall weight.

The CAN line is connected to two nodes:

B

the instrument panel and the Magneti Marelli engine ECU (I.A.W. **5 AM 2**). This network makes it possible to avoid superfluous duplications of the sensors on the motorcycle, since their signals are shared by the two nodes and hence the two processing units. The sensors are connected to the nearer of the two units (instrument panel or ECU), which then transmits their signal to the network so that it can be used by the ECUs.

The CAN line is composed of only two wires carrying series of digital signals, each of which contains precisely defined and decodable information. The nodes connected to the line (instrument panel and engine ECU) are equipped with hardware to determine when the signals are of interest to them and should be used by their processors.

C

The signals exchanged over the CAN line between instrument panel and engine ECU are as follows:

D

- Motorcycle speed (input to engine ECU)
- Neutral selected (input to engine ECU)
- Engine oil pressure (input to engine ECU)
- Coolant temperature (input to engine ECU)
- Oil temperature (input to engine ECU)
- Starter motor actuation (starter button) (input to engine ECU)
- First level diagnostics generated by ECU
- Engine oil pressure (input to engine ECU)
- Scheduled service limit (instrument panel LED lights up)
- Intake air temperature (input to instrument panel)
- Battery voltage
- Motorcycle model identification
- EOBD LED control
- Immobilizer recovery
- Atmospheric pressure (sensor integrated in the instrument panel).

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P

Engine

A

B

C

D

E

F

G

H

L

M

N

P

	1 - Removal-refitting of the engine assembly	5
A	Removal of the engine	6
	Refitting the engine	9
	2.1 - Lubrication system: oil pump	10
	Removal of the oil pump	11
B	Disassembly of the oil pump	12
	Reassembly of the oil pump	13
	Refitting the oil pump	14
	2.2 - Lubrication system: oil cooler	15
C	Removal of the lubrication system	16
	Oil cooler inspection	18
	Refitting the lubrication system	18
	3.2 - Cooling system: radiator	20
D	Removal of the radiator	21
	Renewal of the cooling fan	23
	Refitting the radiator	24
	Removal of the cooling system hoses and unions	26
E	Refitting the cooling system hoses and unions	29
	3.3 - Cooling system: water pump	32
	Removal of the water pump	33
F	Refitting the water pump	36
	4.1 - Cylinder head assemblies: checks and adjustments	41
	Checking and adjusting the valve clearances	42
	Checking valve lift	44
G	Checking the engine timing	46
	4.2 - Cylinder head assemblies: timing	49
	Removal of the timing belt covers	50
	Removal of the tensioner pulley/timing belt	51
H	Removal of the camshaft pulleys/idler pulley	51
	Removal of the tensioner and idler pulley mounting studs	52
	Disassembly of the camshaft pulleys	53
	Removal of the timing belt driveshaft pulleys	54
	Refitting the timing belt driveshaft pulleys	56
L	Refitting the idler and tensioner pulley mounting studs	58
	Reassembly of the timing pulleys	59
	Refitting the camshaft pulley/idler pulley	60
	Refitting the timing belts	63
	Refitting the timing covers	65
M	4.4 - Cylinder head assemblies: camshafts	66
	Removal of the camshafts	67
	Checking the camshafts and supports	69
	Refitting the camshafts	70
N	Removal of the intake manifold and coolant union	76
	Refitting the intake manifold and coolant union	77
	4.5 - Cylinder head assemblies: valves-rocker arms	78
	Removal of the cylinder heads	79
P	Removal of the valves	80
	Removal of the valve rocker arms	81

Overhaul of cylinder head components	84	
Reassembly of the cylinder head	91	
Fitting the cylinder head assemblies	98	A
5 - Cylinder/piston assemblies	100	
Disassembly of the cylinder/piston	101	
Overhaul of the cylinder barrel/piston components	104	B
Refitting the cylinder/piston assembly	109	
6.1 - Clutch assembly: clutch	113	
Description	114	
Disassembly of the clutch	115	C
Inspection and overhaul of the clutch components	120	
Reassembly of the clutch	122	
6.2 - Clutch assembly: right-hand side crankcase cover	126	
Removal of the right-hand side crankcase cover	127	D
Disassembly of the right-hand side crankcase cover	128	
Reassembly of the right-hand crankcase cover	129	
Refitting the right-hand side crankcase cover	131	
6.3 - Clutch assembly: primary drive gears	133	E
Removal of the primary drive gears	134	
Refitting the primary drive gears and checking backlash	137	
7.1 - Gearbox assembly: gearchange mechanism	140	F
Removal of the gearchange mechanism	141	
Disassembly of gear interlock plunger and pawl assembly	143	
Refitting the gear interlock plunger and pawl assembly	144	
Refitting the gearchange mechanism	145	
7.2 - Gearbox assembly: gearbox shafts	147	G
Removal of the gearbox assembly	148	
Disassembly of the gearbox shafts	150	
Overhaul of the gearbox	155	
Inspection of the gear selector forks	156	H
Inspection of the gear selector drum	157	
Reassembly of the gearbox shafts	158	
Reassembly of the gearbox	162	
8 - Flywheel/alternator	163	L
Removal of the left-hand side crankcase cover	164	
Disassembly of the left-hand crankcase cover	166	
Removal of the flywheel/alternator assembly	167	
Overhaul of the flywheel/alternator assembly	169	M
Refitting the flywheel/alternator assembly	177	
Refitting the left-hand crankcase cover	179	
9.1 - Crankcase assembly: external components	182	
Removal of external components	183	N
Refitting the external components	186	
Removal of the timing gears	190	
Refitting the timing gears	191	
Removal of the starter motor idler gear	192	
Refitting the starter motor idler gear	193	P
Checking the engine sensor air gap	194	

A

9.2 - Crankcase assembly: crankcase halves	195
Separation of the crankcase halves	196
Overhaul of the crankcase halves	199
Main bearings	203
Reassembly of the crankcase halves	204
Shimming the shafts	207
Reassembly of the crankcase halves	212

B

9.3 - Crankcase assembly: connecting rods	218
Removal of the connecting rods assembly	219
Disassembly of the connecting rods	220
Overhaul of the connecting rods	221
Reassembly of the connecting rods	226
Refitting the connecting rods.	228

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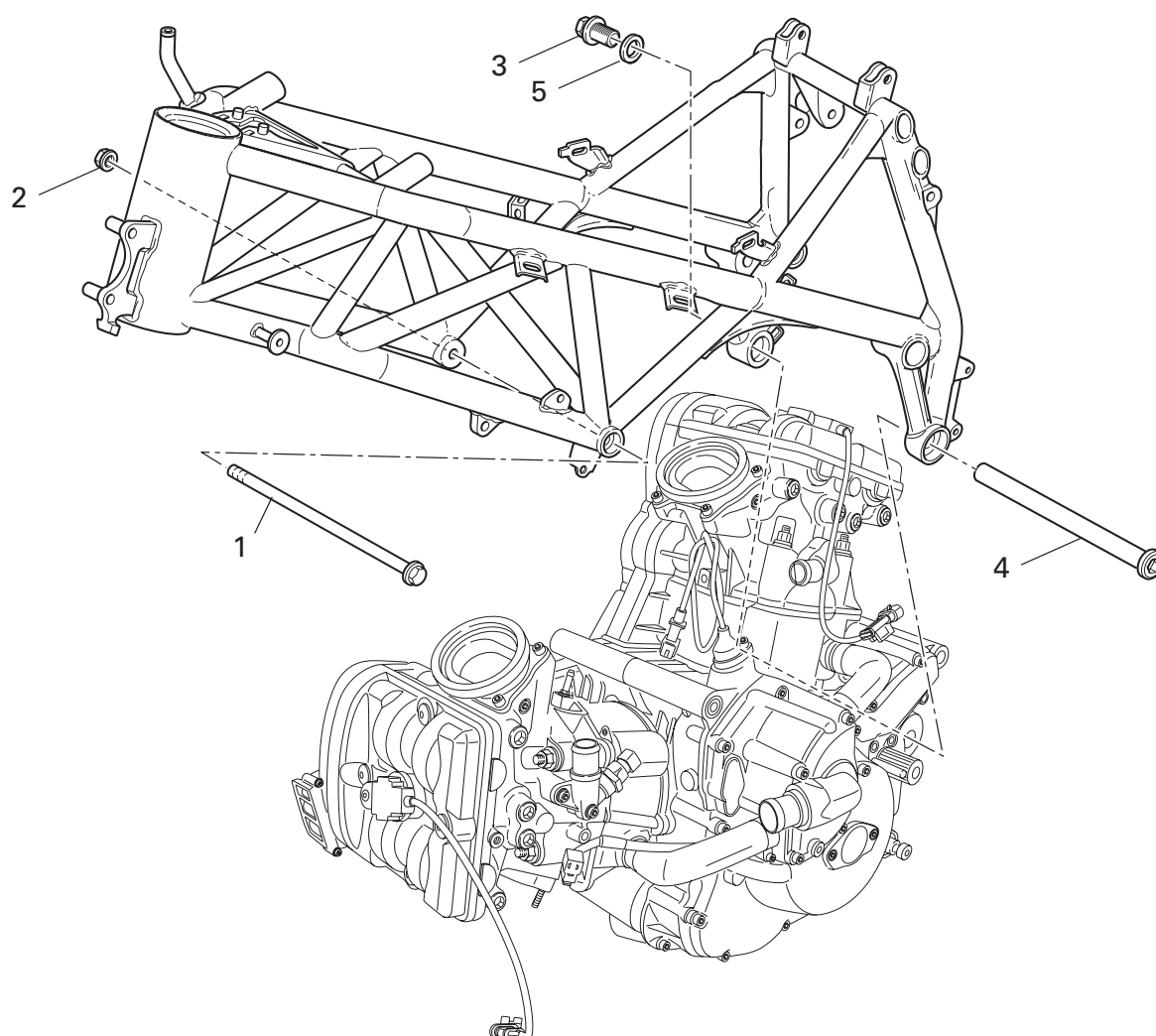
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1 - Removal-refitting of the engine assembly



- 1 Bolt
- 2 Nut
- 3 Bolt
- 4 Swingarm pivot shaft
- 5 Washer
- 6 Washer



Important

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

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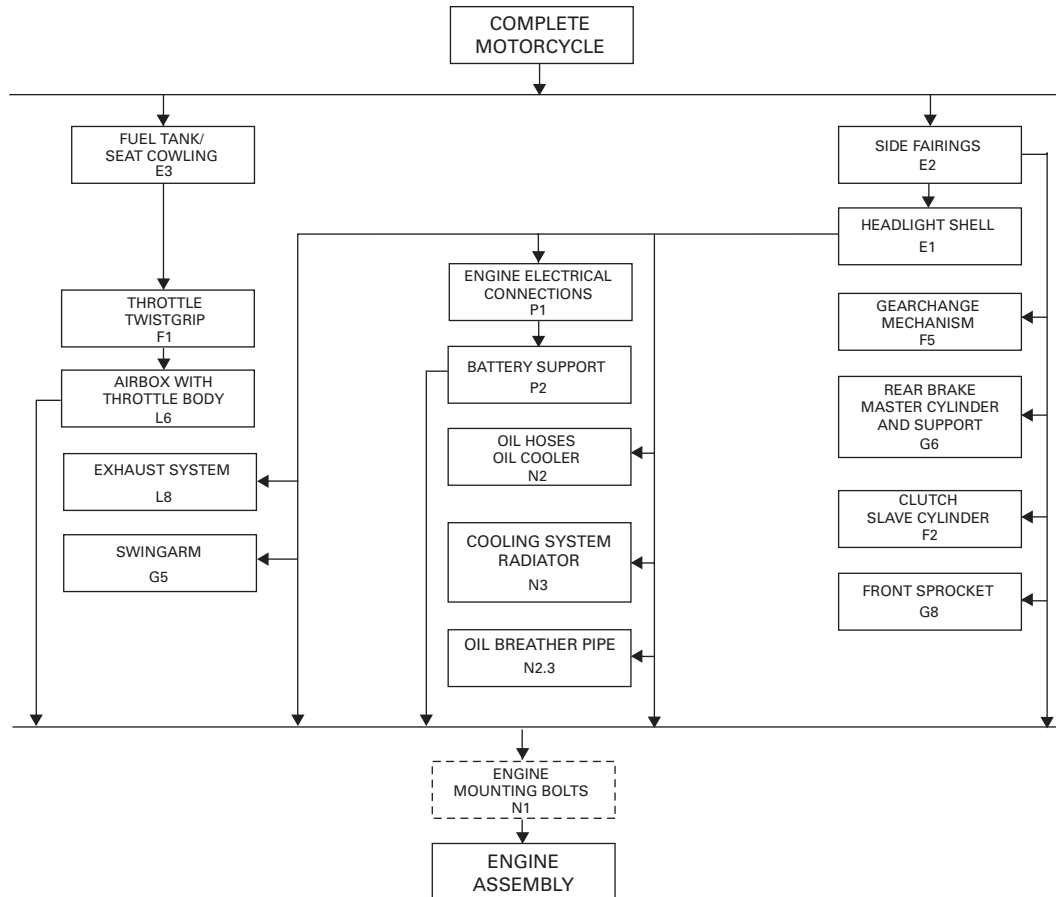
Removal of the engine

In order to remove engine you must first remove a series of other components from the motorcycle.

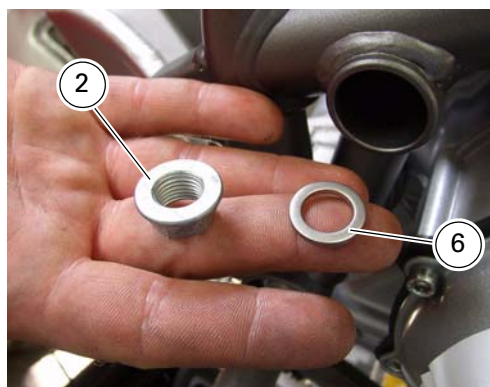
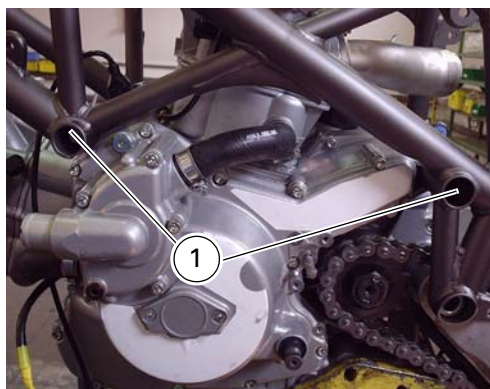
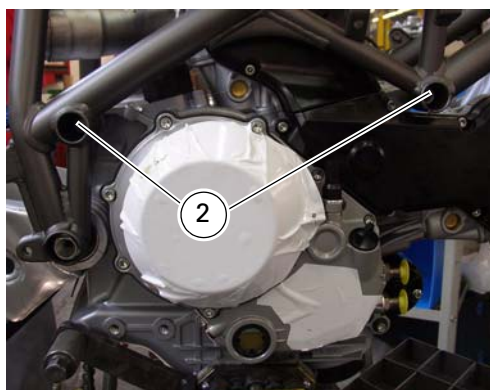
Most of these removal procedures are described in the relative sections of this manual.

The following flow chart illustrates the logical sequence in which the parts are to be removed from the motorcycle and a reference to the section where the removal procedure is described.

This section describes only the operations to be carried out after having removed all the parts listed in the diagram.



Place a stand beneath the engine to support it during removal from the frame.
Unscrew the nuts (2) on the right-hand side of the frame, on the two upper engine bolts (1) and recover the washers (6).



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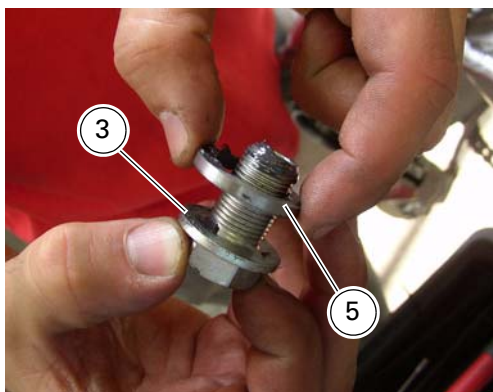
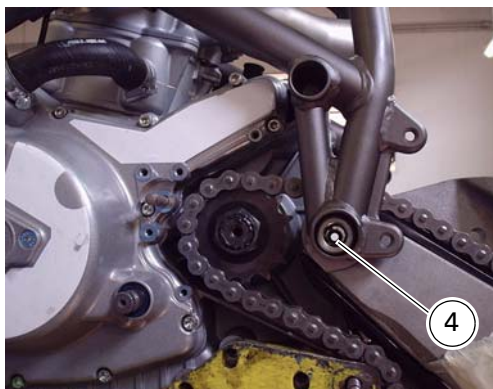
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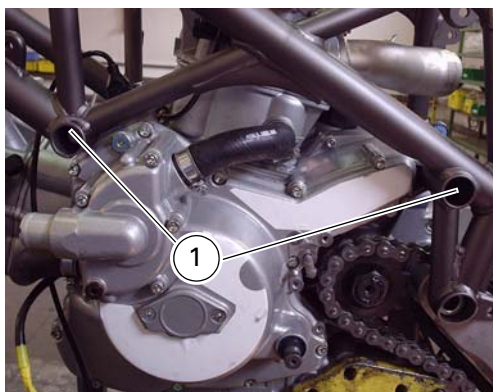
Restrain the swingarm pivot shaft (4) from the left side of the motorcycle while undoing the bolt (3) with washer (5) on the opposite side.

Use the drift **88713.1074** to fully extract the swingarm pivot shaft.

This frees the swingarm from the engine and therefore it can be left attached to the frame.



Remove the two upper bolts (1).



Withdraw the complete engine assembly from the frame by lowering it and pushing it forwards.

Refitting the engine

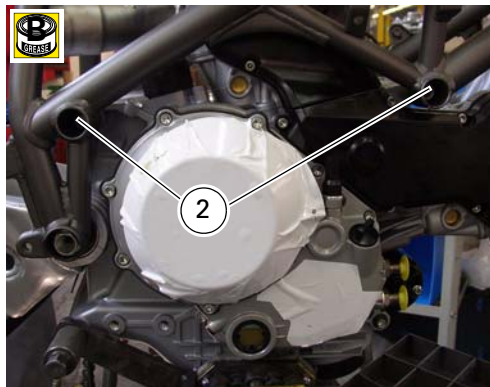
Refitting is the reverse of removal.



Important

Apply the recommended grease to the nuts (2) and tighten to the specified torque (Sect. C 3, engine tightening torques).

Refit the removed parts by performing the steps shown in the table and in the specific sections of the manual in reverse order.



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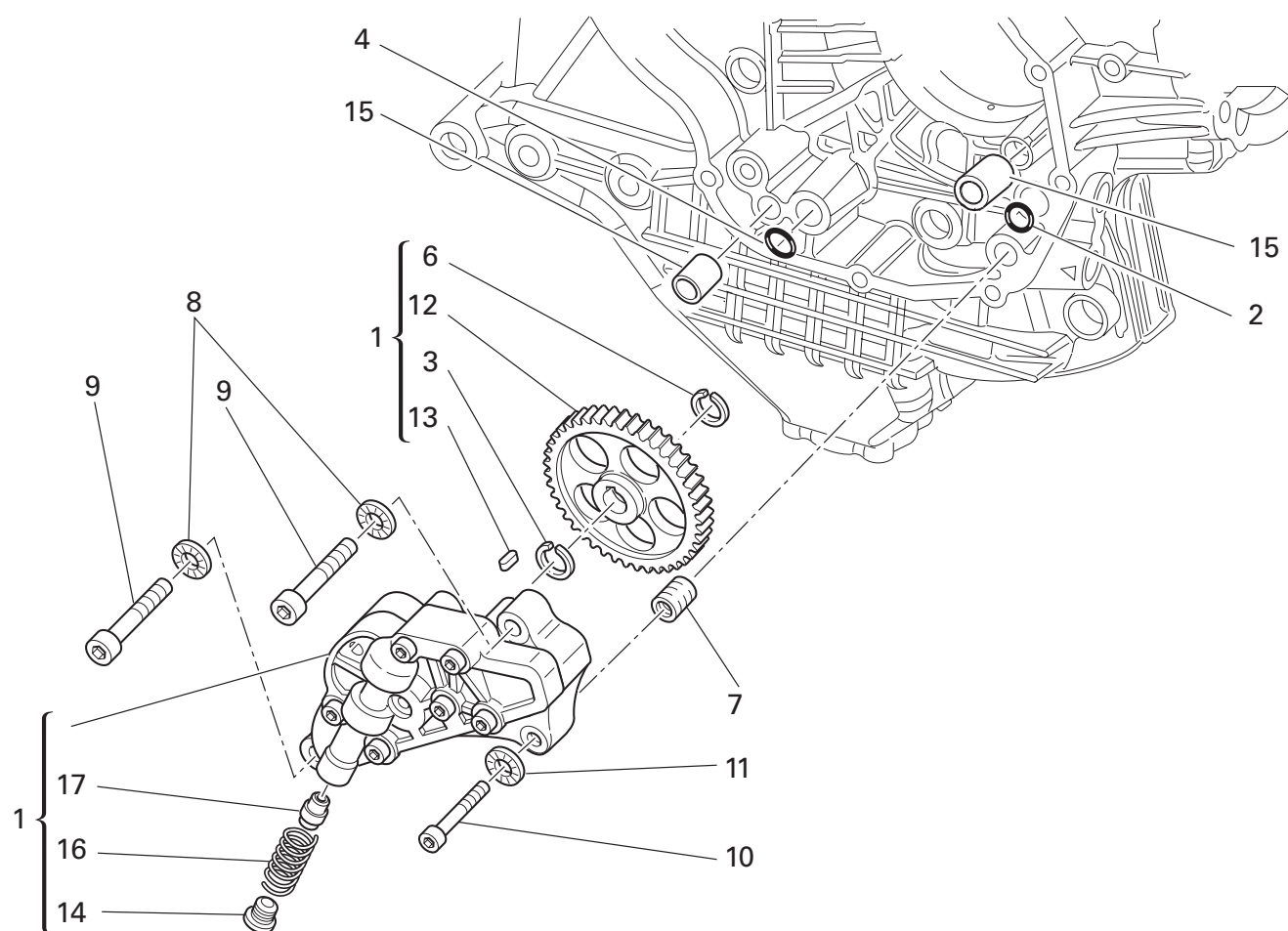
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2.1 - Lubrication system: oil pump



- 1 Complete oil pump assembly
- 2 O-ring
- 3 Circlip
- 4 O-ring
- 5 Pump body
- 6 Circlip
- 7 Reducer bush
- 8 Spring washer
- 9 Bolt
- 10 Bolt
- 11 Spring washer
- 12 Pump drive gear
- 13 Key
- 14 By-pass plug
- 15 Locating dowel
- 16 By-pass spring
- 17 By-pass valve

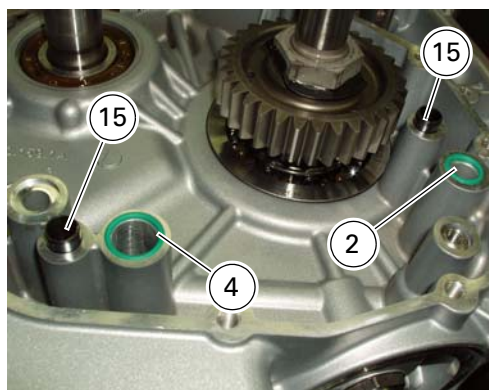
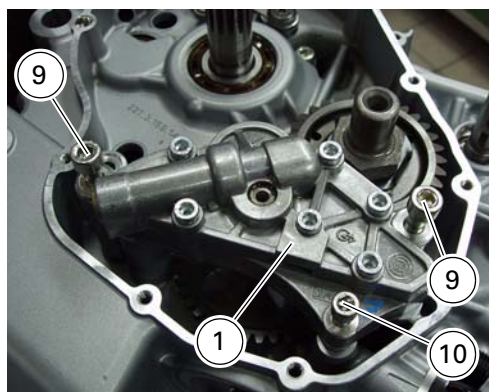
 **Important**
 Bold reference numbers in this section identify parts not shown in the figures next to the text. Refer to the exploded view diagram.

Removal of the oil pump

Operation	Section reference
Remove the engine from the frame	N 1, Removal of the engine
Remove the right-hand side crankcase cover	N 6.2, Removal of the right-hand side crankcase cover

Undo and remove the bolts (9) and (10) securing the pump assembly.

Remove the oil pump assembly (1) and extract O-rings (2) and (4) from the crankcase half together with two locating bushes (15).



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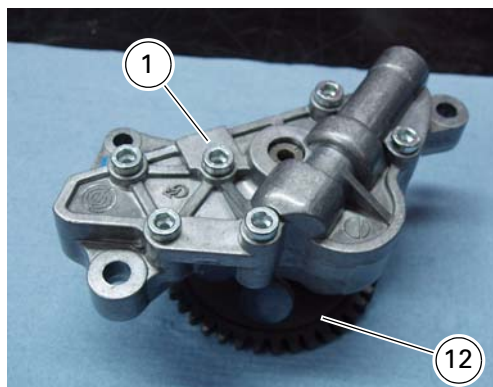
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Disassembly of the oil pump

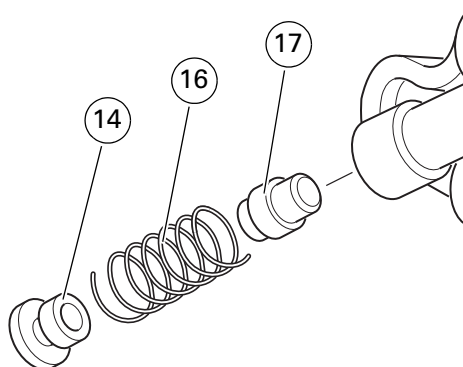
Hold the oil pump (1) in a vice taking care not to damage the drive gear (12).



Warning

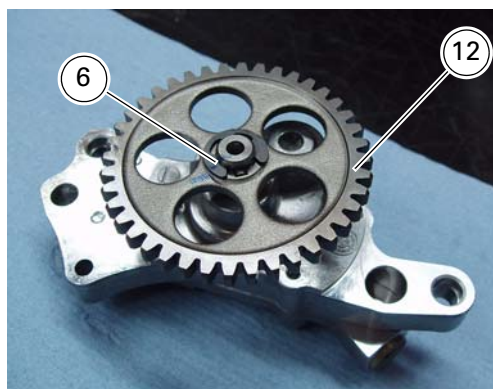
Make sure that vice jaws are faced with soft material.

Remove plug (14) and extract the spring (16) and by-pass valve (17).



Check the condition of the above components.

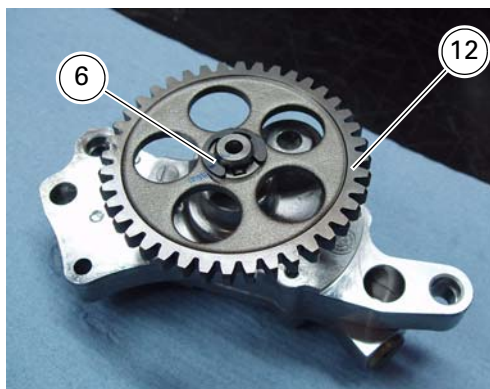
Remove the circlip (6) and withdraw the pump drive gear (12).



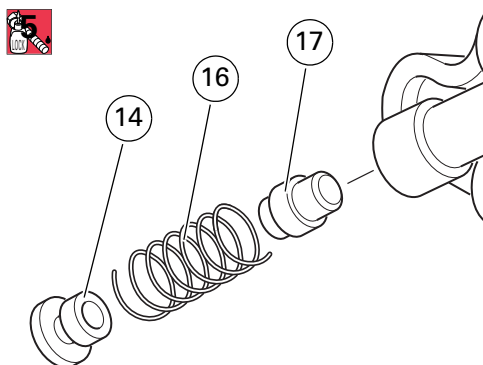
Reassembly of the oil pump

Check that the circlip (**3**) and Woodruff key (**13**) are both present on the pump.

Fit the pump drive gear (**12**) on to the oil pump and secure it by installing the circlip (**6**) in its groove.



Install in the pump the by-pass valve (17) and the spring (16); screw in the plug (14) and tighten to the specified torque (Sect. C 3, Engine torque settings) after applying a medium strength threadlocker.



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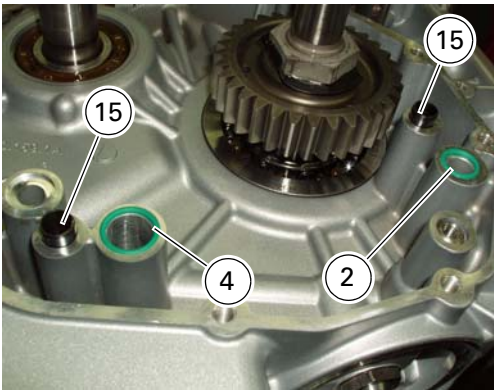
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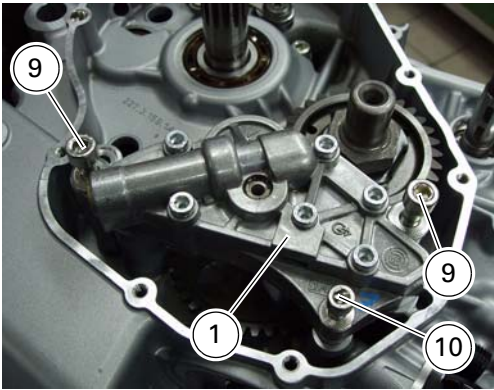
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Refitting the oil pump

Position the locating bushes (15) and the O-rings (2) and (4) in correspondence with the crankcase lubrication oilways.



Position the oil pump on the crankcase and tighten the bolts (9) and (10) to the specified torque (Sect. C 3, Engine torque settings).



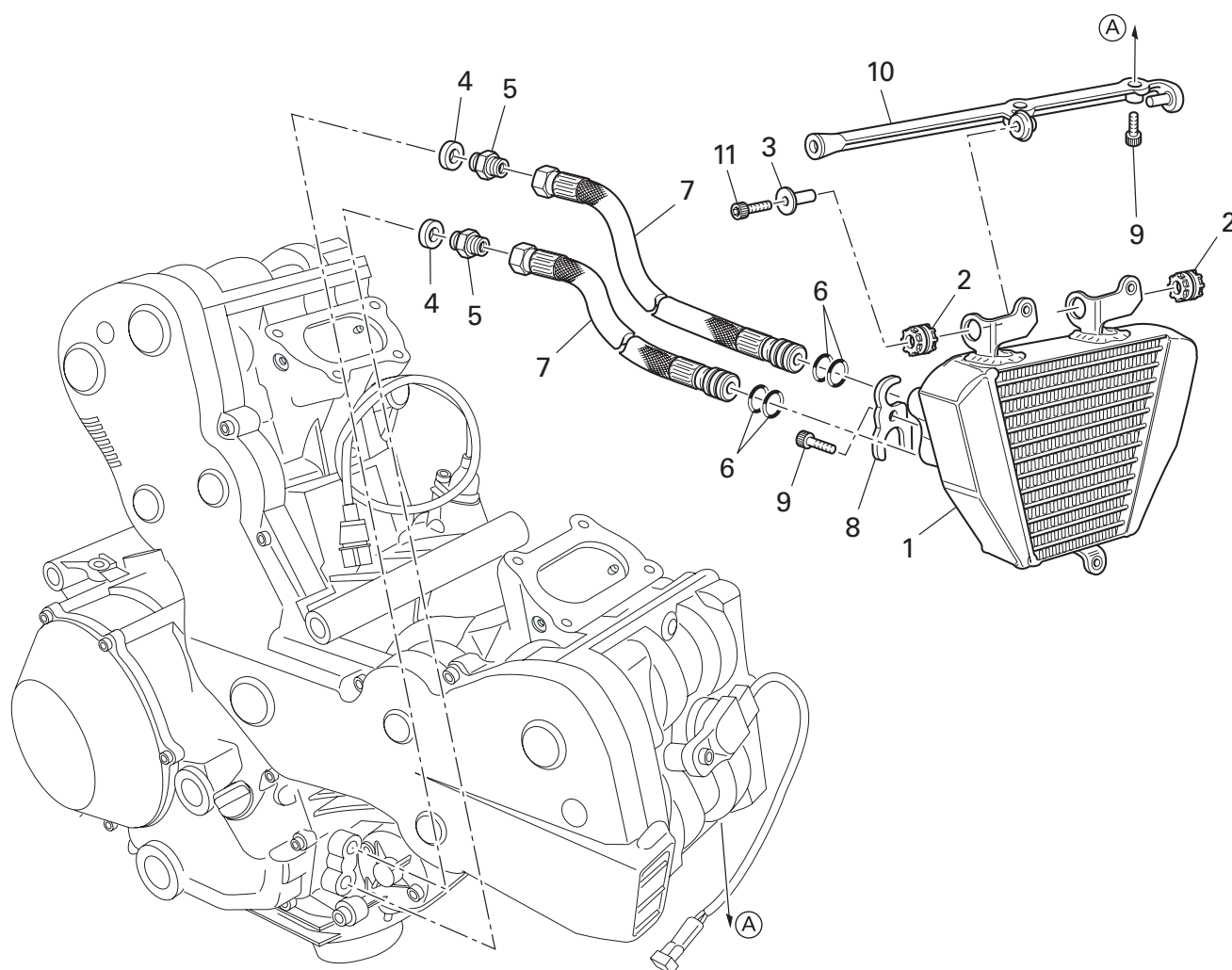
Check the gear backlash with the driving pinion by fixing dial gauge part no. **88765.1518**, equipped with the appropriate stylus, to the crankcase half.

Position the dial gauge stylus on a tooth of the oil pump gear and set the gauge to zero. Move the gear slightly to measure backlash; take four readings in diametrically opposed positions of the gear. The backlash should be **0.10** mm.



Operation	Section reference
Refit the right-hand crankcase cover	N 6.2, Refitting the right-hand side crankcase cover
Refit the engine to the frame	N 1, Refitting the engine

2.2 - Lubrication system: oil cooler



- 1 Oil cooler
- 2 Rubber mounting
- 3 Spacer
- 4 Aluminium gasket
- 5 Nipple
- 6 O-ring
- 7 Oil hose
- 8 Plate
- 9 Bolt
- 10 Support
- 11 Bolt



Important

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

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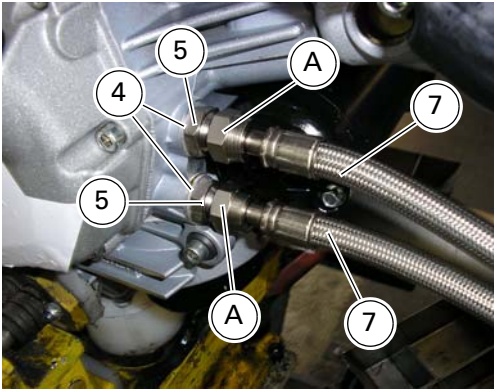
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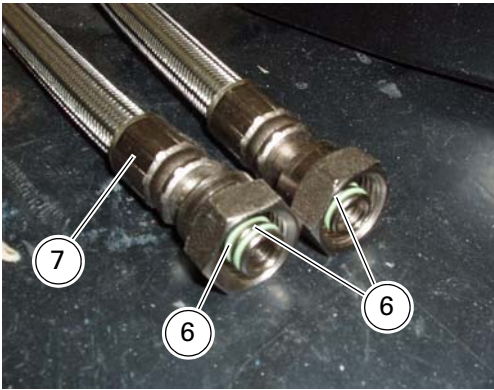
Removal of the lubrication system

Operation	Section reference
Remove the side fairings	E 2
Drain the oil from the lubrication system	D 4

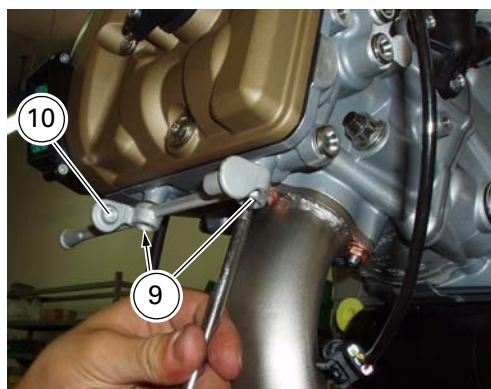
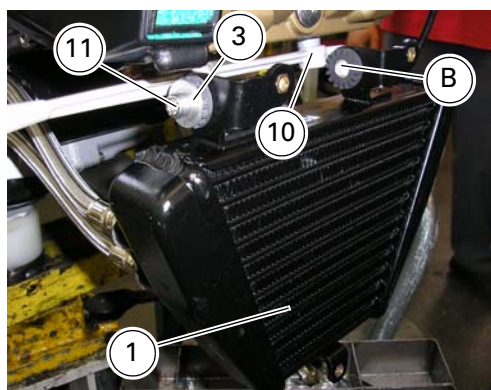
Undo the nuts (A) on the feed and return hoses (7) and the nipples (5) and disconnect them from the engine.
Unscrew the nipples (5) on the crankcase and recover the gaskets (4).



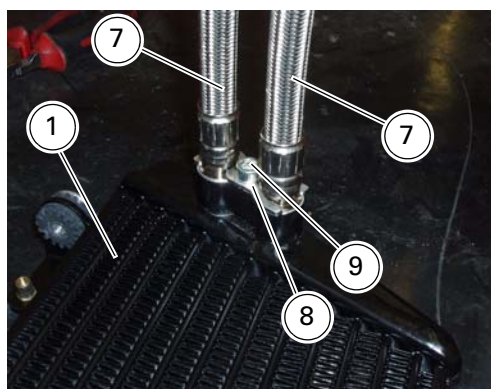
During removal, take care not to lose the O-rings (6) which ensure a tight seal.



Unscrew and remove the bolt (11) with the spacer (3) securing the oil cooler to the support (10). Remove the oil cooler, withdrawing the pin (B) of the support (10).
The support (10) can now be removed by unscrewing the bolts (9).



Unscrew the bolt (9) securing the plate (8) to the oil cooler (1).
Unscrew the feed and return hoses (7) from the oil cooler (1).



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Oil cooler inspection

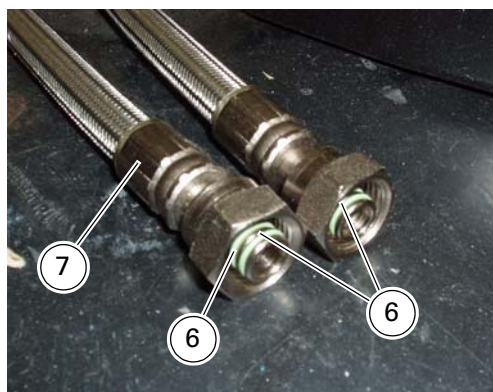
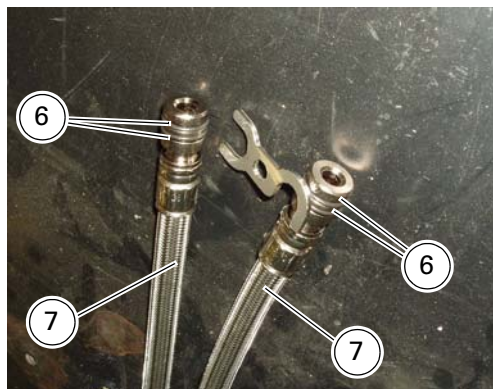
Make a visual inspection of the oil cooler. Renew the cooler in the presence of damage or leaks.

Refitting the lubrication system

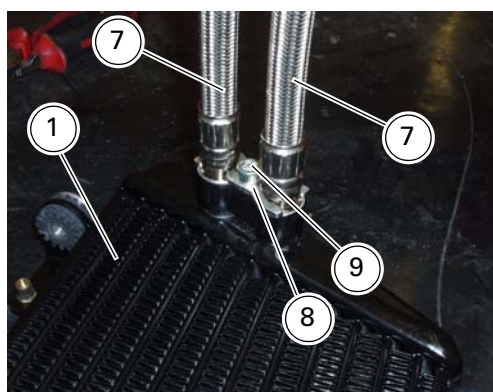


Notes

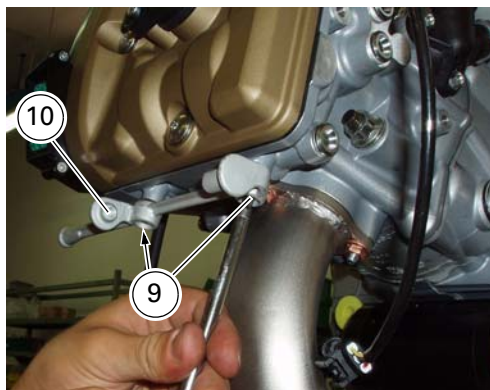
Before installing the hoses (7), check that the O-rings (6) are installed and lubricate them with engine oil.



Locate the feed and return hoses (7) on the cooler with the plate (8) and tighten the bolt (9) to secure.



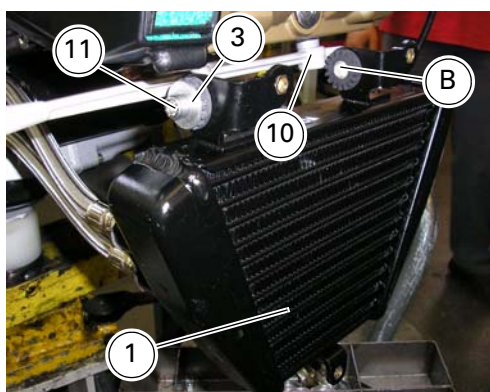
If removed, refit the support (10) securing it to the horizontal cylinder head with the two bolts (9).



Fit the oil cooler (1), firsts inserting it in the pin (B) of the support (10).

Fit the spacer (3) and the bolt (11).

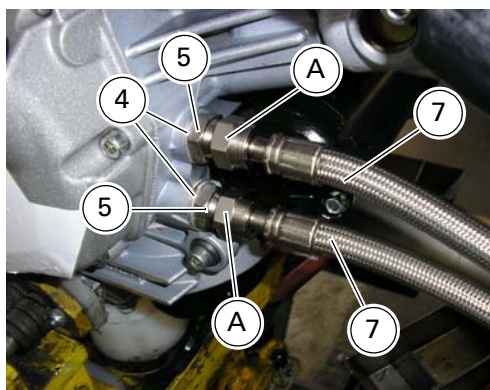
Tighten the bolt (11) to the specified torque (Sect. C 3).



Locate the gaskets (4) and the nipples (5) in their seats in the crankcase.

Tighten the nipples (5) to the specified torque (Sect. C 3).

Locate the feed and return hoses (7) on the crankcase and tighten the nuts (A).



Operation	Section reference
Fill the lubrication system	D 4
Refit the side fairings	E 2

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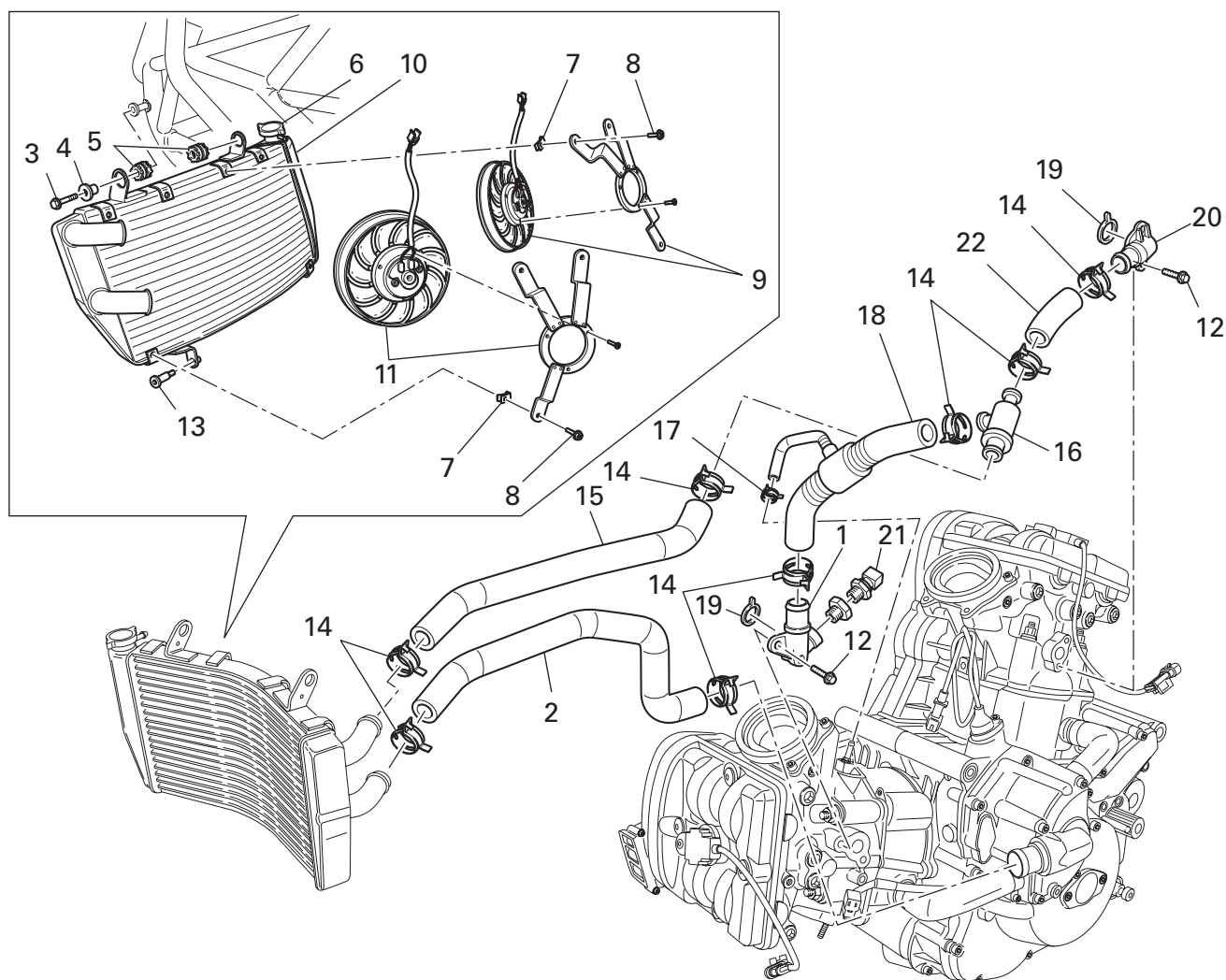
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3.2 - Cooling system: radiator



- 1 Horizontal coolant outlet union
- 2 Pump/radiator hose
- 3 Bolt
- 4 Spacer
- 5 Rubber
- 6 Radiator cap
- 7 Spacer
- 8 Bolt
- 9 RH cooling fan
- 10 Radiator
- 11 LH cooling fan

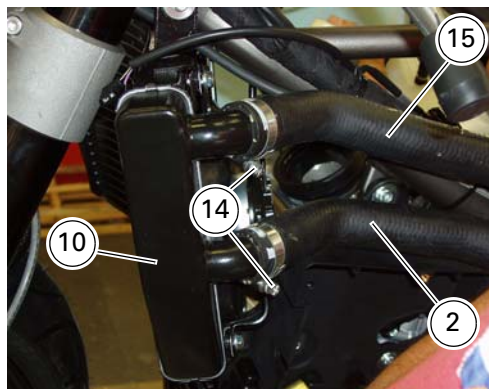
- 12 Bolt
- 13 Special screw
- 14 Clamp
- 15 Radiator/thermostat hose
- 16 Thermostat
- 17 Clamp
- 18 Thermostat/cylinder head hose
- 19 Seal
- 20 Vertical coolant outlet union
- 21 Coolant temperature sensor
- 22 Thermostat/cylinder head hose

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

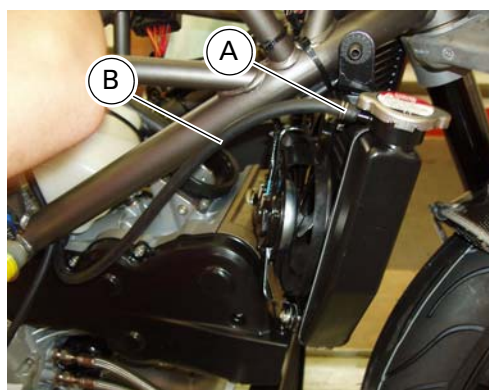
Removal of the radiator

Operation	Section reference
Drain the cooling system	D 4
Remove the side fairings	E 2
Remove the battery support	P 2

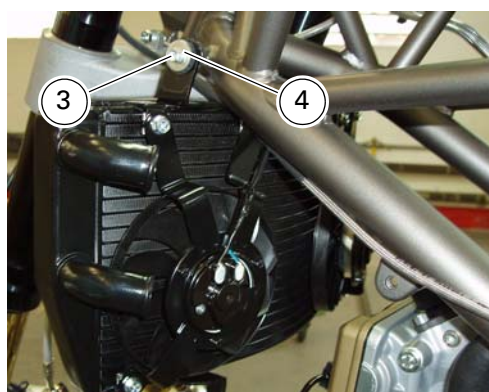
Loosen the clamps (14) on the coolant hoses (15) and (2); disconnect the hoses from the unions on the radiator (10).



Loosen the clamp (A) and remove the expansion tank-radiator hose (B).



Undo the bolt (3) with the spacer (4) fixing the radiator to left-hand side of frame.



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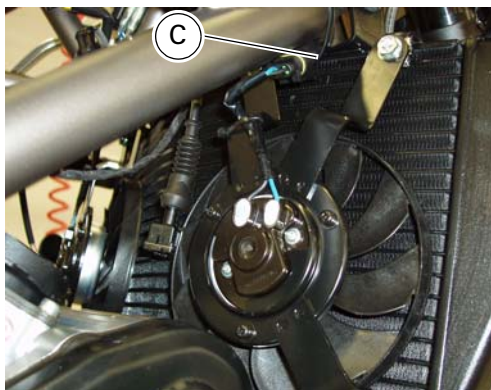
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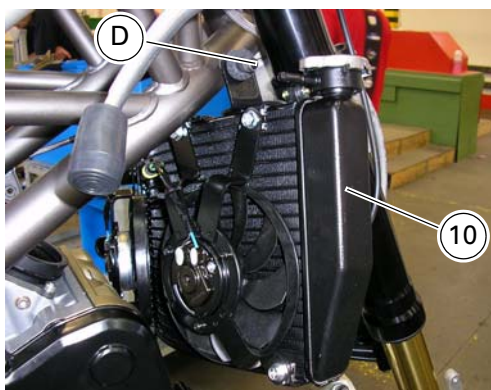
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Disconnect the wiring connectors of the main wiring loom (C) from both fans.



Remove the radiator (10) from the motorcycle, withdrawing it from the pin (D), on the upper right-hand side of the frame.



Radiator inspection

Make a visual inspection of the radiator. If it shows signs of damage or leaks, the radiator must be renewed. Check also that the air flow through the radiator core is not obstructed by leaves, insects, mud, etc.



Important

An excessively high coolant temperature may be caused by partial obstruction of the radiator core.

Carefully check the condition of the radiator core.

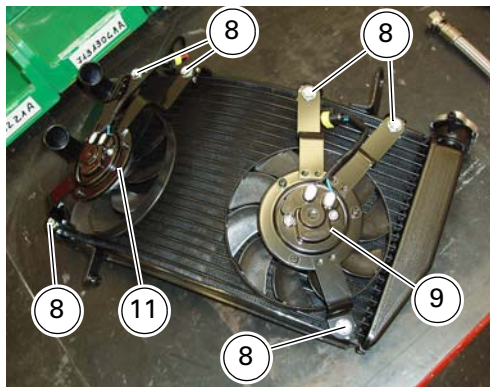


Renewal of the cooling fan

Unscrew the three fan retaining bolts (8) and remove the fan (11) from the radiator.

Repeat the above operation for the other cooling fan (9).

When refitting the fan, tighten the bolts (8) to the specified torque (Sect. C 3).



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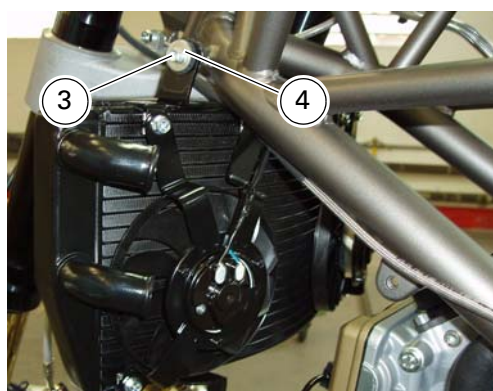
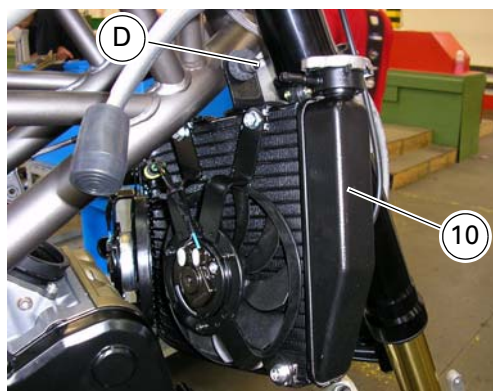
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Refitting the radiator

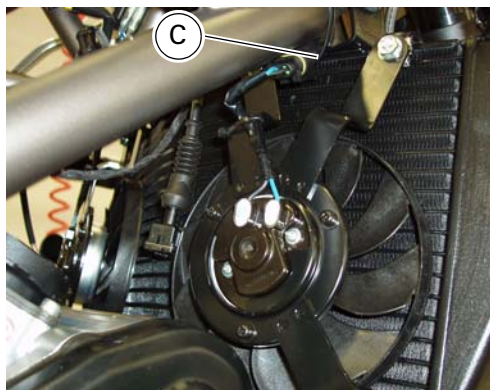
Check that the rubber mountings (5) are present on the upper radiator brackets (10) and that the special screw (13) is fitted.



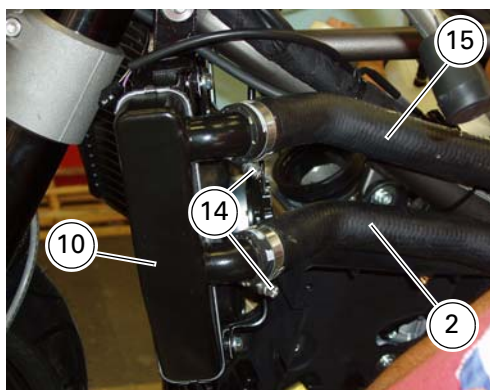
Insert the support of radiator (10) on the pin (A) on the right-hand side of the frame and then fit the screw (3) with the spacer (4) on the left-hand side.
Tighten the bolt (3) to the specified torque (Sect. C 3).



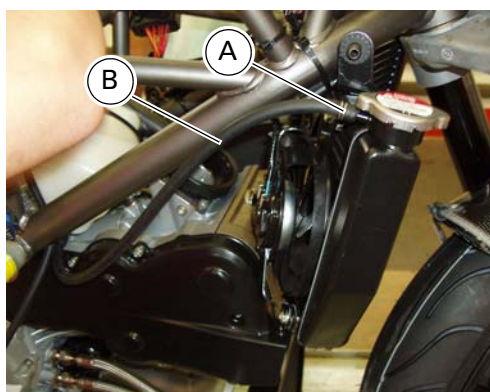
Reconnect the fan wiring to the main wiring loom (C).



Connect the cooling system hoses (15) and (2) to their respective unions on the radiator and tighten the clamps (14) to the specified torque (Sect. C 3).



Connect the expansion tank-radiator hose (B) to the inlet on the radiator cap and tighten the clamp (A) to the specified torque (Sect. C 3).



Operation	Section reference
Refit the battery support	P 2
Refit the side fairings	E 2
Drain the cooling system	D 4

A

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C

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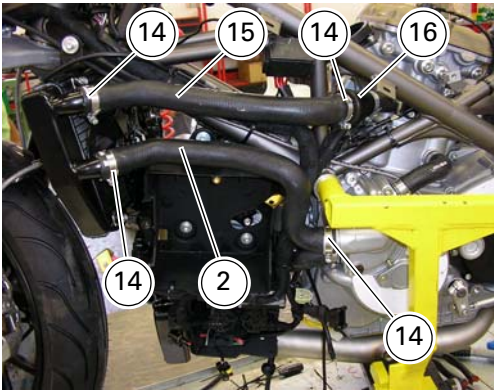
N

P

Removal of the cooling system hoses and unions

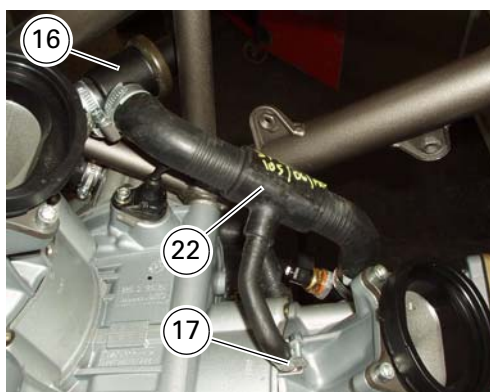
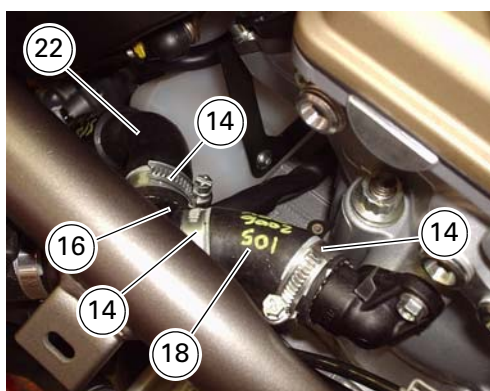
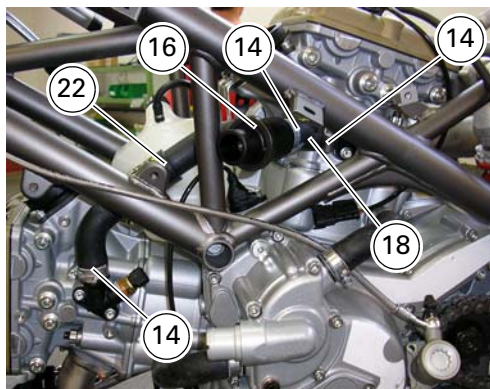
Operation	Section reference
Drain the cooling system	D 4
Remove the side fairings	E 2
Remove the battery support	P 2

Loosen the clamps (14) securing the hose (2) connecting the radiator (10) to the pump and the radiator/thermostat hose (15) to the thermostat (16).



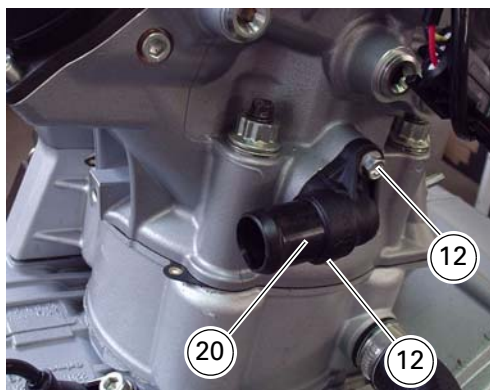
Loosen the clamps (14) and (17) securing the thermostat assembly (16) – thermostat/cylinder head hose (18) - thermostat/cylinder head hose (22).

Loosen the clamps (14) to dismantle the thermostat assembly (16) – thermostat/cylinder head hose (18) - thermostat/cylinder head hose (22).



Undo the bolts (12) and remove the union (20).

Recover the O-rings (19) located between the union and the vertical cylinder head.



A

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C

D

E

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G

H

L

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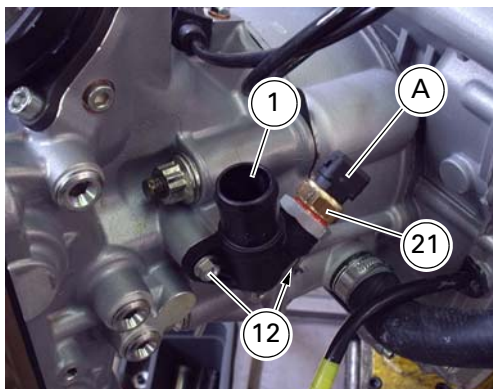
N

P

Disconnect the wiring connector (A) of the temperature sensor (21) on the horizontal cylinder head union (1) from the main wiring loom.

Unscrew the bolts (12) and remove the horizontal cylinder union (1).

Recover the O-rings (19) located between the union and the horizontal cylinder head.



Important

Periodically check the connection hoses for signs of leaks.

Hoses that are cracked, swollen, or hardened should be renewed.

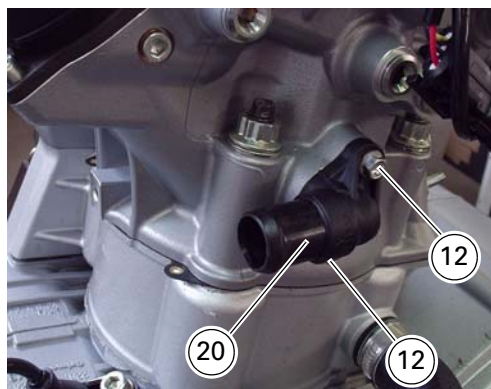
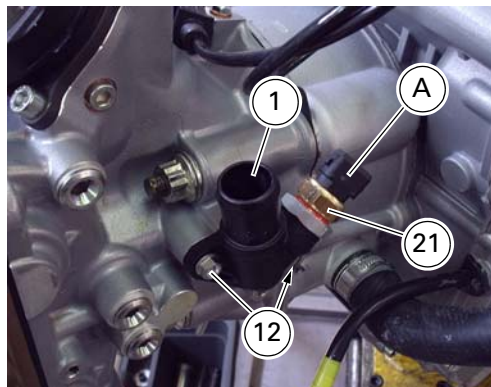
Refitting the cooling system hoses and unions

Install a seal (**19**) in the seat on the horizontal cylinder head union (1) and one in seat of the union (20).

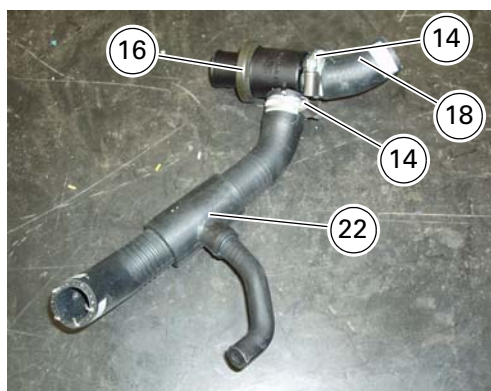
Fix the union (1) to the horizontal cylinder head (12) and tighten the bolts to the specified torque (Sect. C 3, Frame torque settings).

Fix the union (20) to the horizontal cylinder head (12) and tighten the bolts to the specified torque (Sect. C 3, Frame torque settings).

Reconnect the wiring connector (A) of the temperature sensor (21) on the horizontal cylinder head union (1) from the main wiring loom.



To reassemble the thermostat (16) - thermostat/cylinder head hose (18) – thermostat/cylinder head hose (22) assembly, locate the clamps (14) and tighten to the specified torque (Sect. C 3, Frame torque settings).



A

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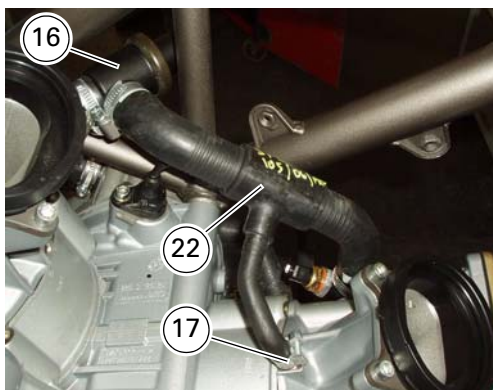
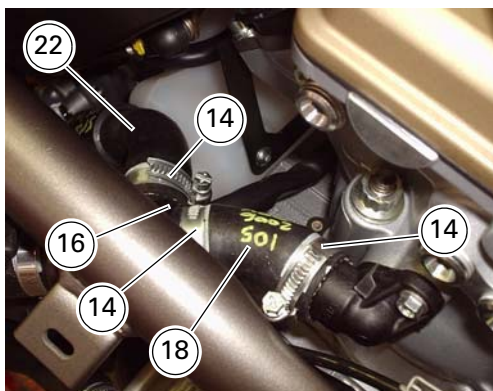
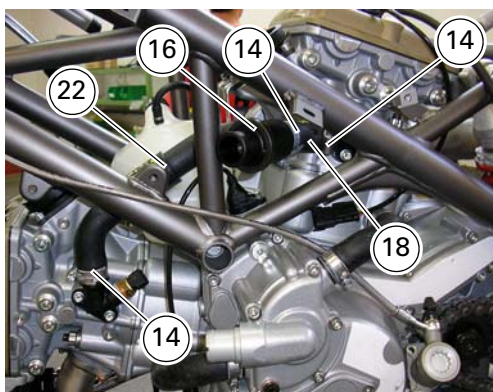
L

M

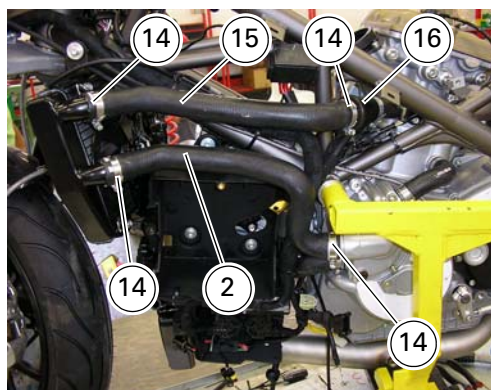
N

P

Locate the thermostat (16) - thermostat/cylinder head hose (18) – thermostat/cylinder head hose (22) assembly with the clamps (14) and (17) and tighten the clamps to the specified torque (Sect. C 3, Frame tightening torques).



Locate the pump/radiator hose (2) and radiator/thermostat hose (15) with the clamps (14) and tighten the clamps to the specified torque (Sect. C 3, Frame tightening torques).



Operation	Section reference
Refit the battery support	P 2
Refit the side fairings	E 2
Fill the cooling system	D 4

A

B

C

D

E

F

G

H

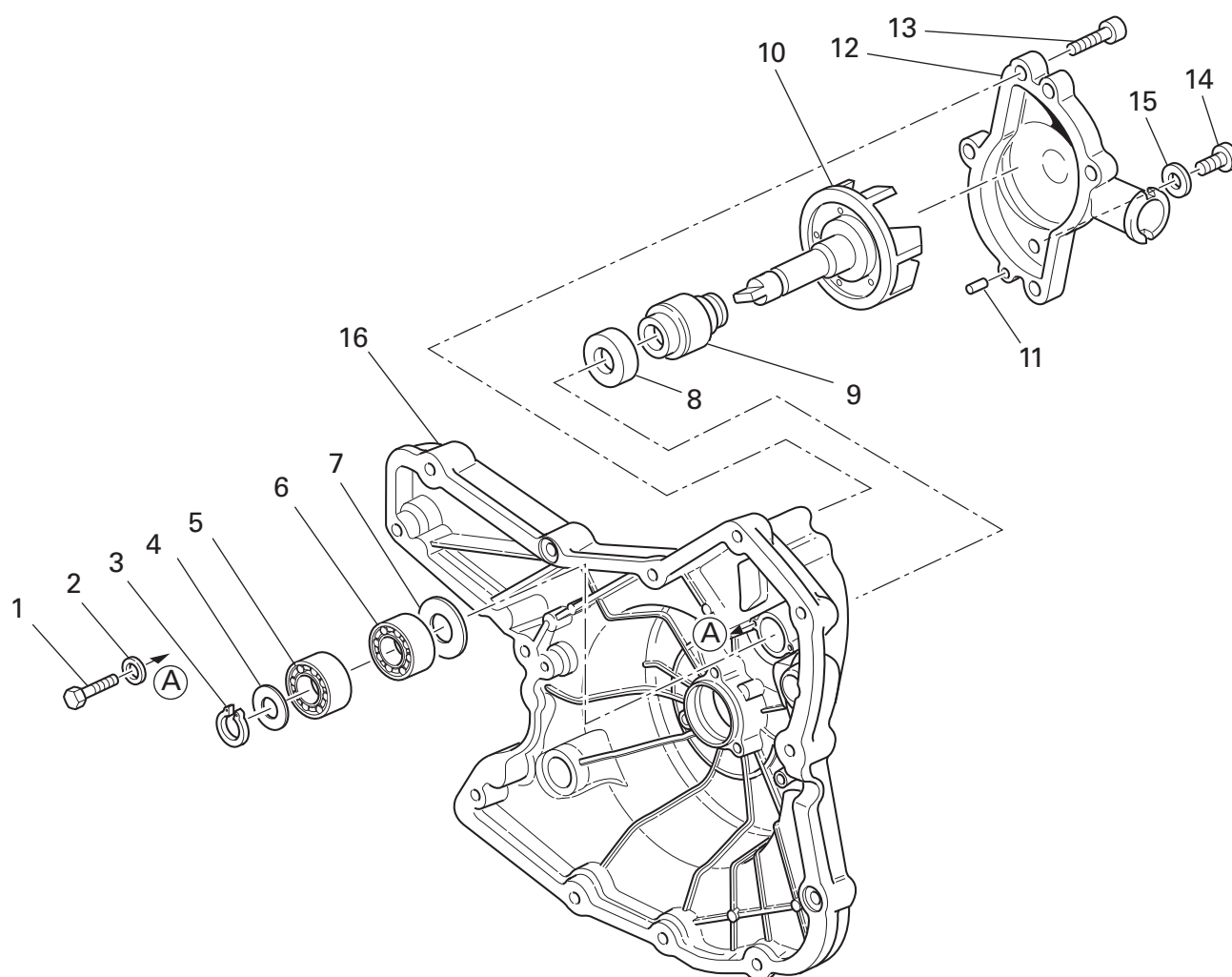
L

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N

P

3.3 - Cooling system: water pump



- 1 Bolt
- 2 Washer
- 3 Circlip
- 4 Washer
- 5 Outer bearing
- 6 Inner bearing
- 7 Spacer
- 8 Seal seat
- 9 Mechanical seal
- 10 Water pump impeller
- 11 Locating dowel
- 12 Water pump cover assembly
- 13 Bolt
- 14 Plug
- 15 Seal
- 16 Left-hand side crankcase cover

 Important

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

Removal of the water pump

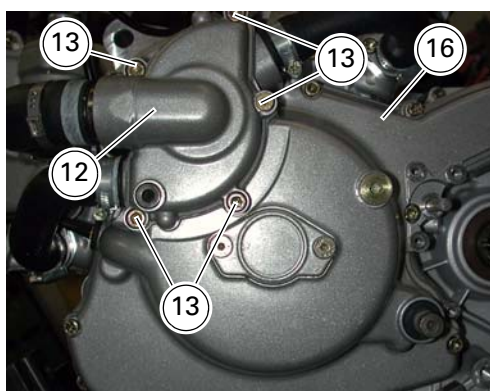
Operation	Section reference
Remove the side fairings	E 2
Drain the cooling system	D 4
Remove the cooling circuit hoses from the water pump cover.	N 3.2
Remove the left-hand side crankcase cover	N 8



Notes

For clarity, the figures show the engine removed from the frame.

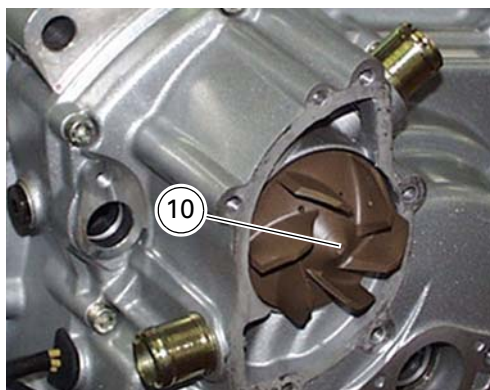
Undo and remove the five screws (13) securing the water pump cover (12) to the left-hand side crankcase cover (16).
Remove the water pump cover (12).



Clean the pump housing of any scale. Rotate the impeller shaft (10) to check the bearings for wear. If there is excessive play, renew the bearings as described below.

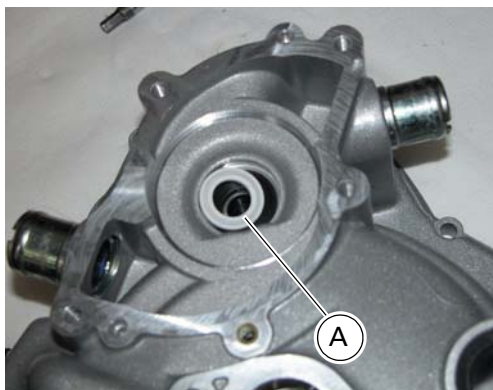
Remove the circlip (3) and washer (4) from the impeller shaft.

Withdraw the impeller (10) with the mechanical seal (9) from the outside.

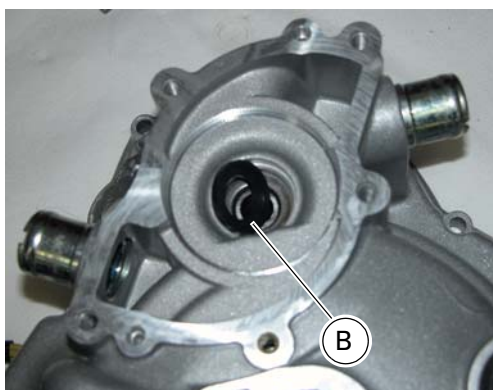


Recover the ceramic washer (A) and seal ring (B) located on the inner side.

A



B



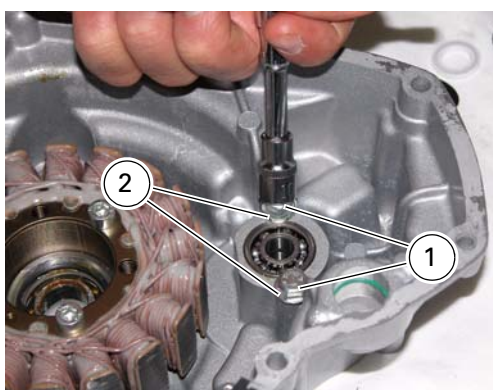
C

D

E

F

Undo and remove the screws (1) with washer (2).



G

H

Working from the impeller side, use a suitable drift to press on the inner race of the bearing (5) until it can be extracted from the cover.

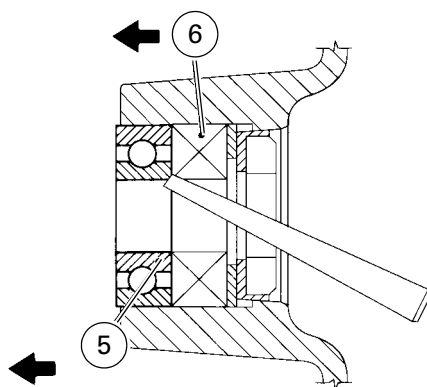
Use the same technique to remove the other bearing (6).

L

M

N

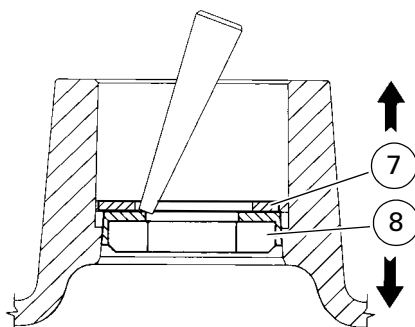
P



Working from the inside of the cover, remove the seat (8) of the mechanical seal (9).

Remove the inner spacer (7).

Check the condition of the components of the mechanical seal: there should be no signs of deformation, cracking, or excessive wear. In the case of damage, both components must be renewed.



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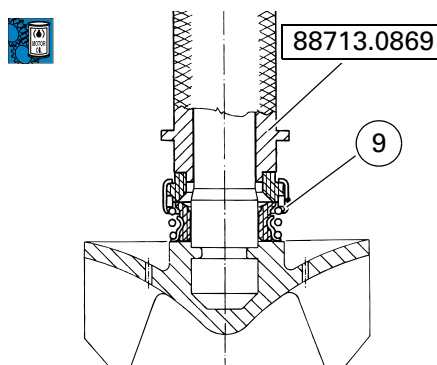
M

N

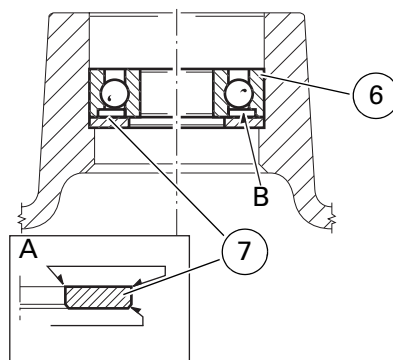
P

Refitting the water pump

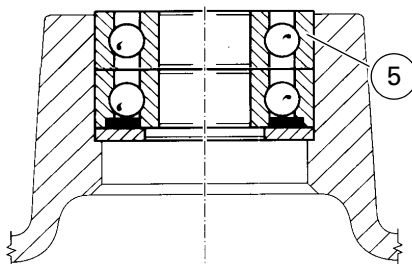
A Clean the seat in the cover, any parts you intend to reuse, and the impeller shaft. Lubricate with engine oil and refit as follows. Use drift part no. **88713.0869** to install the new mechanical seal (9) on the impeller shaft.



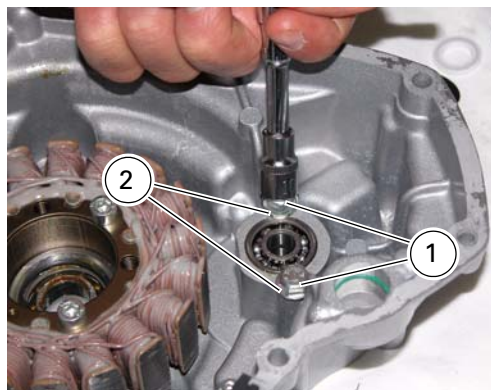
D Working from the inside of the cover, fit the inner spacer (7) with its square edge (A) facing outwards. Using a suitable drift that bears on the outer race, drive home the bearing (6) against the spacer (7) with the shield side facing the cover.



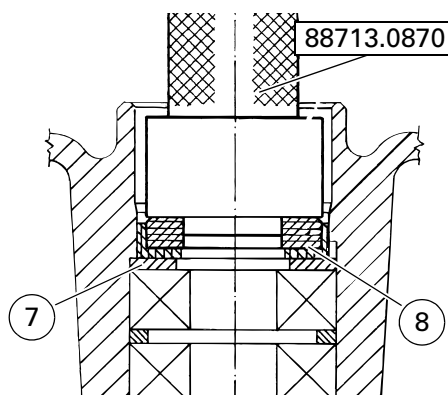
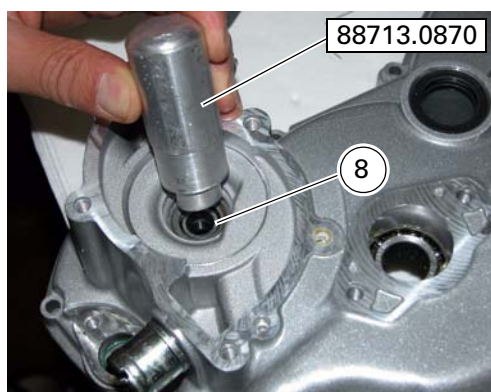
G Fit the other bearing (5) and drive it fully home against the previously fitted bearing.



Fit the two screws (1) with washer (2) and tighten them to the specified torque (Sect. C 3).



Turn over the cover and use drift part no. **88713.0870** to install the seal seat (8), oriented as shown in the figure, fully home against spacer (7).



A

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Fit the seal ring (B) and the ceramic washer (A).

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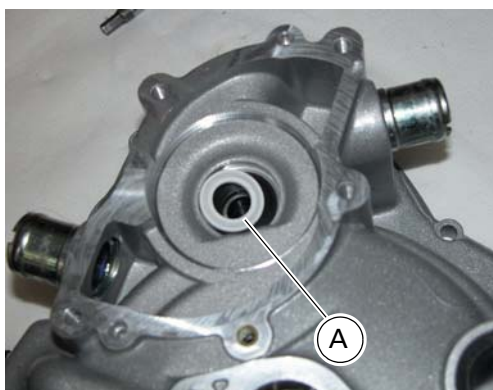
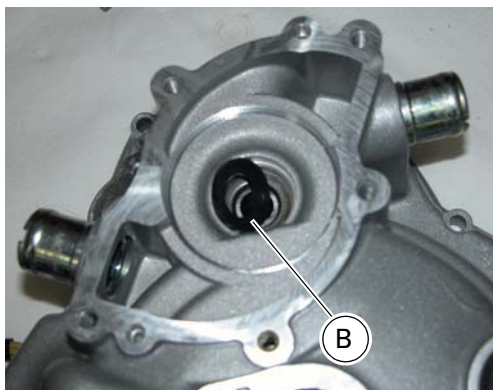
H

L

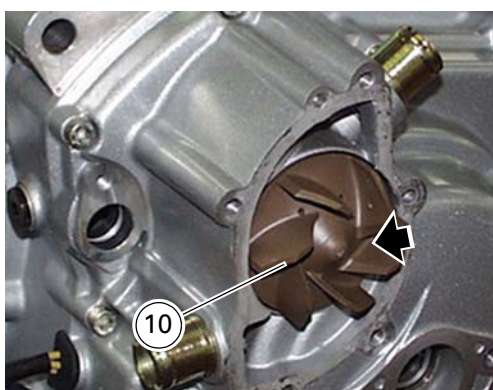
M

N

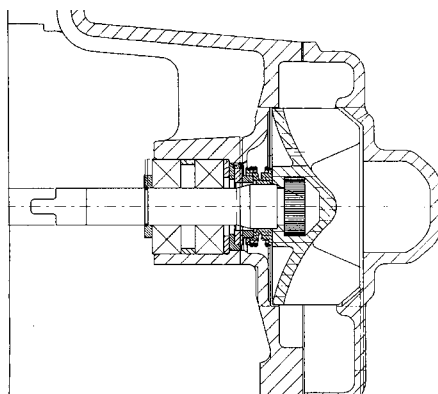
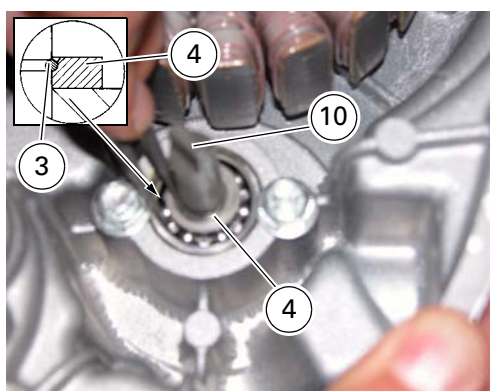
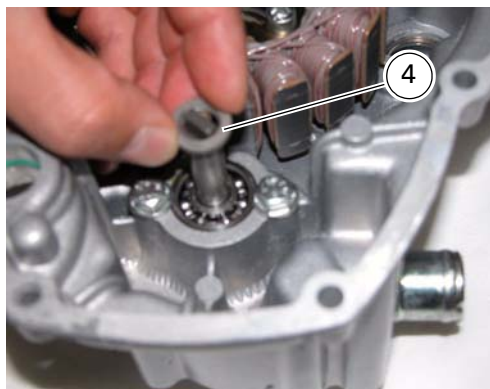
P



Insert the impeller shaft (10) with the mechanical seal (9). Turn the cover over.



Insert the impeller shaft (10) with the mechanical seal. Turn the cover over.
Fit the spacer (4), positioned as shown in the cross-sectional view, and secure with the circlip (3).
Rotate the impeller (5) and make sure it turns smoothly without sticking.
Clean the mating surfaces thoroughly on the pump cover and on the left-hand side crankcase cover.



A

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A

Apply a bead of liquid gasket to the water pump cover (12) as shown in the figure.
Fit the locating dowels (11) and position the pump cover (12) on the left-hand side crankcase cover.
Start the screws (13) in their threads.
Tighten the screws (13) to the specified torque (Sect. C 3).
Refit the components removed in the procedure.

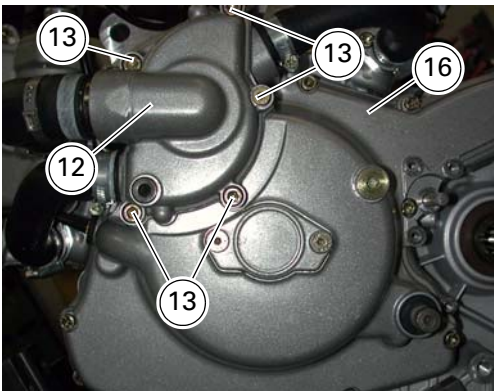
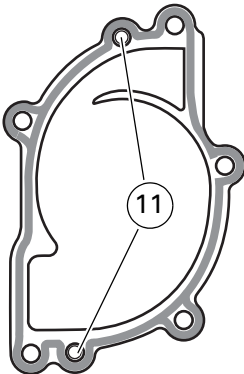
B

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D

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F



G

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L

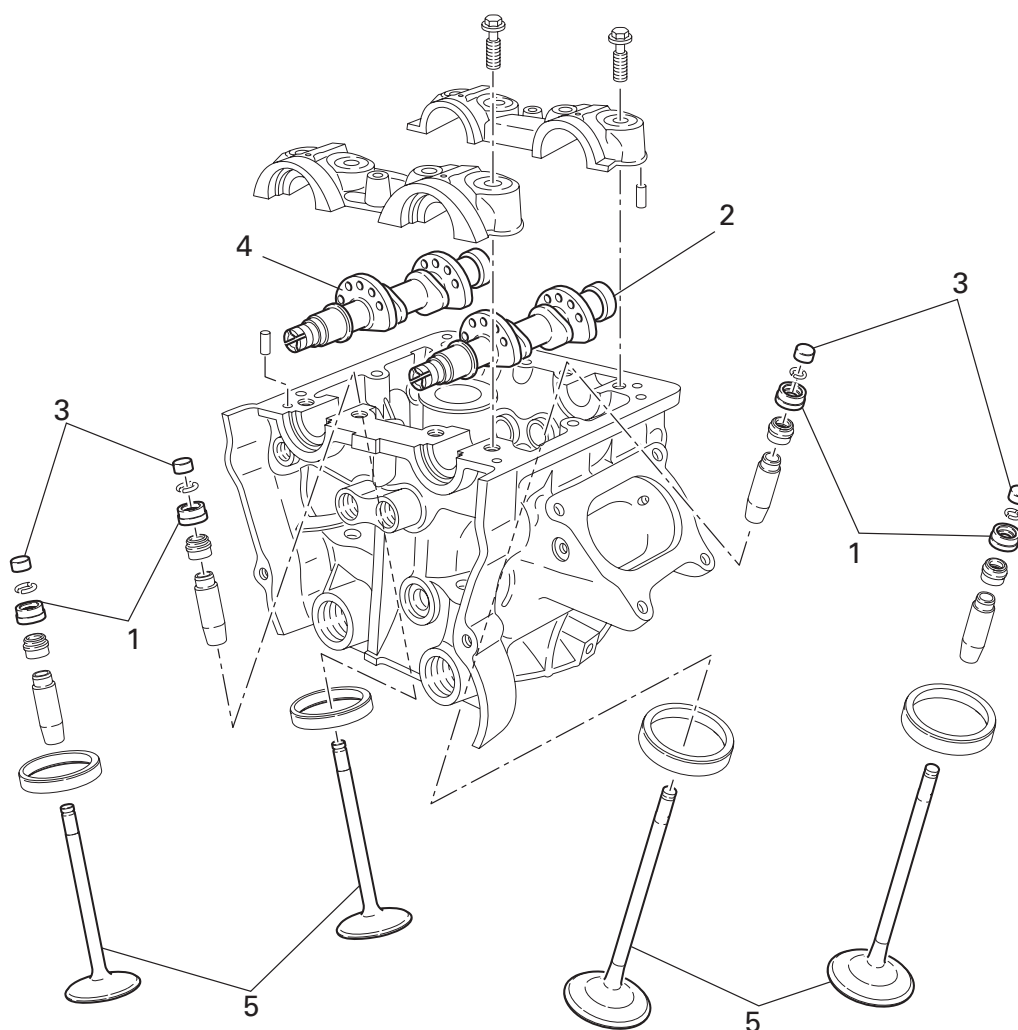
M

N

P

Operation	Section reference
Refit the left-hand side crankcase cover and the connect the cooling system hoses to the crankcase cover.	N 8
Refit the cooling system hoses to the water pump cover.	N 3.2
Fill the cooling system	D 4
Fit the side fairings	E 2

4.1 - Cylinder head assemblies: checks and adjustments



- 1 Closing shim
- 2 Intake side camshaft
- 3 Opening shim
- 4 Exhaust side camshaft
- 5 Valve



Important

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

A

B

C

D

E

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H

L

M

N

P

Checking and adjusting the valve clearances

A

Operation	Section reference
Remove the side fairings	E 2
Remove the radiator	N 3.2
Remove the fuel tank/seat cowling assembly	E 3
Remove the airbox	L 6
Remove the timing belts	N 4.2
Remove the rocker cover	N 4.4

B

C

Notes

For clarity, the figures show the engine removed from the frame.

D

Checking the opening clearance

Move the piston of the cylinder being checked to TDC of the power stroke: in this condition all the valves are closed and the camshafts are in their rest position and thus free to rotate.

Using a feeler gauge, check the clearance between the opening rocker arm (A) and the lower edge of the camshaft cam (B).

The clearance must be within the specified limits (Sect. C 1.1).

If it is not, remove the opening shim (3), as described in the paragraph "Removal of the valves" (Sect. N 4.5), and replace it with a shim of adequate height to obtain the specified clearance.

E

Notes

Opening rocker arm shims measuring 2 to 3.45 are available as replacement parts: each shim is marked with its size.

F

G

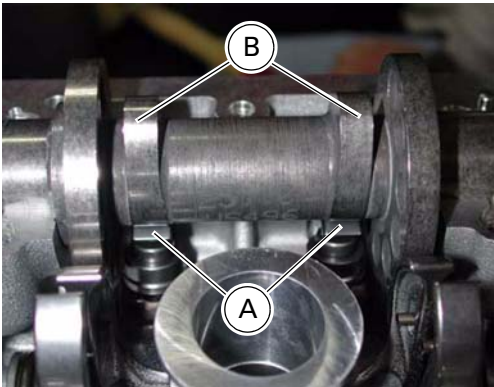
H

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M

N

P



Checking the closing clearance

Using a feeler gauge, check the clearance between the closing rocker arm shoe and the upper edge of the camshaft cam, taking care not to compress the rocker arm return spring.

The clearance must be within the specified limits (Sect. C 1.1).

If it is not, remove the closing shim, as described in the paragraph "Valve disassembly" (Sect. N 4.5), and replace it with a shim of suitable height to obtain the specified clearance.

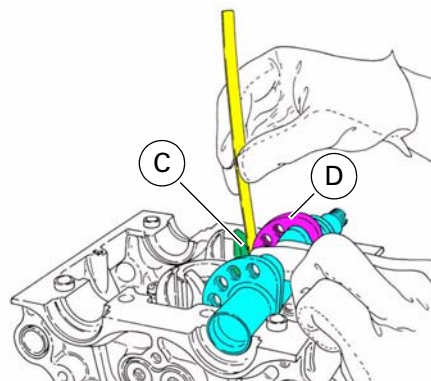
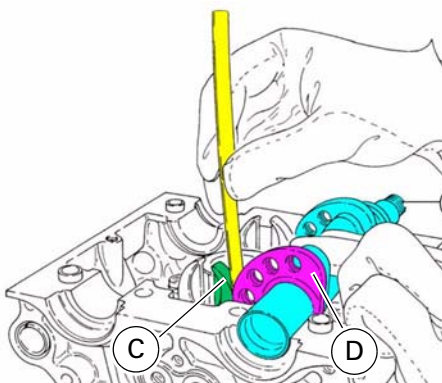


Notes

Closing rocker arm shims measuring from 2.2 to 4.5 are available as replacement parts: each shim is marked with its size.

Check and adjust the clearances of all valves.

Refit the opening and closing shims as described in paragraph "Refitting rocker arms and valves" (Sect. N 4.5).



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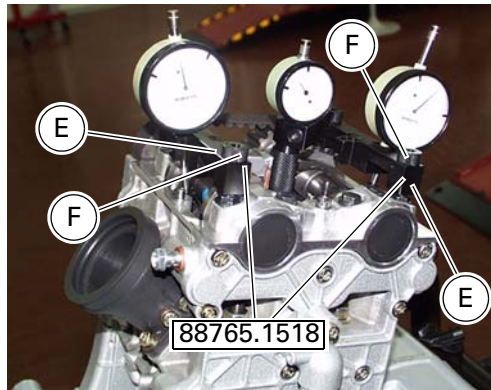
M

N

P

Checking valve lift

Put the engine in the condition described in "Checking and adjusting the valve clearances" above.
Install the dial gauge stand (E) **88765.1518** on the intake side camshaft bearing studs, and secure it with the knobs (F).



Set the opening valve clearance to zero when the camshaft is in its rest position by fitting a feeler gauge between the upper rocker arm and the opening shim.

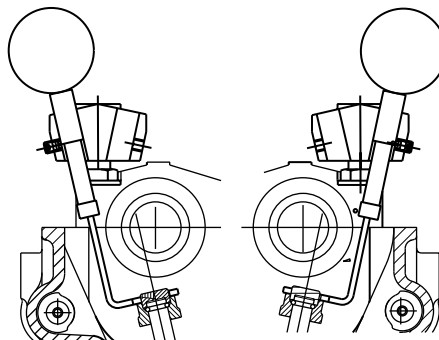
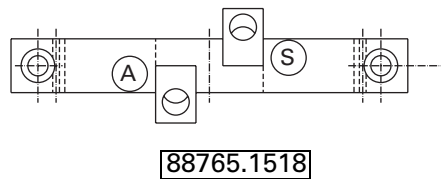
Lock the dial gauge into the seat of the stand marked "A" and position the fork probe against the face of the closing shim.
Set the dial gauge to zero when the valve is fully closed.

Rotate the intake camshaft so as to allow the intake valves to lift fully.

Check that the reading on the dial gauge corresponds to the specified value (Sect. C 1.1).

Repeat the same procedure with the exhaust valves, moving the stand to the opposite studs and fitting the dial gauge into the seat marked "S" on the stand (E).

(E)



Refit all parts by carrying out the operations described under “Checking and adjusting the valve clearances” above.
Refit the components removed in the procedure.

Operation	Section reference
Refit the timing belts	N 4.2
Refit the rocker cover	N 4.4
Refit the airbox	L 6
Refit the fuel tank/seat cowling assembly	E 3
Refit the radiator	N 3.2
Refit the side fairings	E 2

A

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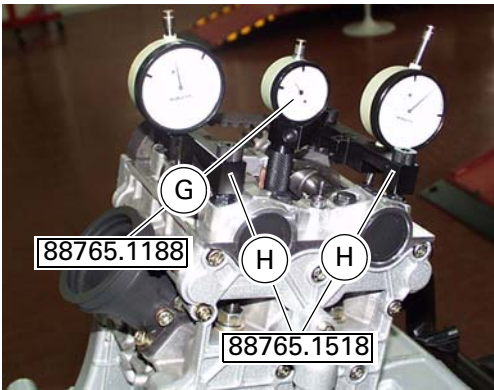
N

P

Checking the engine timing

Operation	Section reference
Remove the side fairings	E 2
Remove the radiator	N 3.2
Remove the fuel tank/seat cowling assembly	E 3
Remove the airbox	L 6
Remove the timing belts	N 4.2
Remove the rocker cover	N 4.4
Remove the water pump cover	N 3.3

Put the engine in the condition described in “Checking and adjusting the valve clearances” above.
Install tool (G) **88765.1188** in the spark plug bore to determine piston's TDC, along with gauges (H) **88765.1518** and the timing check tool (L) (timing degree wheel **88765.1523** with graduated disk).



Set the opening valve clearance to zero when the camshaft is in its rest position by fitting a feeler gauge between the upper rocker arm and the opening shim.
Check that the camshaft can rotate in this condition. If it is stiff, use a thinner feeler gauge.



In this condition, with the piston of the horizontal cylinder at TDC with the valves fully closed as confirmed by the reading on gauge (G), set the gauges (H) to zero.

Refit the belts and tension them as described in Sect. N 4.2.

Turn the degree wheel (L) counterclockwise until the dial gauge (H) on the exhaust side reads a lift of **1 mm**. Check that the angular displacement reading in degrees on the degree wheel (L) is as specified.

Continue to rotate in the same direction until you obtain a **1 mm** lift on the intake side. Check the angular value on the degree wheel.

Continue turning the shaft until you reach total closure of the valve on the expansion stroke.

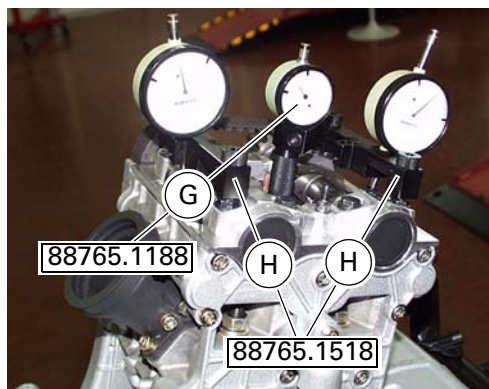
Now reverse the rotation (i.e. clockwise) of the degree wheel (L) until gauge (H) shows a **1 mm** lift of the intake valve.

Check that the angular value is as specified.

Continue turning the degree wheel clockwise until the gauge shows a lift of the exhaust valve of **1 mm**. Check the angular value against the specified value.

Repeat the procedure for the vertical cylinder.

Permissible tolerance for measured values is $\pm 3^\circ$ with respect to specified values.



A

B

C

D

E

F

G

H

L

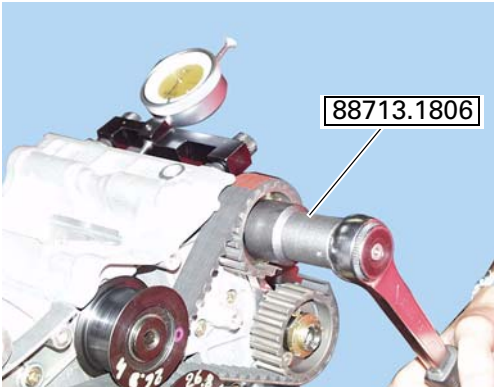
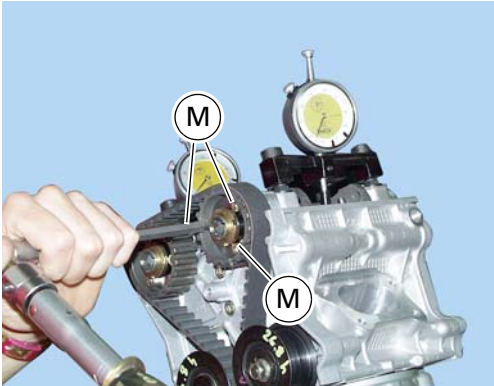
M

N

P

Remove all tools installed for the timing check and tension the belts to their prescribed operating tension, as described in Sect. D 5.

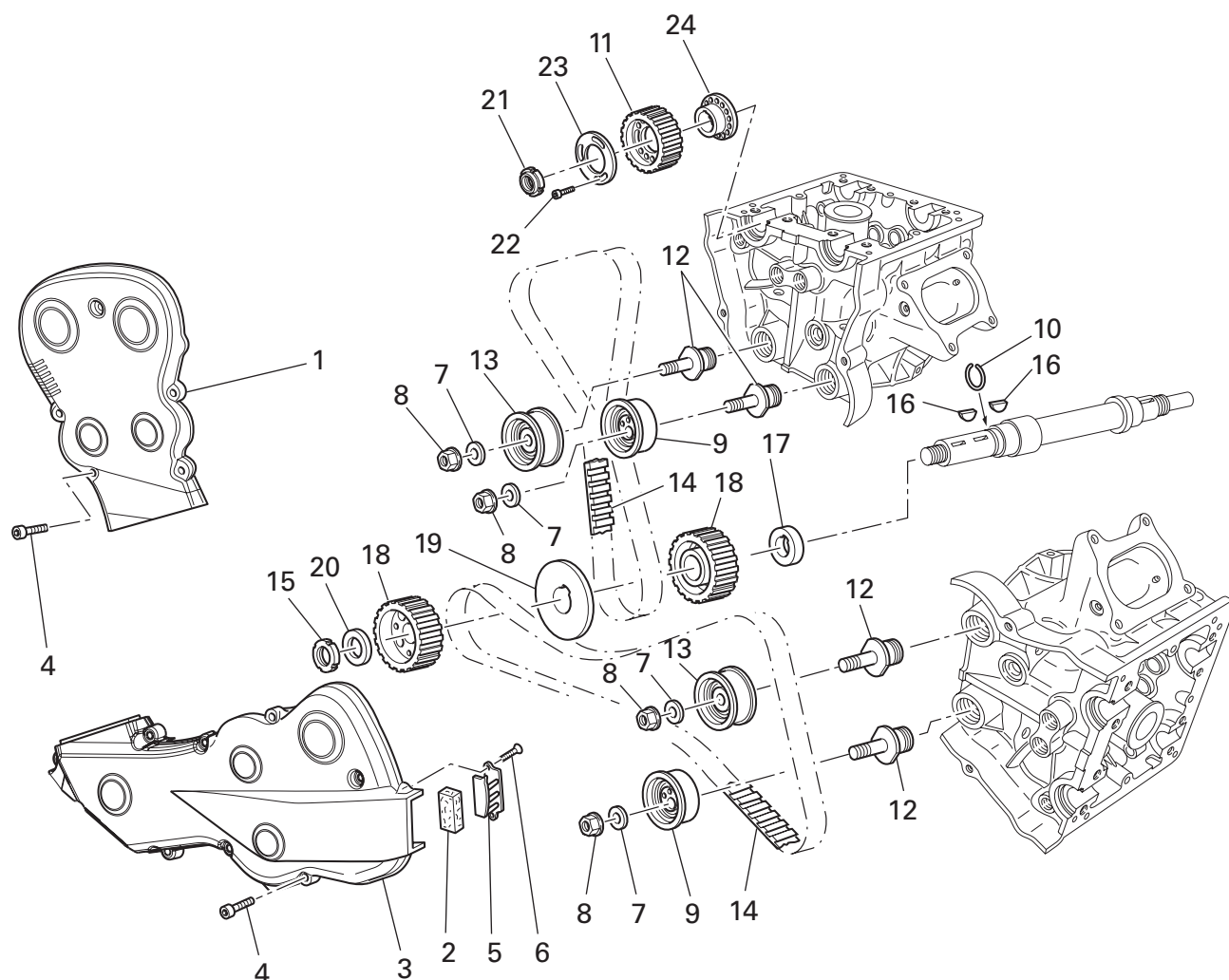
If the values obtained are outside the specified ranges (Sect. C 1.1), loosen the timing pulley bolts (M) and correct the value by using the wrench supplied with service tool part no. **88713.1806** to turn the camshaft nut. Then tighten the three timing pulley bolts (M) to the specified torque (Sect. C 3) and mark the new timing positions on the relative components.



Refit the components removed in the procedure.

Operation	Section reference
Refit the water pump cover	N 3.3
Refit the timing belts	N 4.2
Refit the rocker cover	N 4.4
Refit the airbox	L 6
Refit the fuel tank/seat cowling assembly	E 3
Refit the radiator	N 3.2
Refit the side fairings	E 2

4.2 - Cylinder head assemblies: timing



- | | |
|---|-----------------------------|
| 1 Vertical cylinder timing belt cover | 13 Idler pulley assembly |
| 2 Air filter | 14 Timing belt |
| 3 Horizontal cylinder timing belt cover | 15 Nut |
| 4 Bolt | 16 Key |
| 5 Filter cover | 17 Spacer |
| 6 Bolt | 18 Camshaft pulley |
| 7 Washer | 19 Driveshaft pulley spacer |
| 8 Nut | 20 Spacer |
| 9 Tensioner pulley assembly | 21 Nut |
| 10 Circlip | 22 Bolt |
| 11 Camshaft pulley | 23 Washer |
| 12 Tensioner pulley mounting stud | 24 Spacer flange |



Important

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

A



Notes

For clarity, the figures show the engine removed from the frame.

To work with the engine installed, first proceed as follows:

B

Operation	Section reference
Remove the side fairings	E 2
Disconnect the electrical system components on right-hand side of the engine	P 1

C



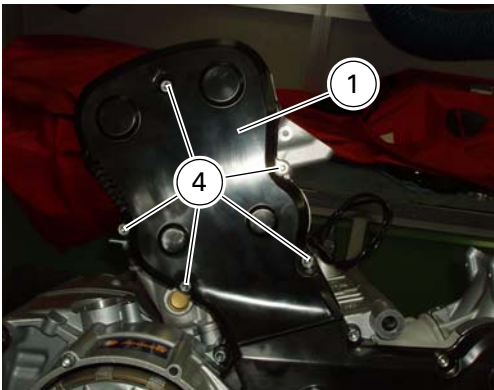
Notes

Remove also any parts which may impede the procedure in any way.

D

Removal of the timing belt covers

Undo the bolts (4) securing the timing belt cover (1) and remove it from the vertical cylinder assembly.

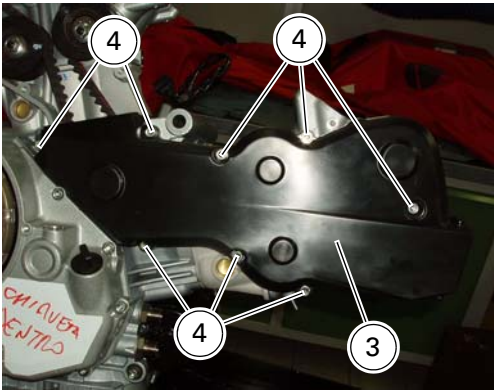


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Undo the bolts (4) securing the timing belt cover (3) and remove it from the horizontal cylinder unit.



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Removal of the tensioner pulley/timing belt

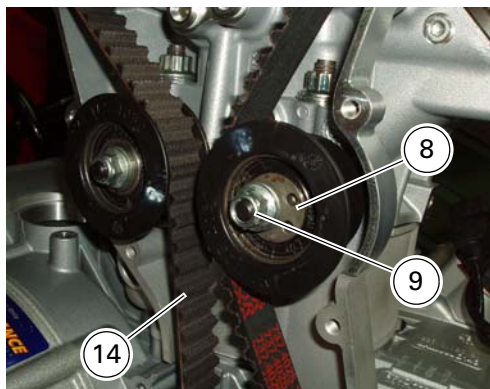
Loosen the nut (8) and remove the tensioner pulley (9) from its mounting stud (12) on the cylinder head.
Remove the timing belt (14) from the horizontal cylinder assembly.



Important

If the belts are to be re-used, mark the direction of rotation with an arrow and also mark the cylinder they belong to.

Repeat the procedure for the other cylinder.



Removal of the camshaft pulleys/idler pulley

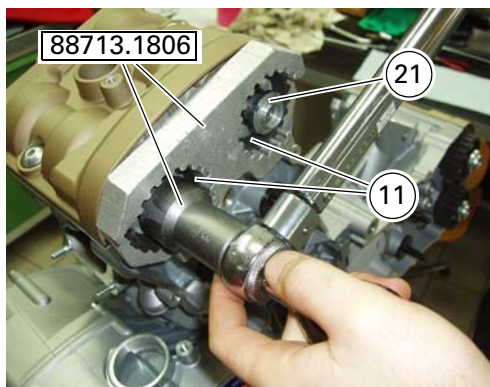
Fit the service tool **88713.1806** on the pulleys to hold them against rotation and use the socket supplied with the tool to slacken off the nuts (21) securing the pulleys.



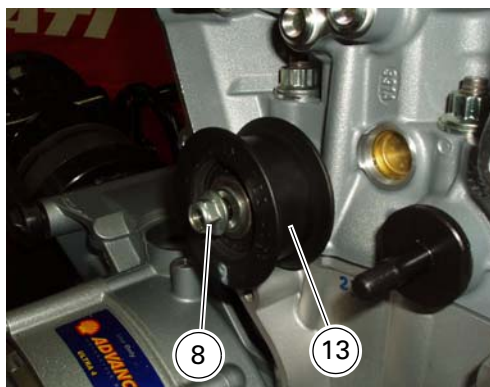
Important

On reassembly, always use new nuts.

Remove the nuts (21) and the pulleys (11) from the camshafts.



Loosen the nut (8) and remove the idler pulley (13).
Repeat the same procedure to remove the other pulley.



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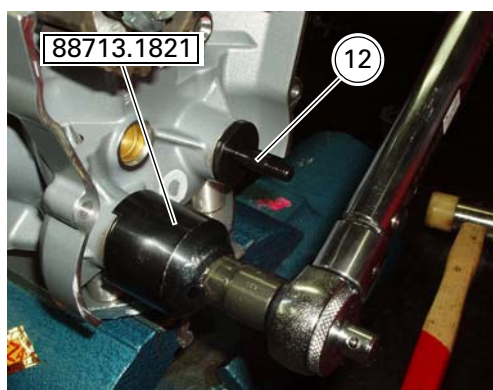
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Removal of the tensioner and idler pulley mounting studs

Using service tool no. **88713.1821**, remove the mounting studs (12) from the cylinder heads.

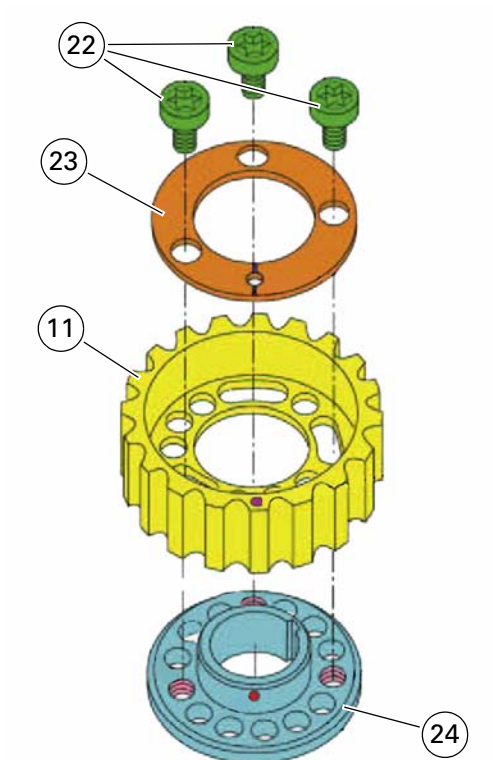


Disassembly of the camshaft pulleys

Undo and remove the bolts (22).

Slide off the washer (23).

Withdraw the camshaft pulley (11) from the spacer flange (24).



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Removal of the timing belt driveshaft pulleys

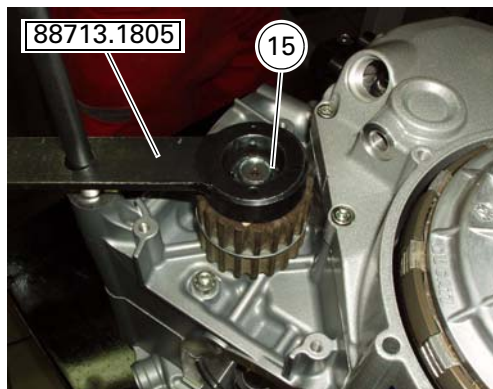
Using service tool no. **88713.1805** hold the driveshaft pulleys against rotation



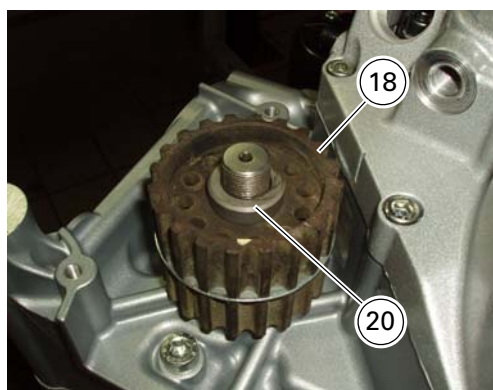
Important

If this operation is carried out with the engine installed in the frame, hold the driveshaft pulleys against rotation using service tool part **88713.2011** on the left-hand crankcase cover.

Loosen the nut (15) using the socket supplied with the service tool.

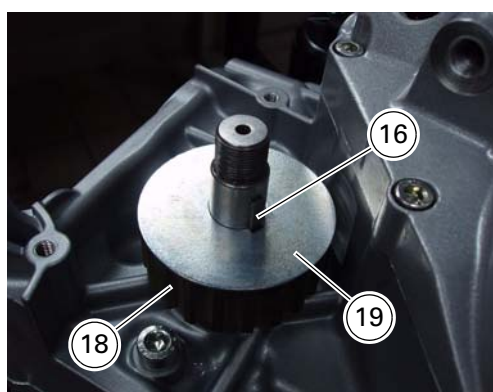


Remove the nut (15), the spacer (20) and the outer pulley (18).

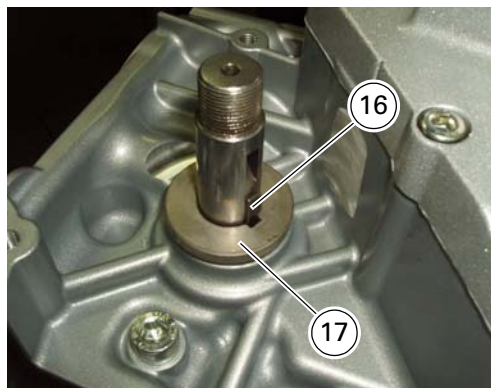


Remove the first Woodruff key (16) from the timing belt driveshaft.

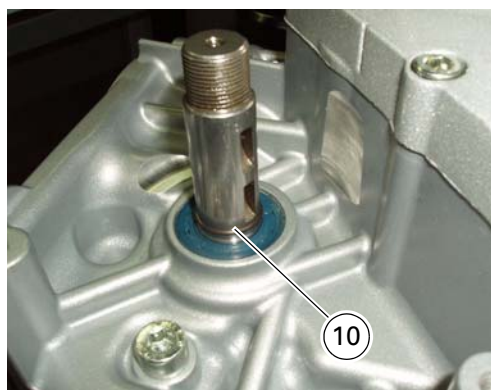
Remove the intermediate spacer (19) and the inner pulley (18).



Remove the inner spacer (17) and second Woodruff key (16) on the timing belt driveshaft.



At this point it is possible to remove the circlip (10) located on the timing belt driveshaft.



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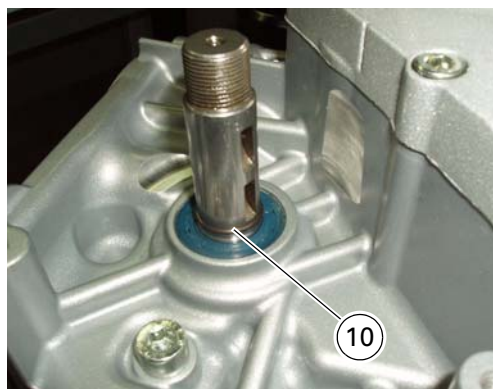
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Refitting the timing belt driveshaft pulleys

To fit the circlip (10) to the driveshaft, use the protective cap **88713.2834**.



Install the inner spacer (17) on the driveshaft, taking care to align the notch in the spacer with the slot for the Woodruff key.



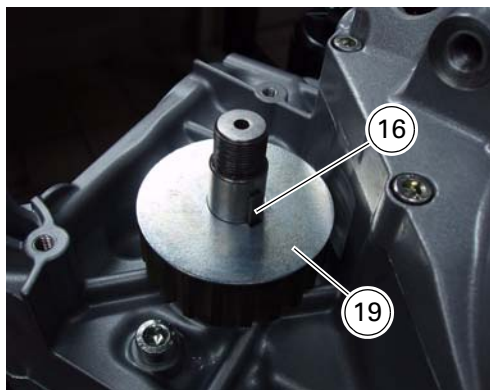
Fit the first Woodruff key (16) on the timing belt driveshaft.



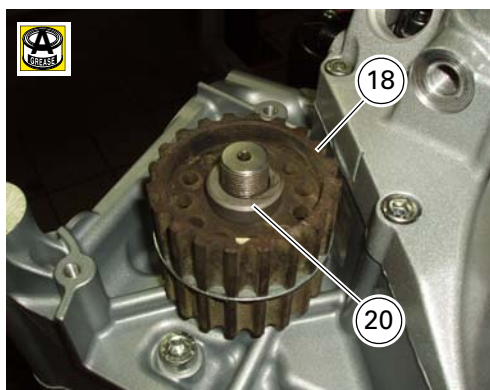
Locate the inner pulley (18).



Refit the second Woodruff key (16) and the washer (19).



Locate the outer pulley (18) and the spacer (20).
Apply the recommended grease to the threads on the end of the driveshaft.



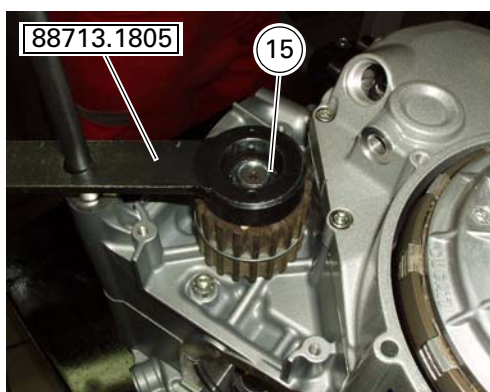
Fit the nut (15).



Important

To prevent the nuts working loose and consequent serious engine damage, always use new self-locking nuts on all timing belt pulleys on reassembly.

Restrain the pulleys with service tool no. **88713.1805** and tighten the self-locking nut to the specified torque (Sect. C 3) using the insert supplied with the tool in conjunction with a torque wrench.



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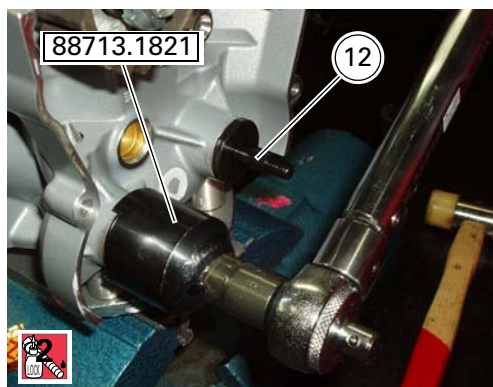
Refitting the idler and tensioner pulley mounting studs

A Apply the recommended threadlocker to the threads of the studs

To fit the studs correctly on the cylinder heads, note the references of the parts given in the photographs.

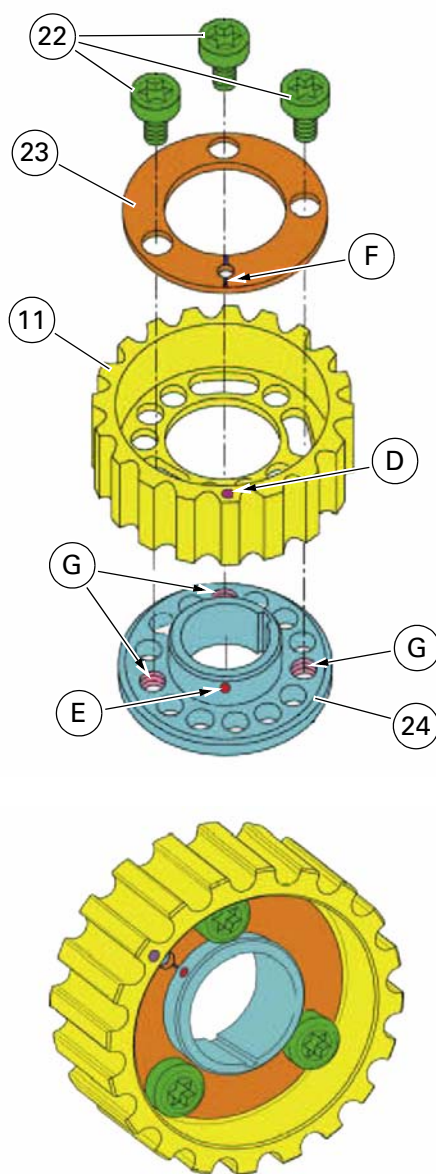
Insert the idler and tensioner pulley mounting studs (12) in the cylinder heads and tighten them using service tool no. **88713.1821**.

Tighten the studs to the specified torque (Sect. C 3).



Reassembly of the timing pulleys

Fit the pulley (11) on the hub (24), aligning the timing mark (D) on the pulley with the timing mark on the (E) on the hub. Install the washer (23) up against the pulley, aligning the timing notch (F) with the timing marks on the pulley and the hub. Insert the three bolts (22) in the threaded holes (G) of the hub. Tighten the bolts (22) to the specified torque (Sect. C 3, Engine torque settings).



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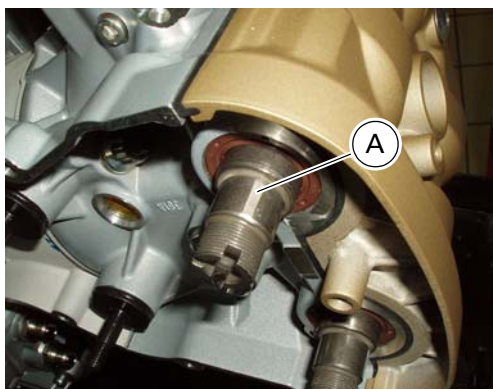
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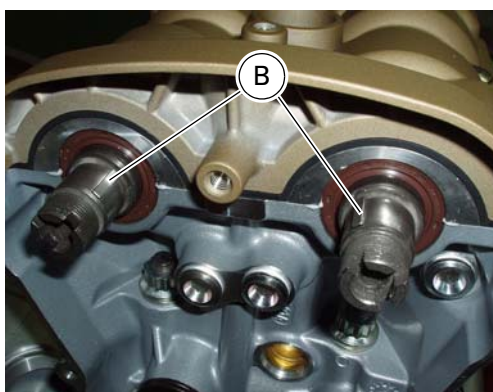
P

Refitting the camshaft pulley/idler pulley

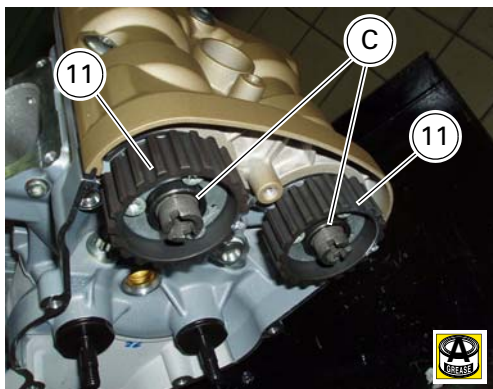
Check that the keyway on the end of the camshaft is in good condition and without burrs.



Fit a Woodruff key in the keyway of each camshaft.



Fit the pulley (11) on the camshaft, inserting the Woodruff key in the in the slot (C) in the pulley.
Apply the recommended grease to the threads on the end of the camshaft.
Repeat the procedure on the other camshaft.

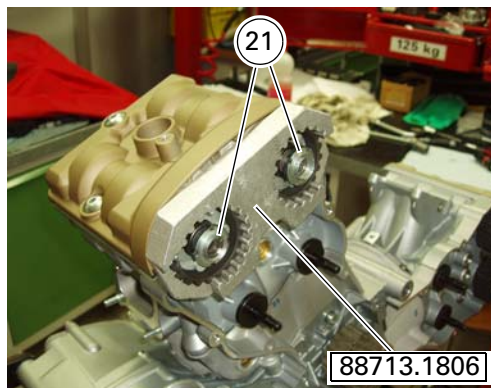


Install service tool no. **88713.1806** on the pulley to hold it against rotation.
Apply the recommended grease to the mating face of the nut (21).
Fit the nut (21).
Carry out the same operations on the other camshaft.

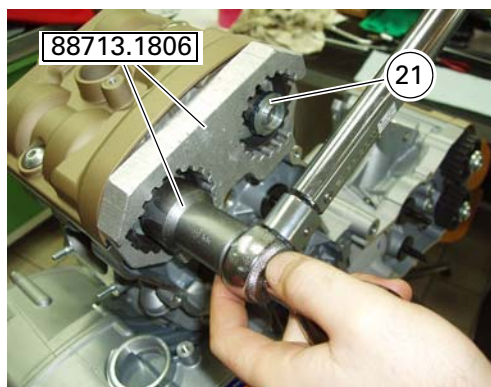


Important

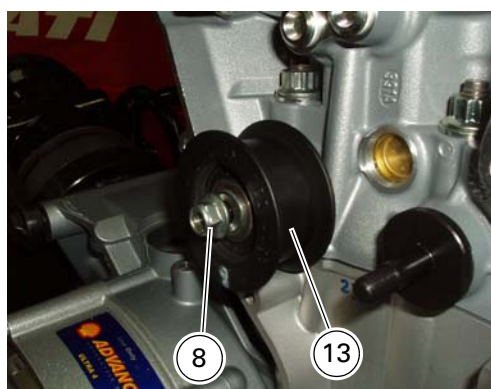
Always fit new nuts on reassembly.



Using the socket supplied with the service tool no. **88713.1806** in combination with a torque wrench, tighten the nuts (21) to their specified torque (Sect. C 3).



Fit the idler pulleys (13), complete with bearings, on to their mounting studs on the cylinder heads and tighten down the nuts (8) to the specified torque (Sect. C 3).



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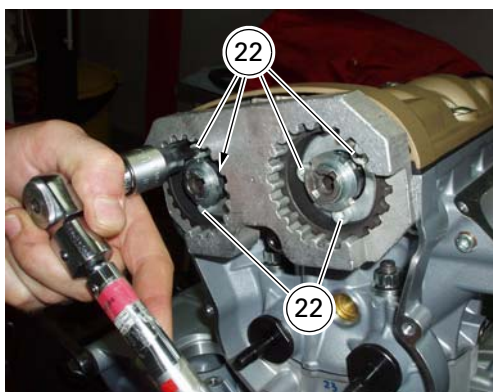
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Unscrew the bolts (22) holding the pulleys, turning them anti-clockwise through $90^\circ \pm 5^\circ$.
Check that the pulleys have no endfloat and can rotate freely at all points along the full length of the slots.



Refitting the timing belts

Turn the pulleys on the timing belt driveshaft until the timing mark on the outer roller is aligned with the mark on the clutch cover. In this condition, the horizontal cylinder piston will be at top dead center.



Install service tool no. **88713.2011** in the seat of the left-hand crankcase cover to prevent crankshaft rotation, and lock it in place with the pin provided.



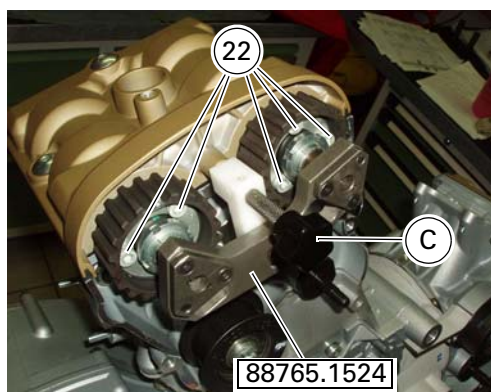
Fit service tools no. **88765.1524** to prevent rotation of the camshafts. one for the vertical cylinder head and one for the horizontal cylinder head.

Fix the tools to the rocker cover with the pin (C).



Important

To ensure correct timing, the bolts (22) securing the pulleys to the hubs must be loose and positioned in the centres of their slots.



Fit the vertical cylinder timing belt around the camshaft pulleys and pass it behind the idler pulley.
Repeat the operation for the horizontal cylinder belt.

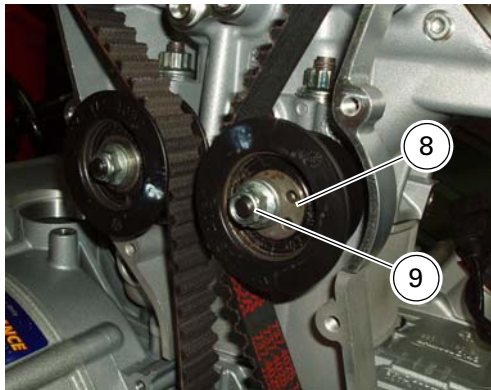


Notes

If the used belts are to be refitted, position them in their original direction of rotation and on their original cylinder.



Fit the tensioner pulleys (9) on the mounting studs on the two cylinder heads.
Start the nut (8) on the crankshaft.

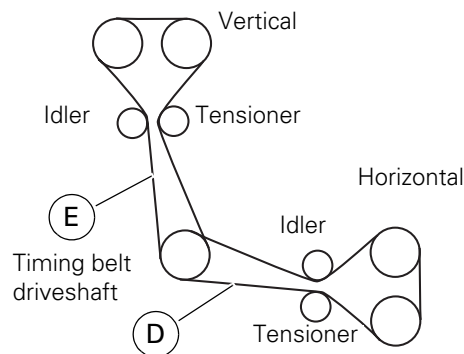


Check the timing belt tension and adjust if necessary as described under the heading "Checking and adjusting timing belt tension" (Sect. D 5).



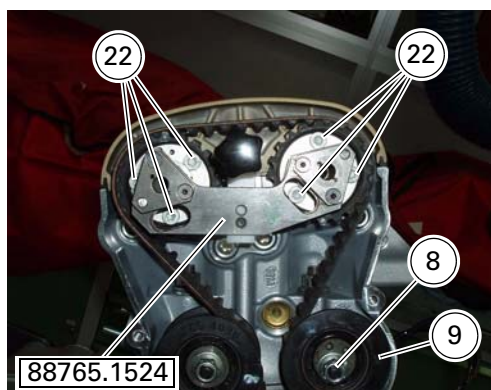
Warning

Check the tension on the belt sections (D) and (E) shown in the figure.



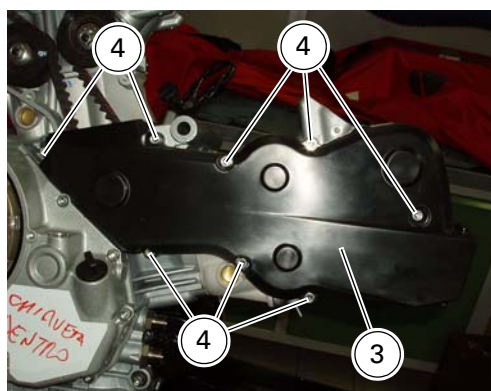
Once the belts are correctly tensioned, ensure that the nuts (8) securing the tensioner pulleys (9) and the bolts (22) are tightened to the specified torque (Sect. C 3).

Remove the camshaft holding tool no. **88765.1524** and crankshaft holding tool no. **88713.2011**.

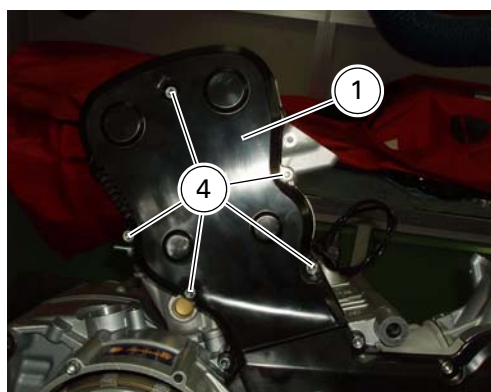


Refitting the timing covers

Locate the horizontal cylinder timing cover (3) and secure it in place with bolts (4).



Do the same with the vertical cylinder outer cover (1).
Tighten the bolts (4) to the specified torque (Sect. C 3).

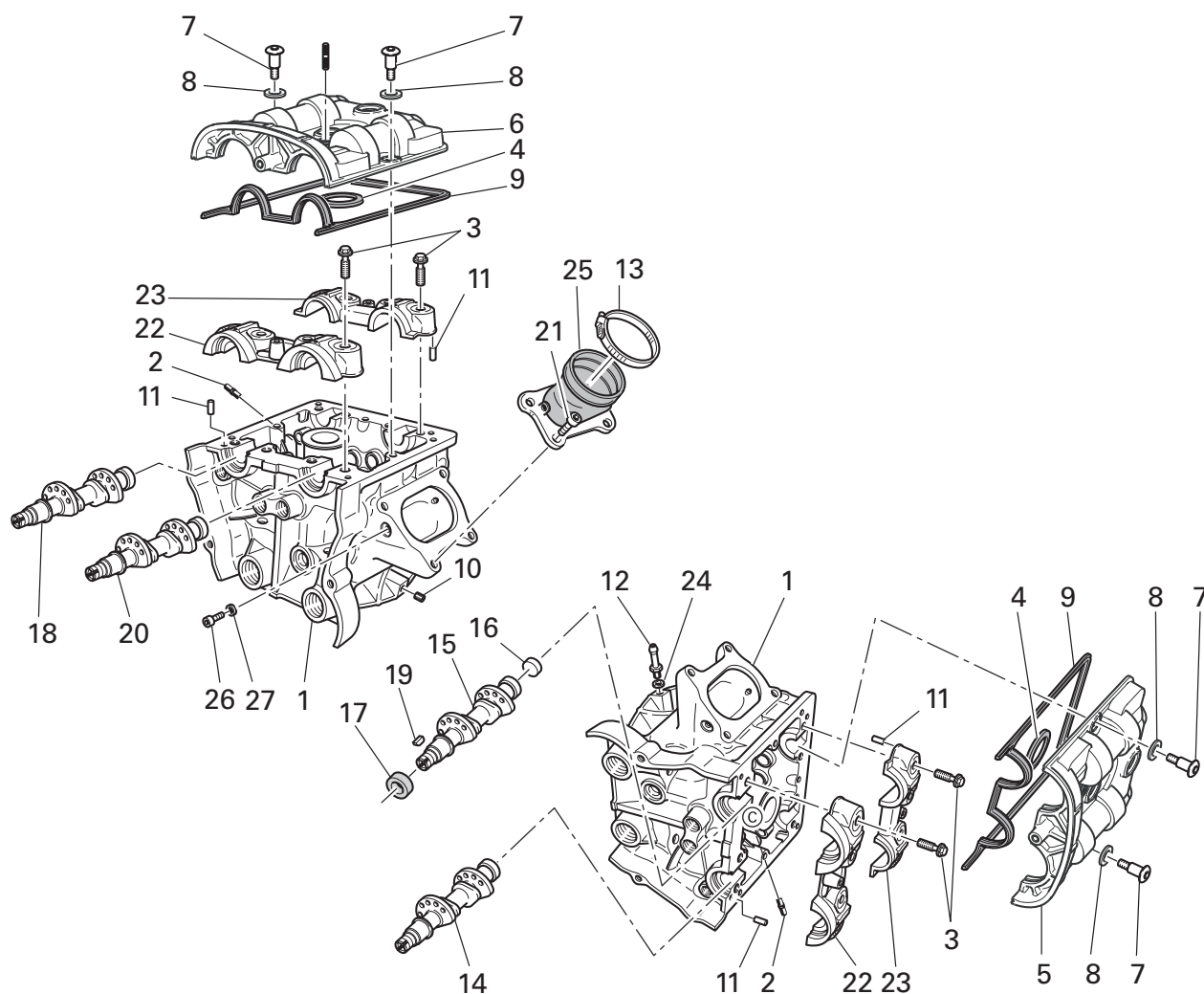


Notes

If the above operations have been carried out with the engine installed in the frame, refit the previously removed parts.

Operation	Section reference
Reconnect the electrical system components on right-hand side of engine	P 1
Refit the side fairings	E 2

4.4 - Cylinder head assemblies: camshafts



- 1 Cylinder head
- 2 Stud bolt
- 3 Special screw
- 4 Seal
- 5 Horizontal cylinder head rocker cover
- 6 Vertical cylinder head rocker cover
- 7 Special screw
- 8 Washer
- 9 Cylinder head gasket
- 10 Grub screw
- 11 Locating dowel
- 12 Union
- 13 Clamp
- 14 Horizontal cylinder exhaust camshaft

- 15 Horizontal cylinder intake camshaft
- 16 Plug
- 17 Oil seal
- 18 Vertical cylinder exhaust camshaft
- 19 Key
- 20 Vertical cylinder intake camshaft
- 21 Bolt
- 22 Timing side support
- 23 Opposite side support
- 24 Seal
- 25 Intake manifold
- 26 Bolt
- 27 Washer

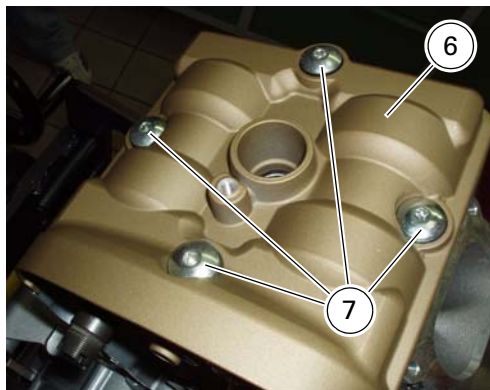
● Important

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

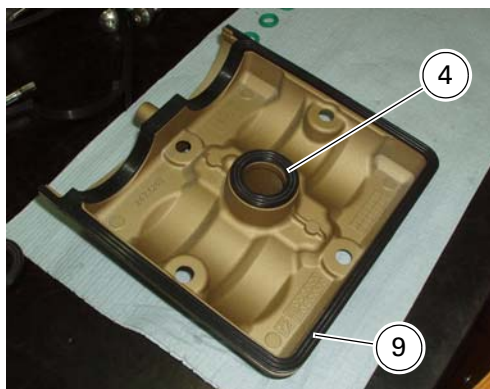
Removal of the camshafts

Operation	Section reference
Remove the engine from the frame	N 1
Remove the timing belt covers, the timing belts and timing belt pulleys	N 4.2
Remove the engine lubrication system	N 2.1
Remove the coils	M 3

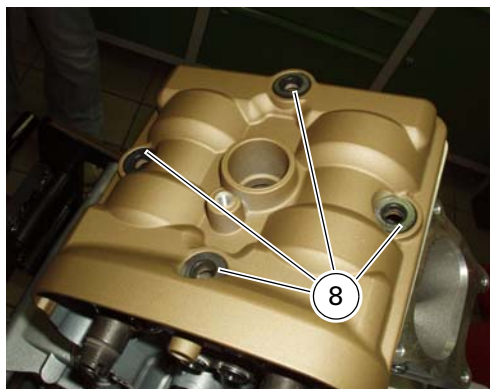
Unscrew and remove the screws (7) in the rocker covers.
Remove the rocker cover (6).



Remove the gaskets (4) and (9).



Repeat the same procedure for the other rocker cover.
Remove the seals (8) on the rocker cover.



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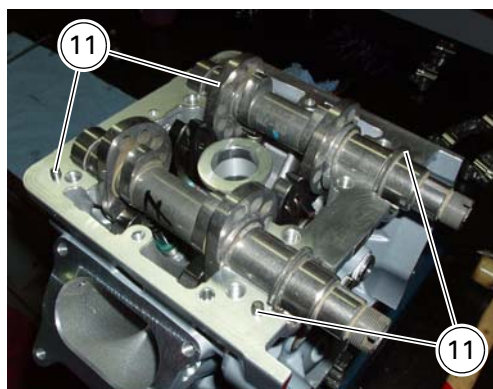
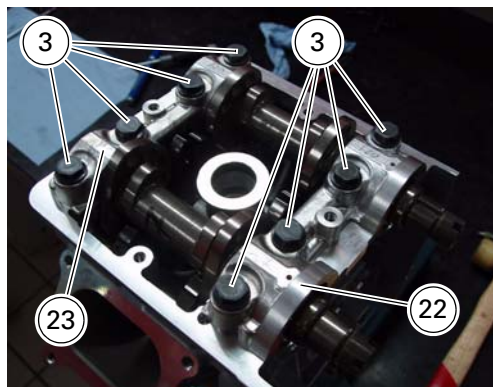
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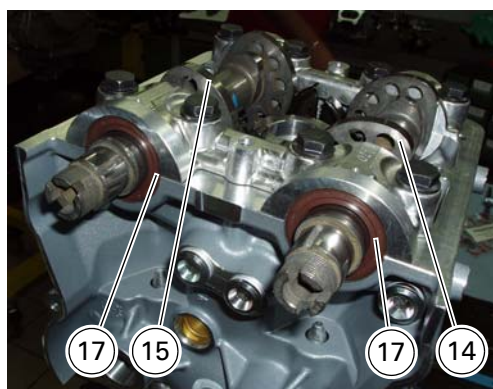
P

Undo the bolts (3) securing the camshaft supports.

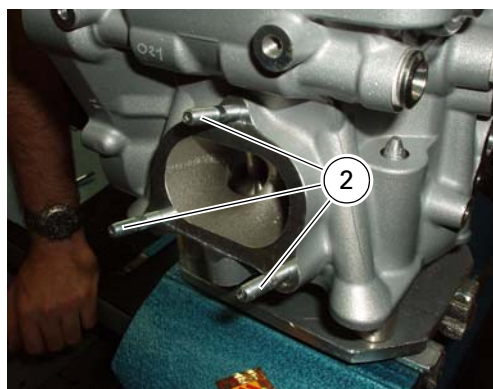
Withdraw the camshaft supports (22) and (23) straight out from the cylinder head, taking care not to damage the machined faces and locating dowels (11).



Remove the exhaust camshaft (14) and the intake camshaft (15), and slide off the seal rings (17) on their ends. Repeat the same procedure for the other cylinder head.

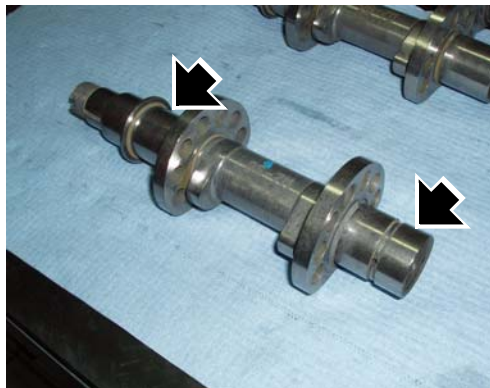


If necessary, unscrew the stud bolts (2) from the cylinder heads.



Checking the camshafts and supports

Check the cam contact surfaces for scratches, grooves, steps and waving.
Worn cams are frequently the cause of poor timing, which leads to loss of engine power.
Place the camshaft between two centres and check the runout using two dial gauges.
Service limit: **0.1 mm**.



Visually inspect the camshaft tracks for scoring and abnormal wear. If any of the above defects are found, the camshaft should be renewed.

If you find scoring or excessive wear, check the operation of the engine lubrication circuit.



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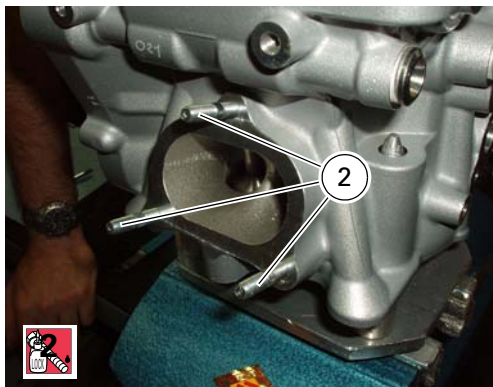
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Refitting the camshafts

If the stud bolts (2) were removed, apply the recommended threadlocker to the short end of the stud bolts (2), i.e. the end that is to be screwed into the cylinder head.

Tighten the stud bolts (2) to the specified torque (Sect. C 3, engine tightening torques).

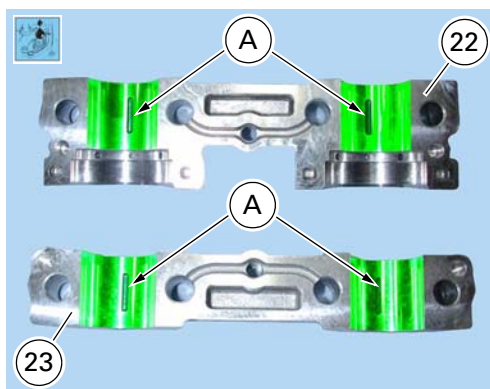
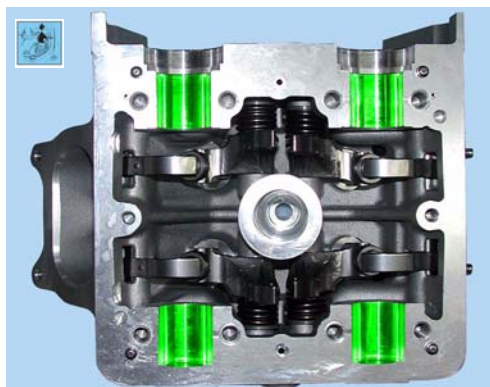


Check that the camshafts (marked "VA" and "VS" for the vertical head and "OS" and "OA" for the horizontal head) are clean and in good condition. If the camshafts are not new, use emery cloth to remove signs of wear on the cam and support surfaces, working on a flat surface.



Lubricate with the specified lubricant (Molycote M55 Plus), the camshaft seats on both the cylinder head and the supports (22) and (23) (green zone).

Fill the reservoirs (A) with lubricant (Molycote M55 Plus).

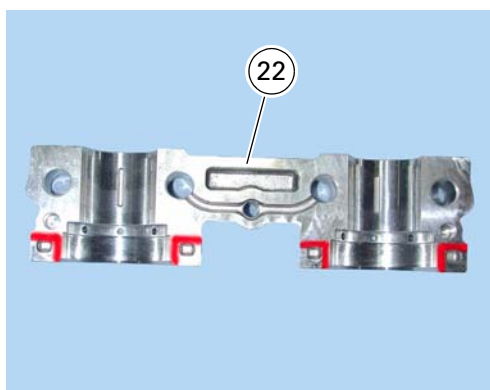


Apply sealant (Three Bond 1215 liquid gasket) at the four points of the support (22) shown in red in the photo. Clean off any excess sealant.



Notes

Only apply sealant to the timing side support (22): do not apply to support (23).



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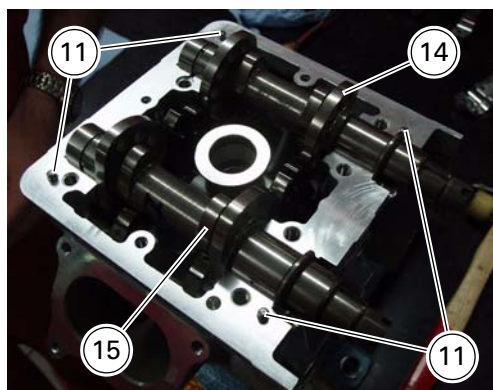
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Install the camshafts (14) and (15) in the cylinder head, and rotate them to distribute the lubricant evenly.
Check that the locating dowels (11) are present.



Fit the supports (22) and (23) to the cylinder head, checking that the number stamped in zone (B) of the cylinder head is the same as the number stamped in zone C (C) of the supports.



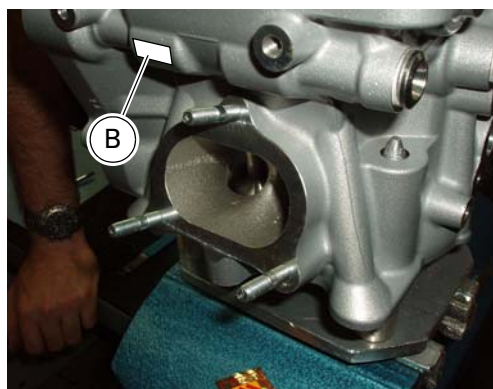
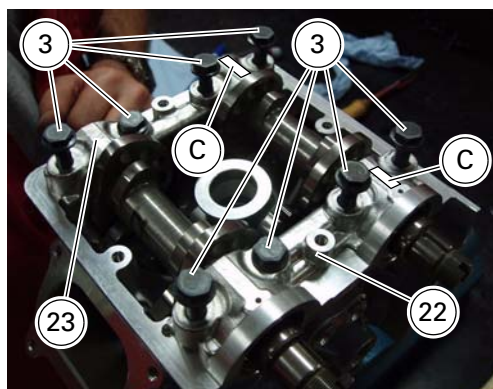
Important

The support (22) must be installed on the timing side.

Bed down the supports.

Apply engine oil to the threads and undersides of the heads of the bolts (3).

Insert the bolts (3).

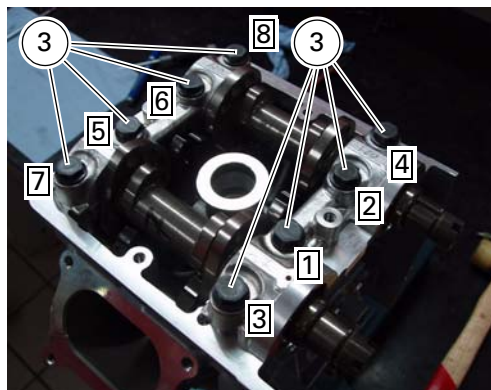


Tighten the bolts (3) to the specified torque (Sect. C 3, engine tightening torques).
Pre-tighten one support at a time, working in the sequence 1-2-3-4-5-6-7-8.
Then tighten the bolts to the specified torque (Sect. C 3, engine tightening torques).
Tighten one support at a time, working in the sequence 1-2-3-4-5-6-7-8.
Remove any excess sealant from between the cylinder head and the support.
Turn the camshafts by hand to check that they rotate freely.



Notes

The bolt (3) in position 1 must always be installed on the intake and timing side.



Important

Check the valve lift as described in Sect. N 4.1.

Oil seals

Lubricate the oil seals (17) with denatured alcohol.

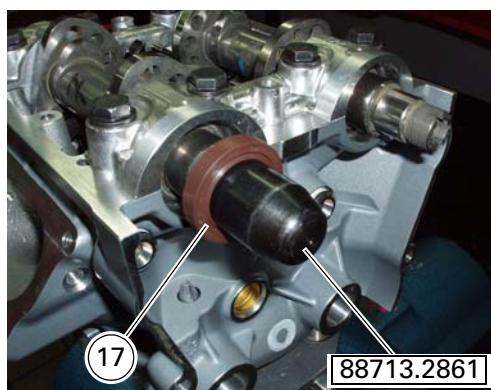
Fit the installer supplied with the service tool no. **88713.2861** on the camshaft and insert the oil seal in the cylinder head with the spring side.



Important

Always fit new oil seals on reassembly.

Use the drift provided with the tool and a mallet to seat the oil seals.



When correctly installed, the oil seal should be flush with the bevel of the cylinder head bore.

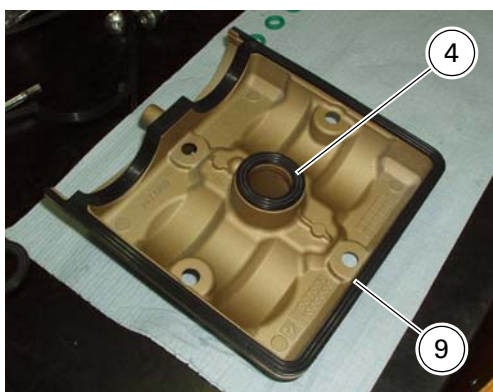


Rocker cover

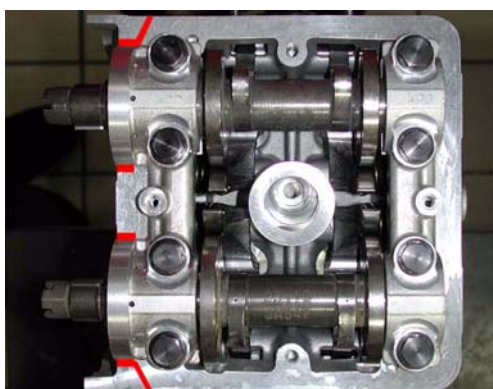
Apply sealant (Three Bond 1215 liquid gasket) at the four points of the rocker cover shown in red in the photo.



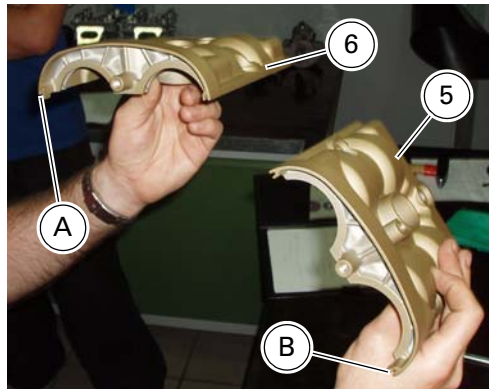
Fit the gaskets (4) and (9) on the rocker cover, as shown in the figure.



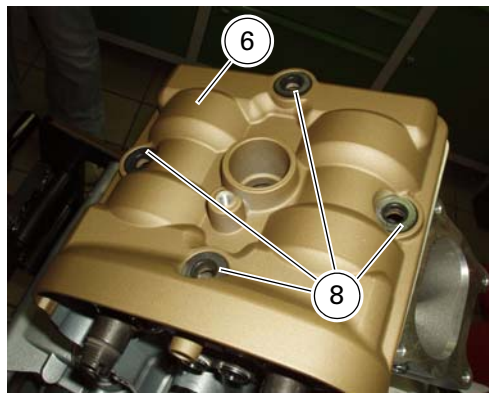
Apply sealant (Three Bond 1215 liquid gasket) at the four points of the cylinder head shown in red in the photo.



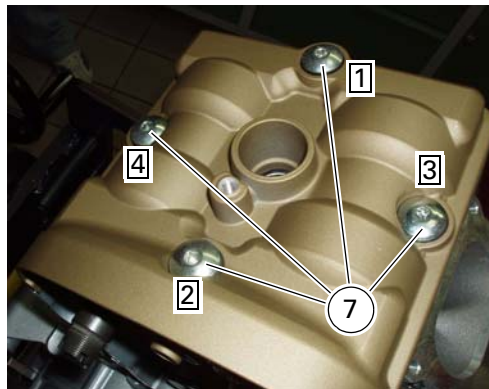
Rocker cover identification: the vertical head rocker cover (6) has a nib (A) on the left-hand side (exhaust side), whereas rocker cover (5) has a nib (B) on the right-hand side (exhaust side).



Locate the cover (6) on the cylinder head, aligning the four fixing holes.
Install the four washers (8) in the cover fixing holes, with the rubber sides facing the cover.



Insert the bolts (7).
Tighten the bolts (7) to the specified torque (Sect. C 3, engine tightening torques) in the indicated sequence.



Remove excess sealant from the area of application.
Repeat the same procedure for the other cylinder head.
Refit all the components removed in the procedure.

Operation	Section reference
Refit the engine lubrication system	N 2.1
Refit the timing belt pulleys, timing belts and the timing belt covers	N 4.2
Refit the engine to the frame	N 1

A

B

C

D

E

F

G

H

L

M

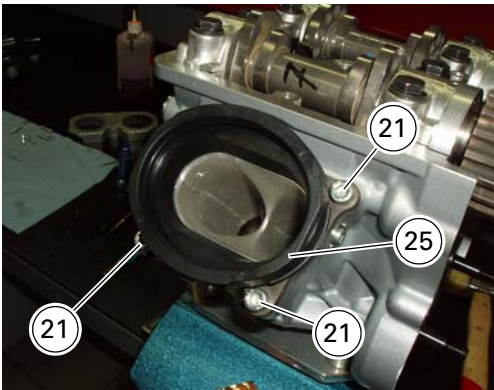
N

P

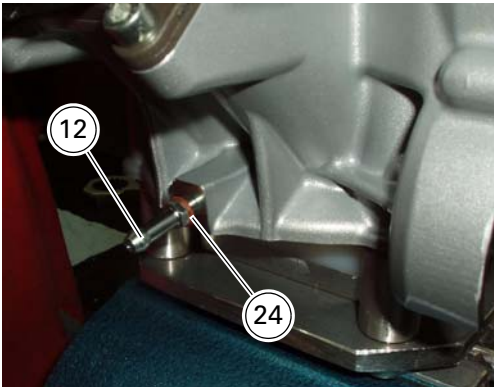
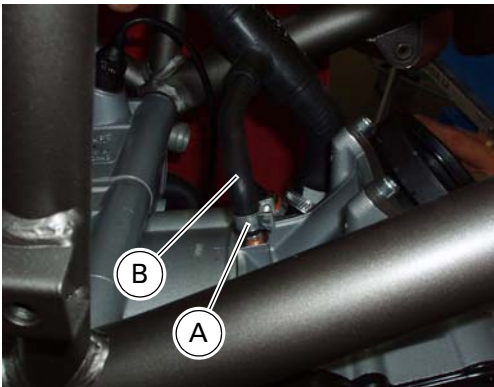
Removal of the intake manifold and coolant union

Operation	Section reference
Remove the side fairings	E 2
Remove the radiator	N 3.2
Remove the fuel tank/seat cowling assembly	E 3
Remove the airbox	L 6

Remove the manifolds (25) by undoing the bolts (21).



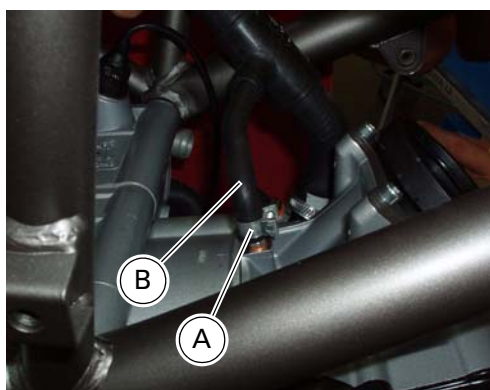
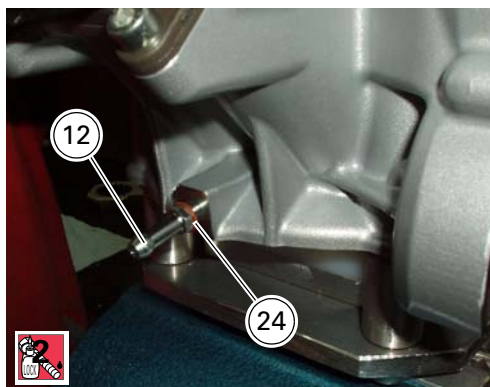
Loosen the clamp (A) and remove the hose (B).
Remove the union (12) and recover the seal (24).



Refitting the intake manifold and coolant union

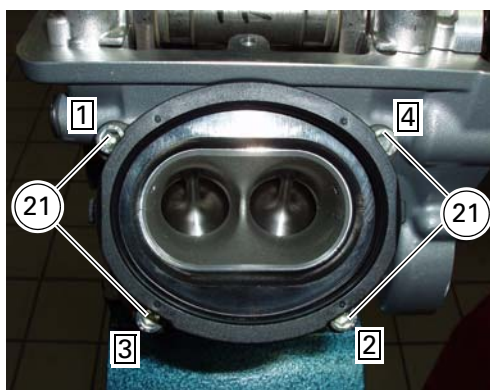
Apply the recommended threadlocker to the union (12), fit it with seal (24) and tighten to the specified torque (Sect. C 3, Engine tightening torques).

Refit the hose (B) and tighten the clamp (A) to the specified torque (Sect. C 3, Engine tightening torques).



Check that the mating surfaces of the cylinder head and manifold are perfectly flat and clean and install the intake manifold (25) on the cylinder head.

Tighten the four bolts (21) to the specified torque (Sect. C 3) in a crosswise pattern (1-2-3-4).



Operation	Section reference
Refit the airbox	L 6
Refit the fuel tank/seat cowling assembly	E 3
Refit the radiator	N 3.2
Refit the side fairings	E 2

A

B

C

D

E

F

G

H

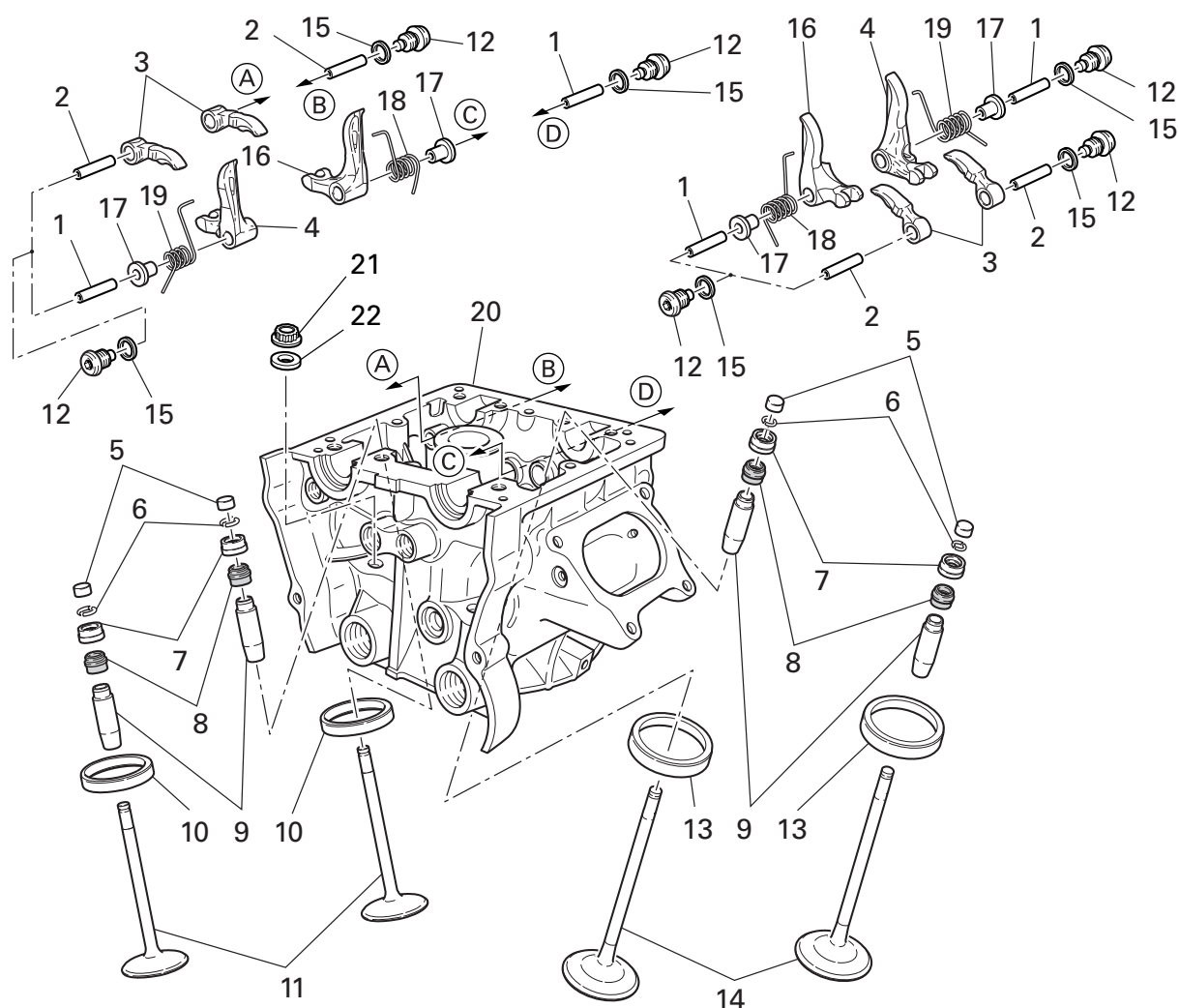
L

M

N

P

4.5 - Cylinder head assemblies: valves-rocker arms



- 1 Closing rocker arm shaft
- 2 Opening rocker arm shaft
- 3 Opening rocker arm
- 4 Closing rocker arm (left)
- 5 Valve opening shim
- 6 Half rings
- 7 Valve closing shim
- 8 Oil seal
- 9 Valve guide
- 10 Exhaust valve seat
- 11 Exhaust valve
- 12 Plug
- 13 Intake valve seat
- 14 Intake valve
- 15 Aluminium gasket
- 16 Closing rocker arm (right)
- 17 Spacer
- 18 Valve return spring (right)
- 19 Valve return spring (left)
- 20 Cylinder head
- 21 Cylinder head nut
- 22 Washer



Important

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

Removal of the cylinder heads

Operation	Section reference
Remove the engine from the frame	N 1
Remove the coolant hoses	N 3.2
Remove the timing belt covers and the timing belts	N 4.2
Remove the engine lubrication system	N 2.1

Using service tool no. **88713.2676**, undo the nuts (21) on the cylinder head stud bolts.



Remove the cylinder head nuts (21) and special washers (22).



Remove the cylinder head assembly by lifting it off the engine studs.
Repeat the same procedure for the other cylinder head.

A

B

C

D

E

F

G

H

L

M

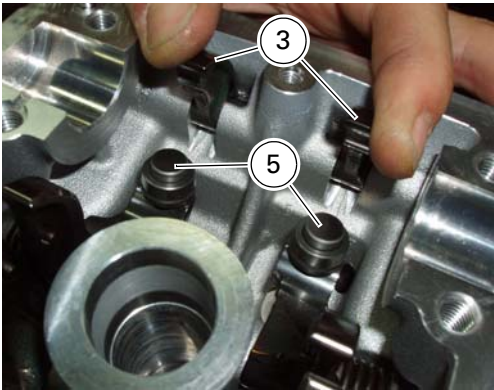
N

P

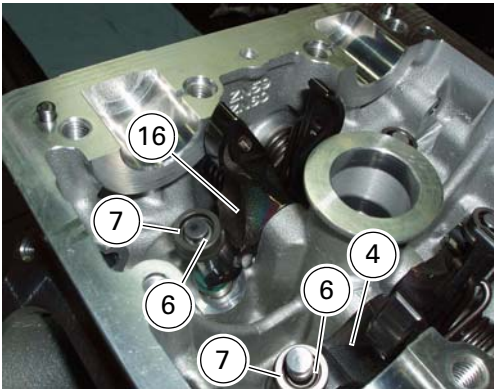
Removal of the valves

Operation	Section reference
Remove the cylinder head assembly from the engine	N 4.5
Remove the timing belt pulleys	N 4.2
Remove the camshafts	N 4.4

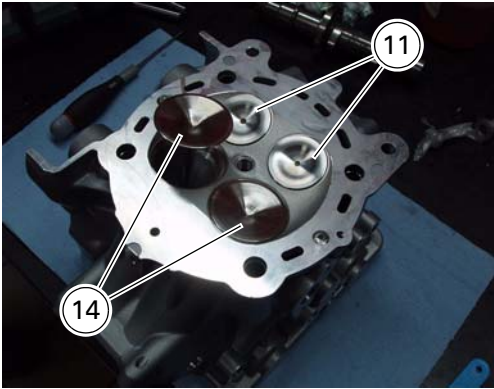
Raise the rocker arm (3) and remove the opening shim (5) from the valves with a pair of pliers (A).



Push down the closing rocker arms (16) and (4) and the closing shim (7).
Remove the half rings (6) from the valves with a magnetic screwdriver. Extract the closing shims (7) from the valve using a pair of pliers.



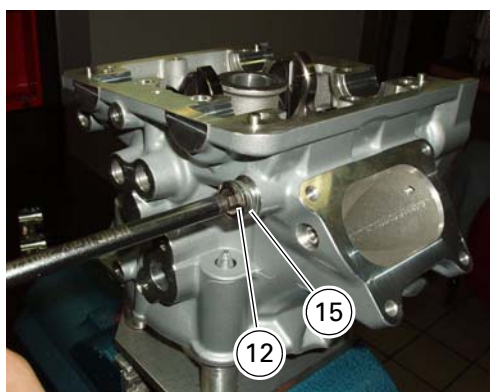
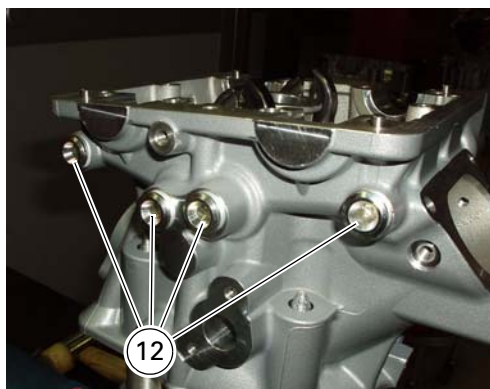
Withdraw the valves (14) and (11) from underside of the cylinder head.



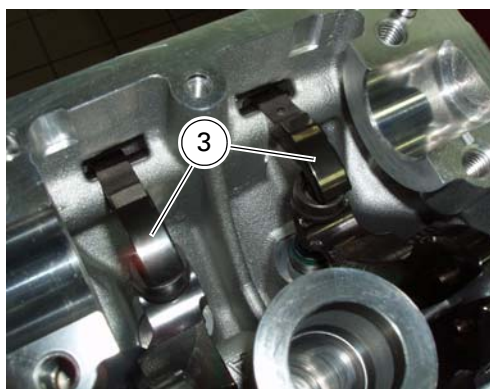
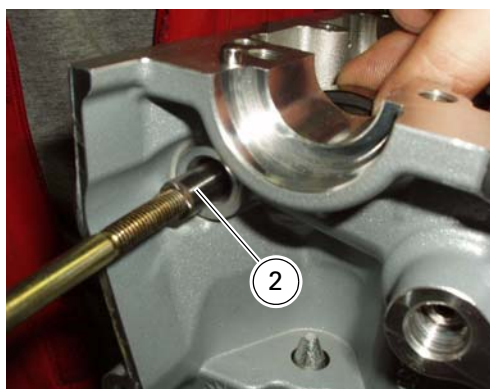
Repeat the same procedure for the other cylinder head.

Removal of the valve rocker arms

With the cylinder head in the condition described in the previous paragraph, remove the rocker arms. Unscrew the eight plugs (12) and recover the seals (15).



Using an M5 bolt, withdraw the shafts (2) of the opening rocker arms (3) on the exhaust and intake sides. Remove the opening rocker arms (3).



A

B

C

D

E

F

G

H

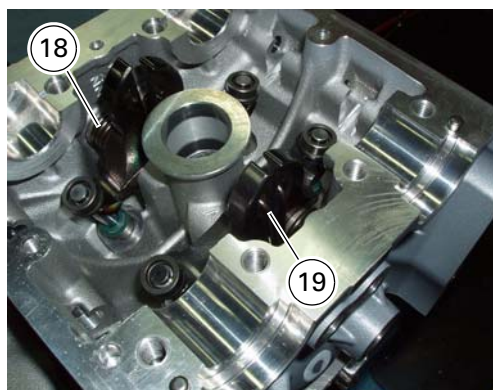
L

M

N

P

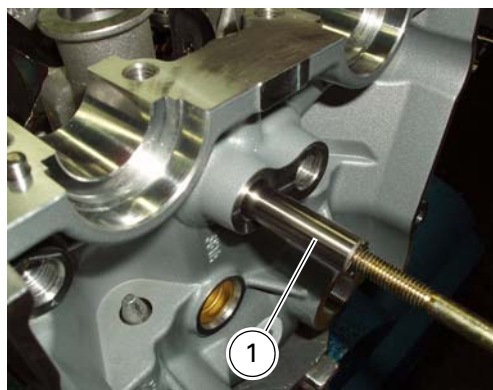
Using accessory (C) of the rocker arm spring tensioning kit **88713.2069** installed between the spring and the inner wall of the cylinder head, move the straight end of the rocker arm return spring (19) and (18) and insert it in the drilled shaft.



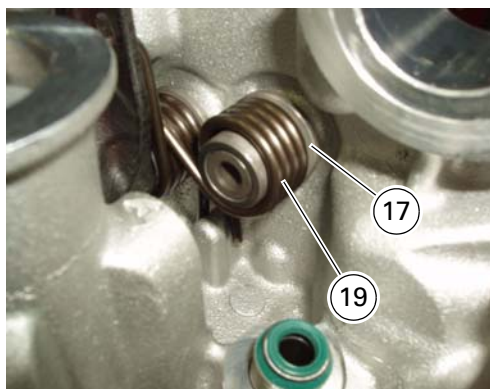
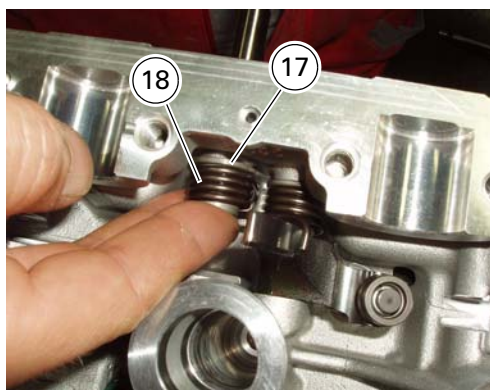
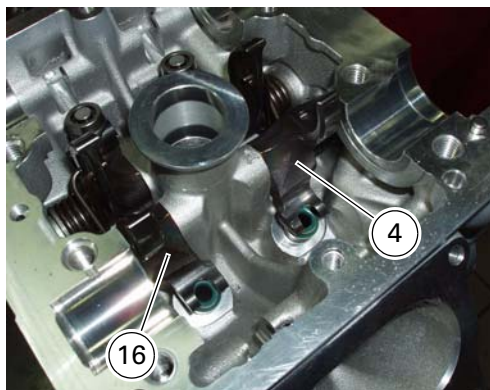
Use the shaft to slide the end of the spring into its final position.



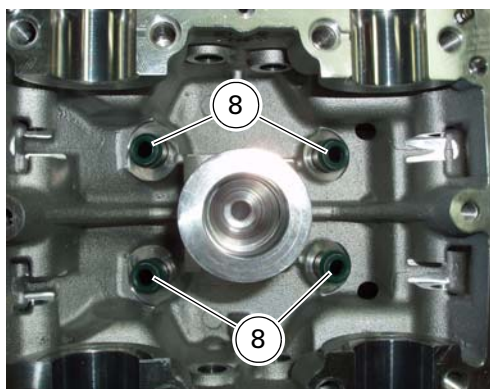
Using an M5 bolt, withdraw the shafts (1) of the closing rocker arms (3) on the exhaust and intake sides.



Remove the closing rocker arms (4) and (16), the springs (18) and (19) with the spacers (17).



Remove the seal rings (8) from the ends of the valve guides.



Repeat the same procedure for the other cylinder head.

A

B

C

D

E

F

G

H

L

M

N

P

Overhaul of cylinder head components

A

Cylinder heads

Remove any carbon deposits from the combustion chamber and its ducts.

Remove any scale from the coolant ducts.

Check for cracking and inspect the sealing surfaces for scoring, ridges or other damage.

B

C

D

E

F

G

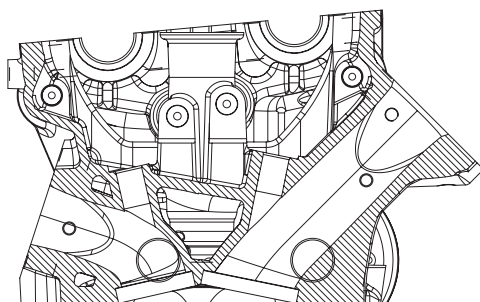
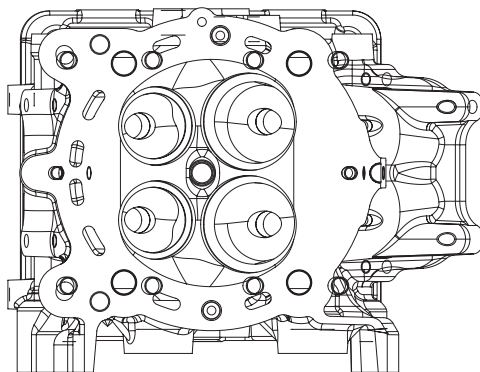
H

L

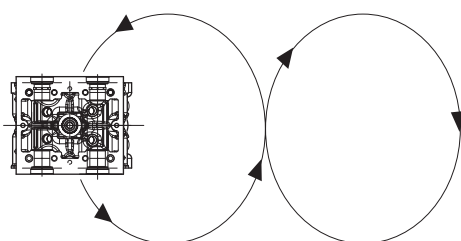
M

N

P



Check that the cylinder barrel mating surfaces of the cylinder head are free of carbon deposits and scale. If not, spread diamond dressing compound (6÷12 micron thickness) on a reference surface and slide the cylinder head on the surface as shown in the figure until a flat finish is obtained.

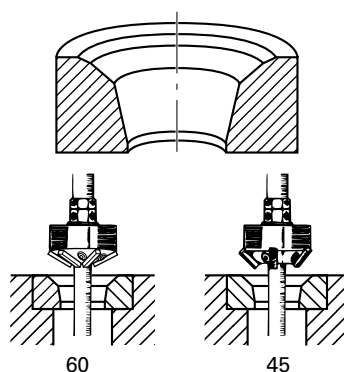


Valve seat

Visually inspect the valve seats: for cracking or pitting.



Minor damage can be repaired by grinding with special 45° and 60° single-blade grinders. Grind the valves and check the seal.



If the valve seats are excessively damaged, fit oversize seats. Replacement seats are available with **0.03** and **0.06** mm oversized outside diameters.



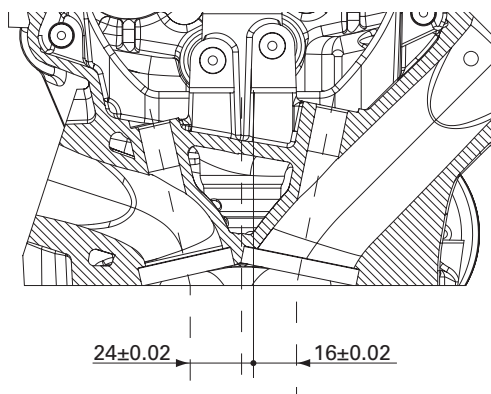
Important

When you change the valve seats, change the valve guides as well.

Proceed as follows:

Remove the worn seats, grinding carefully to avoid any damage to cylinder head bores.

Check the diameter of head bores and choose the oversized valve seat that will give an interference fit of **0.04** to **0.10** mm.



Heat the cylinder head gradually and evenly up to **150 °C** and chill the new valve seats in dry ice.
Drive the seats perfectly square into the head bores using the appropriate valve guide seat installer **88713.2846** and **88713.2847**.
Allow the cylinder head to cool down and grind the seats to the following dimensions:

CA = $\varnothing 41.6 \pm 0.025$ mm

CS = $\varnothing 33.6 \pm 0.025$ mm

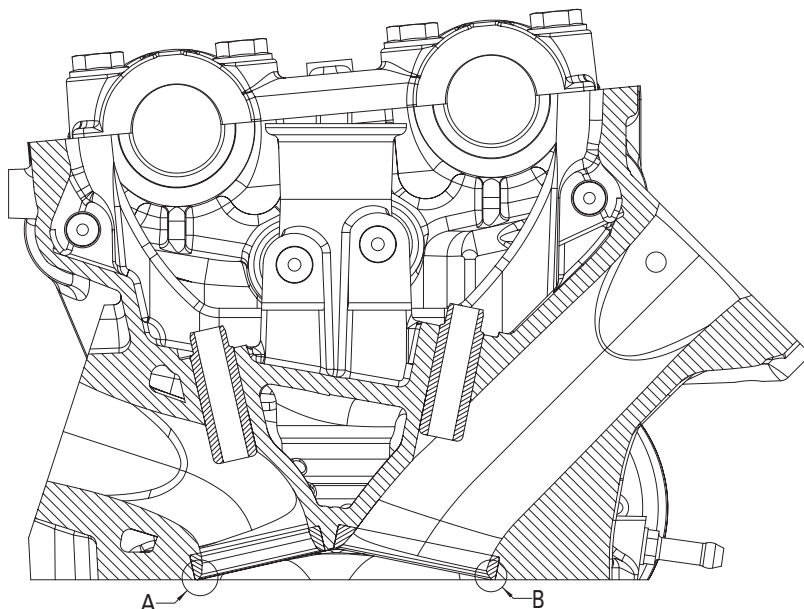
S = 1.2 mm

D = 0.2 to 0.4 mm

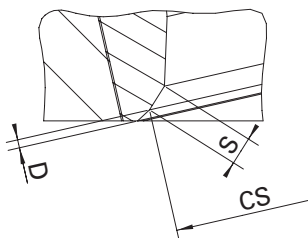


Important

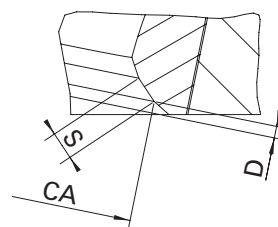
Do not use any lapping compound after final grinding.



A
5:1

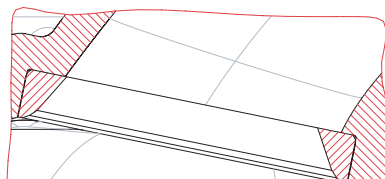


B
5:1

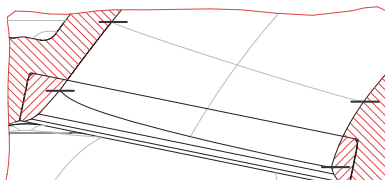


It is advisable to smooth the joint between the intake valves seats and the intake ducts (F = before; G = after).

F



G



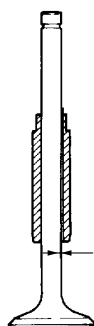
Valve guides

Check the inner surface of the valve guides for cracking or distortion.



Thoroughly check the dimensions of the inner surface of the valve guide. Measure the inside diameter with a bore diameter gauge.

Measure the diameter at different positions of the valve guide.



The assembly clearance must be:

highest measured value – lowest measured value = **0.03 to 0.045** mm.

The maximum permissible wear limit is **0.08** mm.

Change the valve guides when the ovality exceeds permissible limit or the clearance to the valve stem is outside the tolerance range.

When you change the valve guide, you must also change the valve.

Replacement valve guides are available with outside diameter oversizes of **0.03, 0.06** and **0.09** mm.

Change the valve guides as follows:

heat up the cylinder head gradually and evenly up to **150 °C**.

remove the original valve guides using drift part no. **88713.2842**;

allow the cylinder head to cool down and check the condition of the seats.

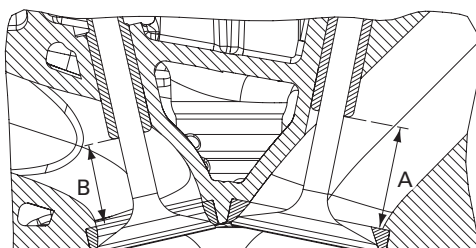
select the most suitable valve guide so as to obtain an assembly clearance with the cylinder head of **0.022 to 0.051** mm; heat the cylinder head up again and chill the new valve guides with dry ice;

lubricate the seats in the head and install the valve guides using the appropriate service tools and referring to dimension given in the figure;

A= 22.4±0.15 mm.

B= 28.45±0.15 mm.

Hone the mating surface with a reamer.



A

B

C

D

E

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G

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P

Checking the valve

Check that the stem and the surface that contacts the valve seat are in good condition. There must be no pitting, cracks, deformations or signs of wear.



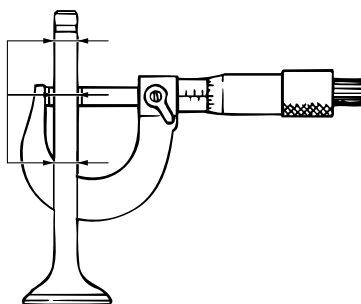
Warning

The valves cannot be ground.



Perform the following checks.

Measure the diameter of the valve stem (B) at various points along the section that runs in the valve guide.



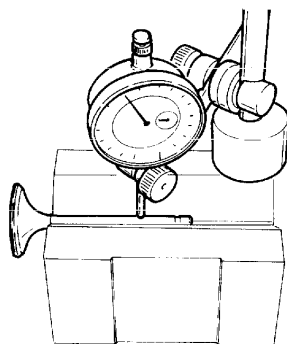
Check the valve stem for buckling. Place it on a "Vee" block and measure deformation with a dial gauge.

Service limit: **0.053** mm.

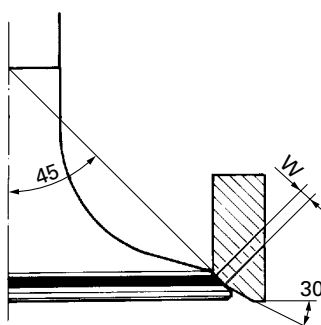
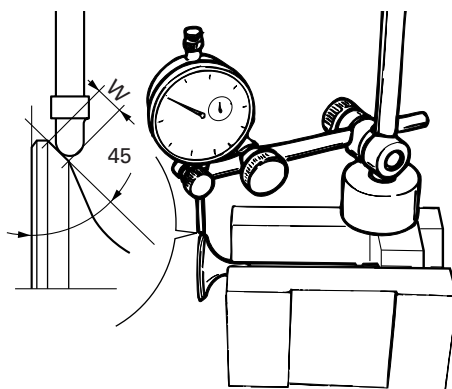
Check that the valve head band (at 45° to the valve head top face) is concentric to the valve stem as follows: place the valve on a Vee block, set a dial gauge at right angles to the head and rotate the valve.

Nominal concentricity: **0.01** mm.

Service limit: **0.03** mm.

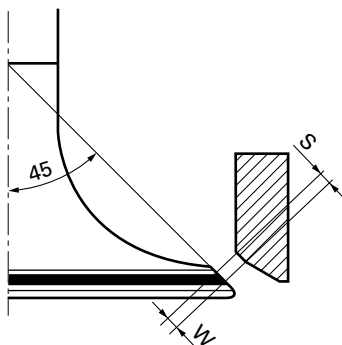


Use Prussian blue or a mixture of minium and oil to check that the contact surface (W) between the valve and seat is **1.4** to **1.6** mm (**1.05** to **1.35** mm when new). Grind the seat if the dimension measured is greater than the above limit.



Checking the valve seal

After grinding the seats it is important to check the seal between the valve face and the seat: if the seat contact area (S) on the valve is wider than the 45° band (W) this could lead to poor sealing.



A

B

C

D

E

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G

H

L

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P

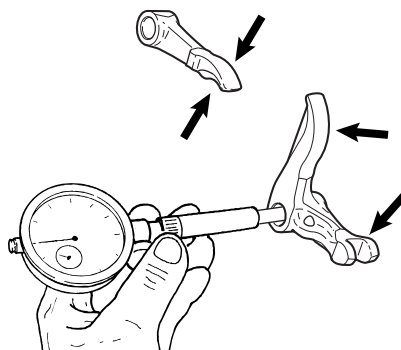
Checking the rocker arms

Check for signs of wear, grooves or chrome flaking off.

Check the condition of rocker arm bore and shaft.

Assembly clearance: **0.025** to **0.049** mm.

Wear limit: **0.08** mm.

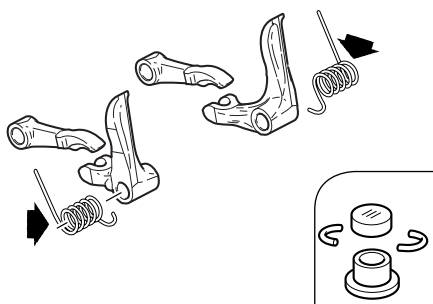


Opening and closing shims - Springs

Check the condition of the contact surfaces of the valve opening and closing shims: there must be no signs of wear.

Check the condition of the closing rocker arm return springs:

Check for cracking, distortion, or loss of elasticity.



Reassembly of the cylinder head



Notes

The cylinder heads are identical. Only the definition of the intake and exhaust side determines whether they are to be installed on the vertical or horizontal cylinder.

The exhaust side can be identified by the three threaded holes on the flange.



The intake side can be identified by the presence of four threaded holes on the flange.



All the photos in this chapter refer to a vertical cylinder head.

Valve guide seals

Position the cylinder head on the service stand **88713.2103**.

Use alcohol to lubricate the valve guide seals (8) and insert them from the spring side onto tool **88713.2442**.

Fit the end of the tool into the valve guide and use a mallet to tap the seals (8) home into the valve guides.



A

B

C

D

E

F

G

H

L

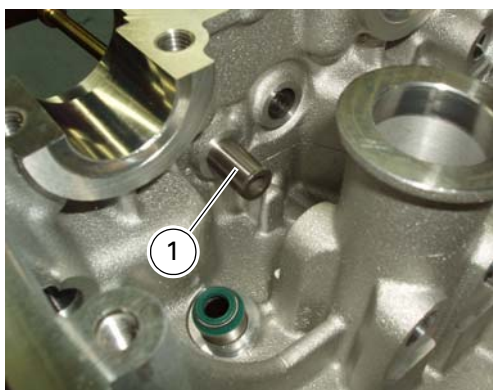
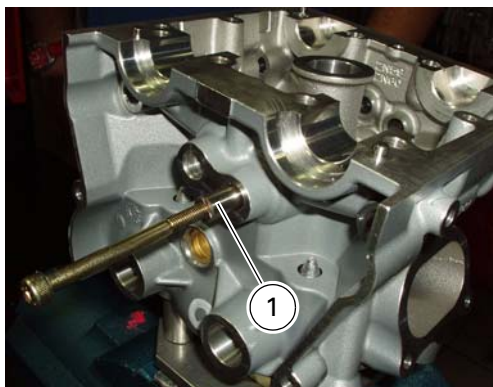
M

N

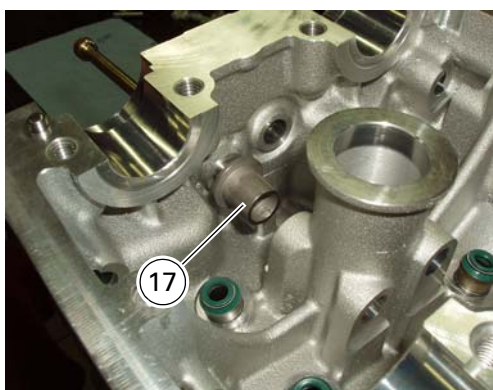
P

Reassembly of the closing rocker arms.

Check that the rocker arms are not scored or show signs of breakage in the area of contact with the camshaft and shim. The closing rocker arm shafts are 10 mm in diameter, whereas the opening rocker arm shafts are 9 mm in diameter. Using an M5 bolt, position the closing rocker shaft (1) towards the exhaust side of the cylinder head.



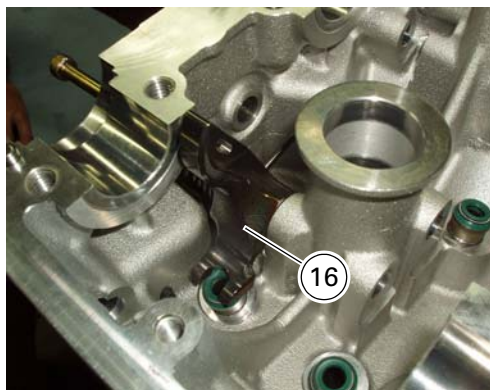
Locate the spacer (17) on the shaft.



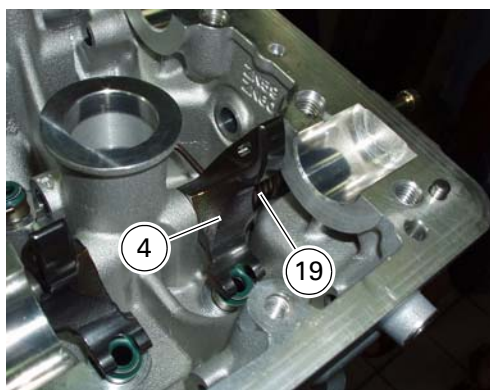
Locate the spring (18) on the spacer (17).



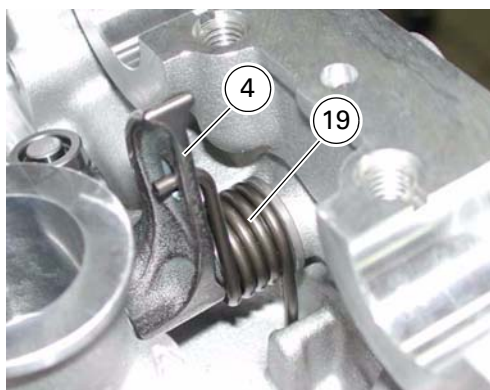
Locate the closing rocker arm (16) and drive the shaft home.



Proceed in a similar manner to install the closing rocker arm (4) with the spring (19) from the exhaust side.



Load the springs (18) and (19) on the closing rocker arms (16) and (4) respectively using service tool no. **88713.2069**.



A

B

C

D

E

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Proceed to install the closing rocker arms (4) and (16), the relative springs and shafts on the intake side (C) in the same manner as described for the exhaust side (D).



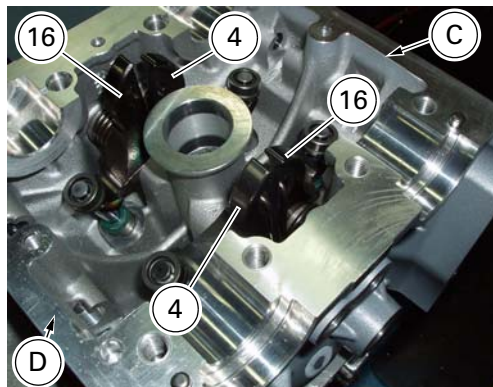
Notes

Always install the closing rocker arms on the exhaust side before those on the intake side.



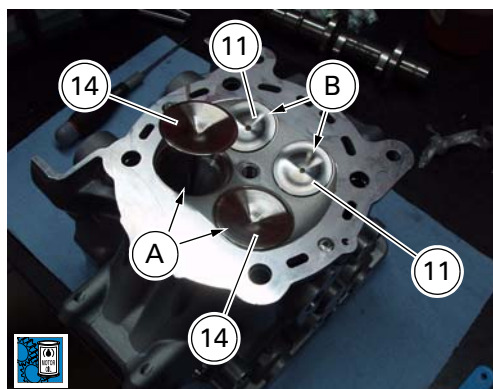
Warning

Take care not to damage the shoe of the closing rocker arm with the intake spring during assembly.

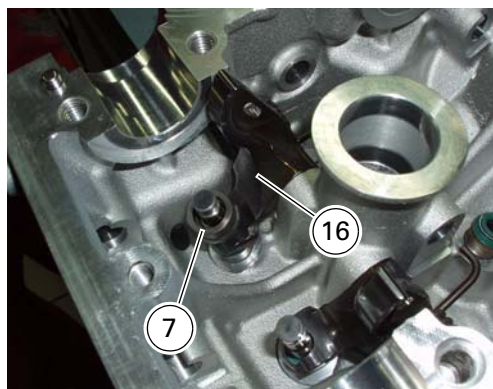


Refitting the valves, closing shims and half rings

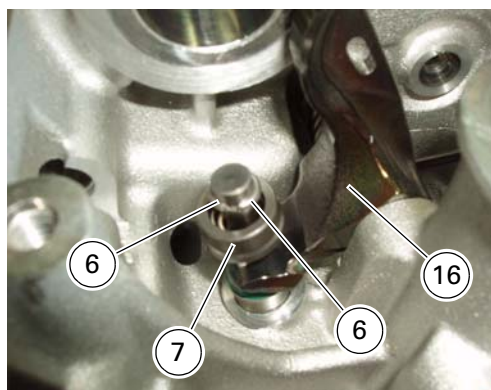
Carefully clean the two intake valve seats (A) and the two exhaust valve seats (B).
Lubricate the stems of the two intake valves (14) and the two exhaust valves (11) with engine oil.
Install the valves in respective seats in the cylinder head.



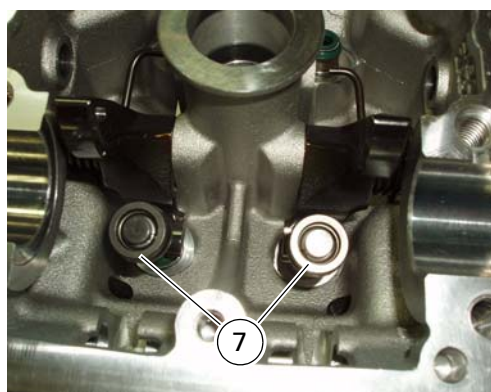
Hold the closing rocker arm (16) pushed downwards and fit the closing shim (7) on the valve stem. If using the old cylinder head, start by fitting the original shim.



Insert the new half rings (6) and release the rocker arm to ensure that they seat inside the shim (7). To ensure the half-rings are seated in the shim, tap the end of the rocker arm (16) with a rubber mallet.



Repeat the procedure with the opposite valve and check that the top of the valve stem is aligned with the surface of the shim (7); if it is not, repeat the half-ring installation procedure.



Install the closing shims on the intake valves (14) using the method described above for the exhaust valves. Refit the camshafts (Sect. N 4.2) to check the valve closing clearances (Sect. N 4.1).

A

B

C

D

E

F

G

H

L

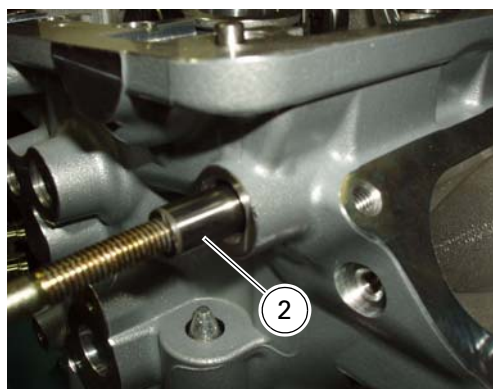
M

N

P

Refitting the opening shims and opening rocker arms

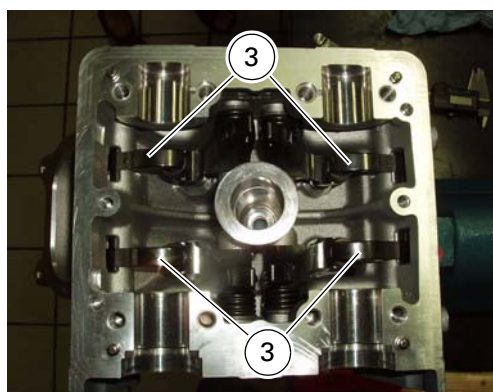
Using an M5 bolt, position the opening rocker arm shaft (2) (diameter 9 mm).



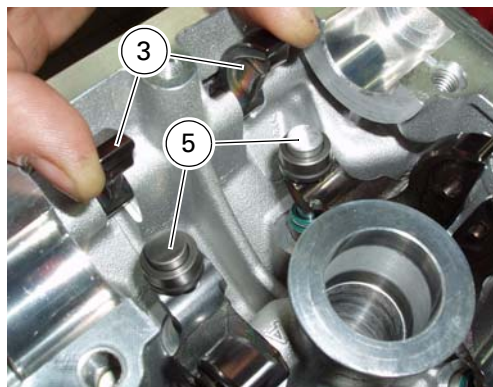
Locate the opening rocker arm (3) and drive the shaft home.



Install the four rocker arms (3) in the manner described above.



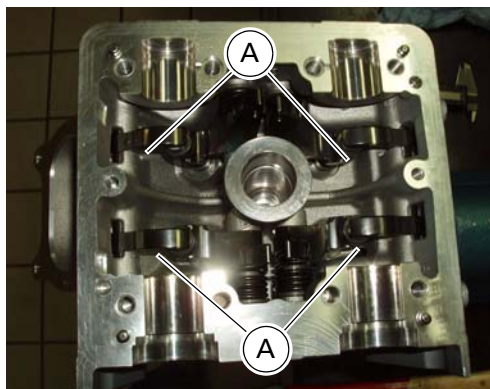
Raise the opening rocker arm (3) and install the opening shim (5) so it seats against the valve stem.



Release the rocker arm so that it rests against the shim.

Ensure the shim is correctly seated by lightly tapping the rocker arm shoe (A) with plastic mallet.

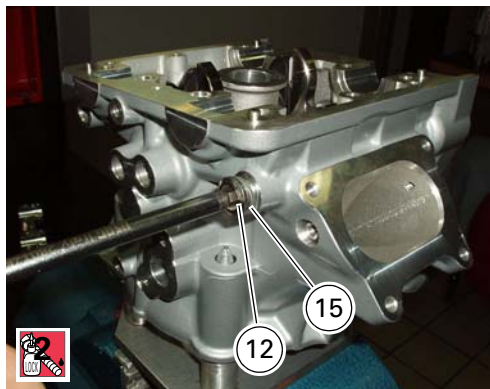
Refit the camshafts (Sect. N 4.2) to check the valve opening clearances (Sect. N 4.1).



Apply the recommended threadlocker to the plugs (12).

Fit the eight plugs (12) with their seals (15): position the seals so that the square edges face the cylinder head.

Tighten the plugs to the specified torque value (Sect. C 3).



Operation	Section reference
Refit the camshaft supports	N 4.4
Refit the timing belt pulleys	N 4.2
Refit the rocker covers	N 4.4
Refit the cylinder head assembly	N 4.5, Fitting the cylinder head assemblies

A

B

C

D

E

F

G

H

L

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P

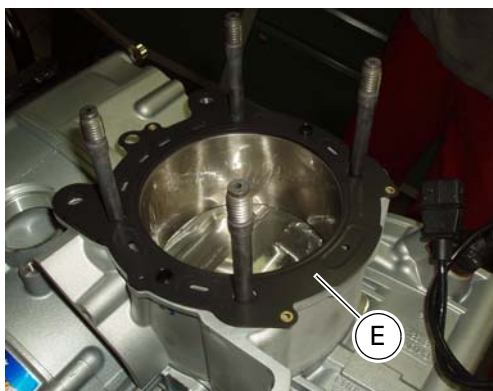
Fitting the cylinder head assemblies

Before fitting the cylinder head, check that gasket is in position on the mating surface between the head and cylinder (Sect. N 5).



Notes

When fitting the gasket, side (E) with the stamped code must be in contact with the cylinder head.



Lower the cylinder head carefully over the studs. Take care not to damage the threads. Fit the special washers (22) and nuts (21) onto the cylinder head studs.



Tighten down the nuts (21) on the studs in the sequence 1-3-2-4 using service tool no. **88713.2676** combined with a torque wrench.

Pre-tighten and tighten the cylinder head nuts (21) to the specified torque (Sect. C 3).



Operation	Section reference
Refit the coolant hoses	N 3.2
Refit the engine lubrication system	N 2.1
Refit the engine cooling system	N 3.2
Refit the timing belts and covers	N 4.2
Refit the engine to the frame	N 1

A

B

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E

F

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H

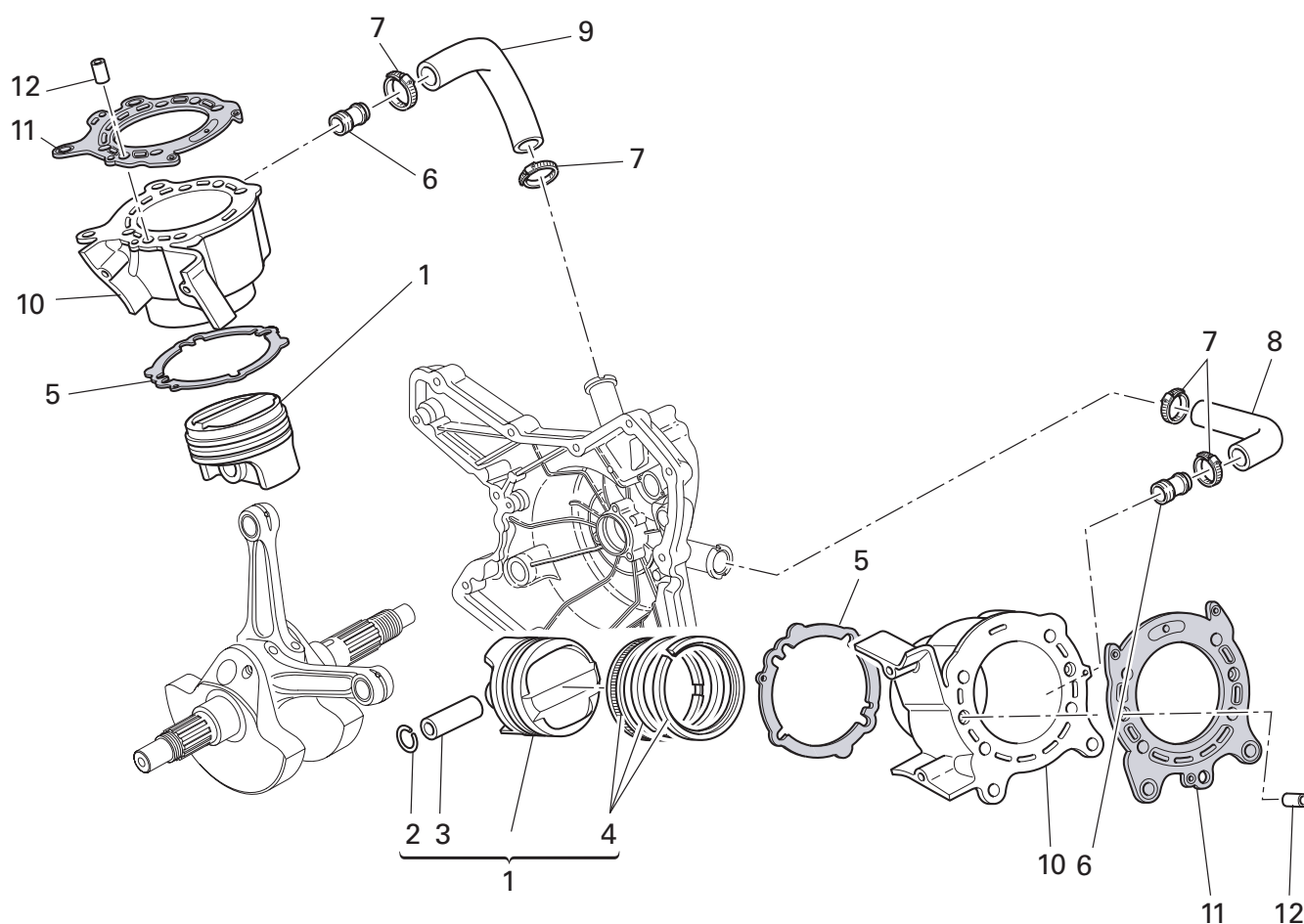
L

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5 - Cylinder/piston assemblies



- 1 Piston
- 2 Gudgeon pin circlip
- 3 Gudgeon pin
- 4 Set of piston rings
- 5 Cylinder-crankcase gasket
- 6 Water pump outlet union
- 7 Hose clip
- 8 Horizontal cylinder coolant inlet hose
- 9 Vertical cylinder coolant inlet hose
- 10 Cylinder barrel
- 11 Cylinder head gasket
- 12 Bush

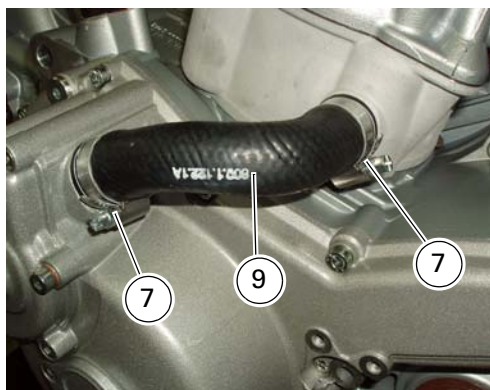
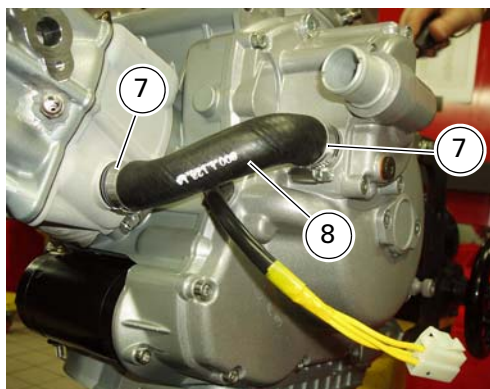


Important

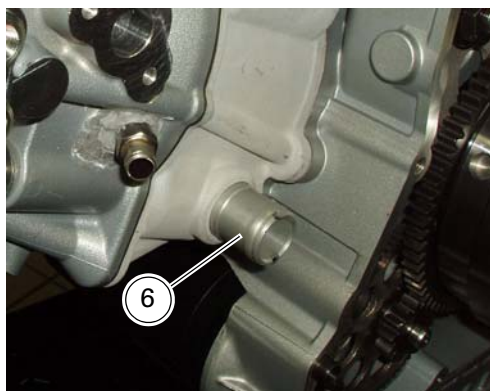
Bold reference numbers in this section identify parts not shown in the figures alongside the text. Refer to the exploded view diagram.

Disassembly of the cylinder/piston

Loosen the clamps (7) and remove the hoses (8) and (9) from the cylinder barrels (10) and from the left-hand crankcase cover.



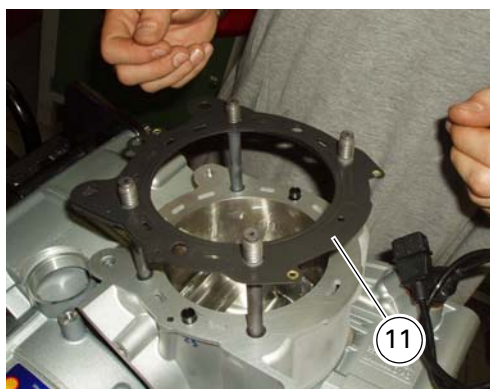
Unscrew the unions (6).



Notes

This operation is described with the engine removed from the frame and the cylinder head removed (Sect. N 4.5).

Remove the cylinder head gasket (11) from the cylinder barrel.



A

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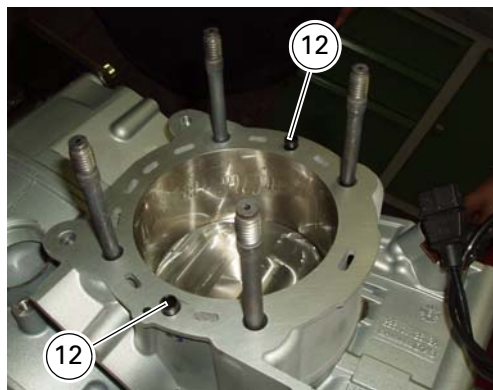
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P

Remove the locating dowels (12).



Use tool no. **88765.1523** to bring the piston of the horizontal cylinder to TDC.

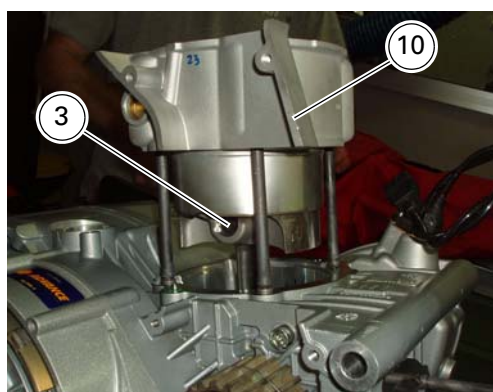


Carefully lift the cylinder barrel (10) off the crankcase, keeping it vertical.

If necessary, rock the cylinder slightly using both hands or tap its base gently with a rubber mallet. Continue to lift the cylinder until you can access the gudgeon pin (3).

In order to avoid on reassembly the difficult operation of fitting the piston in the cylinder, we recommend removing both components as a single assembly, as follows.

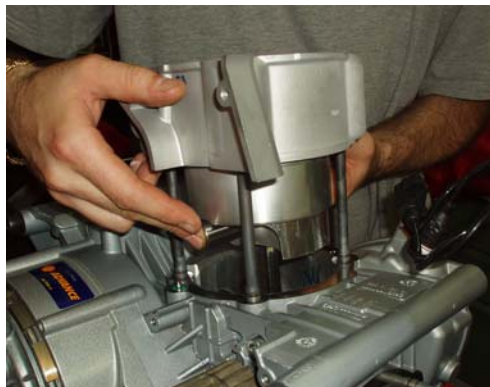
Stuff the crankcase opening with a rag or soft paper to prevent foreign material from falling in.



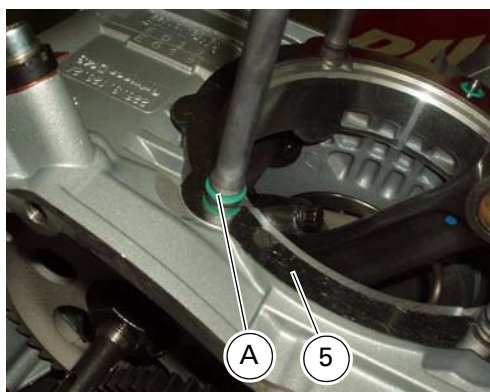
Remove the circlip (2) from the gudgeon pin (3) on the clutch side.



Working from the opposite side, drive out the gudgeon pin sufficiently to release the connecting rod.
Lift the barrel/piston assembly clear of the crankcase studs. If work is to be carried out on the piston, carefully withdraw it from the cylinder.



Remove the four O-rings (A) located on the crankcase studs between the barrel and the base gasket (5).



Important

Mark the pistons to show from which cylinder they were removed:
V= Vertical - H= Horizontal

To remove the vertical barrel-piston assembly, bring the vertical piston to TDC and proceed as for removal of the horizontal cylinder barrel.

A

B

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Overhaul of the cylinder barrel/piston components

A

Overhauling the cylinder

Check that the walls are perfectly smooth. Measure the cylinder bore diameter at 50 mm from the top surface and determine the size class to which it belongs in accordance with the values specified in Sect. C 1.1. Measure the bore diameter again at three different heights A, B and C and at positions offset by 90°; compare the measurements taken with the values given in Sect. C 1.1 to determine any taper and ovality in the bore.

B

In the event of damage or excessive wear the barrel must be renewed as it has a silicon carbide coating (which provides the cylinder walls with excellent anti-friction and anti-wear properties) and therefore cannot be rebored.

The cylinder barrels are marked with letters (stamped between two oil return ways) indicating their size class.

Always match cylinders with pistons from the same size class.

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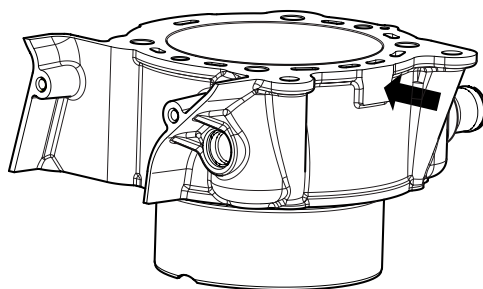
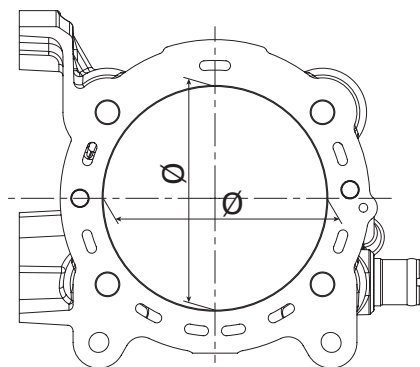
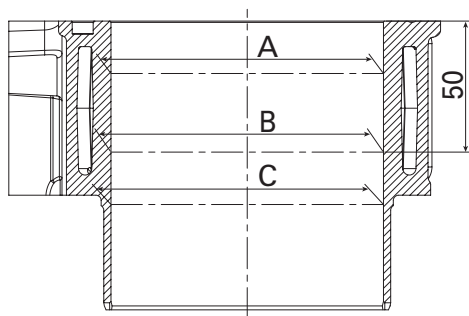
H

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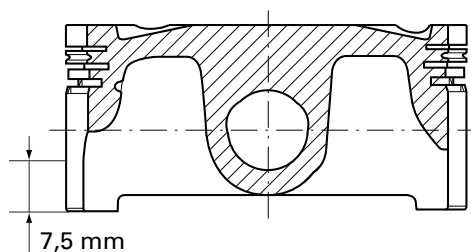
Overhauling the piston

Clean the piston crown and piston ring grooves of any carbon deposits.

Inspect the piston and check its dimensions carefully: there must be no signs of scuffing, scoring, cracks, or other damage.

The piston diameter must be measured at **7.5 mm** up from the bottom of the skirt at a 90° angle to the gudgeon pin.

The pistons must always be renewed as a pair.

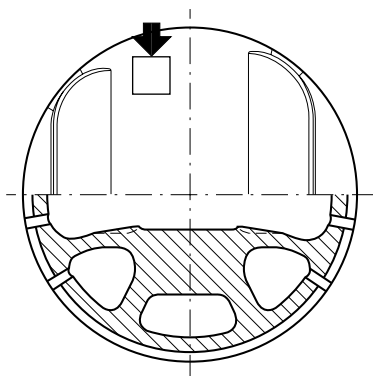


Checking the piston-cylinder clearance

The pistons are marked by a letter (punched into the piston crown) that indicates the size class to which they belong.

Always match cylinders with pistons from the same size class.

For the values, refer to Sect. C 1.1.



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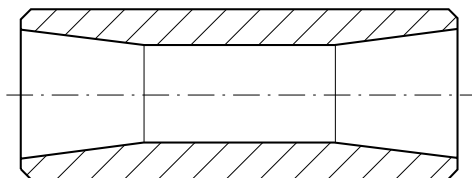
Overhauling the gudgeon pins

Gudgeon pins must be perfectly smooth without signs of scoring, steps, or blueing due to overheating. The well-lubricated gudgeon pin must slide smoothly inside the piston without stiffness.

The assembly clearance with the piston at the time of installation must be **0.002 to 0.008 mm**.

The maximum permissible wear limit is **0.035 mm**.

If a new gudgeon pin is fitted, you must also change the connecting rod small end bush.



Overhauling the piston rings

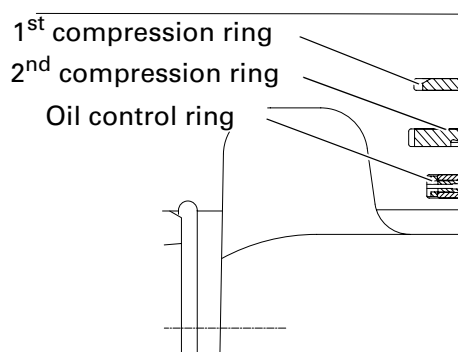
The piston rings must not show any signs of scuffing or scoring. Replacement pistons are supplied complete with piston rings and gudgeon pin.



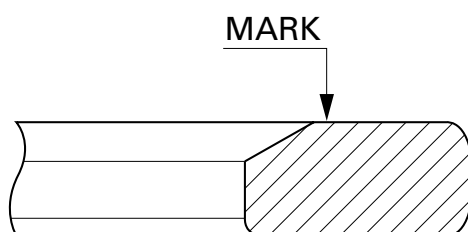
Checking the piston ring-grooves clearance

The maximum permissible wear limit is **0.15** mm for the top compression ring (1st) and **0.10** mm for the others (2nd and oil control ring).

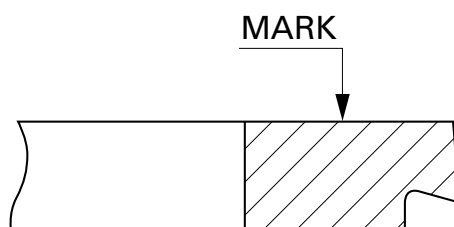
The markings punched on the piston rings must always be facing upwards.



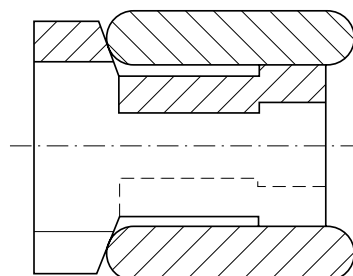
1st compression ring



2nd compression ring



Oil control ring



A

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Checking the piston ring/cylinder clearance

A

Insert the ring in the cylinder bore so that it is positioned 50 mm from the top face of the cylinder barrel; make sure that the ring is positioned perfectly square to the cylinder walls by checking with a gauge at several points around the ring that the top surface of the ring is exactly 50 mm from the top face of the cylinder barrel.
Measure the piston ring gap (A):

B

	(A) mm	Wear limit
Top compression ring	0.2 ÷ 0.4	0.8
Second compression ring	0.3 ÷ 0.5	0.8
Oil control ring	0.2 ÷ 0.7	1.0

C

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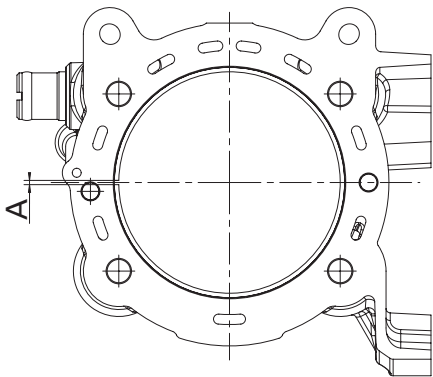
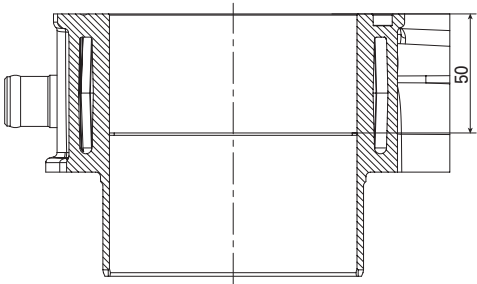
H

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Refitting the cylinder/piston assembly

If you are using new cylinders and pistons, match cylinders with pistons from the same class (see "Overhauling the cylinder barrel piston components" in this section).

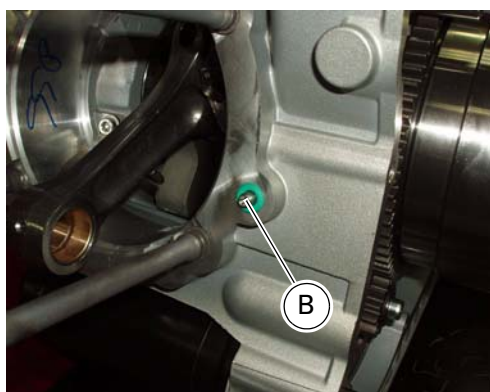
If the pistons have been separated from their cylinders, before reassembling these components, position the piston ring gaps at 120° from one another (the marks must always face the piston crown).

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 recess is on the side of the exhaust port.



Remove any deposits and degrease the contact surfaces of the crankcase and the cylinders. Check that the cylinder barrel locating dowels (B) are fitted on the crankcase.



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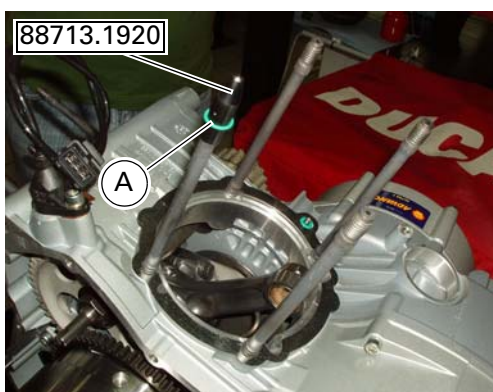
N

P

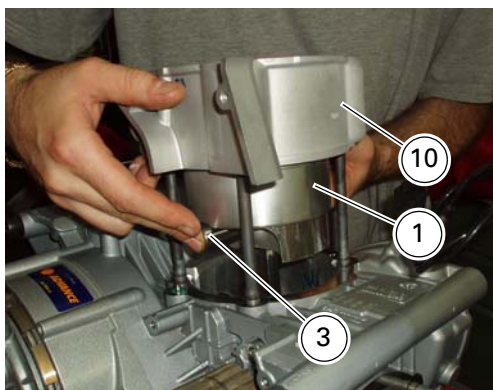
Apply sealant to the gasket (5) then locate the gasket on the crankcase.



Using the cap **88713.1920**, fit the O-rings (A) on each stud and guide them into their seats in the crankcase.



Bring the connecting rod small end close to TDC and slide the barrel-piston assembly (1-10) onto the crankcase studs. Push the connecting rod small end into the piston close to the gudgeon pin (3) bore. Lubricate and insert the gudgeon pin.



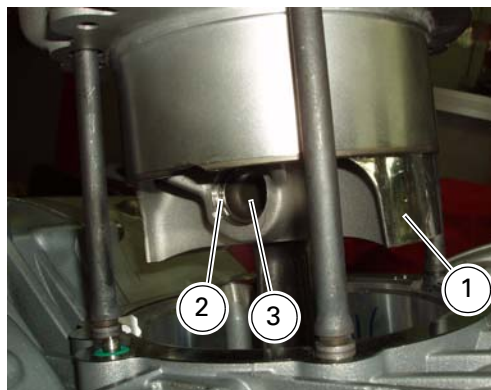
The gudgeon pin (3) must slide smoothly in the connecting rod small end bush and in the piston (1).
Stuff the crankcase opening with a cloth to prevent foreign objects from falling inside and then fit circlip (2).



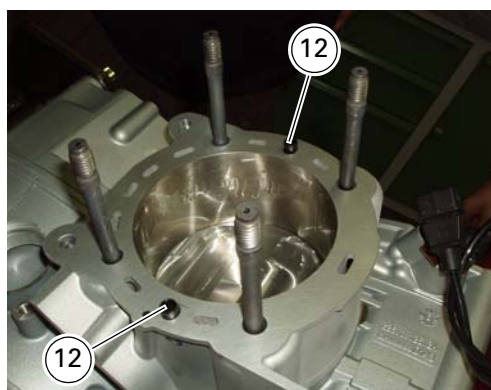
Important

Always use new circlips (2) on reassembly.

Push the cylinder barrel (10) down until it seats against the crankcase.



Refit the locating dowels (12).



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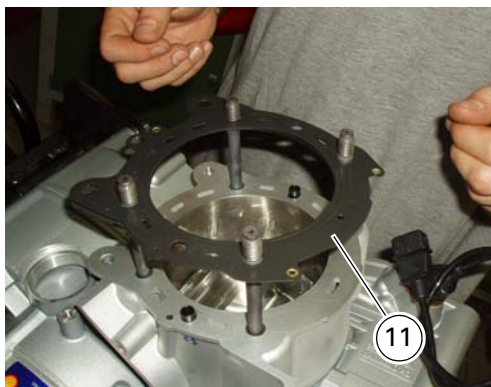
P

Fit the cylinder head gasket (11) over the studs. The side marked with the part number must be facing the head.



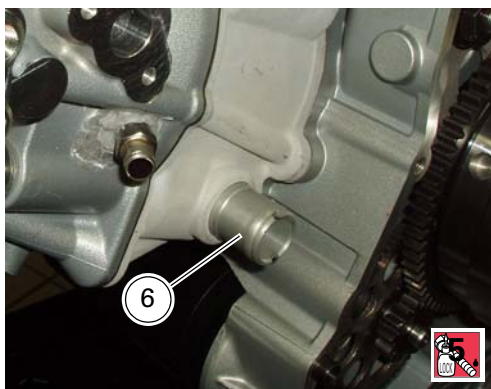
Notes

The shape prevents incorrect fitting of the gasket, provided that the coolant flow holes are aligned with those on the cylinder.

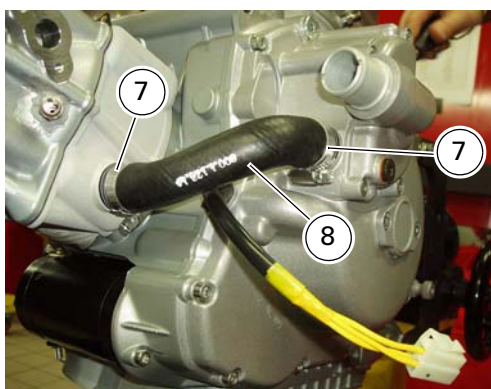


Repeat the procedure for the other cylinder and refit the cylinder heads (Sect. N 4.5).

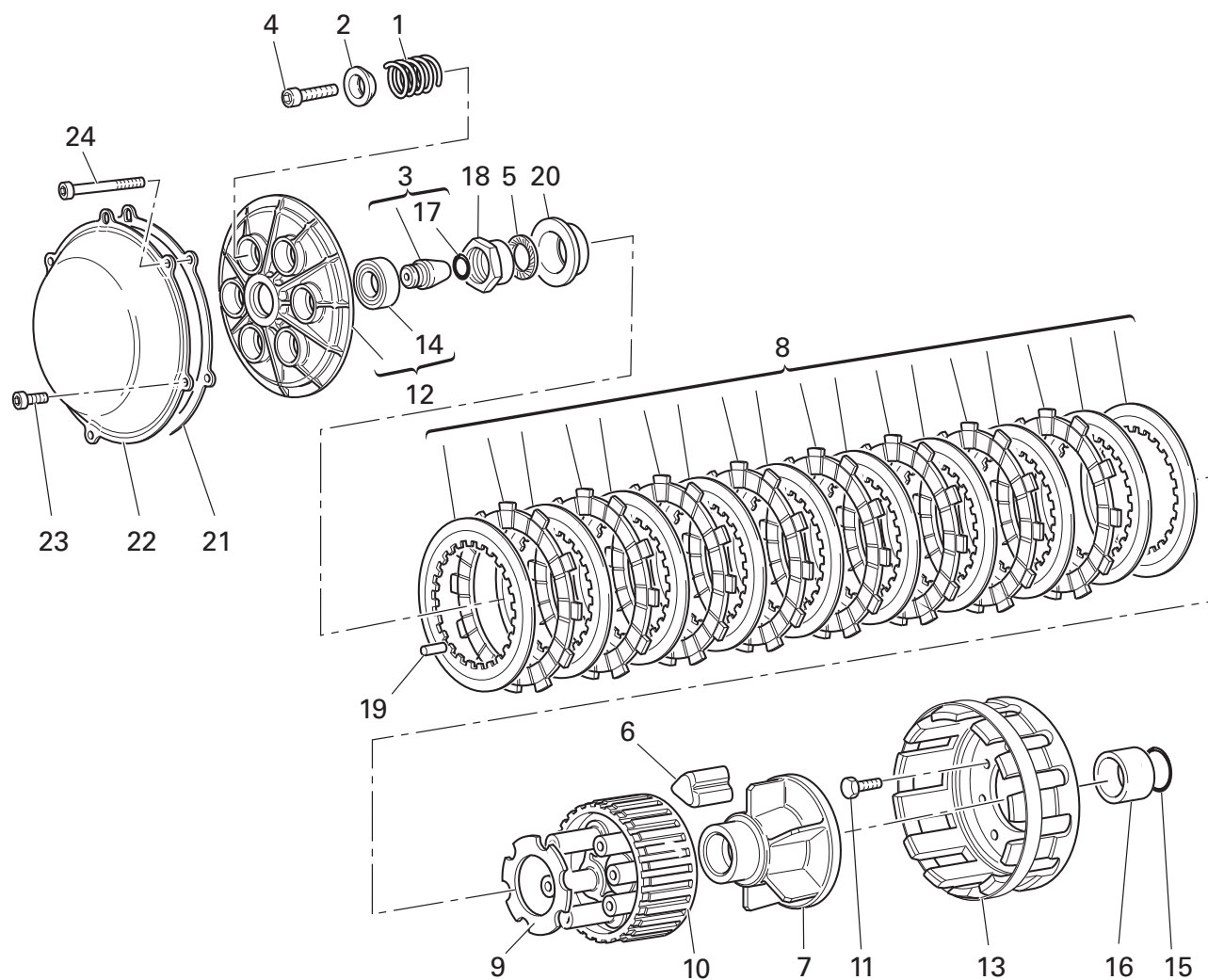
Apply the recommended threadlocker to the unions (6) and tighten them to the specified torque (Sect. C 3, Engine tightening torques).



Fit the hoses (8) and (9) and tighten the clamps (7) to the specified torque (Sect. C 3, engine tightening torques).



6.1 - Clutch assembly: clutch



- 1 Clutch spring
- 2 Collar
- 3 Clutch lifter
- 4 Bolt
- 5 Lock washer
- 6 Cush drive rubber
- 7 Cush drive hub
- 8 Clutch plates
- 9 Thrust washer
- 10 Clutch centre
- 11 Bolt
- 12 Pressure plate

- 13 Clutch drum
- 14 Bearing
- 15 O-ring
- 16 Spacer
- 17 O-ring
- 18 Nut
- 19 Locating dowel
- 20 Bush
- 21 Clutch cover gasket
- 22 Clutch cover
- 23 Bolt
- 24 Bolt



Important

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

A

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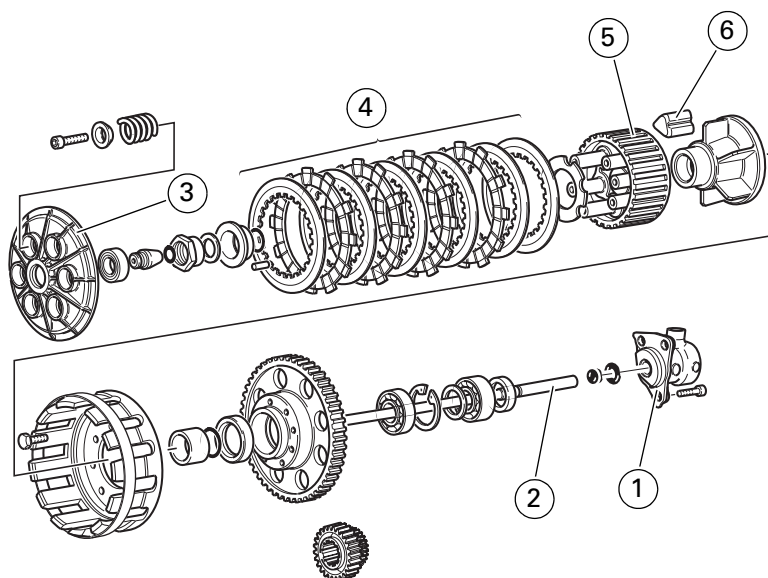
N

P

Description

The clutch is disengaged by a slave cylinder consisting of a piston (1) housed inside a cylinder mounted to the left-hand crankcase cover. This piston moves a pushrod (2), which runs through gearbox input shaft and operates the pressure plate (3) located on top of the clutch plate pack (4).

Motion is transmitted from the clutch centre (5) to the primary shaft through special cush drive rubbers (6), which make for smoother clutch engagement and thus prevent damage to transmission parts. Before working on the internal clutch parts, check that the clutch operates correctly. Then deal with the problem in a systematic manner.



The following is a list of possible causes of clutch malfunctions.

A clutch which does not disengage may be caused by:

- excessive play of the control lever;
- distorted clutch plates;
- incorrect spring tension;
- faulty clutch release mechanism;
- excessive wear of the hub or clutch drum.

A clutch which slips may be caused by:

- insufficient play of the control lever;
- worn clutch plates;
- weakened springs;
- faulty clutch release mechanism;
- excessive wear of the hub or clutch drum.

A noisy clutch may be caused by:

- excessive backlash between the primary drive gears;
- damaged primary drive gear teeth;
- excessive play between driving plate tabs and clutch drum;
- worn gear/clutch drum bearings;
- worn cush drive rubbers;
- the presence of metal particles (filings) on the gear teeth.

Disassembly of the clutch

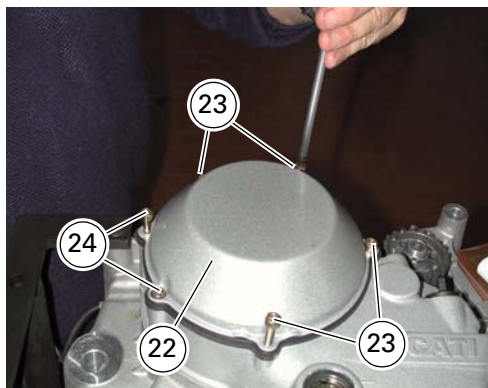
Operation	Section reference
Remove the side fairings	E 2



Notes

For clarity, the figures show the engine removed from the frame.

Undo the four retaining bolts (23) and the two retaining bolts (24) from the clutch cover (22).
Remove the cover and the sound deadening gasket (21).



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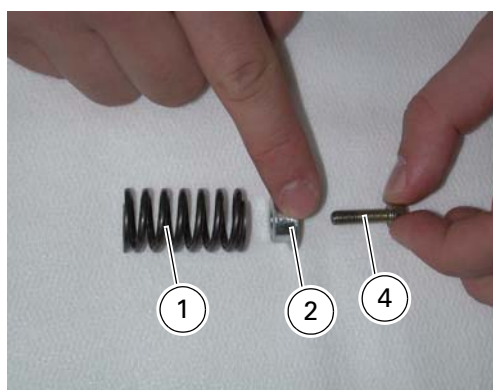
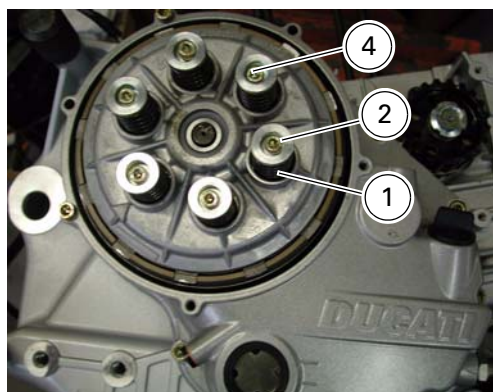
L

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Unscrew the retaining bolts (4) and remove the collars (2) and the clutch springs (1).



Remove the pressure plate (12).

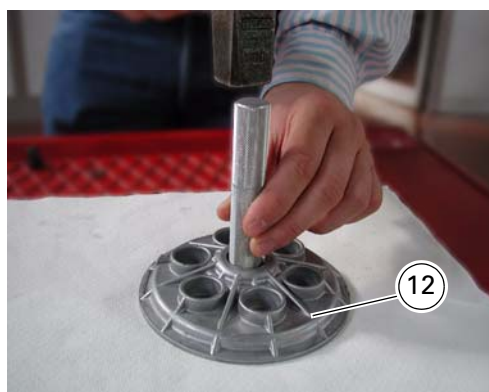
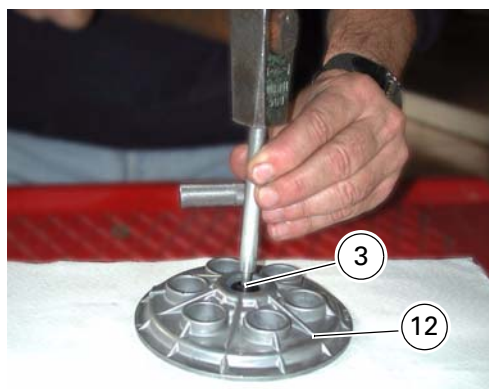


Remove the clutch lifter (3) and its O-ring (17) using a suitable drift and a plastic headed mallet. Then remove the bearing (14) installed from inner side of the pressure plate (12) using a drift of suitable size.



Notes

Once disturbed, the bearing must be renewed.



Remove the clutch plates (8).

When removing the clutch plates, keep them together in pairs in the correct order and set them aside, tying them together, if necessary.



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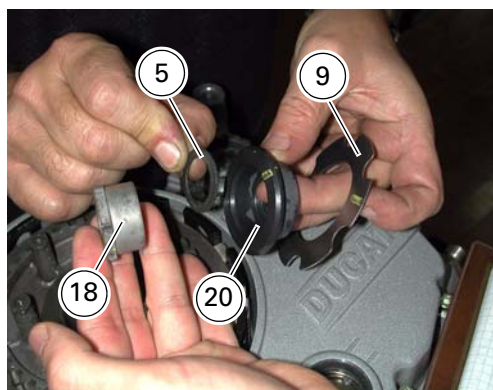
N

P

Restrain the clutch centre (10) using service tool **88713.2133** and remove the centre nut (**18**).



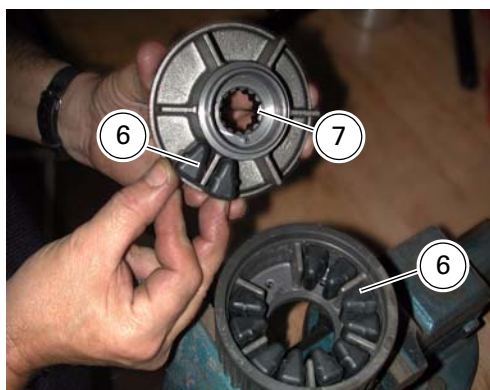
Remove the washer (5), bush (20) and thrust washer (9).



Remove the clutch centre (10) complete with the cush drive rubbers from the shaft.



When renewing the cush drive rubbers (6), use a drift to remove the hub (7) from the clutch centre (10) and overcome the resistance of the rubbers.



Slide off the spacer (16), taking care not to damage its internal O-ring (15).

Visually check the O-ring for wear and renew it if necessary.

Position service tool no. **88713.1805** to prevent the clutch drum from rotating when loosening the bolts (11).

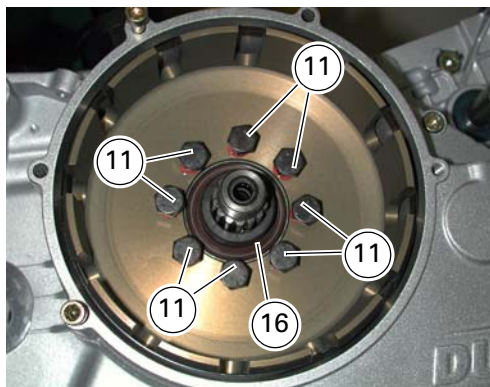


Notes

If no cover parts need to be serviced, leave the clutch drum assembly and the primary drive gear installed on the clutch cover.

Undo the eight bolts (11) securing the clutch drum to the primary drive gear.

Remove the clutch drum.



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Inspection and overhaul of the clutch components

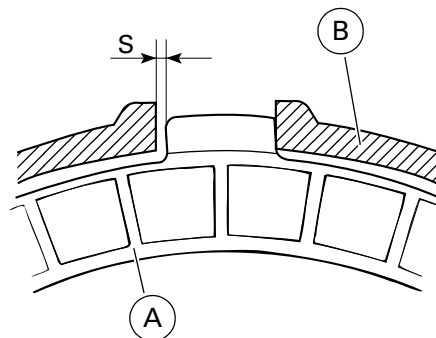
A

Checking the clearance between the clutch drum and the friction plates

Insert the friction plate (A) in the clutch drum (B) and measure tang-to-slot 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.

B



C

D

Overhaul of the friction plates

The friction plates must not show any signs of blackening, grooves or deformation.

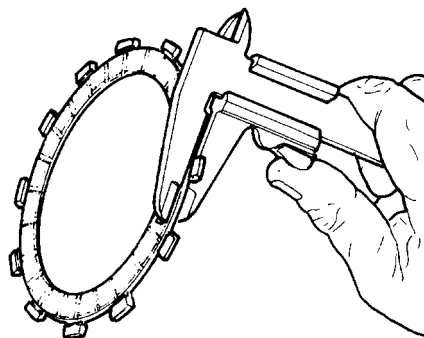
Measure the thickness of the friction plates. It should not be less than **2.8 mm**.

Place the plate on a flat surface and check the amount of deformation with a feeler gauge.

Max flatness error: **0.2 mm**.

E

F



G

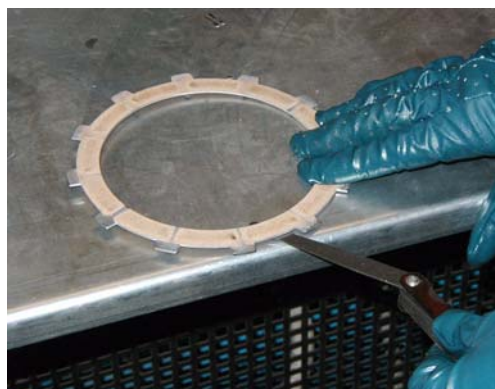
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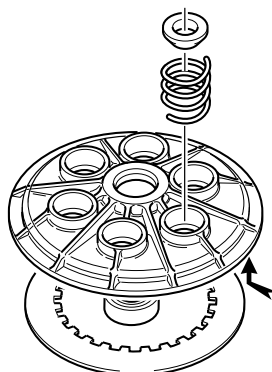


Overhaul of the pressure plate

Check the condition of the bearing: renew the bearing if the play is excessive.

Check the contact surface of last plain steel plate. If extremely scored, polish it in the same manner as described previously for the cylinder head surface.

Check the condition of the spring guide cups and always replace the spring retaining collars.

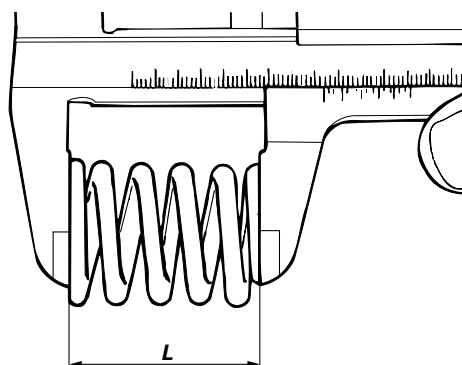


Overhaul of the clutch springs

Measure the length "L" of each spring:

Minimum length: **36.5** mm.

Renew any springs that are shorter than the above limit value.



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Reassembly of the clutch

Assemble the clutch drum to the primary drive gear.

Apply threadlocker to the threads of the eight retaining bolts (11) and insert them into the gear.

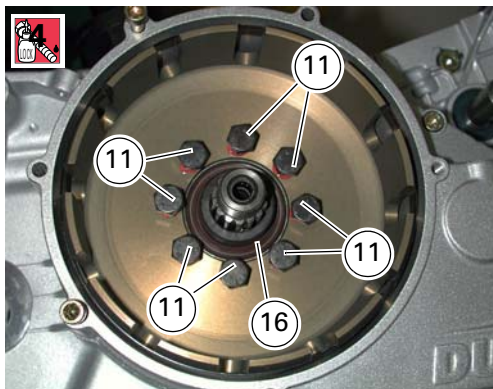


Important

Use new bolts.

Tighten the bolts (11) to the specified torque working in a crosswise pattern (Sect. C 3).

Fit the spacer (16) to the gearbox input shaft along with the lubricated O-ring (15). The O-ring side should face the engine.

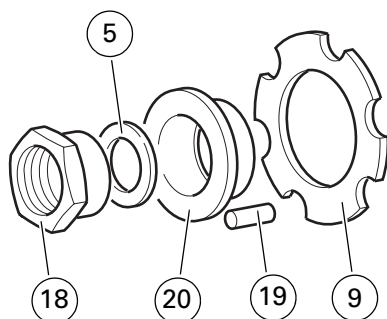


Fit the clutch centre (10) complete with the cush drive rubbers onto the input shaft.



Fit the following parts onto the end of the input shaft:

- thrust washer (9);
- bush (20) with pin (19) in the cush drive hub;
- safety washer (5) and nut (18).

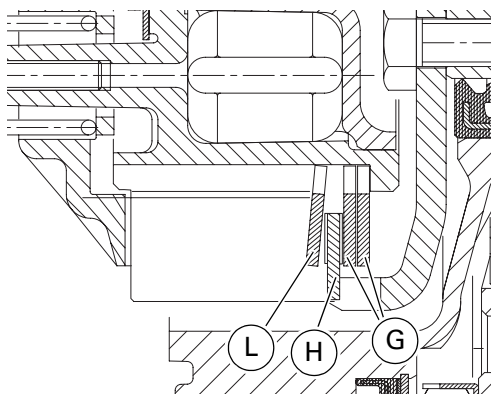
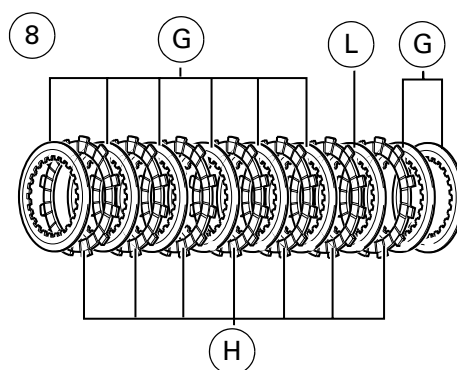


Restrain the clutch centre with the service tool **88713.2133**, grease the retaining nut and tighten it to the specified torque (Sect. C 3).



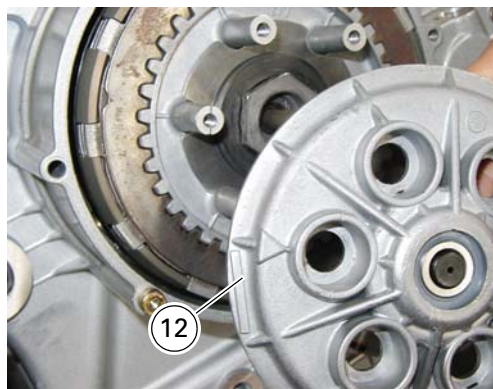
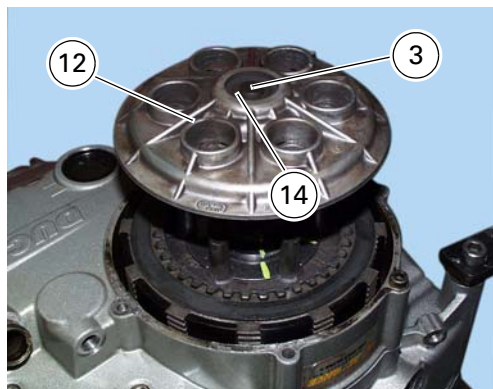
Fit the clutch plates (8) in the following order (see figure):

- two plain plates (G) **1.5** mm thick;
- one friction plate (H) **3** mm thick;
- a convex plate (L) **1.5** mm thick, installed as shown in cross-section;
- a set of six friction plates (H) alternated with six plain plates (G). The clutch pack should be completed with a friction plate.

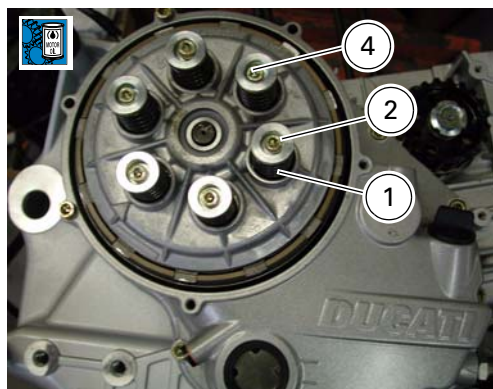


Insert the clutch lifter (3) in the bearing (14) of the pressure plate (12).

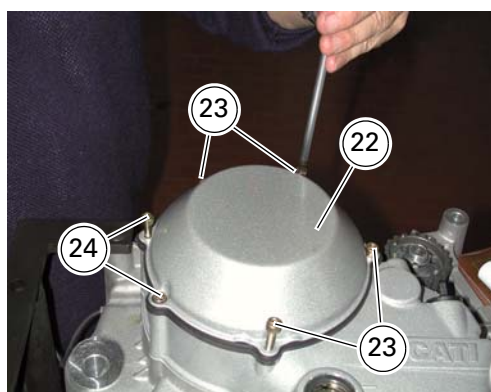
Install the pressure plate (12) so that the mark on the end of one of the clutch spring posts is aligned with the marks on the corresponding pressure plate hole, indicated by the triangle.



Fit a spring (1) and collar (2) into each recess and fit the retaining screws (4) after lubricating their threads with engine oil. Tighten the bolts (4) gradually in a crosswise pattern and then tighten to the specified torque (Sect. C 3).



Locate the gasket (21) and the clutch cover (22) and then tighten the cover retaining bolts (24) and (23) to the specified torque (Sect. C 3).



Operation	Section reference
Refit the side fairings	E 2

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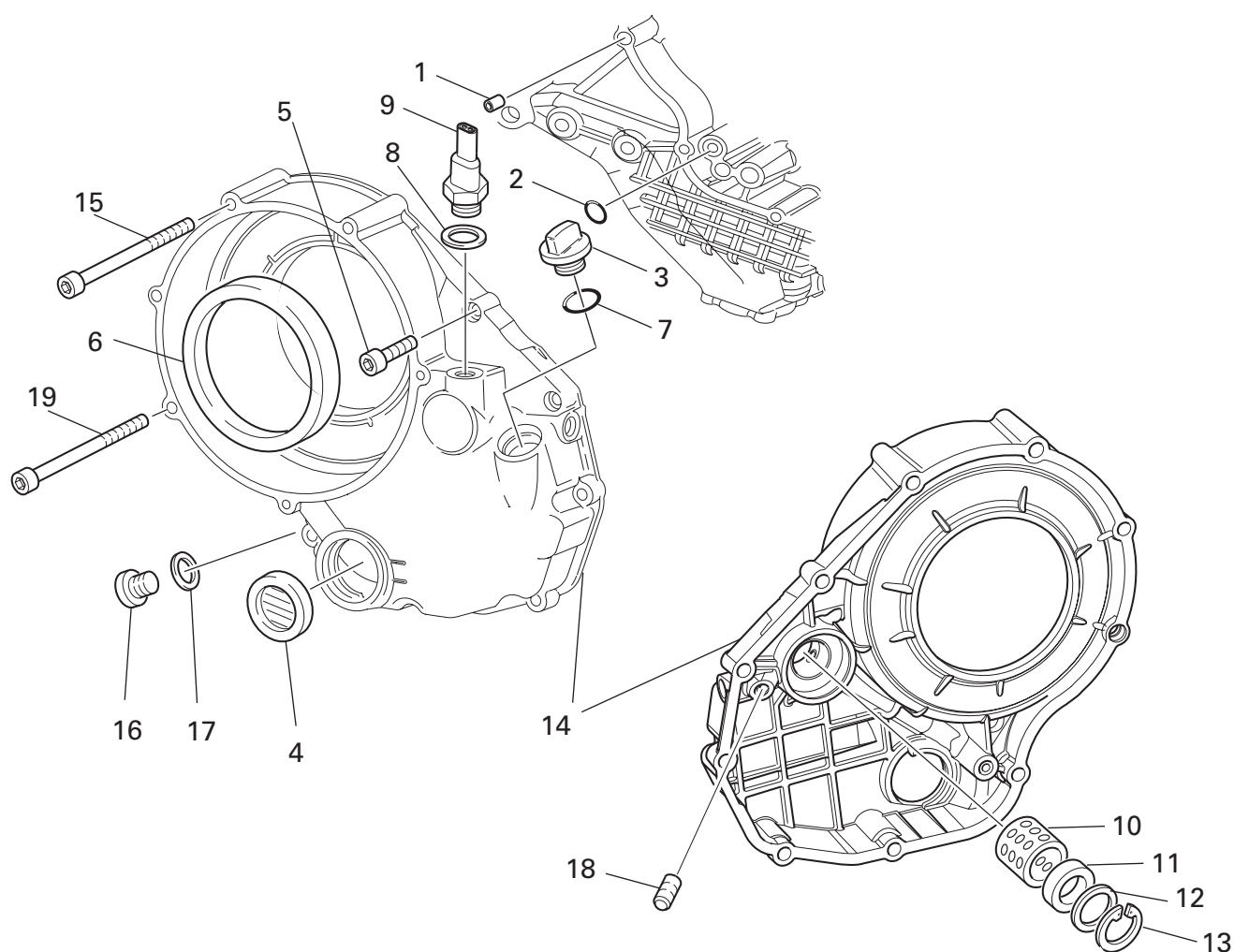
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6.2 - Clutch assembly: right-hand side crankcase cover



- 1 Locating dowel
- 2 O-ring
- 3 Plug
- 4 Oil level plug
- 5 Bolt
- 6 Ring
- 7 O-ring
- 8 Seal
- 9 Switch
- 10 Bush
- 11 Oil seal
- 12 Shim
- 13 Circlip
- 14 Right-hand side crankcase cover
- 15 Bolt
- 16 Plug
- 17 Seal
- 18 Grub screw
- 19 Bolt

● Important

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

Removal of the right-hand side crankcase cover

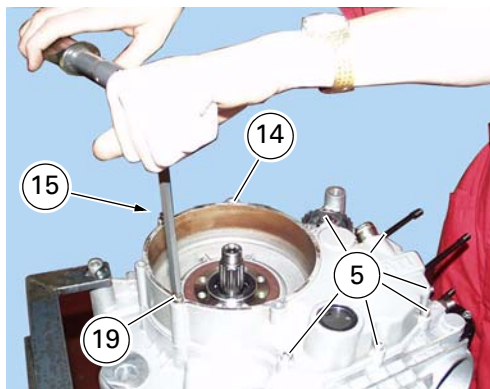
Operation	Section reference
Remove the side fairings	E 2
Drain the engine oil	C 4
Remove the clutch centre	N 6.1



Notes

For clarity, the figures show the engine removed from the frame.

Undo and remove the six short bolts (5) and the long retaining bolts (15) and (19) from the crankcase cover (14).



Tap around the edge of the cover with a plastic mallet to detach it from the crankcase half.

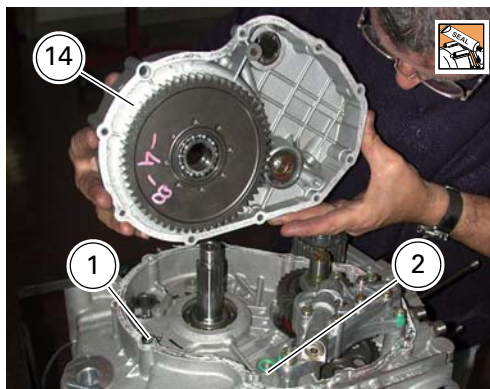
Remove the right-hand side crankcase cover from the crankcase, taking care to recover the locating dowel (1).



Important

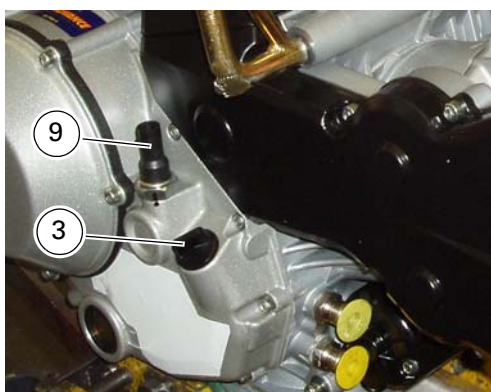
The rh crankcase cover (14) can be removed complete with the clutch drum and primary drive gear.

Remove the O-ring (2) located next to the crankcase oil way.

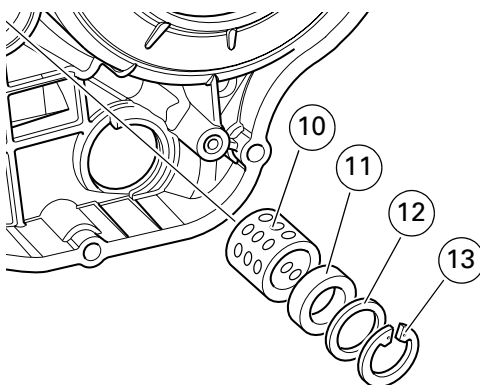
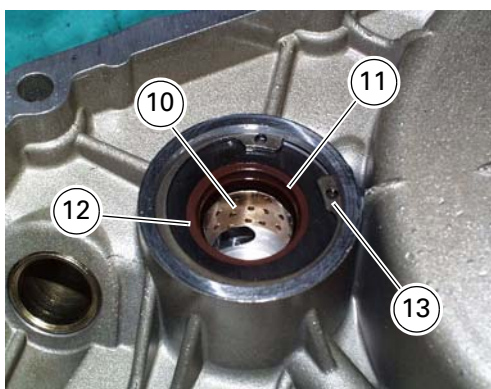


Disassembly of the right-hand side crankcase cover

Remove the plug (3) and the O-ring (7), the engine oil pressure sensor (9) and the seal (8), the plug (16) and the seal (17) from the crankcase cover.



Remove the circlip (13) and withdraw the shim (12) and the oil seal (11).
The drilled bush (10) is mounted to the cover by a forced interference fit. Remove it using a suitable puller.
Inspect the oil seal (11) and renew it if necessary.



To check the condition of the oil seal (6) installed in the rh crankcase cover between the clutch drum and primary drive gear, first remove the latter two components (Sect. N 6.1).



Reassembly of the right-hand crankcase cover

If the bush has been renewed, seat the new bush (10) in the crankcase cover using a suitable drift or a press.

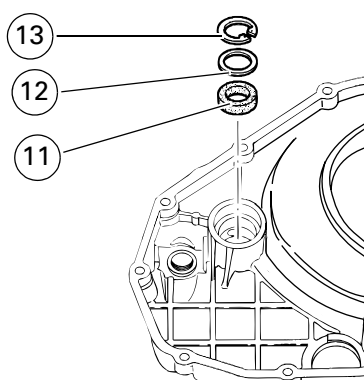
If the oil seal (11) needs to be renewed, fit the new seal into the crankcase cover, positioning it so the side without a spring is facing the circlip (13).

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 (12) and the circlip (13).

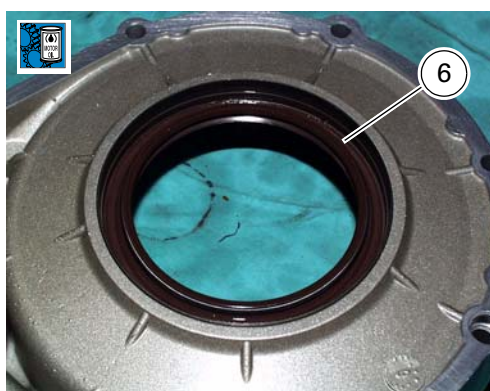


Important

In order for the oil seal (11) to function correctly, it must have an assembly clearance that allows the circlip (13) to rotate.



If it has been removed, install the new oil seal (6) in the crankcase cover, with the spring side facing inwards (see figure), and lubricate the seal lips with engine oil.



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Fit the plug (3) and the seal (7). Fit the sensor (9) and the seal (8). Fit the plug (16) and the seal (17).

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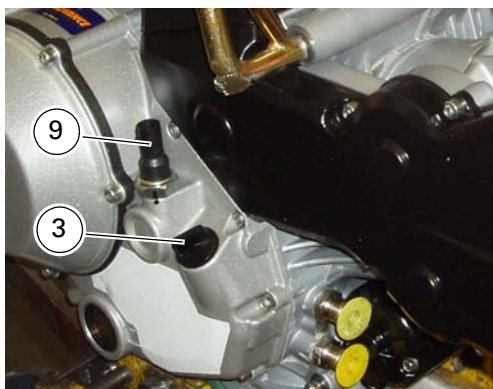
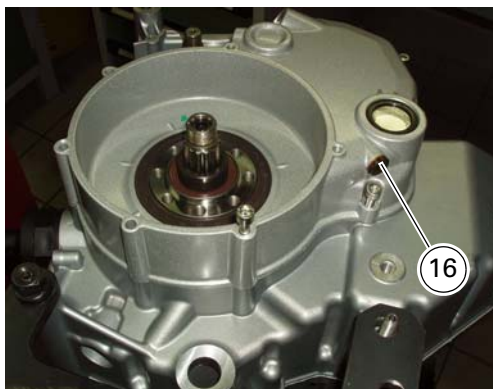
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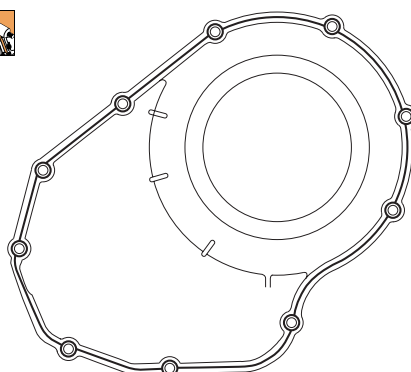
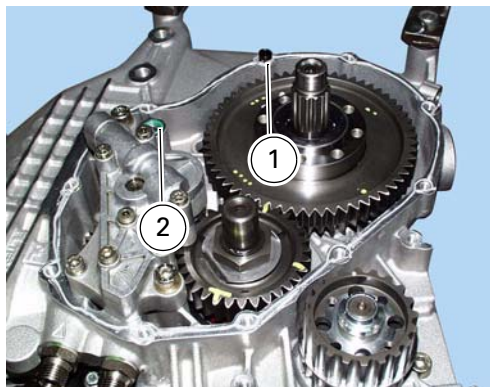
P



Refitting the right-hand side crankcase cover

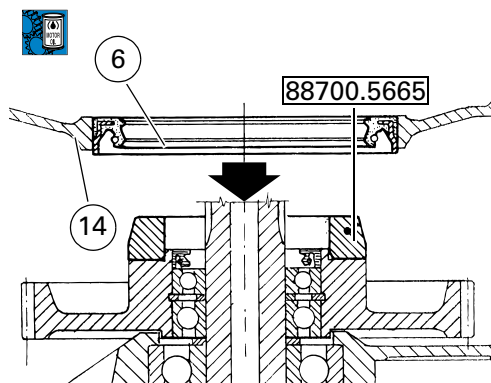
Clean and degrease mating surfaces on the clutch cover and crankcase and ensure that locating bush (1) and the O-ring (2), located in correspondence with the oil way, are installed in the crankcase.

Apply a uniform continuous bead of DUCATI liquid gasket onto crankcase mating surfaces, working around all the holes.



Lubricate the oil seal (6) with engine oil and fit the bush **88700.5665** onto the primary drive gear so as not to damage the seal while fitting the cover.

Fit the cover assembly (14) to the crankcase and insert the retaining screws.



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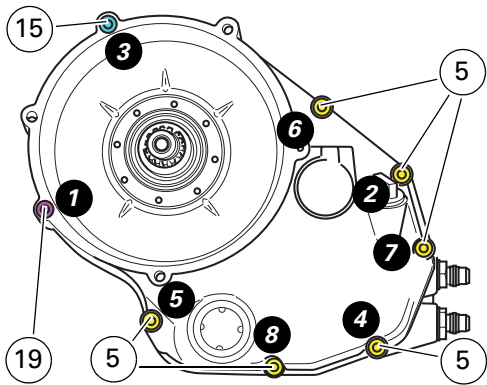
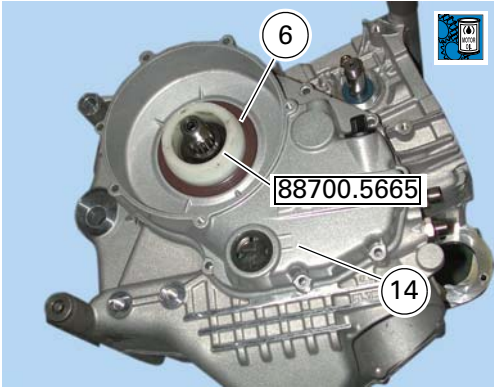
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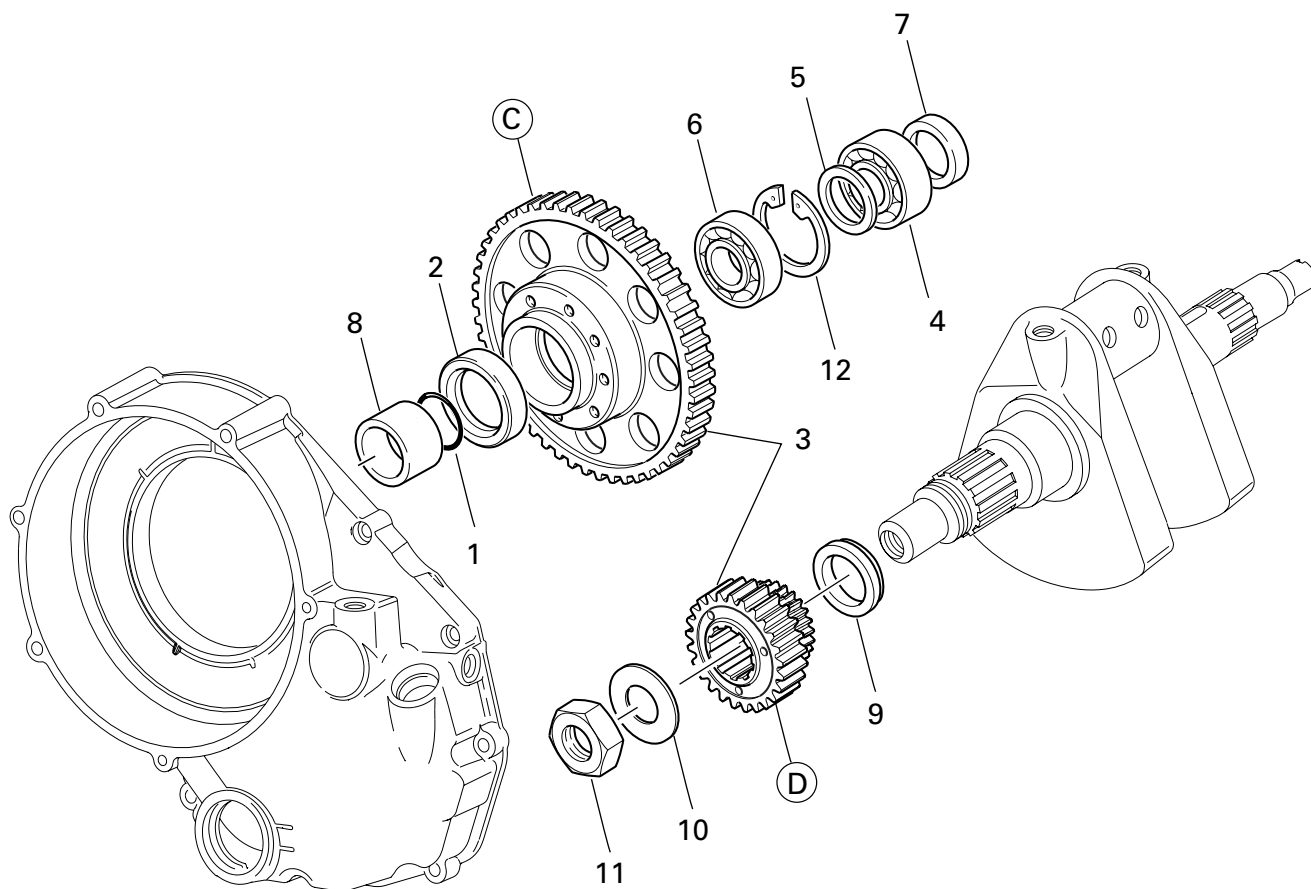
Tighten the bolts (5), (15) and (19) to the specified torque (Sect. C 3) following the numbered sequence:

Retaining bolts		
See	Type	Qty.
5	M6x25 hex socket bolts	6
19	M6x65 hex socket bolts	1
15	M6x70 hex socket bolts	1



Operation	Section reference
Refit the clutch drum, clutch centre and the clutch plate pack	N 6.1
Top up the engine oil	D 4
Refit the side fairings	E 2

6.3 - Clutch assembly: primary drive gears



- 1 O-ring
- 2 Oil seal
- 3 Primary drive gears
- 4 Bearing
- 5 Circlip
- 6 Bearing
- 7 Spacer
- 8 Spacer
- 9 Spacer
- 10 Lock washer
- 11 Nut
- 12 Circlip



Important

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

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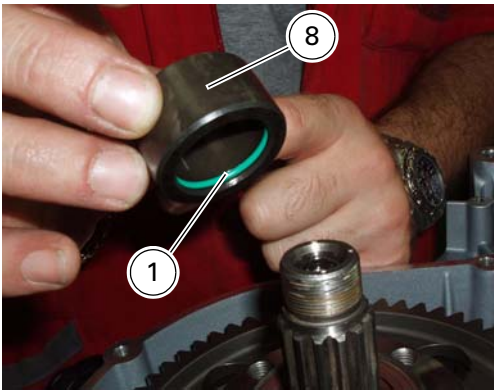
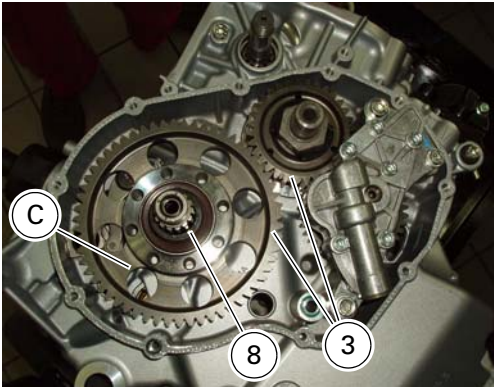
Removal of the primary drive gears

Operation	Section reference
Remove the side fairings	E 2
Remove the clutch drum, the clutch centre and the clutch plate pack	N 6.1
Remove the right-hand side crankcase cover	N 6.2

Notes

For clarity, the figures show the engine removed from the frame.

- Withdraw from the input shaft the spacer (8) and the O-ring (1) seated against the bearing (6) of the driven gear (C) of the primary drive (3).
- Remove the driven gear (C) of the primary drive (3) complete with the bearings and oil seal.



To renew the inner parts of the gear, use a suitable drift (A) and a support (B).

After removing the oil seal (2), tap from the inside towards the exterior using part of the inner race of bearing (4) to be removed, after moving aside spacer (5) located between the two bearings.

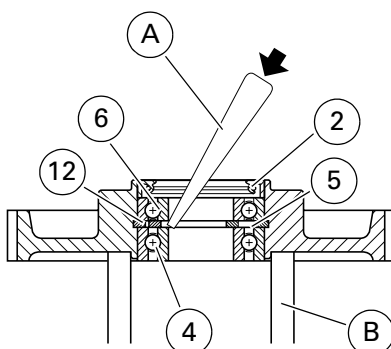
Tap on different points to remove the components squarely.

Use the same technique to remove the bearing (6).



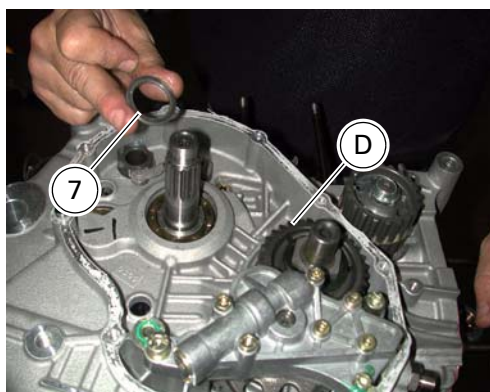
Important

Once disturbed, the oil seal (2), circlip (12) and the spacer (5) must be renewed. The latter two components must always be renewed as a pair.

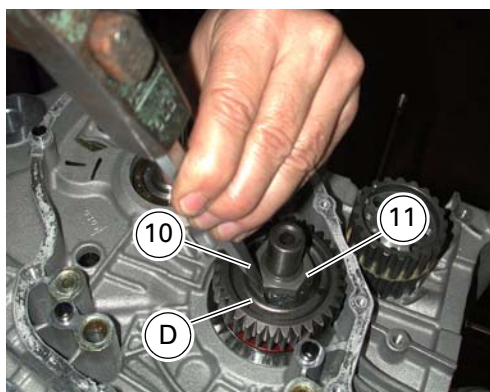


Remove the spacer (7) from the gearbox input shaft.

Remove the oil pump (Sect. N 2.3) to disengage the driving gear (D).



Straighten out the lock washer (10) on the nut (11) securing the driving gear (D) of the primary drive pair.



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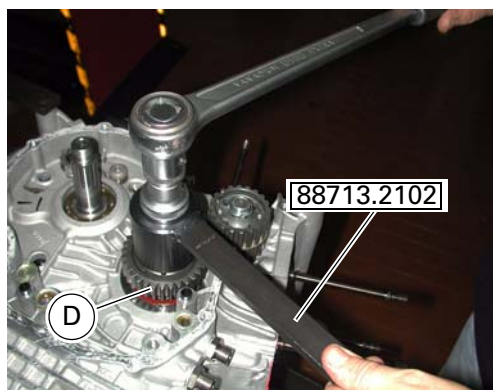
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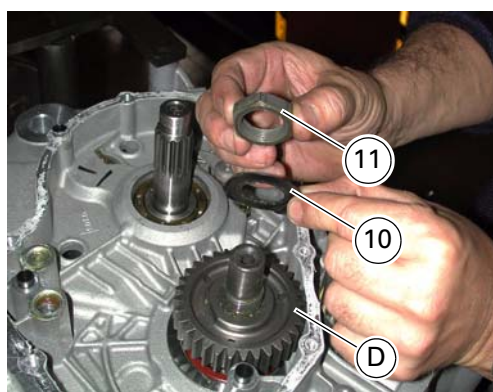
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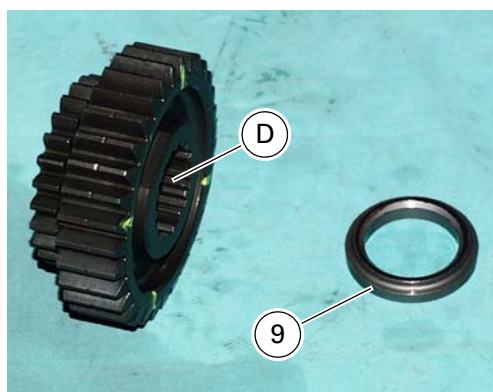
Fit the service tool no. **88713.2102** to the gear (D) and immobilise it by inserting a pin in one of the holes mounting the engine block to the frame.



Loosen the retaining nut (11) of the driving gear (D) using a socket wrench of suitable length. Remove the nut (11) and the lock washer (10).

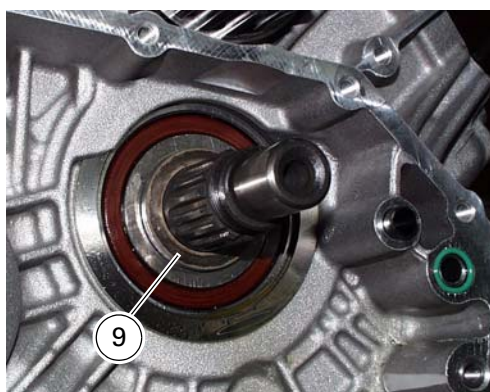
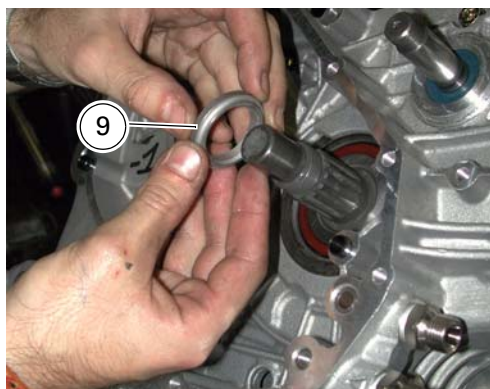


Remove the driving gear (C) of the primary drive and the spacer (9) from the crankshaft.

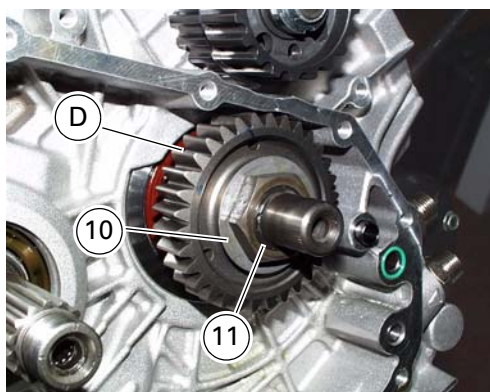


Refitting the primary drive gears and checking backlash

Carefully degrease the splined end of the crankshaft and the corresponding internal splines of the primary gear.
Fit the inner spacer (9) to the shaft with its flat side facing outwards.



Fit gear (D) onto the crankshaft with oil pump drive sprocket facing the crankcase.
Temporarily secure the gear with washer (10) and nut (11).



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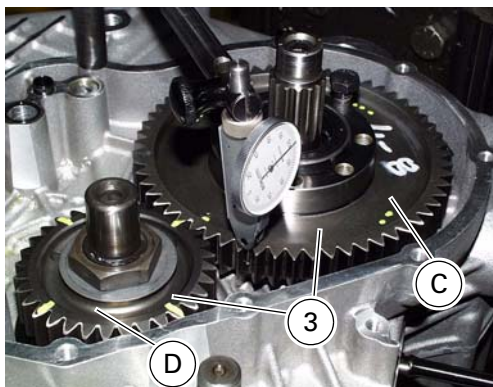
P

If fitting a new primary drive gear pair (3), check the backlash.

Temporarily fit the gear (C) complete with the bearings and the oil seal onto the gearbox input shaft and fix a dial gauge on the crankcase; position the dial gauge stylus on a gear tooth.

Turn the driven gear (D) to mesh the teeth and check with the dial tool that backlash ranges between **0.05** and **0.07** mm.

Measure the backlash at 16 diametrically opposed points of the gear.

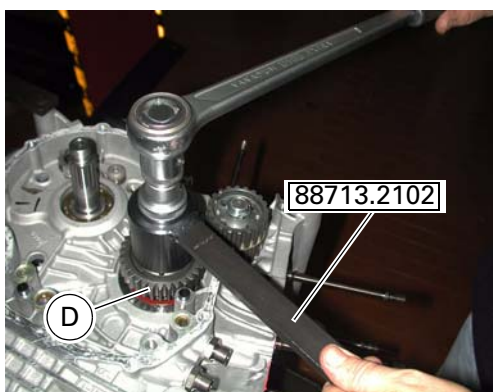


If the measured values are outside the permissible tolerance, change the position of the driven gear (C) on the input shaft leaving crankcase gear (D) untouched. If still outside tolerance values, renew the primary drive gear pair.

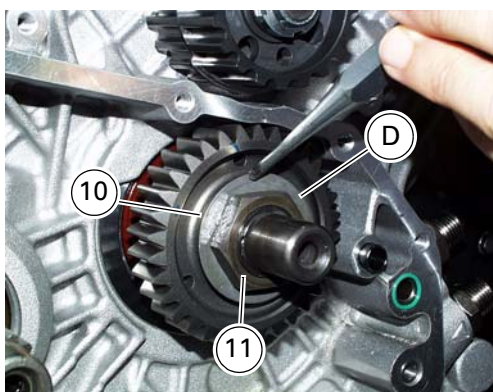
When this test is complete, finally tighten the previously installed nut (11).

Fit the service tool no. **88713.2102** to the gear (D) and immobilise it by inserting a pin in one of the holes mounting the engine block to the frame.

Tighten the nut to the specified torque with a torque wrench (Sect. C 3), working clockwise.



Stake the washer (10) on the gear (D) in correspondence with the milled location and on the nut (11) in a diagonally opposed position.



Refit the oil pump and check the backlash between the oil pump gear and primary drive gear on the crankshaft (Sect. N 2.3).

Operation	Section reference
Refit the right-hand crankcase cover	N 6.2
Refit the clutch drum, clutch centre and the clutch plate pack	N 6.1
Refit the side fairings	E 2

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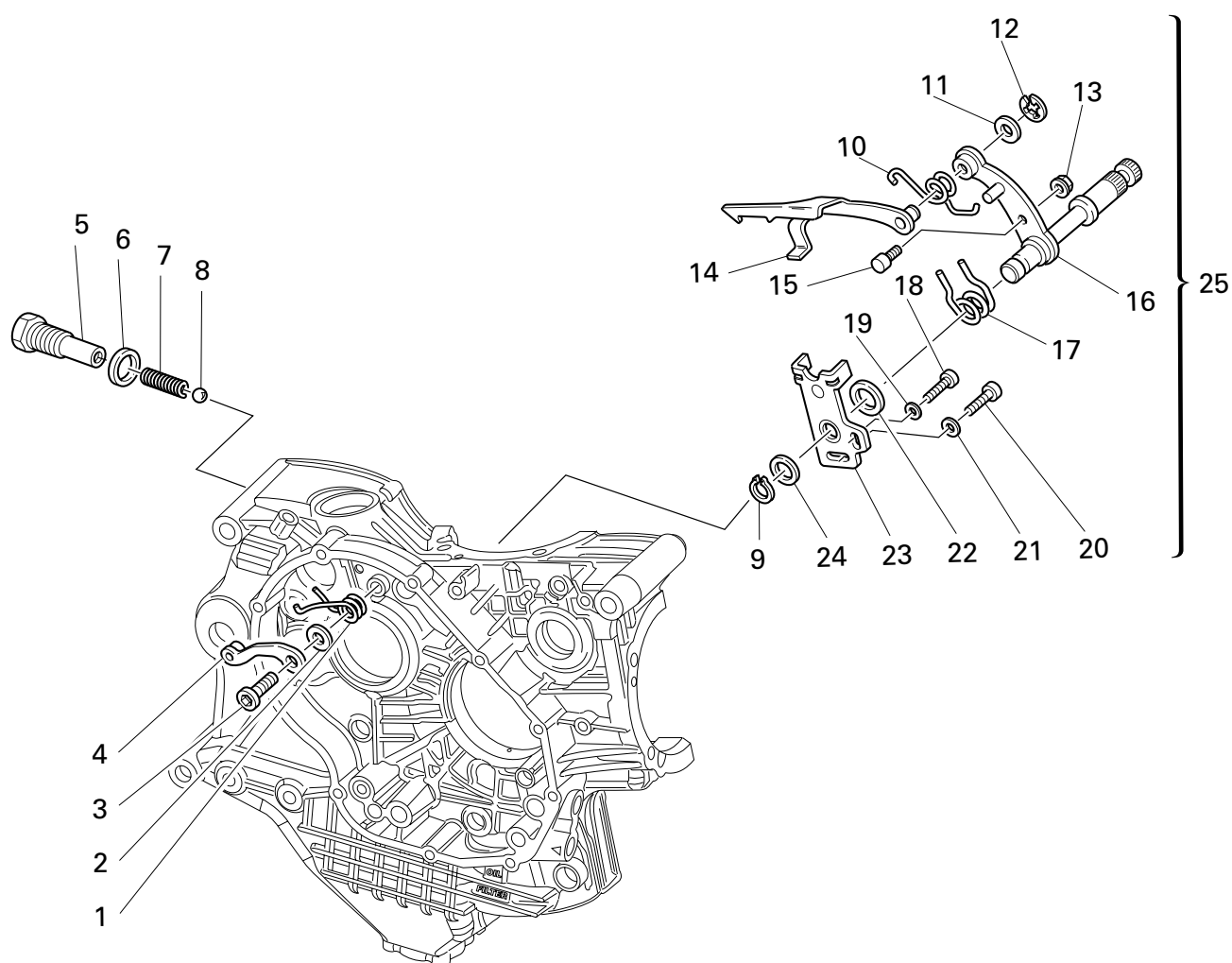
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7.1 - Gearbox assembly: gearchange mechanism



- 1 Return spring
- 2 Washer
- 3 Special screw
- 4 Gear pawl assembly
- 5 Interlock plunger holder
- 6 Seal
- 7 Detent ball spring
- 8 Ball
- 9 Circlip
- 10 Selector claw return spring
- 11 Shim, thickness 0.5
- 12 Shim, thickness 0.2
- 13 Ring
- 14 Nut

- 15 Selector drum control fork
- 16 Gearchange lever pin
- 17 Shaft with gearchange lever arm
- 18 Gearchange lever arm return spring
- 19 Bolt
- 20 Washer
- 21 Bolt
- 22 Washer
- 23 Locating ring
- 24 Stop plate
- 25 Shim, thickness 0.2
- 26 Shim, thickness 0.5
- 27 Gearchange mechanism

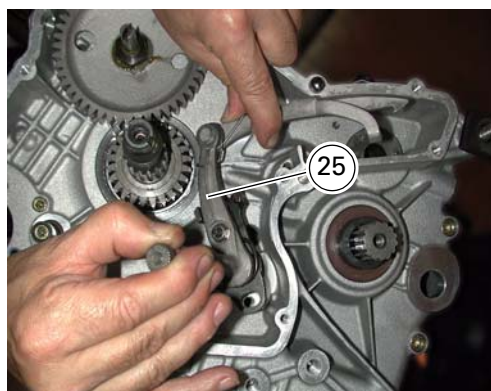
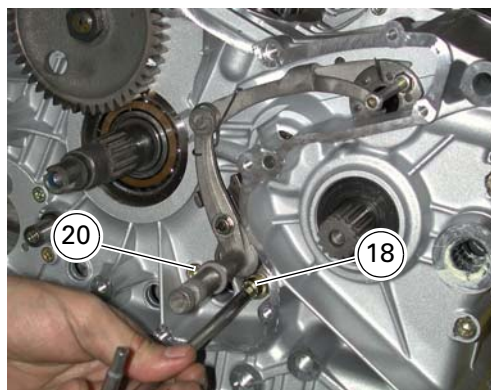
Important

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

Removal of the gearchange mechanism

Operation	Section reference
Remove the alternator cover and flywheel/ alternator assembly	N 8
Remove the right-hand crankcase cover complete with clutch drum and primary drive gear	N 6.2

Undo and remove the bolts (18) and (20) securing the gearchange mechanism (25).
Remove the gearchange mechanism complete with the shaft, spring, and stop plate.



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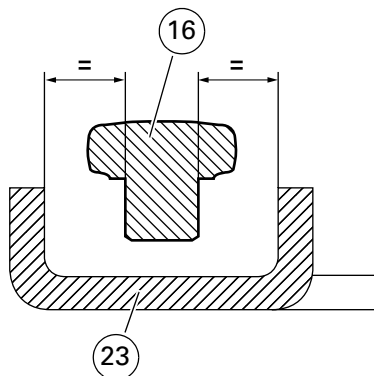
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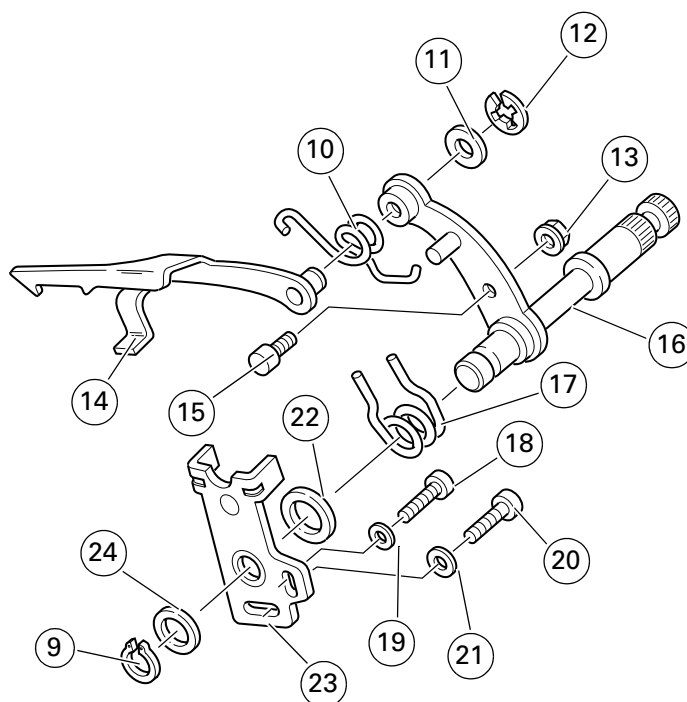
Important

Visually inspect the gear selector claw (14) for wear, particularly around the area where it contacts the selector drum.

If it is necessary to renew any components, disassemble the gearchange mechanism as shown in the exploded view. Reassemble the gearchange mechanism, orienting the eccentric pin (15) in such a way that the lever arm (16) is positioned centrally with respect to the shoulders of the stop plate (23).

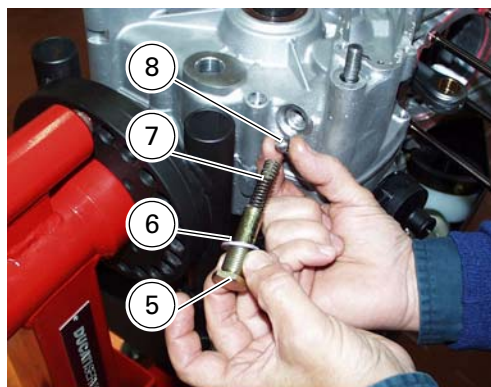


Now tighten the nut (13) to the specified torque (Sect. C 3).

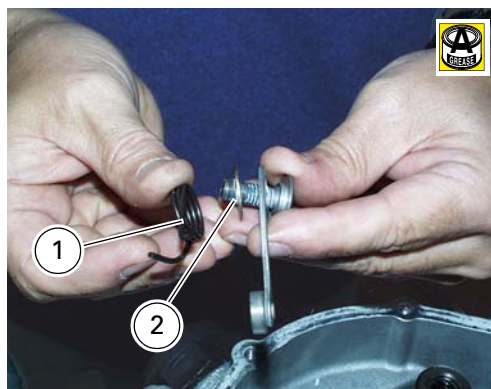
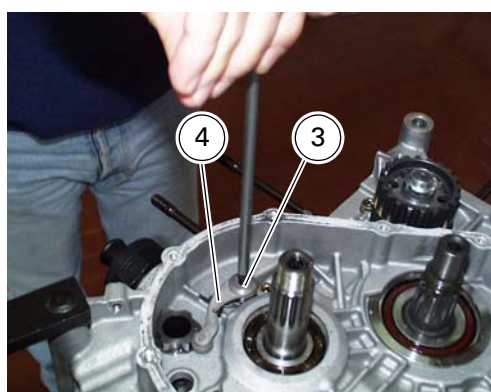


Disassembly of gear interlock plunger and pawl assembly

Unscrew the interlock plunger screw (5) and remove the seal (6), spring (7) and the detent ball (8).



Unscrew the rh crankcase half bolt (3) and remove the pawl (4), washer (2) and spring (1).



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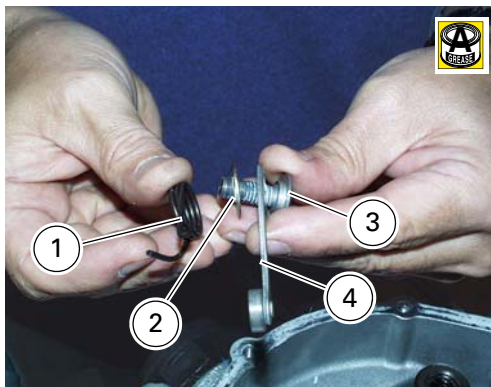
P

Refitting the gear interlock plunger and pawl assembly

Fit the pawl (4), washer (2) and spring (1) on the retaining bolt (3).

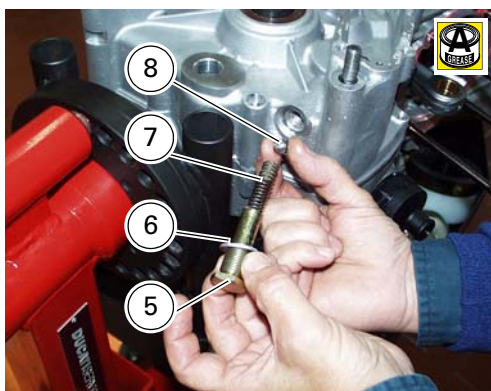
Fit the assembled unit on the right-hand crankcase half, locating the end of spring (1) behind the crankcase rib.

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



Grease and then fit the ball (8), spring (7), and seal (6) to the gear interlock plunger (5).

Tighten the interlock plunger to the specified torque (Sect. C 3).



Refitting the gearchange mechanism

Locate the gearchange mechanism (25) with the shaft, spring, and stop plate, on the chain-side crankcase half.



Locate the gearbox drum selector claw in the centre of the drum rollers.

Temporarily fit the gearchange lever (or a service lever) and the engine sprocket, and shift to second gear.

Fit the plate **88713.2827** in the claw shaft pins (see figure).

Align the notch that marks the centreline of the selector claw, with the end of the plate.



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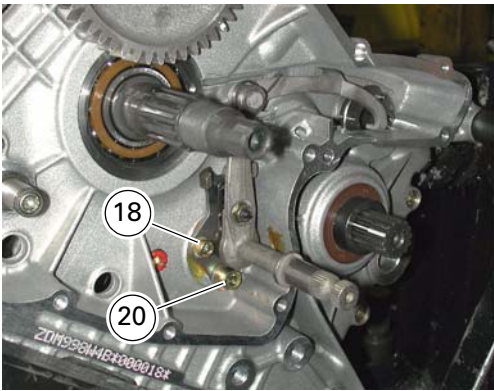
A

Then tighten the retaining bolts (18) and (20) of the gear selector mechanism to the specified torque (Sect. C 3).
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 sprocket at the same time to check that all the gears engage when shifting up and down.
Remove the previously installed lever and sprocket

B

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Operation	Section reference
Fit the right-hand side crankcase cover	N 6.2
Refit the flywheel/alternator assembly and left-hand side crankcase cover	N 8
Install the engine in the frame	N 1

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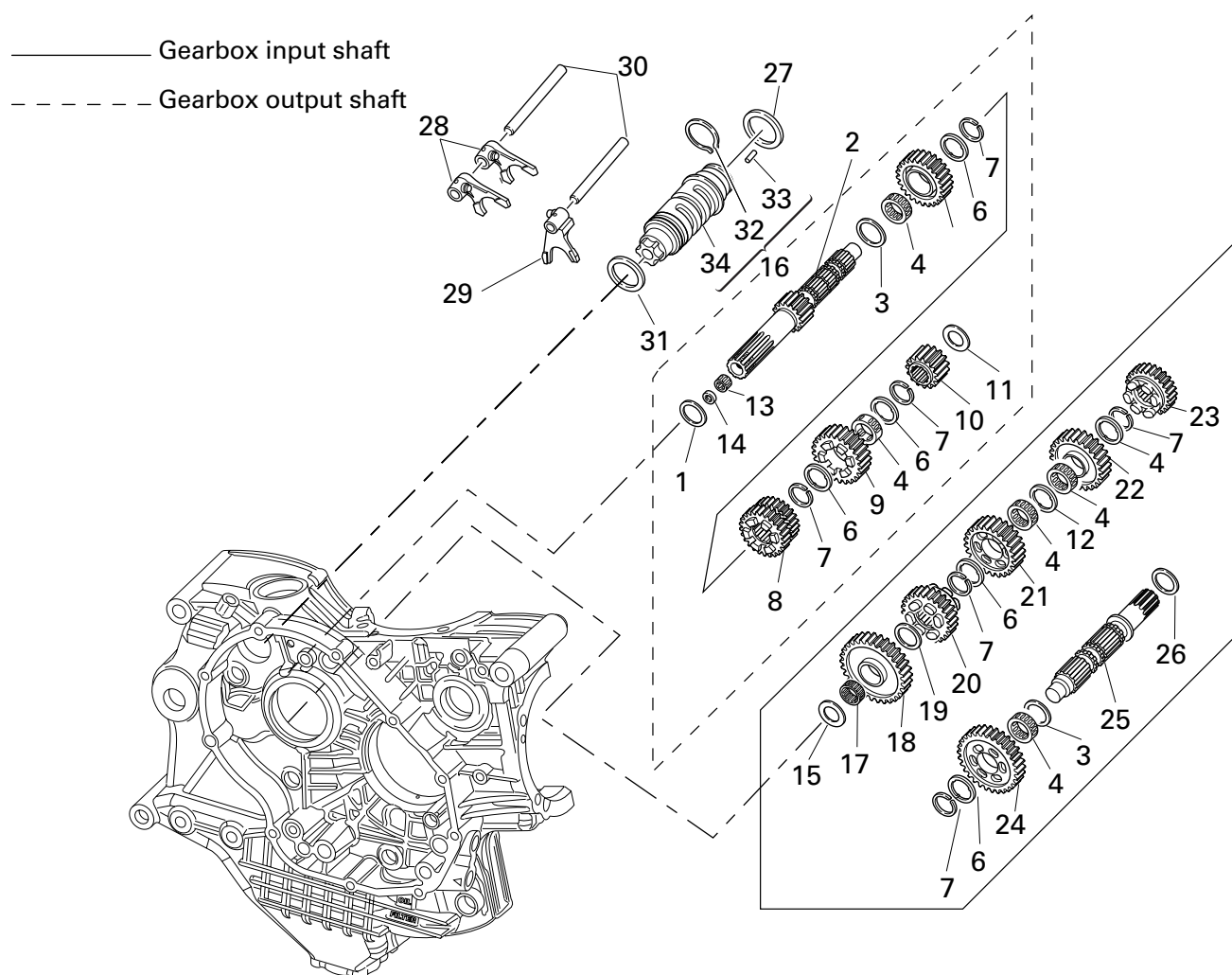
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7.2 - Gearbox assembly: gearbox shafts



- 1 Shim, thickness 1
- 2 Gearbox input shaft
- 3 Shim, thickness 0.5
- 4 Needle roller bearing
- 5 5th speed driving gear
- 6 Splined washer, thickness 0.5
- 7 Circlip
- 8 3rd - 4th speed driving gear
- 9 6th speed driving gear
- 10 2nd speed driving gear
- 11 Shim, thickness 1.8
- 12 Splined washer, thickness 0.5
- 13 Roller bearing
- 14 Oil seal
- 15 Shim
- 16 Selector drum assembly
- 17 Needle roller bearing

- 18 1st speed driven gear
- 19 Shim, thickness 1
- 20 5th speed driven gear
- 21 4th speed driven gear
- 22 3rd speed driven gear
- 23 6th speed driven gear
- 24 2nd speed driven gear
- 25 Gearbox output shaft
- 26 Shim
- 27 Shim, thickness 1
- 28 1st, 4th - 2nd, and 3rd speed selector fork
- 29 5th and 6th speed selector fork
- 30 Selector fork shaft
- 31 Shim, thickness 1
- 32 Needle roller retaining circlip (square cross-section)
- 33 Special needle roller (square cross-section)
- 34 Selector drum



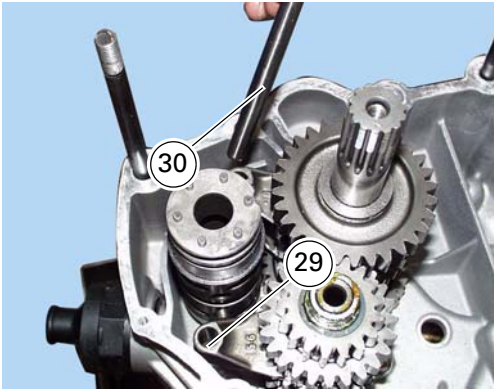
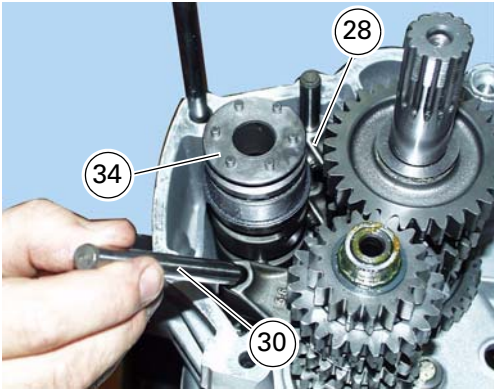
Important

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

Removal of the gearbox assembly

Operation	Section reference
Remove the engine from the frame	N 1
Separate the crankcase halves	N 9.2

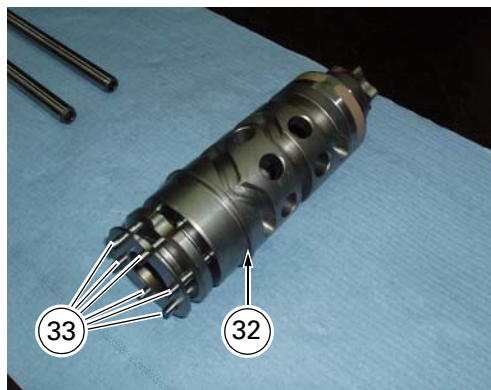
Withdraw the selector fork shafts (30).
Move the forks (28) and (29) to disengage them from the slots in the selector drum (34).



Withdraw the selector drum (16) taking care not to lose shims (31) and (27) mounted on the shaft. Note that the positions of the shims must not be inverted.



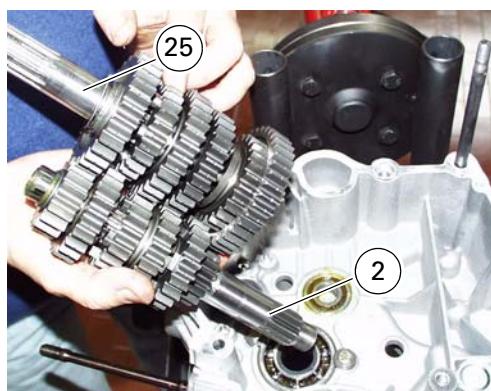
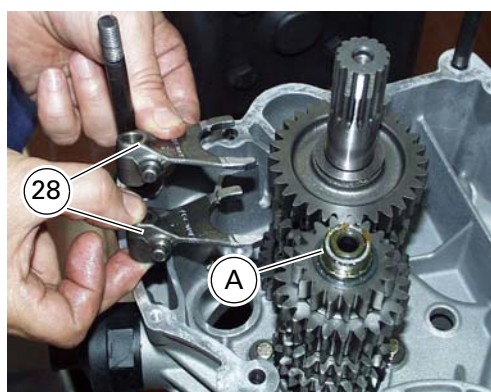
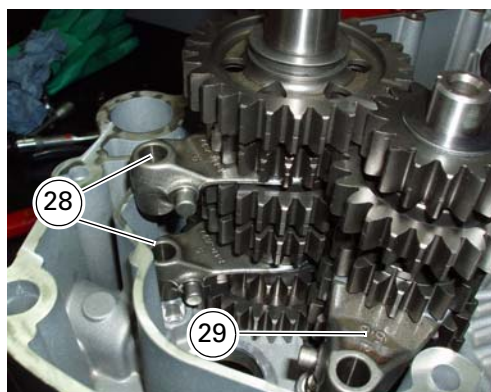
Now you can renew the needle roller retaining ring (32) and the special needle rollers (33).



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 rings (A) are still on the shafts, slide them off the ends of the gearbox input (2) and output (25) shafts (Sect. N 9.2).



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Disassembly of the gearbox shafts

Place the shaft in a vice in such a way as to facilitate the disassembly operations.



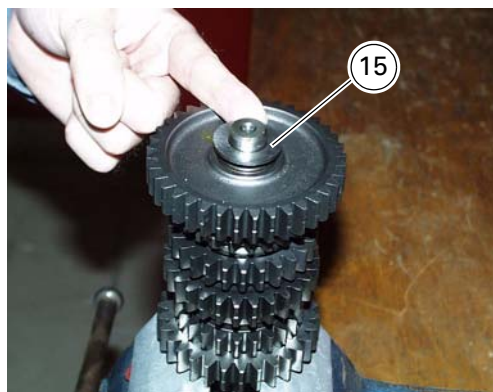
Important

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

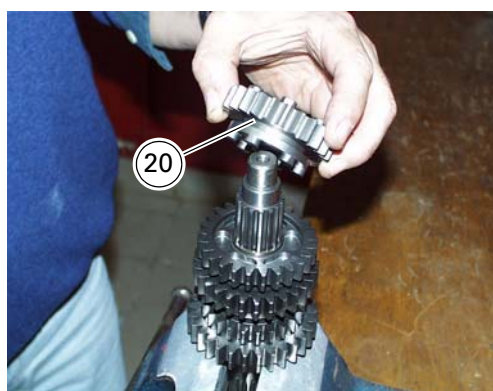
Remove the chain-side shim (15) and the clutch-side shim (26) from the output shaft.



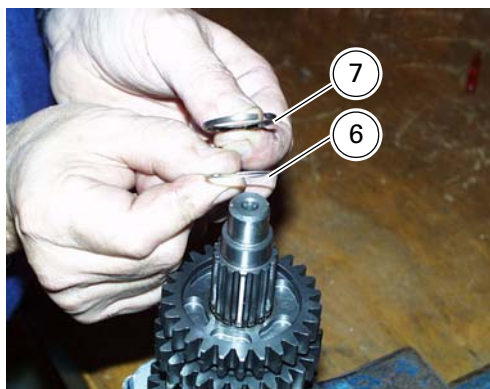
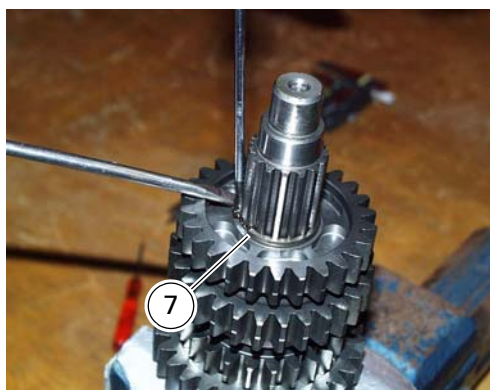
Withdraw the first speed driven gear (18) with the roller cage (17) and the shim (19).



Remove the fifth speed driven gear (20).



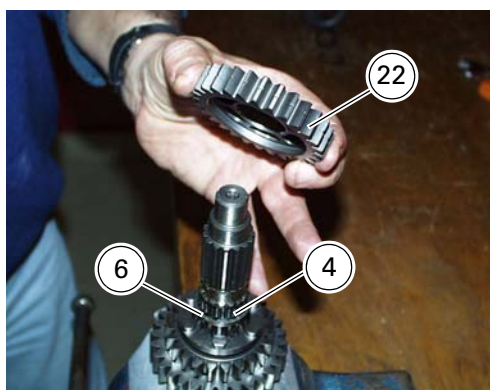
Use two flat screwdrivers to remove the circlip (7) taking care not to damage the shaft surface.
Remove the circlip (7) and the splined washer (6).



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).



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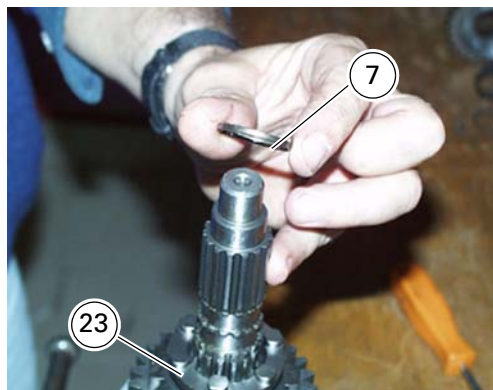
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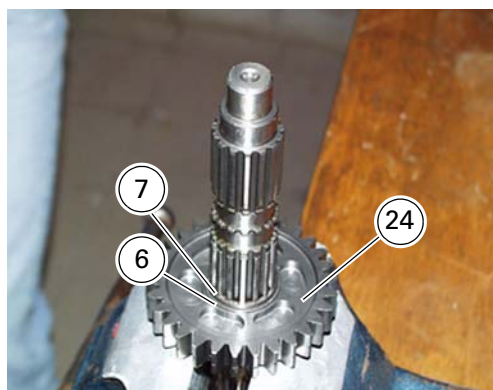
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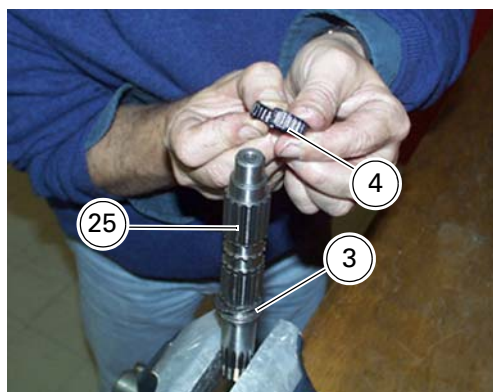
Remove the circlip (7) and remove the sixth speed driven gear (23).



Remove the circlip (7) and withdraw the splined washer (6) and the second speed driven gear (24).



Withdraw the roller cage (4) and the shim (3). All the components have thus been removed from gearbox output shaft (25).



Disassembly of the gearbox input shaft

Remove the chain-side shim (11) and the clutch-side shim (1) from the input shaft.

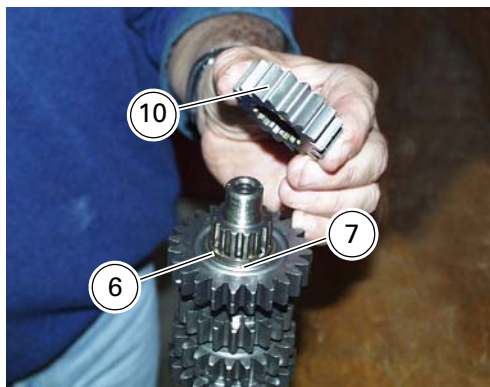


Remove the second speed driving gear (10). Use two screwdrivers to prise out the circlip (7) and the splined washer (6).

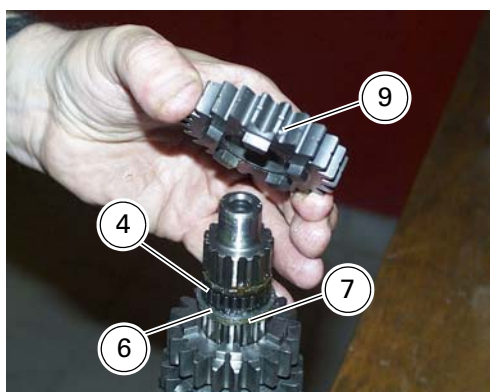


Important

Take care to avoid damaging the surface of the shaft while removing circlip (7).



Remove the sixth speed driving gear (9) with its roller cage (4). Remove the splined washer (6) and the circlip (7).



Slide out the third and fourth drive gears (8).



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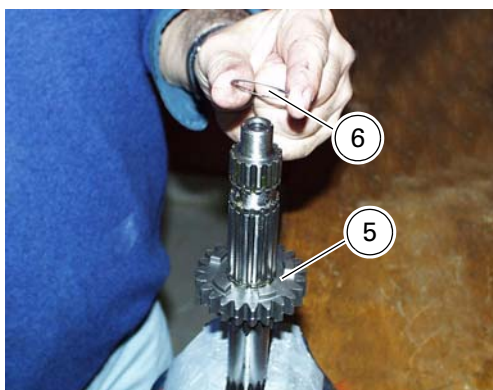
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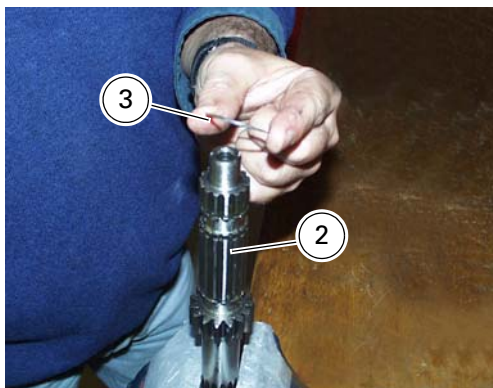
Remove the circlip (7) and the splined washer (6).



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.

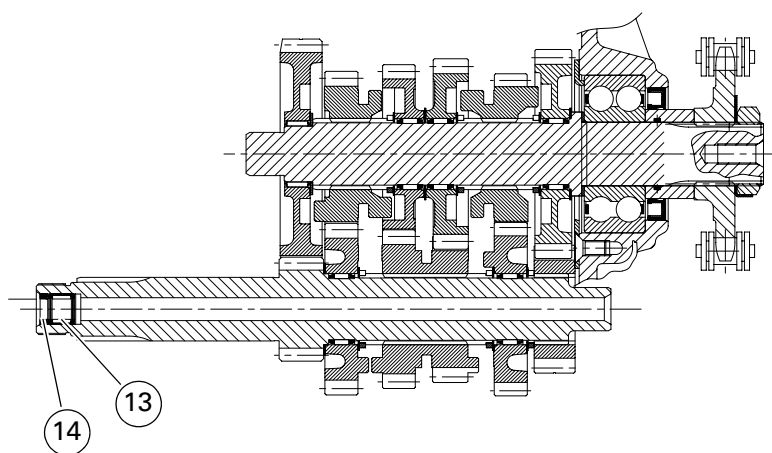
When refitting, make sure the circlips are correctly positioned.

Check the needle roller bearings for wear.

The threads and splines of the shafts must be in perfect condition.

At each overhaul, check the condition of the needle roller cage (13) and the oil seal (14) located on the end of the gearbox input shaft: remove them if necessary using a suitable puller and renew them.

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 endfloat values, refer to Sect. C 1.1.

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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).



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 changed by comparing dimensions with those of new components (Sect. C 1.1).

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.



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Reassembly of the gearbox shafts

Figure 1 shows all the parts to be reassembled on the gearbox input shaft (2), with the calculated shims (1) and (11) (Sect. N 9.2).

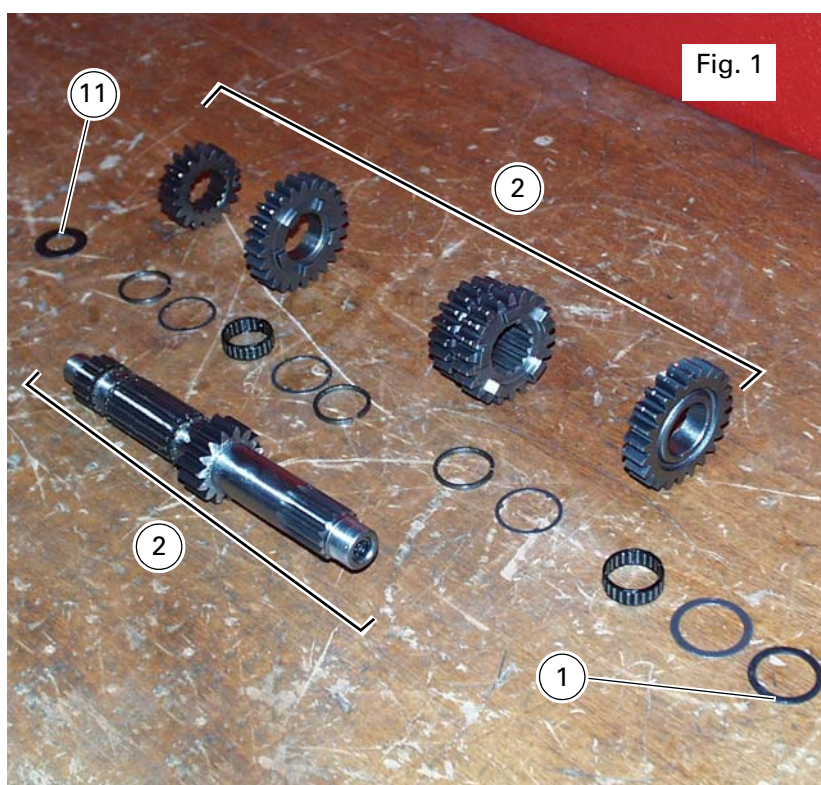
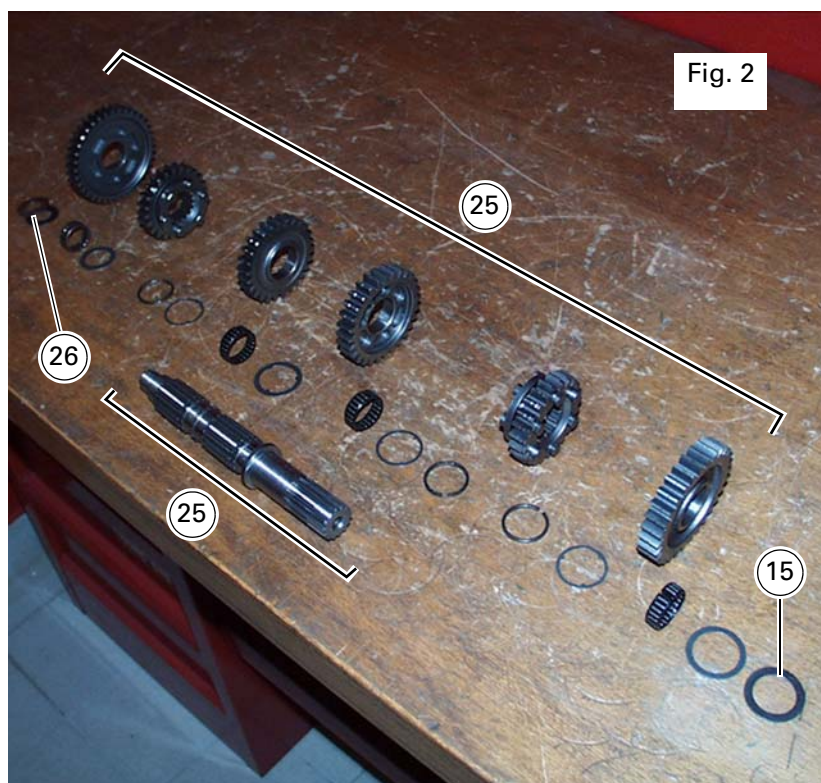


Figure 2 shows all the parts to be reassembled on the gearbox output shaft (25), with the calculated shims (15) and (26) (Sect. N 9.2).

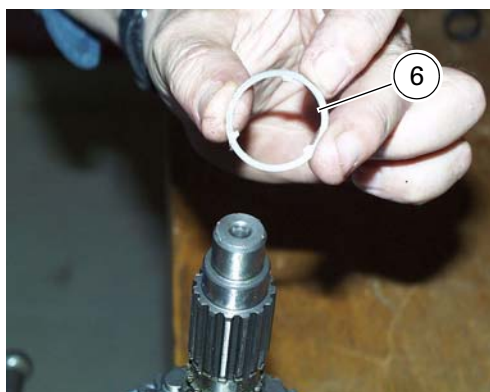
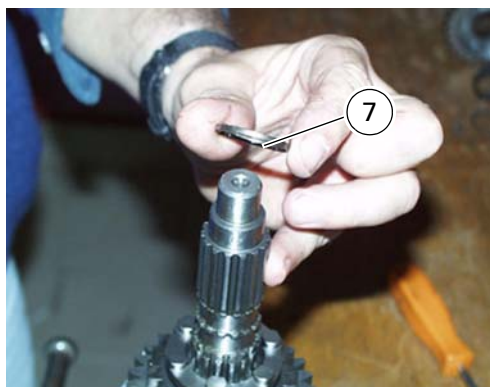


Reassemble the gears on the gearbox shafts by reversing the disassembly procedure.

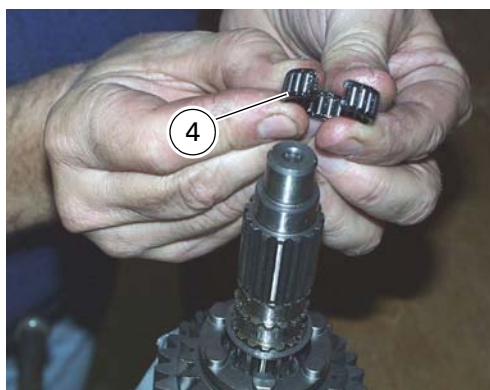
Take particular care when installing the idler gears. The assembly of the 3rd and 4th speed gears and the relative fixing components on the output shaft is given as an example.

Fit the circlip (7), checking that it is fully inserted into its groove on the shaft. Push the circlip (7) home using 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.



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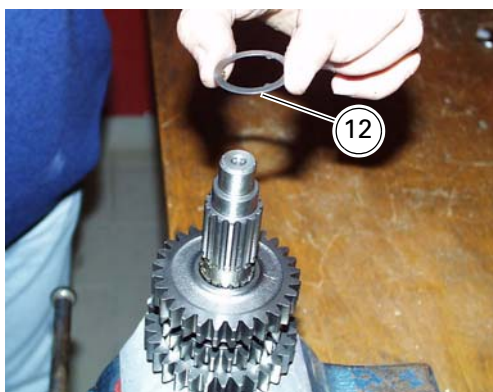
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Fit the 3rd speed gear (22).



Fit the three-pointed washer (12), which can be distinguished from its counterpart (6) by its bigger outside diameter.



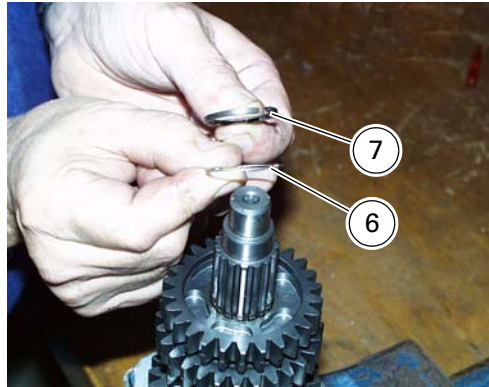
Fit another needle roller cage (4) using the method already described.



Fit the 4th speed gear (21).



Fit another 3-pointed washer (6) and another circlip (7) onto the shaft. Seat the circlip using the drift used previously.



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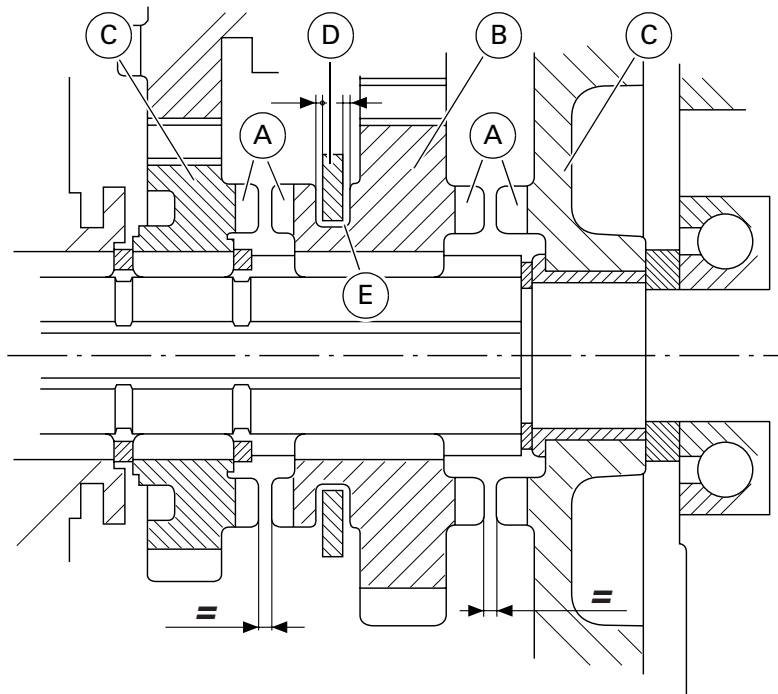
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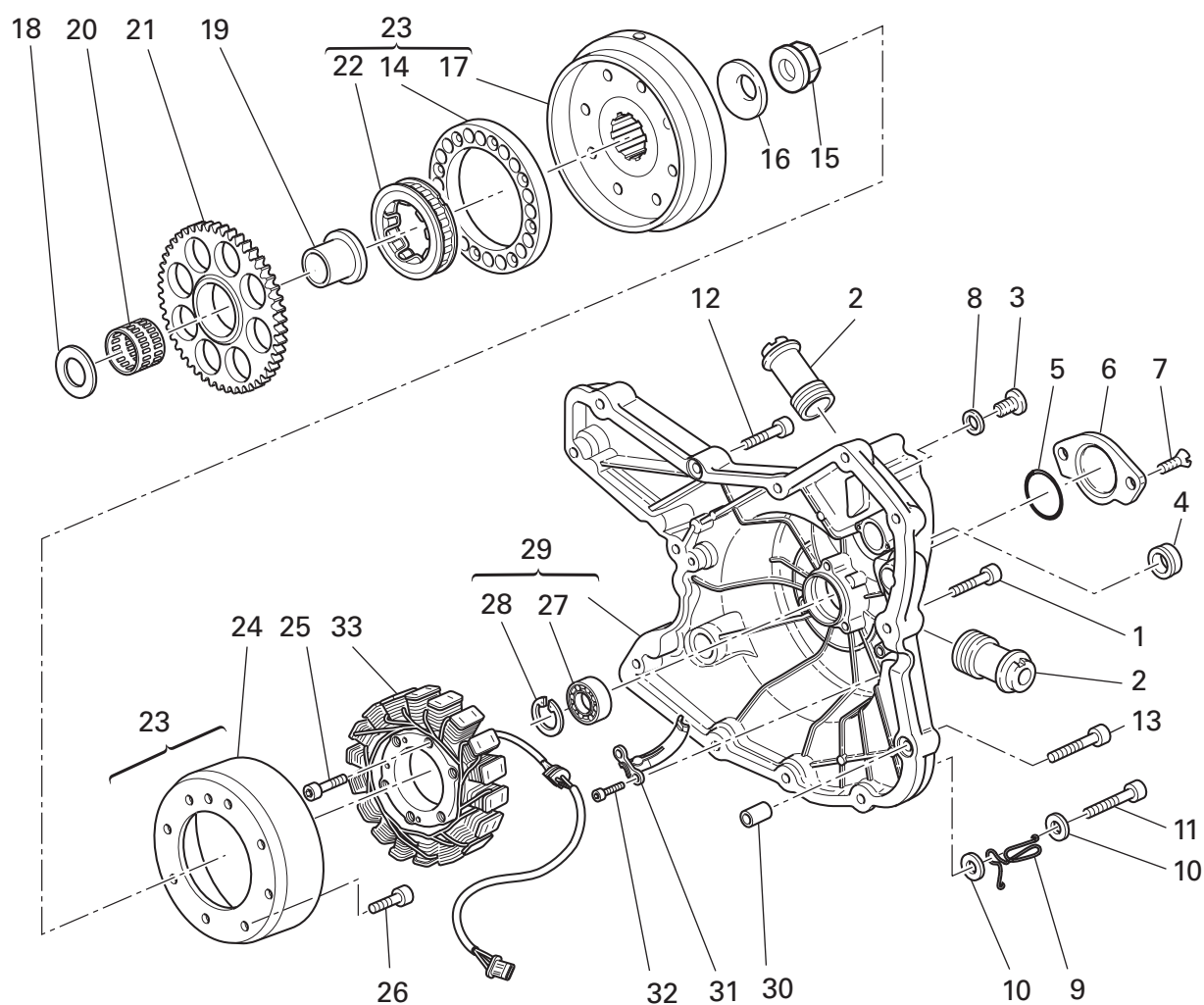
Reassembly of the gearbox

To reassemble the gearbox components, follow the procedure in Sect. N 9.2 relating to reassembly of the engine crankcases. 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 crankcases	N 9.2
Refit the engine to the frame	N 1

8 - Flywheel/alternator



- | | |
|--------------------------------|-------------------------------------|
| 1 Bolt | 18 Washer |
| 2 Cylinder coolant inlet union | 19 Inner ring |
| 3 Ignition inspection plug | 20 Needle roller bearing |
| 4 Oil seal | 21 Electric starter driven gear |
| 5 O-ring | 22 Starter clutch |
| 6 Cover | 23 Flywheel-starter clutch assembly |
| 7 Bolt | 24 Alternator rotor |
| 8 Aluminium gasket | 25 Bolt |
| 9 Cable guide | 26 Bolt |
| 10 Washer | 27 Bearing |
| 11 Bolt | 28 Circlip |
| 12 Bolt | 29 Left-hand side crankcase cover |
| 13 Bolt | 30 Locating dowel |
| 14 Flange | 31 Bracket |
| 15 Flanged nut | 32 Bolt |
| 16 Belleville washer | 33 Alternator stator |
| 17 Flywheel | |



Important

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

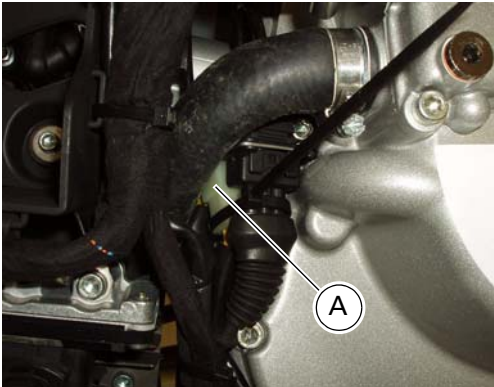
Removal of the left-hand side crankcase cover

Operation	Section reference
Remove the front sprocket cover	G 7
Drain the engine oil	D 4
Remove the clutch pushrod	F 10
Remove the pump-cylinder hoses	N 5
Remove the water pump-radiator hose	N 3.3

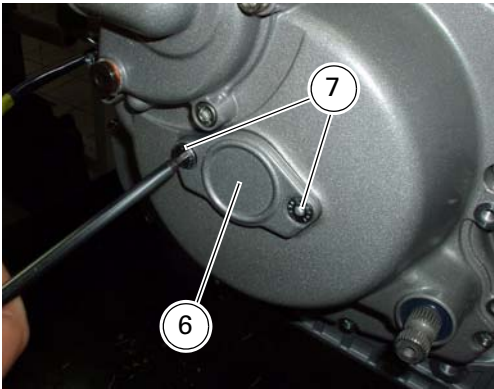
 Notes

This operation is described for an engine removed from the frame since all reassembly procedures are easier with the engine on the bench.

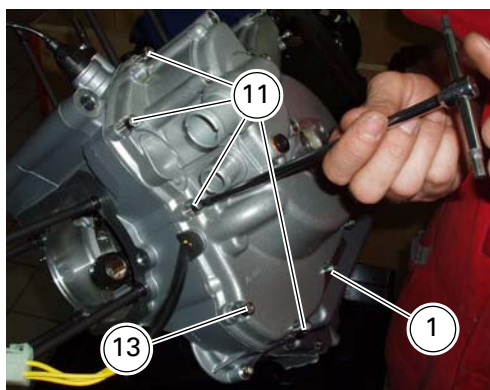
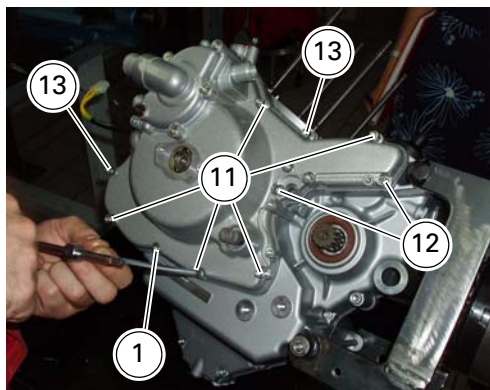
Disconnect the alternator wiring connector from the main wiring loom (A).



Unscrew the two retaining bolts (7) of the centre cap (6) over the end of the crankshaft.



Unscrew the left-hand crankcase cover bolts (1), (11), (12) and (13).



Fix service tool **88713.1749** to the holes of the two bolts (7) you have just removed. Turn the tool shaft slowly to remove the cover (29) from the LH crankcase half.



On the cover in correspondence with the gearchange shaft, there is an oil seal (4) that may be damaged when removing the crankcase cover. Always check the condition of this oil seal and renew it if damaged.



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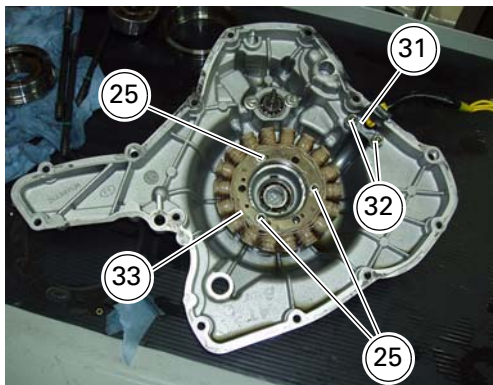
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Disassembly of the left-hand crankcase cover

Undo the three stator retaining bolts (25) and the two cable guide bracket (31) retaining bolts (32) from inside the lh crankcase cover.

Remove the stator (33) and the cable guide (31).

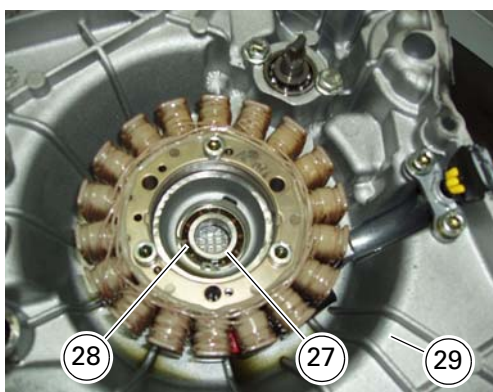


The lh crankcase cover is fitted with a bearing (27), held in place by circlip (28), which locates on the end of the crankshaft. Remove the circlip (28) with circlip pliers.

Remove the bearing (27) using a universal puller.

Be careful when fitting the new bearing (27) to ensure it is positioned with the shielded side facing away from the cover.

Secure the bearing with the circlip (28), ensuring that it is correctly fitted in its seat in the lh crankcase cover (29).



Unscrew the horizontal and vertical cylinder coolant inlet unions (2).

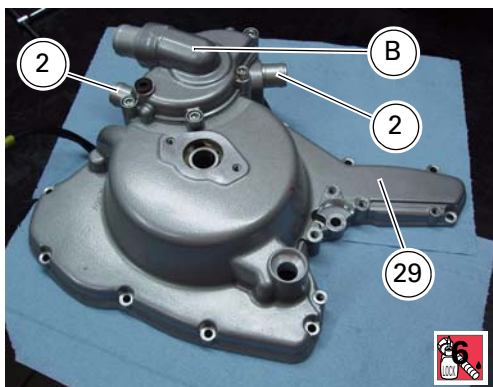
When fitting new components, apply the recommended threadlocker and tighten to the specified torque (Sect. C 3).



Important

The unions (2) may also be removed without removing the lh crankcase cover (29) from the engine.

Disassemble the components of the water pump (B) as described in (Sect. N 3.3).



Removal of the flywheel/alternator assembly

Use the service tool no. **88713.2874** fixed on the M10 sidestand fixing holes (D).

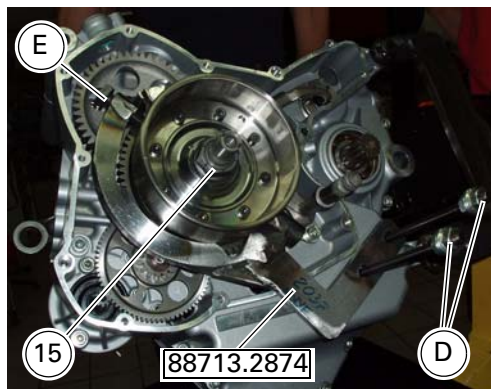
Secure the tool to the flywheel with the bolt (E).

Unscrew the alternator/flywheel retaining nut (15).

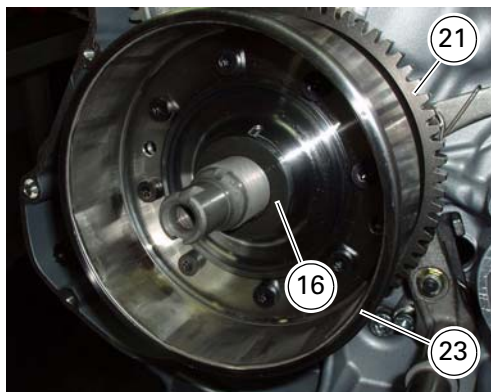
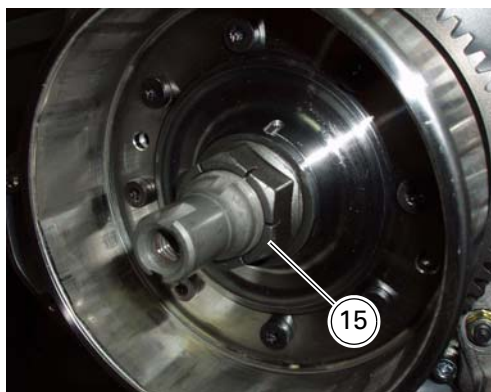


Warning

While unscrewing the nut, apply axial pressure to the wrench socket to avoid damage or injury in the event of the wrench suddenly slipping off the nut.



Remove the nut (15), the Belleville washer (16) and the flywheel assembly (23) with the driven gear (21) from the crankshaft.



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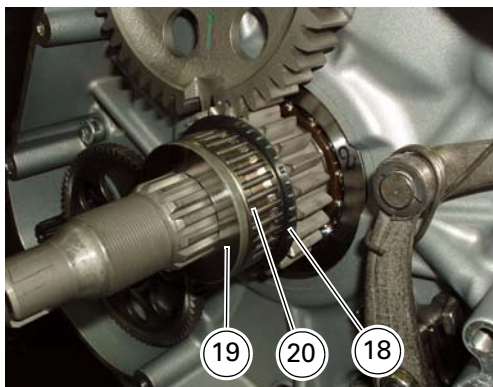
P

Remove the inner ring (19), the needle roller bearing (20) and the washer (18).



Important

Check the bush (19), the needle roller bearing (20) and the inner washer (18) for wear. Renew if worn.



Overhaul of the flywheel/alternator assembly

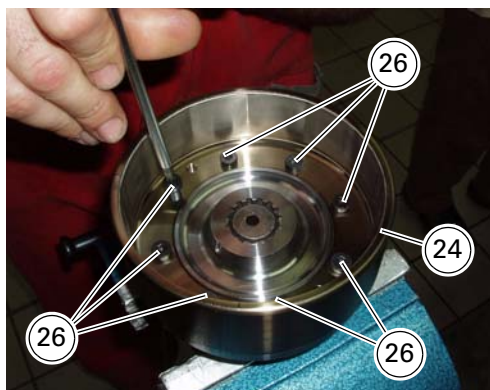
Check that the inner part of alternator rotor (24) shows no signs of damage.

Check that the starter clutch is working properly and that the needle races do not show signs of wear or damage of any kind. If there is any malfunction, remove the whole assembly.



Disassembly of the flywheel/alternator

Undo the eight bolts (26) and remove the rotor (24) from the flywheel.



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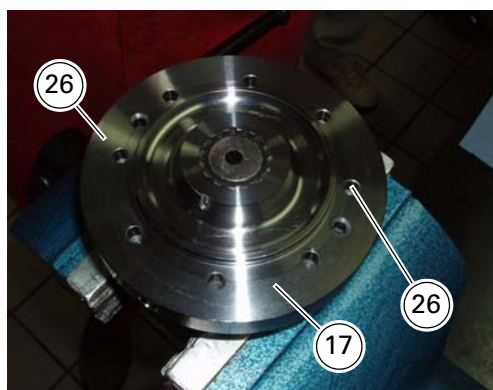
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Insert two of the bolts (26) just removed from the flywheel rotor-side in their holes in order to remove the flange (14) and the starter clutch (22) from the flywheel (17).

The starter clutch is a slight interference fit on the flange. To remove it, use a suitable drift.



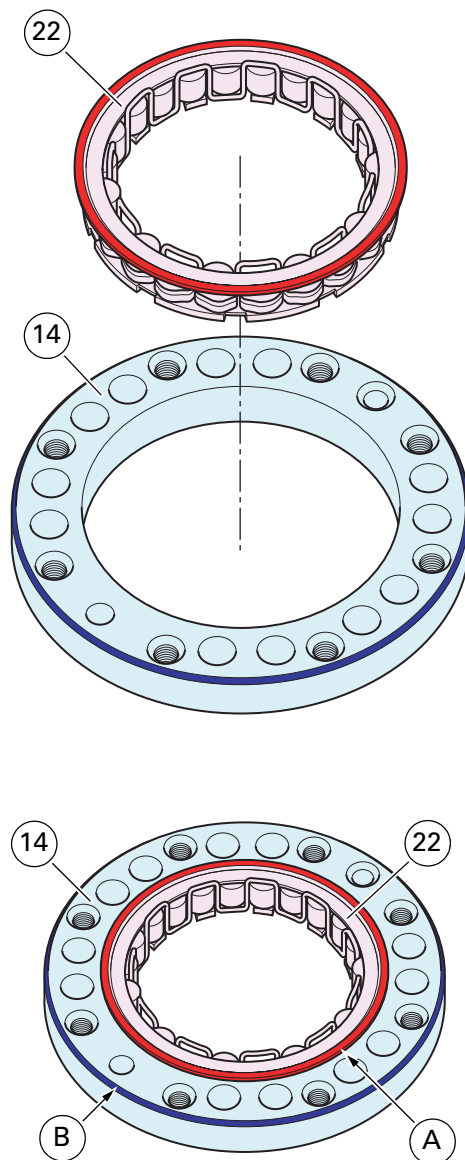
Reassembly of the flywheel/alternator assembly

Install the starter clutch (22) in the flange (14) to bring the edge (A) of the clutch up against the flange.



Important

Assemble the components (starter clutch and flange) so that the edge (A) of the starter clutch is positioned on side of the flange with the bevelled edge (B).



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Seat the flange (14) with the starter clutch (22) in the flywheel (17), aligning the flange locating hole (C) with the flywheel locating hole (D).



Notes

The flange locating hole (C) is the hole with the countersunk lead-in (E).



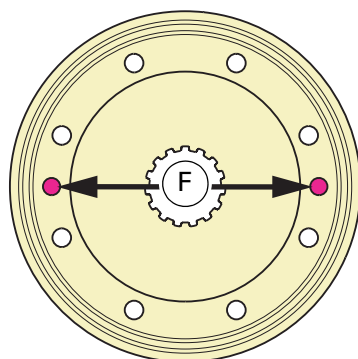
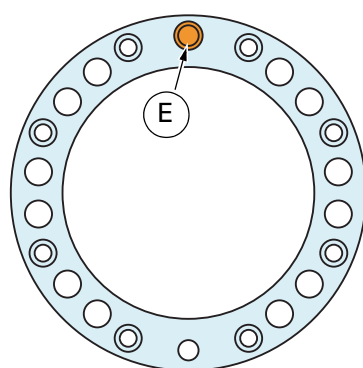
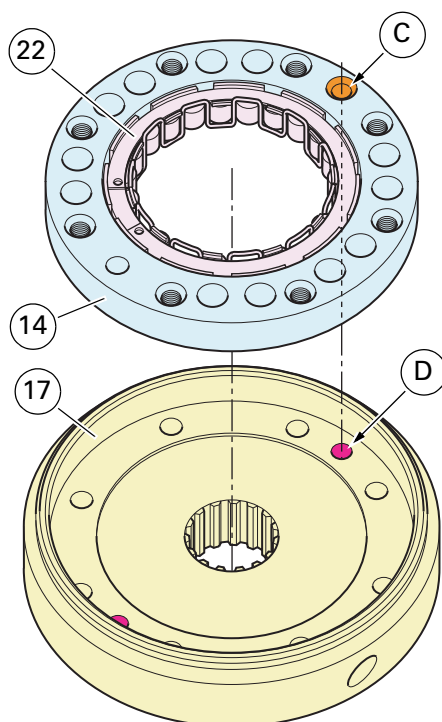
Notes

The locating hole (D) of the flywheel can be either one of the two holes (F).



Notes

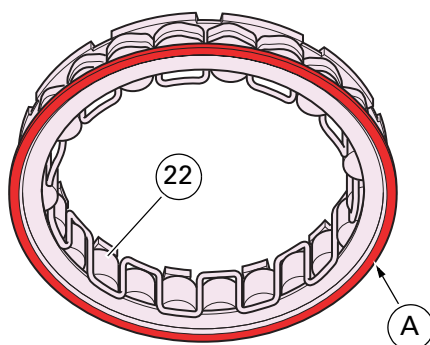
Use suitable tools to align the locating holes.





Important

Assemble the components (flange and flywheel) so that edge (A) of the starter clutch (22) is enclosed between the flange and flywheel.



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Install the rotor (24) on the flywheel (17), aligning the flywheel locating hole (D) with the rotor locating hole (G).



Notes

The flywheel locating hole (D) of the flywheel is the hole that was previously aligned with the flange locating hole (C), i.e. the hole with the countersunk lead-in (E).



Notes

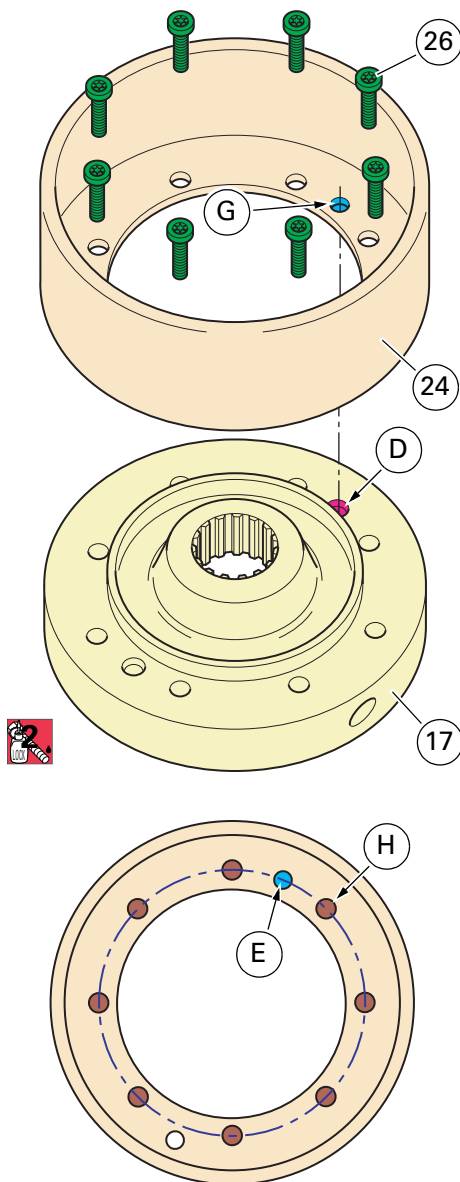
The rotor locating hole (G) is the hole positioned on the same diameter as the fixing holes (H).



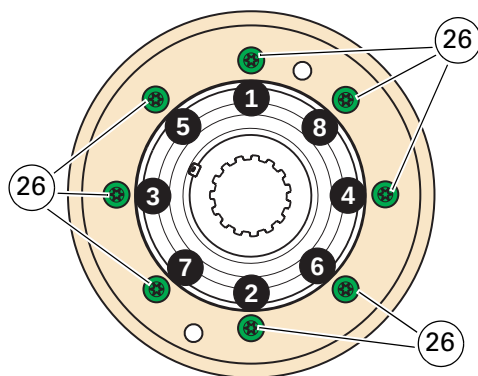
Notes

Use suitable tools to align the locating holes.

Apply threadlocker to the rotor/flywheel fixing bolts (26) and start them in their threads.



Tighten the bolts (26) to the specified torque (Sect. C 3, Engine torque settings) in the indicated sequence.



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Lubricate the surface (L) of the driven gear (21) with engine oil.
Install the driven gear in the starter clutch, ensuring it is properly seated.

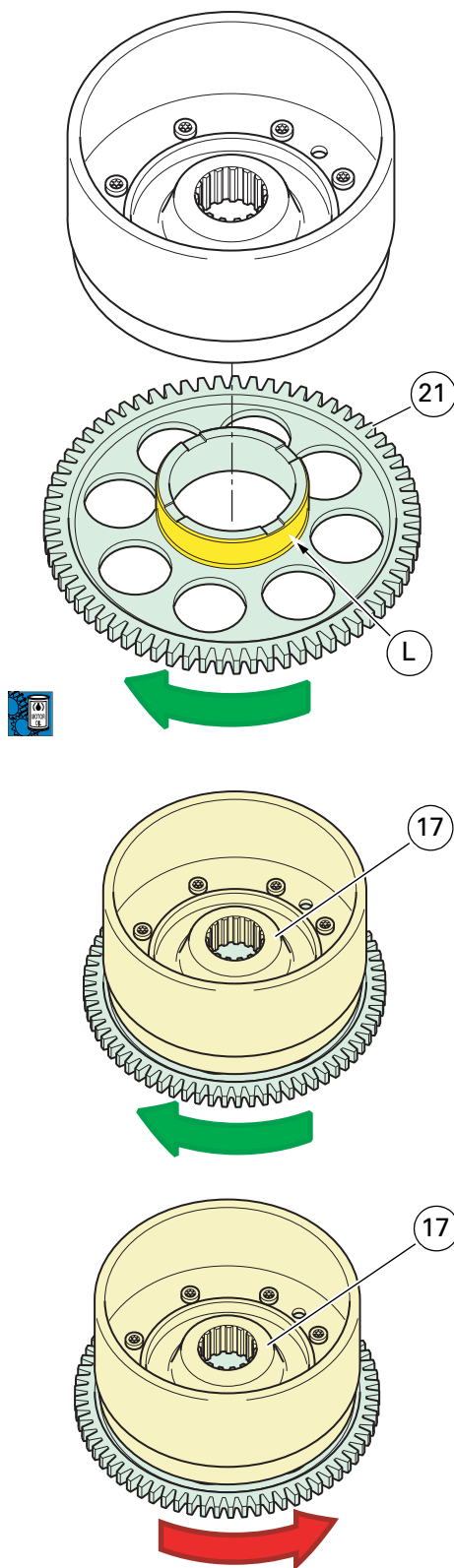


Notes

To facilitate installation, rotate the driven gear in the direction of the green arrow.

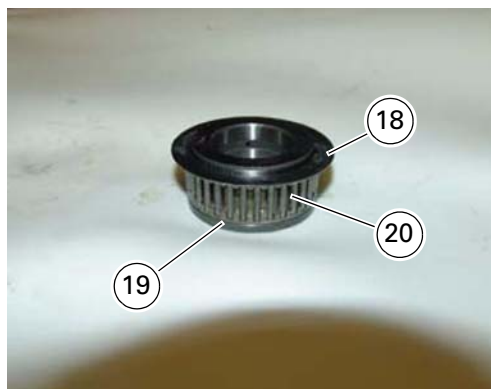
Hold the flywheel (17) with one hand and check that the driven gear can rotate freely in the direction of the green arrow but not in the direction of the red arrow.

If either of these two is not met, this means that the starter clutch has not been installed correctly.

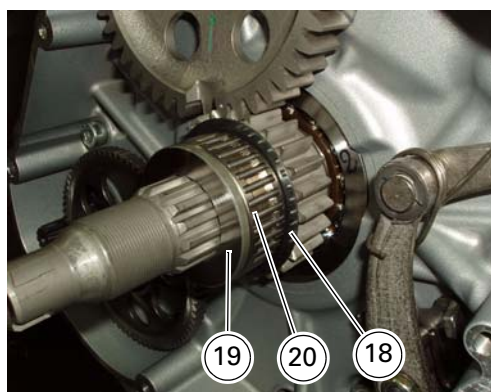


Refitting the flywheel/alternator assembly

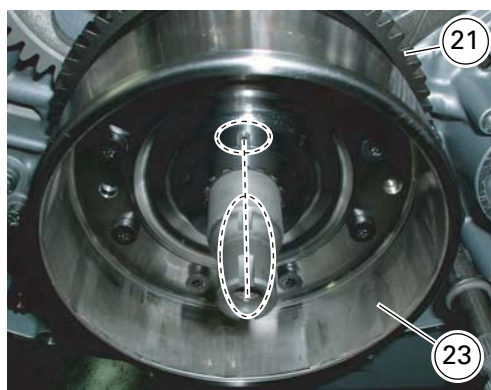
Install the roller cage assembly (20) with the washer (18) and inner ring (19).



Install the roller cage assembly (20) with the washer (18) and inner ring (19).



Install the flywheel assembly (23) with the gear (21), aligning the notches as shown in the photo.



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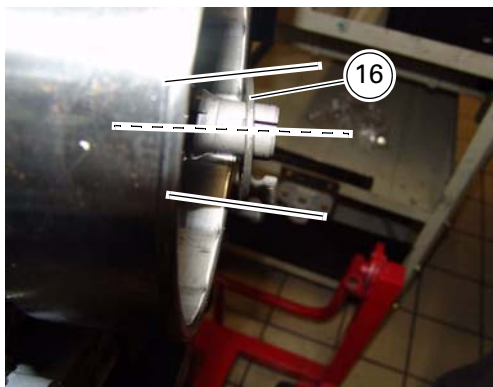
P

Fit the Belleville washer (16) on the end of the crankshaft.



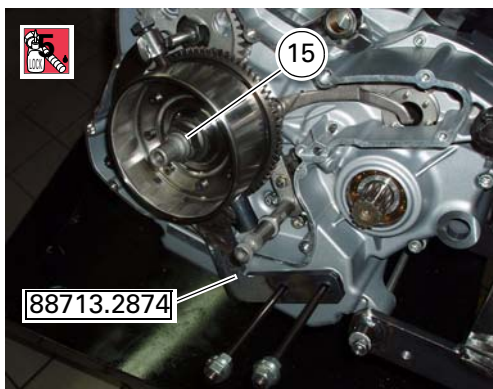
Warning

The Belleville washer is tapered: position it as shown in the photo.



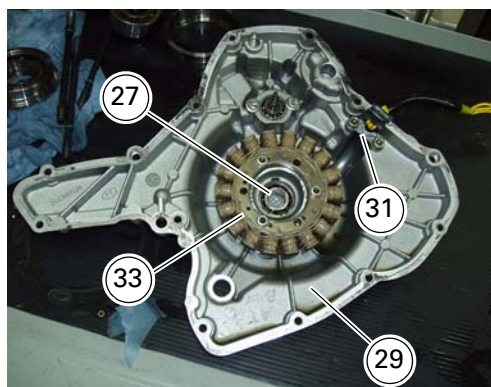
Apply the recommended threadlocker to the thread on the end of the crankshaft and the nut (15). Start the nut (15) on the crankshaft.

Hold the flywheel with service tool no. **88713.2874** to prevent rotation, and tighten the nut (15) to the specified torque (Sect. C 3, engine tightening torques).



Refitting the left-hand crankcase cover

Make sure that the following parts are installed in the lh crankcase cover (29) before refitting it:
crankshaft end bearing (27) with its circlip;
the alternator stator (33) with the cable clamp (31).
Install the water pump (Sect. N 3.3).



Remove any scale and grease from the mating surfaces of the left-hand crankcase half and the cover.
Fit the two locating dowels (30).



Spread a continuous uniform bead of DUCATI liquid gasket on the cover mating surface, ensuring continuity around the holes for the retaining screws and bushes.

Grease the end of the crankshaft and the gearchange shaft to facilitate installation of the cover and to prevent the oil seal (4) from being damaged, if already installed in the cover.

While positioning the cover on the crankcase, slightly turn the timing belt drive shaft pulleys to facilitate insertion of the pump control shaft.

Tap the cover at different positions with a rubber mallet to facilitate its location on the shafts and locating dowels.



Notes

Should it be necessary to remove the cover again, fit the puller **88713.1749** to the threaded holes located in correspondence with the crankshaft.



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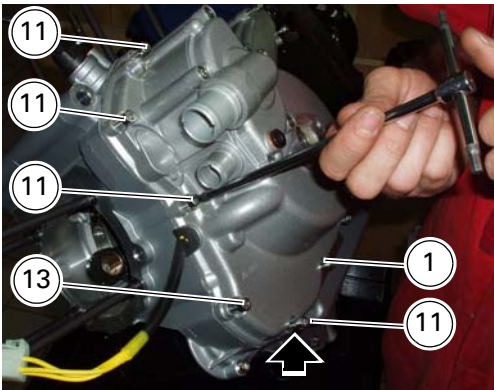
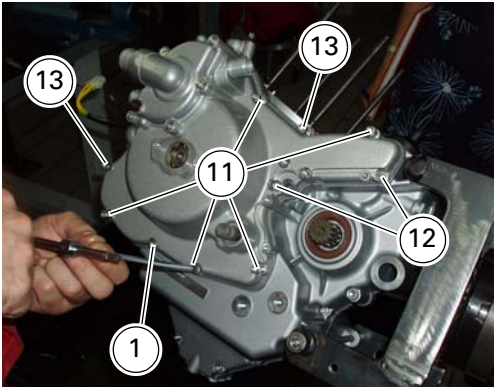
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P

Insert the retaining bolts in their holes following the indications given in the table.

Ref.	Qty.	Description
11	8	M6x25 mm bolts
12	2	M6x20 mm bolts
13	2	M6x30 mm bolts
1	1	M6x25 mm drive-lock bolt

Under the bolt (11), located in correspondence with the starter motor, fit the washer (10) and hose/wiring clip (9). Tighten the retaining bolts to the specified torque (Sect. C 3).

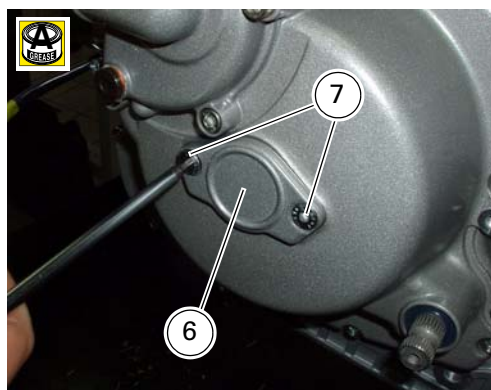


Dampen the seal (4) with alcohol and install it in the lh crankcase cover, in correspondence with the gear change shaft.

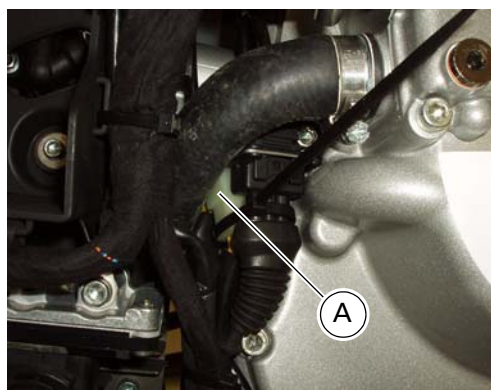


Apply threadlocker to the bolts (7).

Tighten the two retaining bolts (7) of the centre cap (6) over the end of the crankshaft to the specified torque (Sect. C 3).



Reconnect the alternator wiring to the main wiring loom (A).



Operation	Section reference
Refit the water pump-radiator hose	N 3.3
Refit the pump-cylinder hoses	N 5
Fit the clutch pushrod	F 10
Refit the sprocket cover	G 7
Top up the engine oil	D 4

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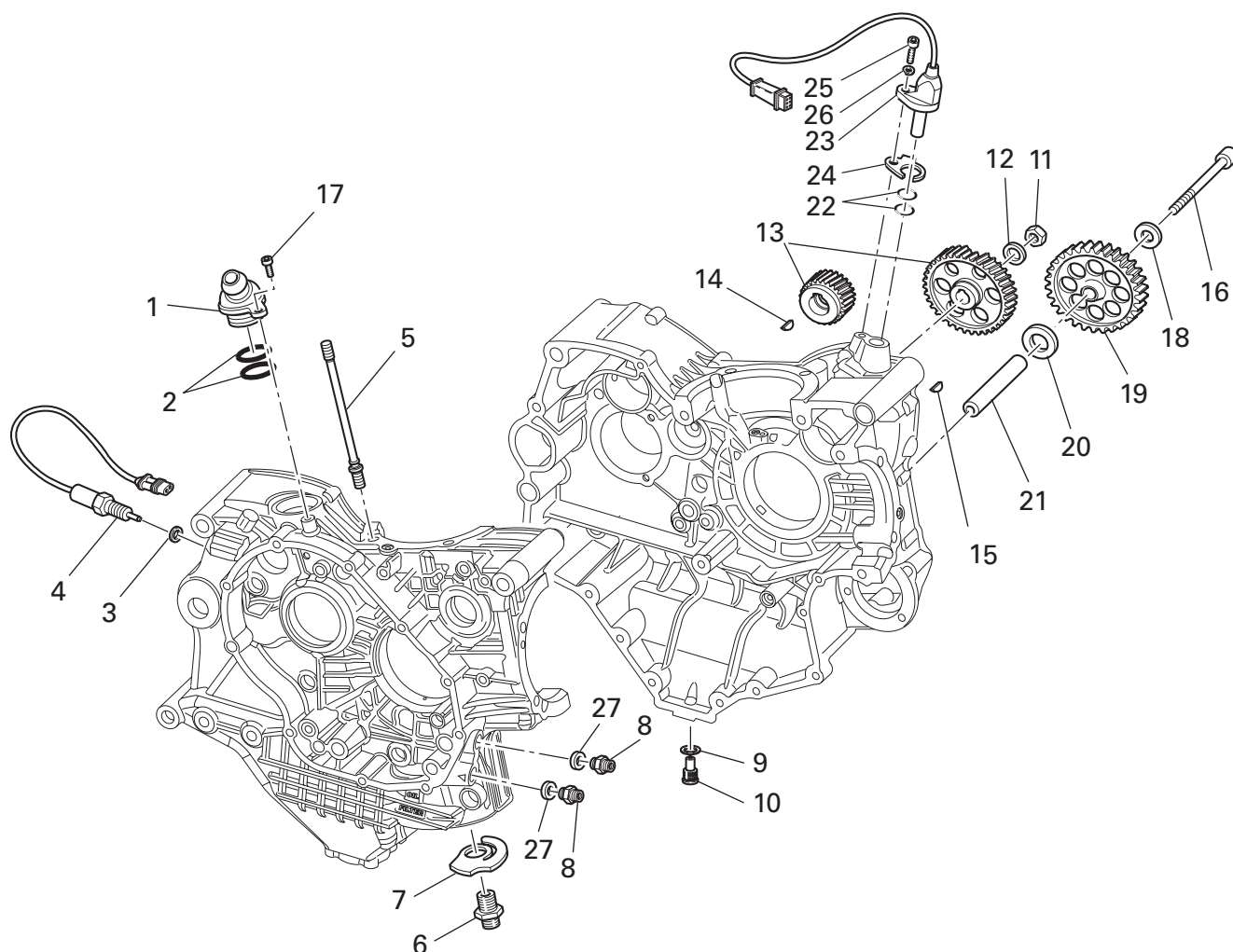
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9.1 - Crankcase assembly: external components



- 1 Oil breather valve
- 2 O-ring
- 3 Seal
- 4 Neutral switch
- 5 Cylinder barrel/head stud
- 6 Nipple
- 7 By-pass spring
- 8 Nipple
- 9 Plug
- 10 Aluminium gasket
- 11 Nut
- 12 Lock washer
- 13 Timing gear pair
- 14 Key

- 15 Key
- 16 Bolt
- 17 Bolt
- 18 Washer
- 19 Starter idler gear
- 20 Washer
- 21 Gear shaft
- 22 O-ring
- 23 Engine sensor
- 24 Shim
- 25 Bolt
- 26 Washer
- 27 Aluminium gasket

 Important

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

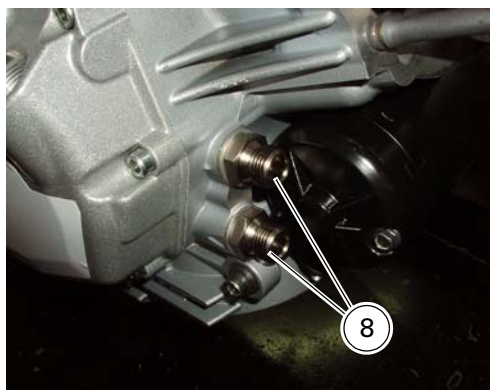
Removal of external components

Operation	Section reference
Remove the engine from the frame	N 1
Remove the lubrication system	N 2.1
Remove the oil filter cartridge	D 4
Remove the cylinder head assemblies and the timing parts	N 4.2
Remove the cylinder barrel/piston assemblies	N 5

Unscrew the bolt (17) and remove the oil breather valve (1) with the O-rings (2). Check the condition of O-rings (2) and renew them if necessary.



Unscrew and remove the oil inlet and outlet nipples (8) from the right-hand crankcase half and recover the seals (27).



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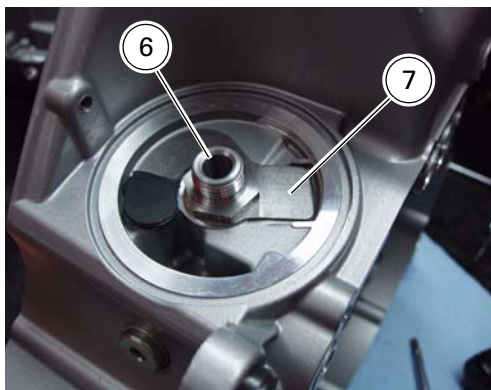
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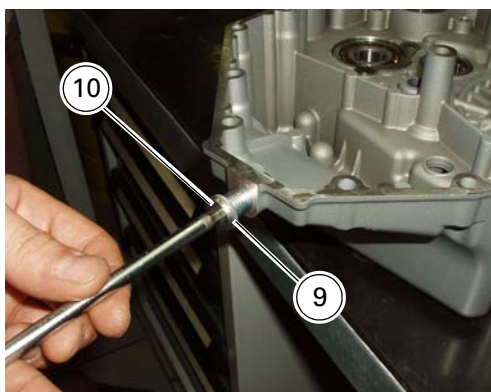
Unscrew and remove the oil filter support nipple (6) and remove also by-pass spring (7).



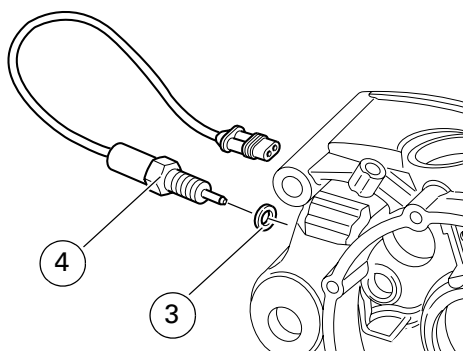
Remove the mesh filter (A) with its seal from the right-hand crankcase half (Sect. D 4).



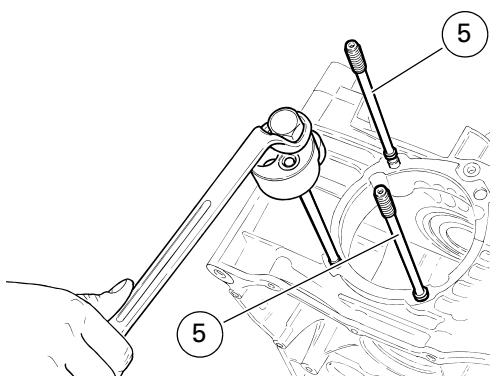
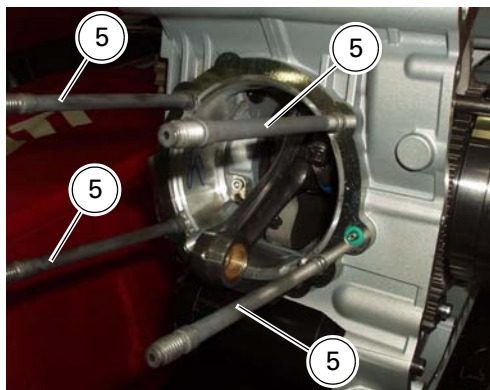
Remove the drain plug (10) with its seal (9).



Remove the neutral switch (4) with its seal (3).



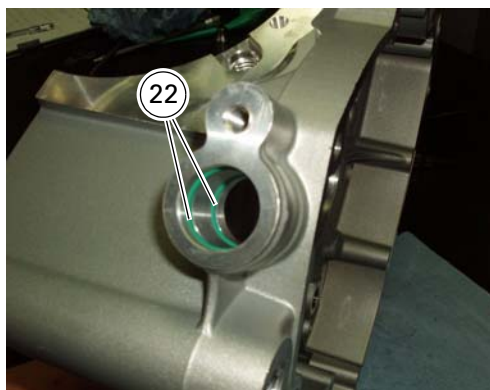
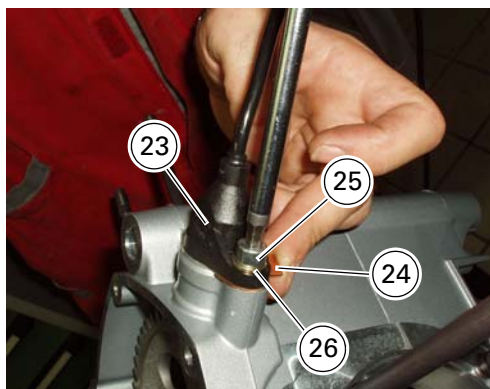
Remove the cylinder head studs (5) with the aid of the appropriate tool.



To remove the engine sensor (23), unscrew the bolt (25) and recover the shim (24) and the washer (26).

Check the condition of O-rings (22) and renew them if necessary.

If the engine sensor is to be renewed, it will be necessary to check the air gap as indicated in the paragraph "Checking the engine sensor air gap".



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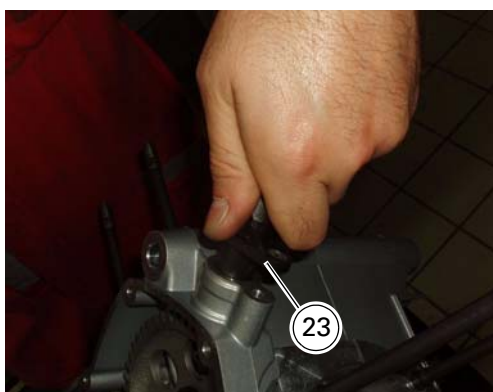
P

Refitting the external components

Grease the engine sensor (23) in the part indicated.



Fit the engine sensor (23) in its seat in the crankcase.



Position the **0.6** mm thick shim (24).



Insert the bolt (25) with washer (26) and tighten to the specified torque (Sect. C 3, Engine torque settings).

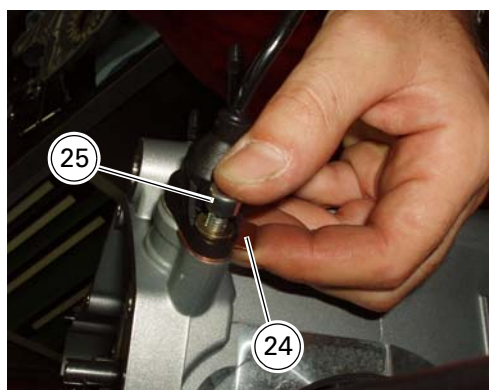
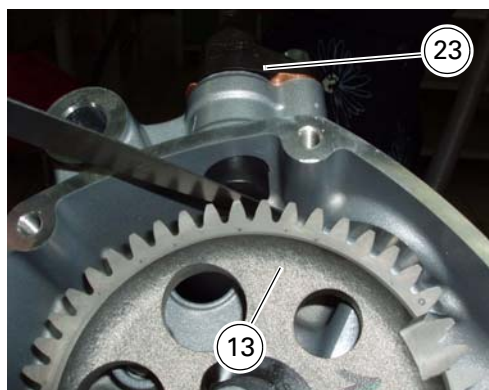


Use a feeler gauge to check the clearance between the engine sensor (23) and the timing gear (13). The values must be between **0.6** and **0.8** mm.



Notes

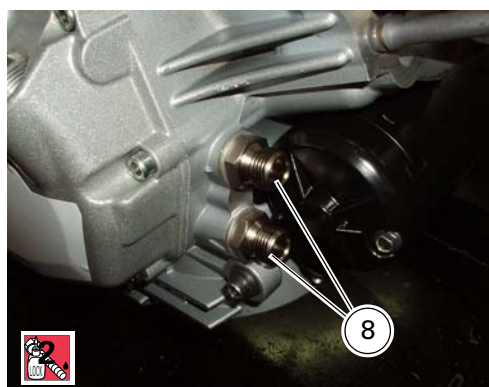
If the gap is incorrect, loosen the screw (25) of the engine sensor and replace the shim (24) with one of suitable thickness (paragraph "Checking the engine sensor air gap").



Install the oil vapour breather valve (1) in the crankcase along with O-ring (2). Tighten the bolt (17) to the specified torque (Sect. C 3, Engine torque settings).



Tighten the two oil hose connection nipples (8) with the seals (27) to the specified torque (Sect. C 3).



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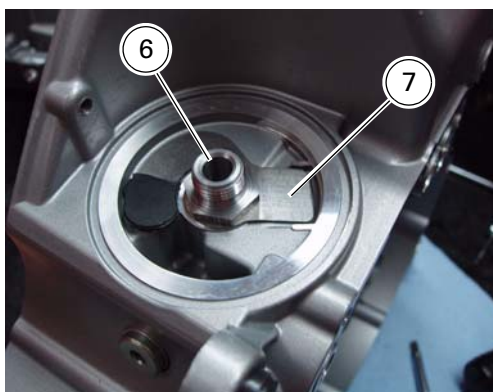
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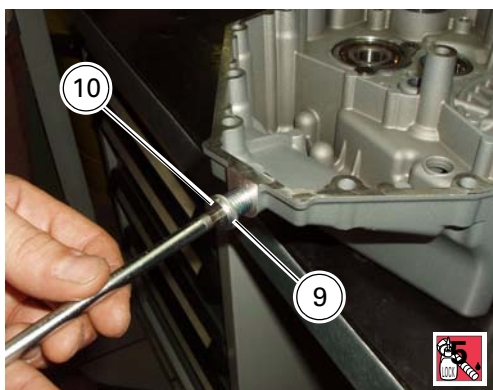
N

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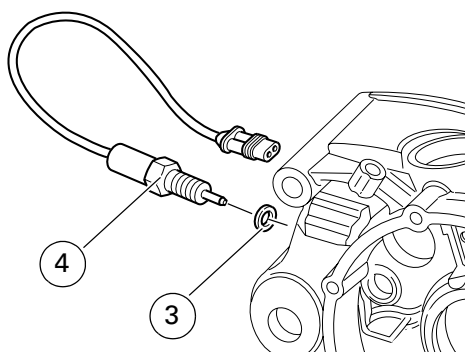
Locate the by-pass spring (7) and screw in the nipple (6) that supports the oil filter cartridge, tightening to the specified torque (Sect. C 3).



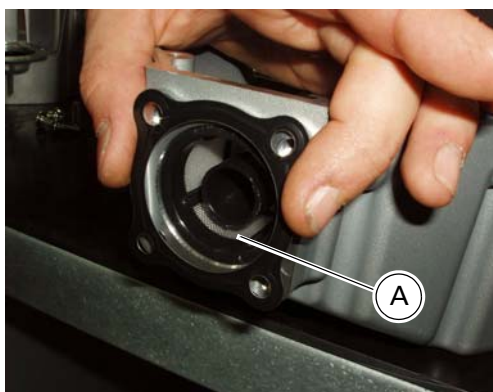
Fit the drain plug (10) with its seal (9) and tighten to the specified torque (Sect. C 3) applying the specified threadlocker.



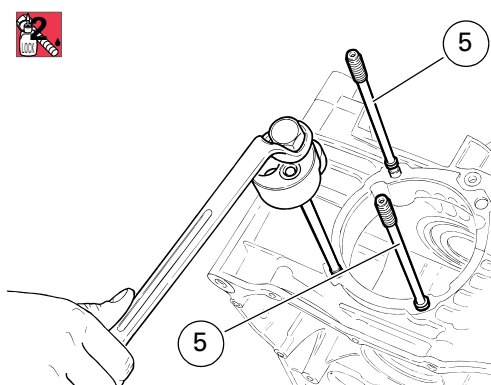
Refit the neutral switch (4) with seal (3).



Refit the mesh filter (A) with seal as described in Sect. D 4.



Install the studs (5) in the crankcase, applying thread locker and tightening to the specified torque value (Sect. C 3). Use the appropriate commercial tool for this operation.



Operation	Section reference
Refit the cylinder barrel/piston assemblies	N 5
Refit the cylinder head assemblies and the timing parts	N 4.2
Refit the oil filter cartridge	D 4
Refit the lubrication system	N 2.1
Refit the engine to the frame	N 1

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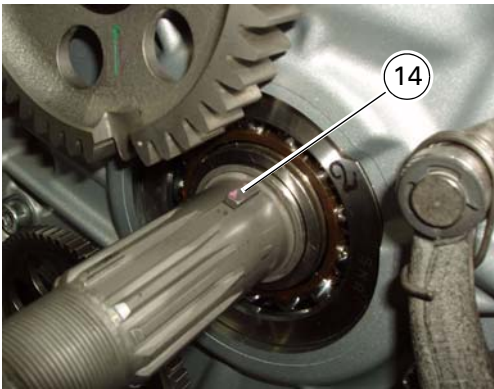
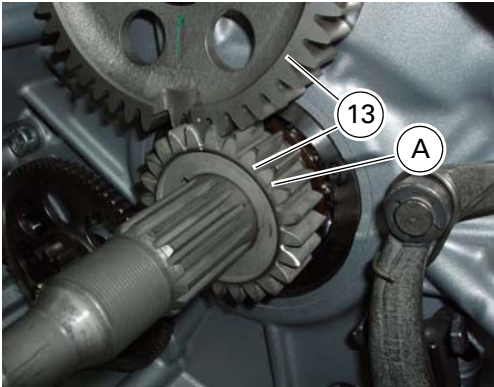
N

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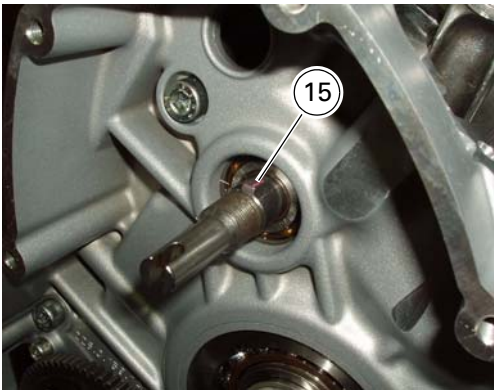
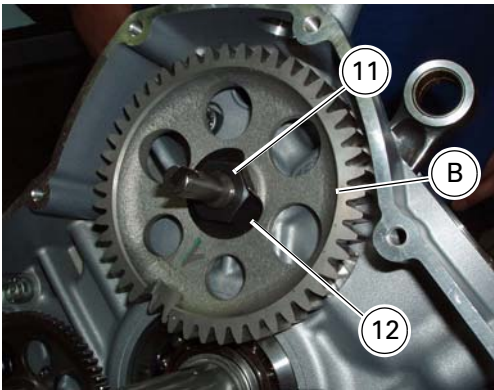
Removal of the timing gears

Operation	Section reference
Remove the left-hand crankcase cover and alternator assembly	N 8

Slide out driving gear (A) of timing gear pair (13) and remove the Woodruff key (14).



Relieve the staking on the lock washer (12) of the nut (11).
Restrain the driven timing gear by inserting a pin (C) in one of the holes, and unscrew the nut (11).
Remove the nut (11), washer (12), driven timing gear (B) and Woodruff key (15) from the timing belt driveshaft shaft.



Refitting the timing gears

Before refitting, check the wear on the timing gear pair (13) and renew if necessary.



Important

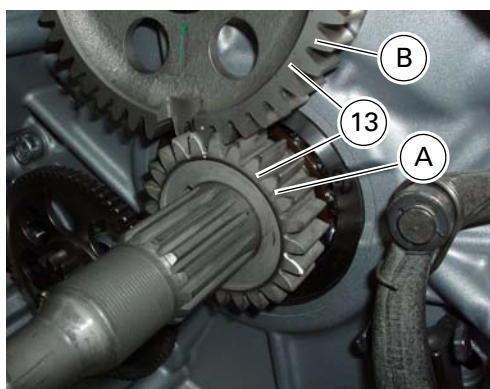
The timing gears (13) must always be renewed as a pair.

Refitting is the reverse of removal.



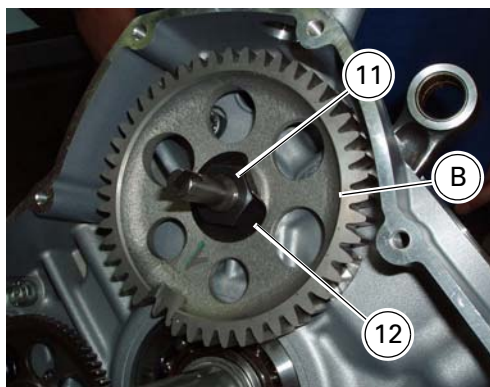
Warning

When installing the driven gear (B), align the timing mark with that on the driving gear (A).



Important

On completion of the refitting operations, check that tab washer (12) is staked against nut (11) in such a way as to prevent the nut from working loose.



Operation

Section reference

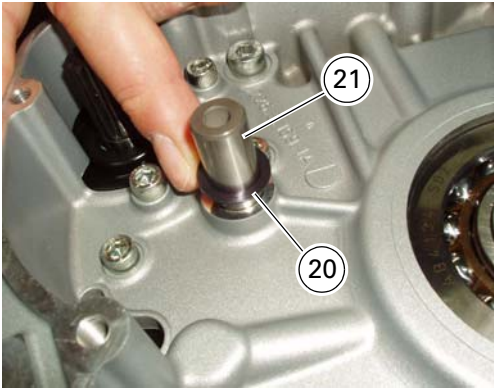
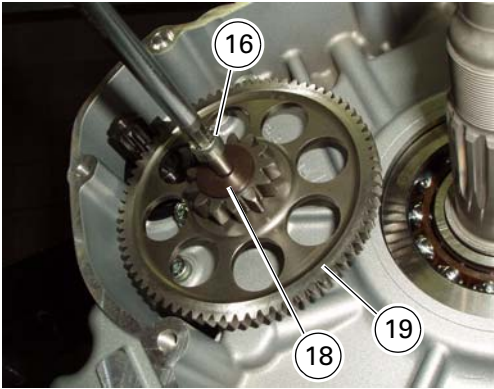
Refit the left-hand crankcase cover and
alternator assembly

N 8

Removal of the starter motor idler gear

Operation	Section reference
Remove the left-hand crankcase cover and alternator assembly	N 8

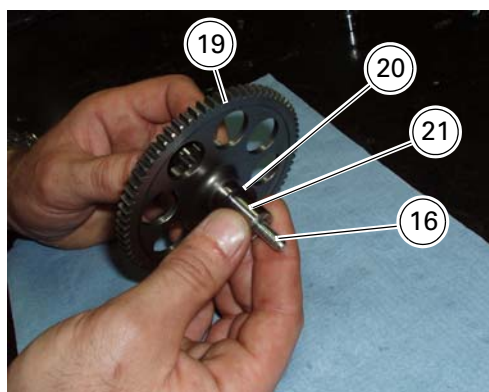
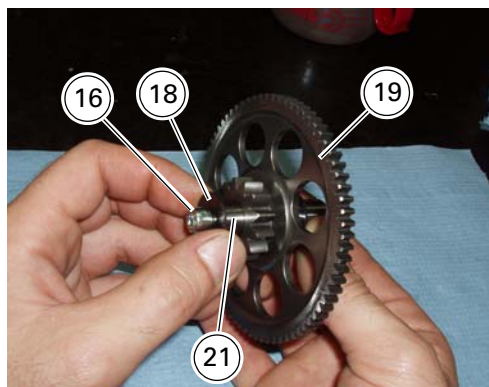
Unscrew the bolt (16) and remove the idler gear (19) with the washers (18) and (20) and the shaft (21).



It is now possible to remove the starter motor as described in Sect. P 3.

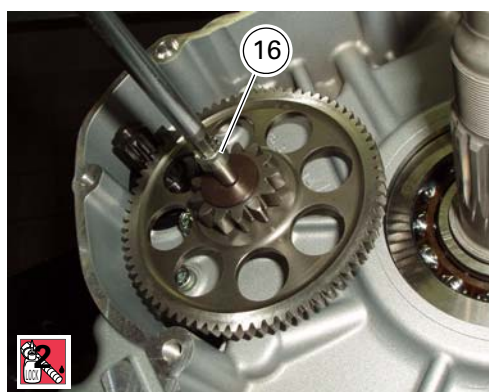
Refitting the starter motor idler gear

Refit the idler gear assembly (19), bolt (16), washers (18) and (20) and shaft (21) as indicated.



Notes

Apply the prescribed threadlocker to the bolt (16) and tighten to the specified torque.



Operation	Section reference
Refit the left-hand crankcase cover and alternator assembly	N 8

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Checking the engine sensor air gap

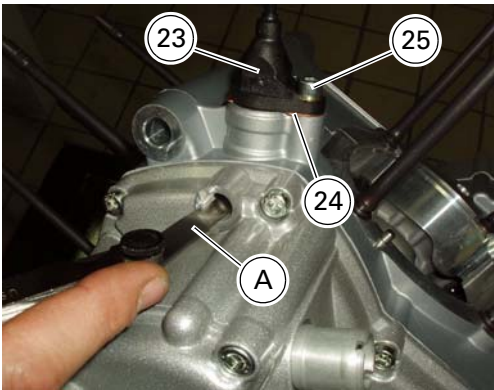
If either the alternator or the engine sensor has been renewed, the sensor air gap must be checked as described below.

Operation	Section reference
Remove the left-hand fairing	E 2

Remove the plug (B) from inspection hole in the left-hand crankcase cover.



Insert a feeler gauge (A) through the hole, positioning it between the end of sensor (23) and the teeth of timing belt driveshaft gear. Check that gap is **0.6 to 0.8** mm.
If not, slacken off the screw (25) securing the sensor (23) so as to extract the shim (24) and replace it with one of suitable thickness.



 Notes

There are three different shims available, and these can be identified by their colours, as shown in the figure.

0.6 mm SHIM
(Copper colour)



0.8 mm SHIM
(Stainless steel colour)



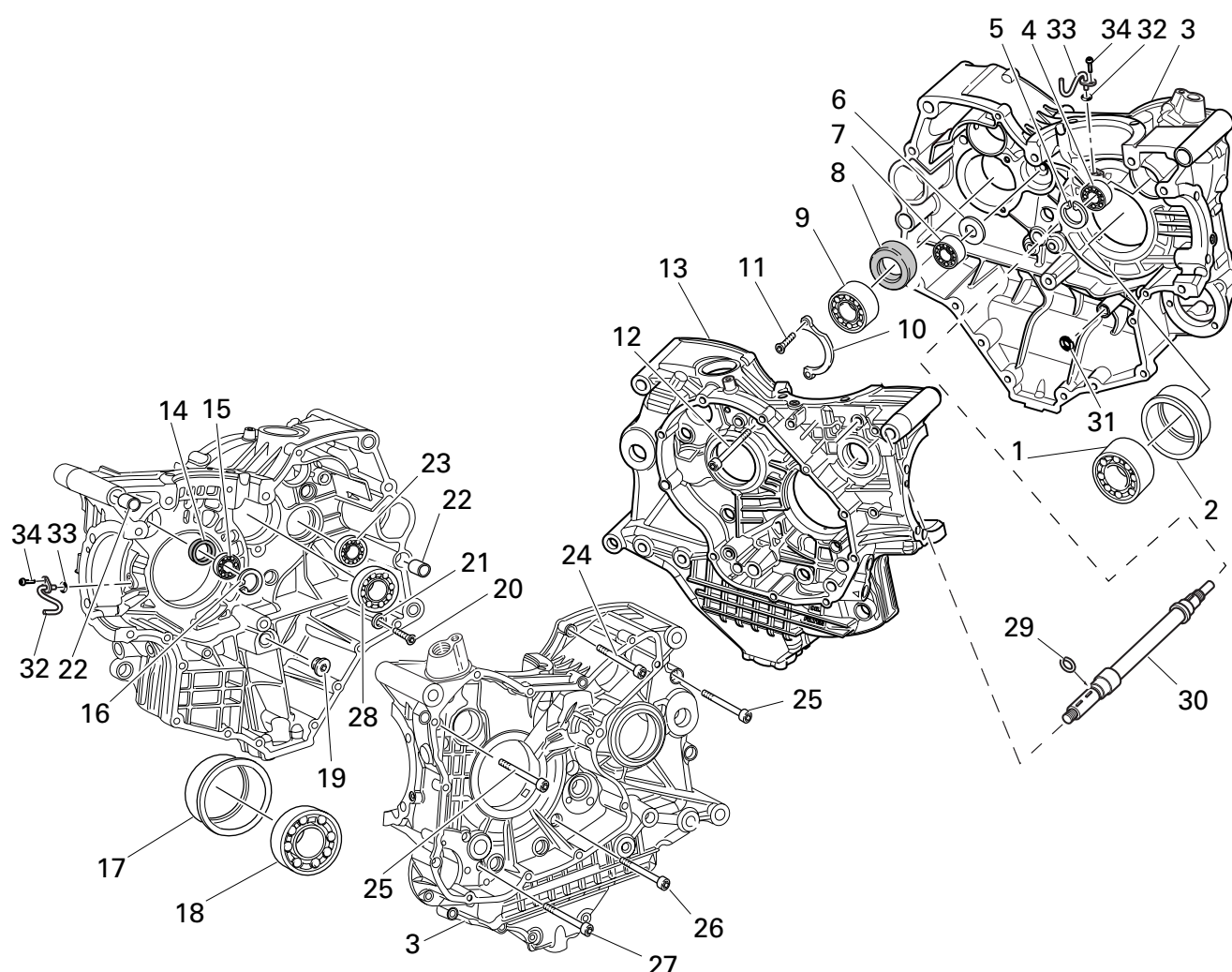
1.0 mm SHIM
(Brass colour)



Tighten the bolt (25) to the specified torque (Sect. C 3).
Refit the plug (B) with seal (C) and tighten to the specified torque (Sect. C 3).

Operation	Section reference
Refit the fairings	E 2

9.2 - Crankcase assembly: crankcase halves



- | | |
|-----------------------------------|---------------------------|
| 1 Bearing | 18 Bearing |
| 2 Bearing shell | 19 Bearing |
| 3 Crankcase half - front | 20 Bolt |
| 4 Bearing | 21 Spacer |
| 5 Circlip | 22 Bush |
| 6 Washer | 23 Bearing |
| 7 Bearing | 24 Bolt (M6x35) |
| 8 Oil seal | 25 Bolt (M8x75) |
| 9 Bearing | 26 Bolt (M8x75, drilled) |
| 10 Retaining plate | 27 Bolt (M6x75) |
| 11 Bolt | 28 Bolt (M8x90) |
| 12 Bolt (M8x90) | 29 Circlip |
| 13 Right-hand side crankcase half | 30 Timing belt driveshaft |
| 14 Oil seal | 31 O-ring |
| 15 Bearing | 32 O-ring |
| 16 Circlip | 33 Hose |
| 17 Bearing shell | 34 Bolt |



Important

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

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Separation of the crankcase halves

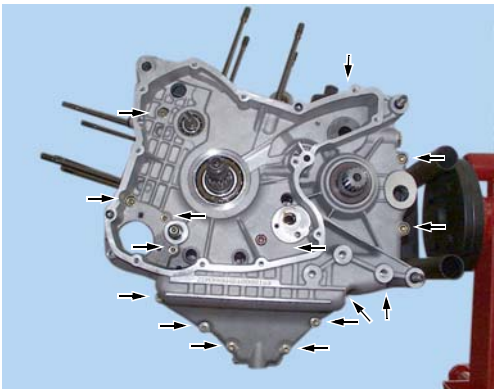
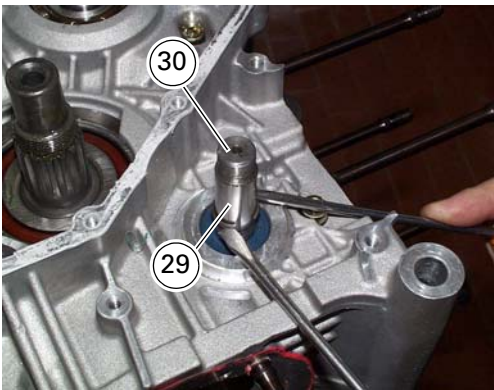
Operation	Section reference
Remove the engine from the frame	N 1
Remove the lubrication system	N 2.1
Remove the cooling system	N 3.2
Remove the cylinder head assemblies and the timing parts	N 4.2
Remove the cylinder barrel/piston assemblies	N 5
Remove the left-hand crankcase cover and alternator assembly	N 8
Remove the engine starting system	P 3
Remove the right-hand crankcase cover	N 6.2
Remove the clutch assembly	N 6.1
Remove the gauze filter	D 4

Use two screwdrivers to remove the circlip (29) from the timing belt driveshaft shaft (30) on the right-hand crankcase half.

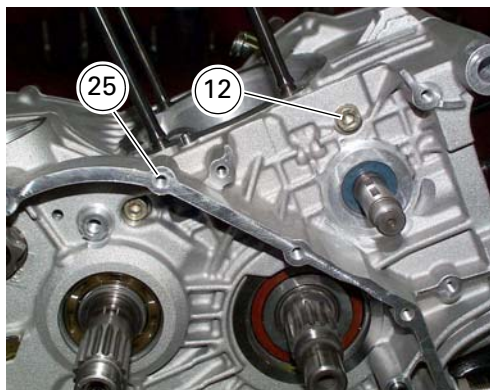
Notes

Take care to avoid scoring the surface of the shaft while removing the circlip.

Unscrew the crankcase bolts working from the chain side.



Unscrew the two bolts (12) and (25) on the right-hand side near the vertical cylinder.



Re-use the left-hand crankcase cover or a service cover with puller **88713.1749**. Secure it to the crankcase half using some of the original screws and begin separating the crankcase halves by turning the central pin of the tool. Tap the end of the gearbox output shaft with a plastic mallet to separate the crankcase halves.



Notes

Take care not to lose the shims on the shafts and on the selector drum.



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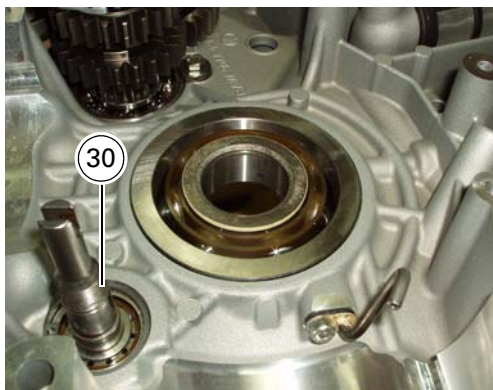
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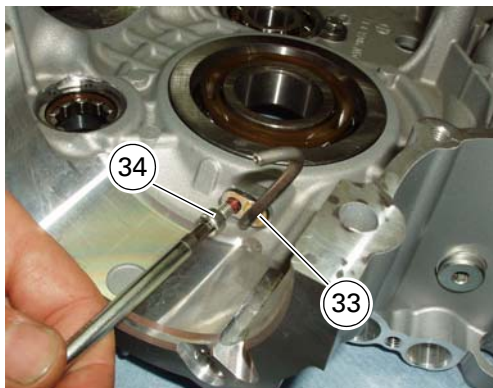
Remove the gear shafts and gear selector drum from the crankcase halves as described in Sect. N 7.2.
Drive out the crankshaft (L) using a plastic mallet, taking care not to lose the shims.



Remove the timing belt driveshaft (30).



Remove the bolts (34), remove the hoses (33) and recover the O-rings (32).

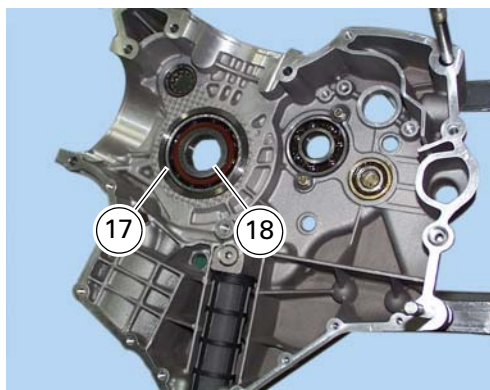
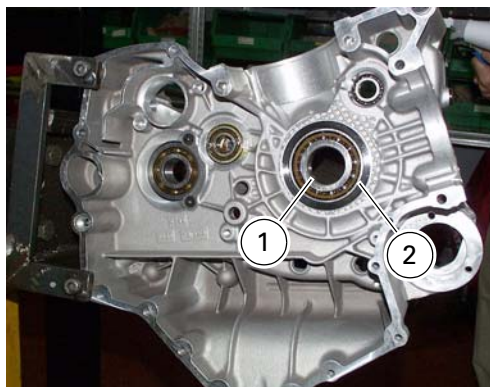


Overhaul of the crankcase halves

Carefully examine the engine crankcase halves.

Check that the surfaces of the crankcases are perfectly flat using a reference surface.

Check that bearings (1) and (18) and bushes (2) and (17) are in perfect condition. Note that main bearings must always be changed in pairs (refer to the procedure below in "Main bearings").



Notes

When overhauling an engine it is good practice to renew all the crankcase bearings.

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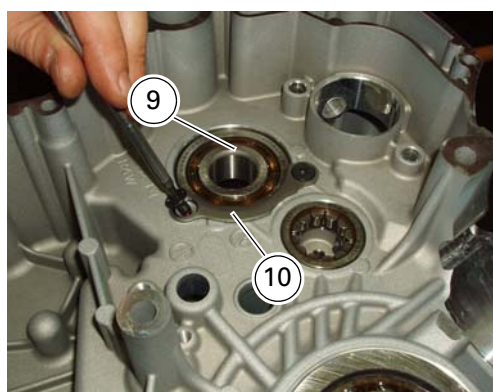
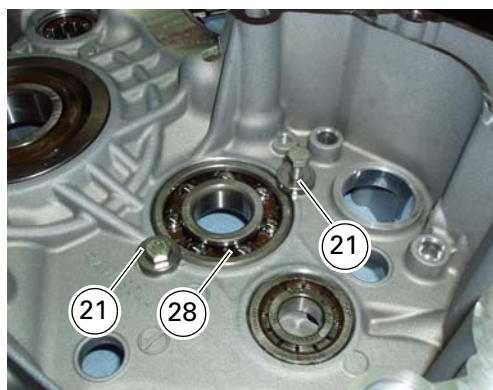
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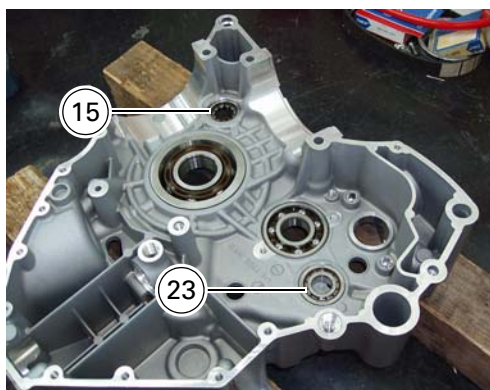
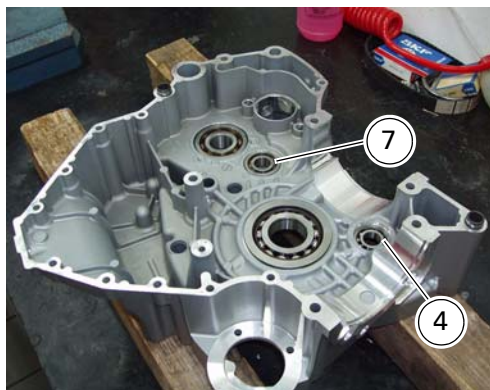
After having renewed the gearbox shaft bearings (28) and (9), secure them in the crankcase with the spacers (21) and the retaining plate (10).



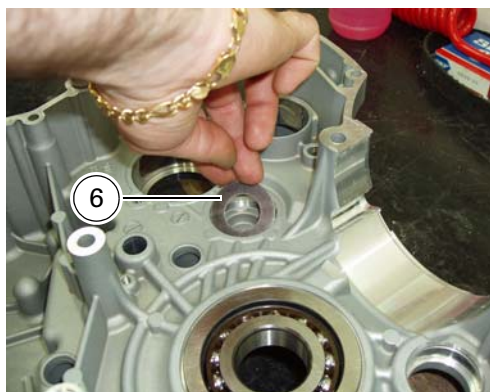
At each overhaul it is recommended to renew also the oil seal (8) on the outside of bearing (9).



Renew the bearings (7) and (23) on the ends of the gearbox shafts and timing belt driveshaft bearings (4) and (15).



Take care not to lose the shim (6) interposed between the bearing (7) on the end of the gearbox input shaft and the chain side crankcase half.



The oil seal (14) on the external side of the roller bearing (15) must be renewed at each engine overhaul.



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Check that the oilways are free of restrictions or clogging.

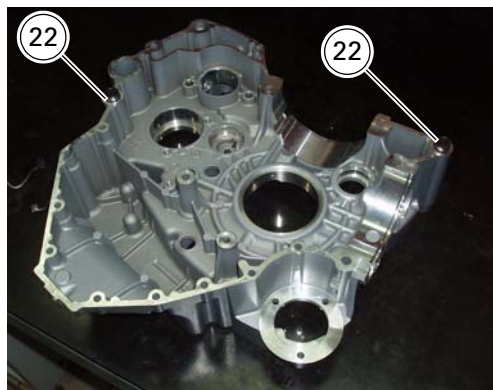
Check the condition of locating dowels (22). In the event of signs of distortion or excessive assembly clearance with the corresponding seats, remove the locating dowels using appropriate tools.

If it proves difficult to remove the dowels (22) from the crankcase, use a tap with a left-hand thread to force them out.

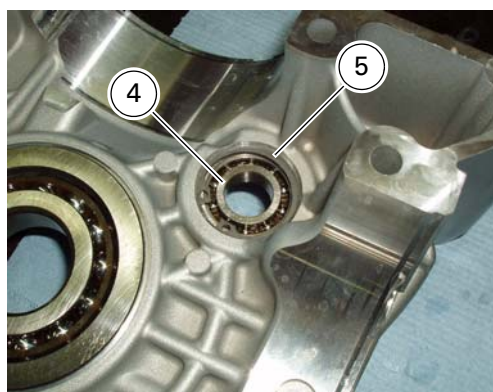
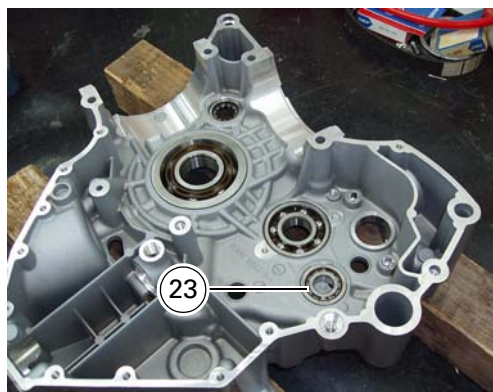


Important

The dowels (22) must always be renewed when they have been removed using the above procedure.



Remove the bearing (23), the circlip (5) and the roller bearing (4).



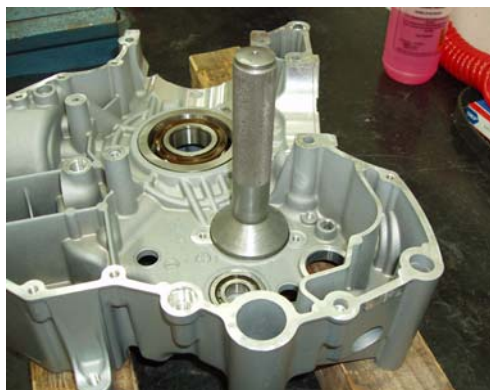
Main bearings

The main bearings have are of the angular contact type with offset inner races so that the balls transmit loads from one groove to the other along straight lines at an angle to the axis of the bearing. Angular contact thrust bearings are designed to withstand combined loads (radial and axial loads).

Bearings of this type can bear thrust loads in one direction only. In fact, under the action of a radial load inside the bearing, an axial force is created that must be counterbalanced by an axial force acting in the opposite direction; that is why these bearings are generally fitted back to back in pairs.

To renew the bearings proceed as follows:

- heat the crankcase half in an oven up to **100 °C**;
- remove the bearing using a drift and hammer;
- install the new bearing (while the crankcase is still hot) keeping it perfectly square in its seat using a tubular drift that only bears on the outer ring of the bearing;
- allow the parts to cool and check that the bearing is securely seated in the crankcase.



Important

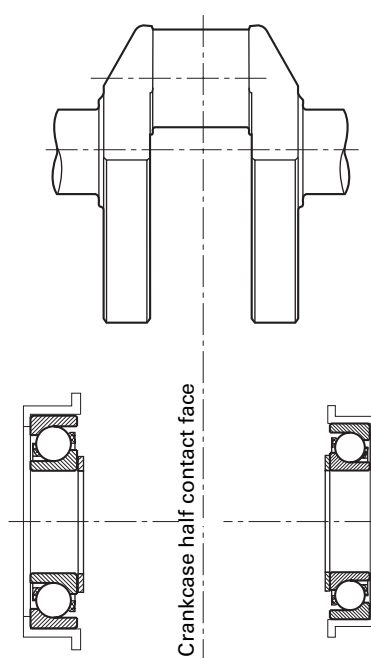
On worn engines, the bearing holder may no longer be a tight fit in the crankcase half.

After having removed the bearing holder, check that the interference fit between the crankcase and the holder with the bearing installed is no less than **0.03 mm**, otherwise the crankcase halves must be renewed.



Notes

For shimming the main bearings, see the chapter at the end of this section.



Reassembly of the crankcase halves

The crankcase halves must be in good condition and perfectly clean. The mating surfaces must be perfectly flat and free from burrs.

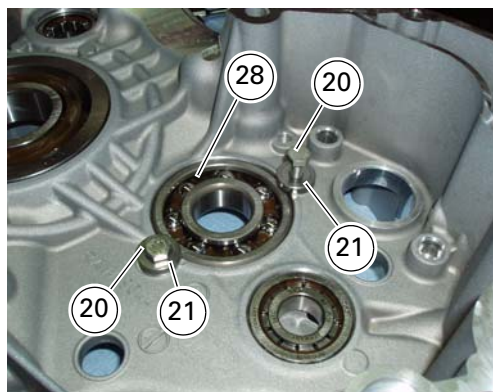
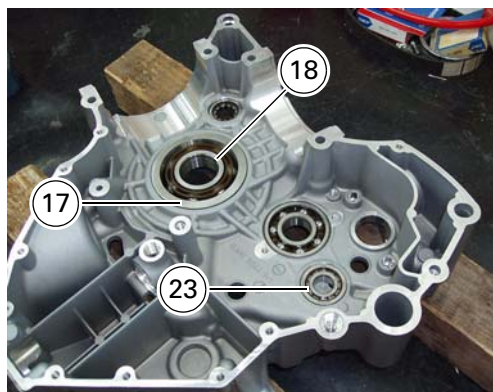
Overhauling the right-hand side crankcase half

The following parts must be present on the internal side of the crankcase half:

the output shaft end bearing (23);

the input shaft bearing (28), secured with bolts (20) and retaining spacer (21).

The main bearing (18) complete with bush (17).

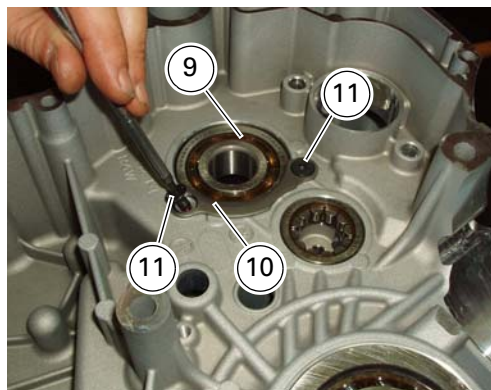


The roller bearing (15) with retaining circlip (16) installed in correspondence with the end of the timing belt driveshaft.

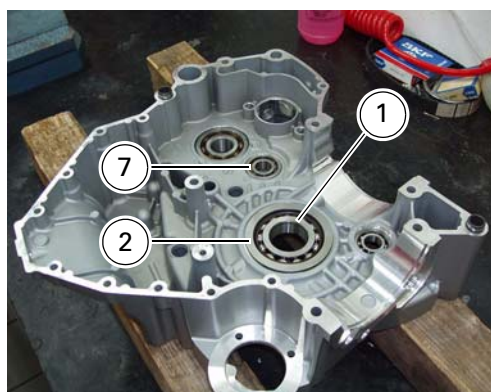
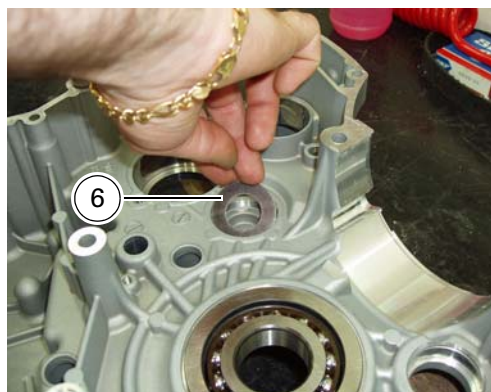


Refitting the left-hand side crankcase half

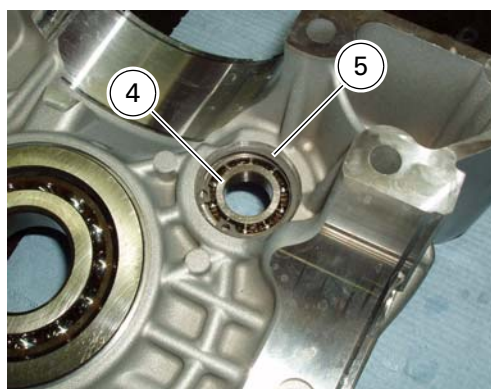
The following parts must be present on the internal side of the crankcase half:
the double cage ball bearing (9) supporting the fork control shaft with stop plate (10) and retaining bolts (11).



The gearbox input shaft end bearing (7) with the inner spacer (6).
The main bearing (1) complete with bush (2);



The bearing (4) with the retaining circlip (5) installed in correspondence the timing belt driveshaft.



Notes

None of the bearings except the main bearings have an obligatory assembly direction.

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Refit the gauze filter as described in Sect. D 4.



Important

To avoid damaging the filter, insert it by hand only. Do not use hammers or other metal tools.

Above the gauze filter seat there is a plug (19) which closes off the lubrication oilway. If it is to be renewed, apply the prescribed threadlocker to its threads.

Tighten the bolts and plug to the specified torque (Sect. C 3).



Shimming the shafts

Before assembling the crankcase halves, calculate the shims required to obtain the correct end float of the crankshaft and gearbox shafts.

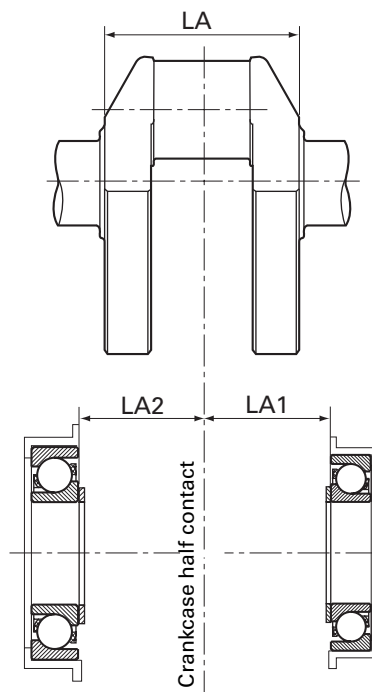
To determine the correct shim thicknesses proceed as follows.

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.



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Add a pre-load of **0.30** mm to prevent excessive crankshaft end float when the crankcase halves are at their normal operating temperature.

This gives:

$$SA = LA1 + LA2 + 0.30 - LA$$

To calculate the each single shim thickness note that:

$$SA = SA1 + SA2$$

where "SA1" and "SA2" represent the shims for the right-hand crankcase half 1 and the left-hand crankcase half 2.

Considering the alignment of the shaft, this gives:

$$SA1 = LA1 + 0.15 - LA/2;$$

And finally, the second shim thickness: $SA2 = SA - SA1$.

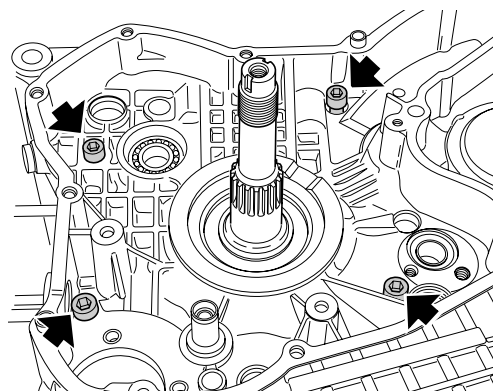


In addition to the above description, the following text illustrates a practical shimming procedure, providing a guide on how to calculate the crankshaft shim thicknesses accurately.

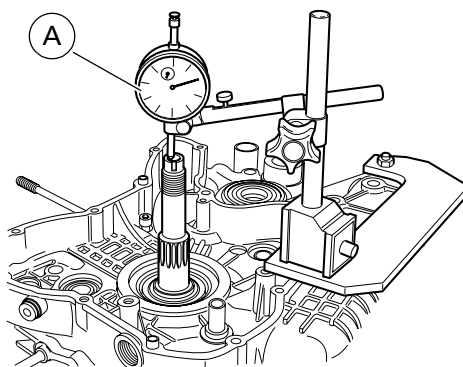
Install a shim of minimum thickness (**1.90** mm) on each side of the crankshaft to prevent contact between the crankshaft web and the engine block.

Install the crankshaft and assemble the two crankcase halves.

Fit four M8 bolts into the holes shown in the figure and tighten to the specified torque (Sect. C 3).



Place a dial gauge (A) with a magnetic base on a support plate fixed to the crankcase.
Bring the stylus into contact with the end of the crankshaft and set the dial gauge to zero in this position.



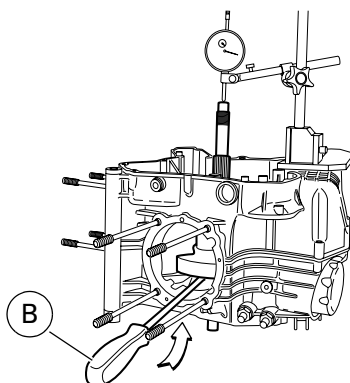
Insert a lever (B) between the crankcase and the crank web and force the crankshaft towards the dial gauge.
Note the dial gauge reading. This is the crankshaft endfloat. Add a preload of **(0.30 mm)** plus the thickness of the shims used **(1.90x2=3.8 mm)**.

Divide the resulting value by two to obtain the thickness of the shim packs to be installed at either end of the crankshaft.



Notes

After assembling the crankcase, the crankshaft should turn with some interference in the new bearings.



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Shimming the gearbox shafts

To establish the total shim thicknesses to be installed on the input shaft "SP" and the output shaft "SS", proceed as follows:
Measure the dimensions "LP" and "LS" on the input and output shafts (for the output shaft add shim thickness "R" of **2.3** mm;
Measure the depth corresponding to the distance between the contact surface of the crankcase half and the contact surface of the inner race of the bearing for the input shaft ("CP1" and "CP2") and for the output shaft ("CS1" and "CS2");

Given that end float should be in the range **0.05** to **0.15** mm, we will take the optimal value of **0.15** mm, this gives:

$$SP = CP1 + CP2 - LP - 0.15 \text{ and } SS = CS1 + CS2 - LS - 0.15.$$

To determine the thickness of each single shim pack, note that:

$$SP = SP1 + SP2 \text{ and}$$

$$SS = SS1 + SS2$$

Where "SP1" and "SP2" are the clutch and chain side input shaft shimming values respectively and "SS1" and "SS2" the corresponding values for the output shaft. This gives:

$$SP1 = CP1 - 64 - 0.075 \text{ and}$$

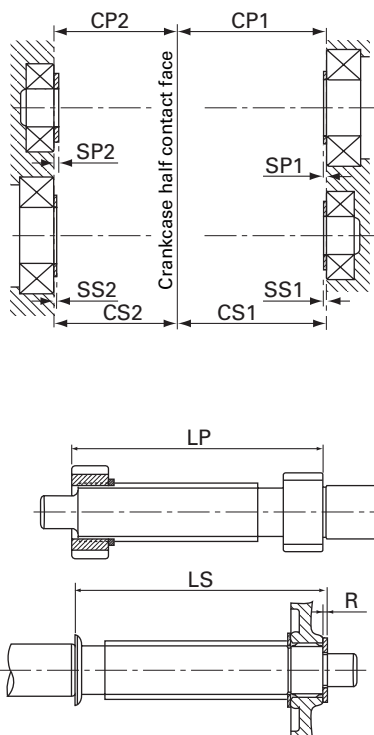
$$SS1 = CS1 - 64 - 0.075, \text{ so that}$$

$$SP2 = SP - SP1 \text{ and } SS2 = SS - SS1.$$



Notes

The method described for the crankshaft can also be used to calculate the shim thicknesses for the gear shafts.



Shimming the gearbox selector drum

A similar procedure is used to establish the total shim thickness "ST" for the gearbox selector drum;

Given that:

LT1 = right-hand side crankcase depth

LT2 = left-hand side crankcase depth

LT = gearbox selector drum shoulder.

Given that endfloat should be **0.10** to **0.40** mm

and taking the mean optimal value of **0.25** mm.

This gives: $ST = LT1 + LT2 - LT - 0.25$.

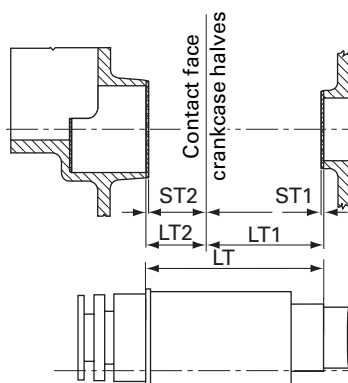
Given that $ST = ST1 + ST2$

we obtain $ST1 = LT1 - 59 - 0.125$, so that $ST2 = ST - ST1$.



Notes

The method described for the crankshaft can also be used to calculate the shim thicknesses for the gear shafts.



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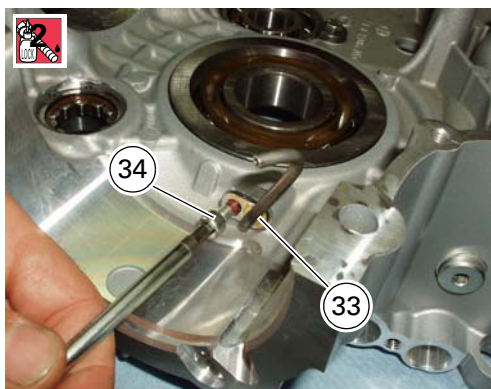
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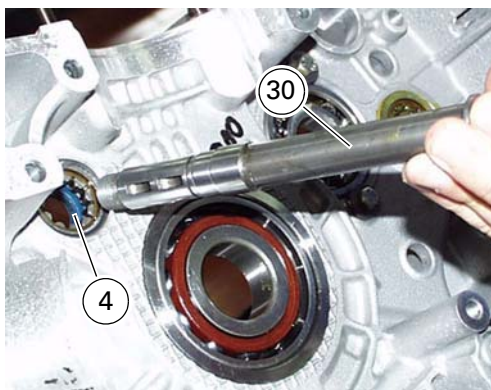
Reassembly of the crankcase halves

Apply the recommended threadlocker to the bolts (34) and secure the hoses (33) with the O-rings (32), tightening the bolts (34) to the specified torque (Sect. C 3).



Install the timing belt driveshaft (30) in the roller bearing (4) in the right-hand crankcase half. To avoid damaging the oil seal (14) on the timing belt driveshaft, protect the threaded end of the shaft with the special protective cap **88700.5749**. Dampen the oil seal (14) with alcohol and fit it on the timing belt driveshaft, seating it up against the roller bearing (4).

Fit the circlip (29) in the groove on the shaft and remove the protective cap.



 Notes

When refitting used components, make sure that the inner races (C) of the gearbox shaft bearings are fitted into the correct bearings and have not been left on the shafts.

Mesh the gearbox shafts and install them on the right-hand crankcase half with the calculated shims.



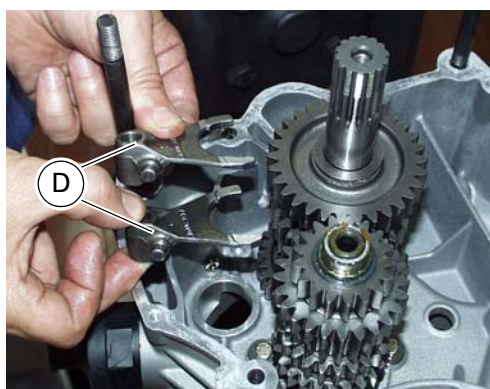
 Notes

A figure and a list of the component parts of the gearbox appear in Sect. N 7.2.

Install the selector forks of the 1st - 4th and 2nd - 3rd gears (D) in their respective grooves in the output shaft driven gears.

 Notes

The two selector forks are identical.



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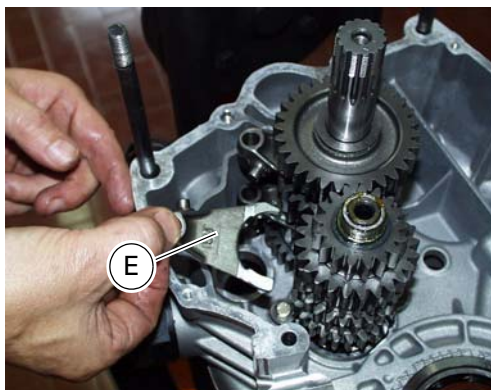
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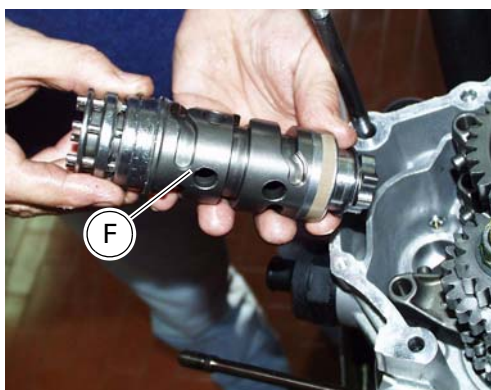
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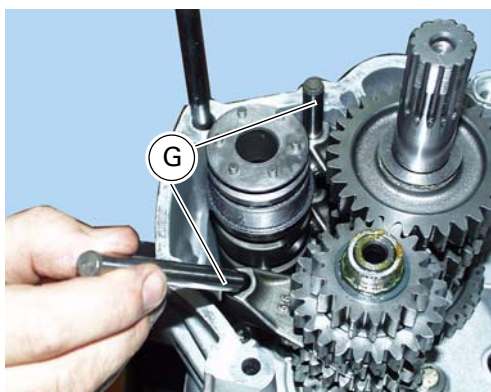
Install the 5th-6th gear selector fork (E) in the input shaft driven gear.



Install the selector drum (F) in the crankcase with calculated shim thickness.



Fit the pins (G) in the previously installed selector forks.

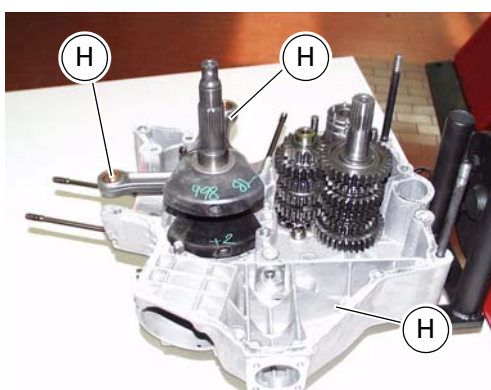


Fit the shimmed crankshaft into the right-hand crankcase half, positioning the connecting rods (H) in correspondence with the relative cylinder barrel seats.

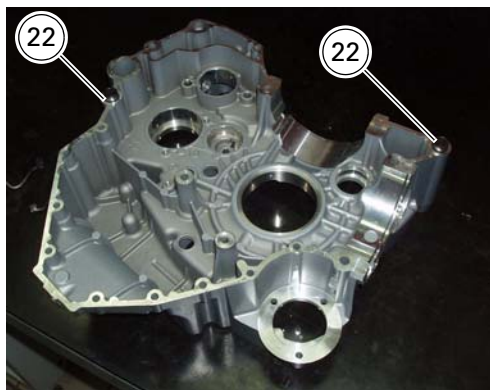


Important

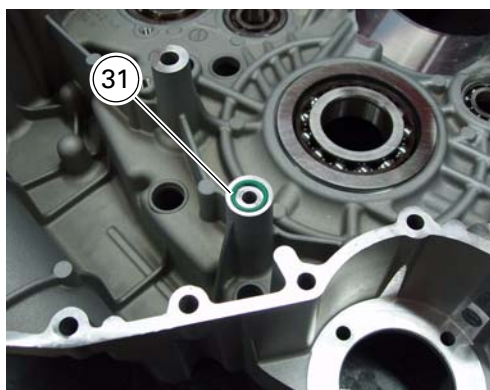
Make sure that the connecting rods (H) are correctly positioned in the respective cylinder seats. Incorrect positioning of the connecting rods at this stage will inevitably lead to the need to re-open the crankcase.



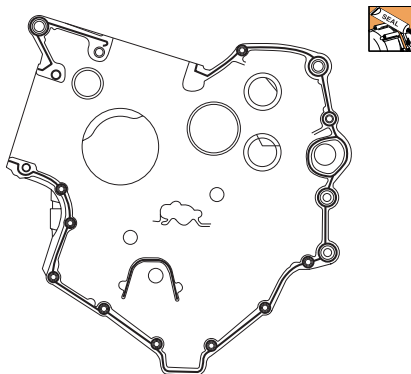
Check that the two locating dowels (22) are correctly installed.



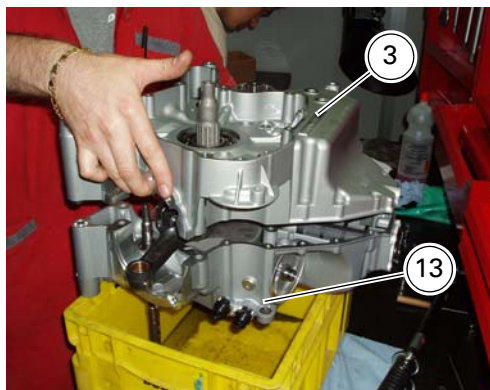
Grease the O-ring (31) to hold it in position and install it.



Apply a uniform and continuous bead of DUCATI liquid gasket to the mating surfaces of the crankcase halves, going around all the holes as shown in the figure.



Bring the crankcase halves (3) and (13) together, tapping with a rubber mallet in the area of the shafts if necessary.



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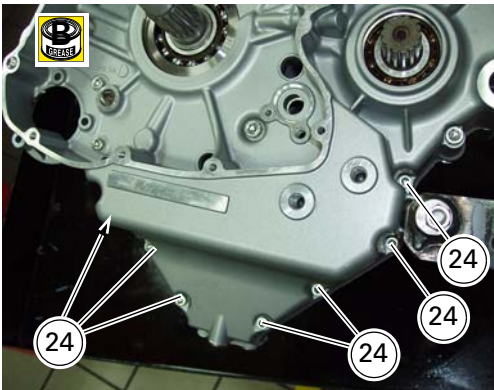
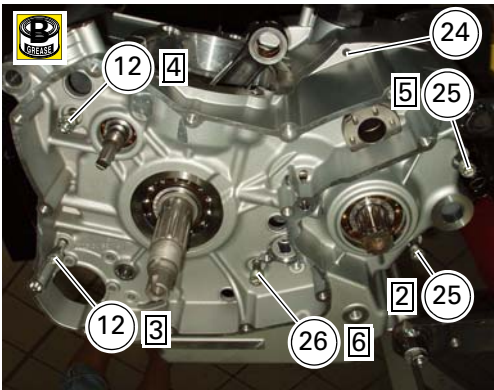
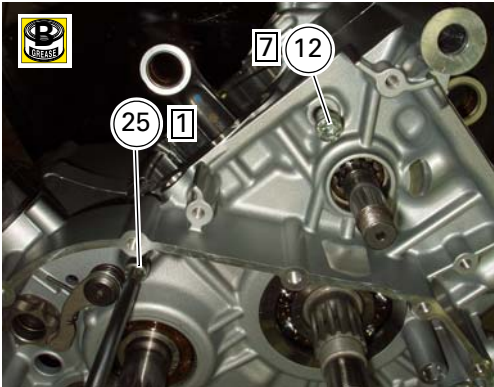
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P

Apply the recommended grease to the bolts and insert them in their holes (note that the bolts are different lengths). Start with the larger diameter bolts (M8), and in particular, the left-hand side bolt (25) and follow the order indicated.

See	Q.ty	Description
12	3	M8x90 mm bolts
25	6	M8x75 mm bolts
26	1	M8x75 mm bolts
24	8	M6x35 mm bolts
27	2	M6x75 mm bolts

Tighten all the bolts to the specified torque (Sect. C 3).



Ensure that the crankshaft can be turned with a certain amount of interference with the main bearings (the crankshaft should have a pre-load of **0.20 to 0.30 mm**); check also that all the parts you have fitted are free to rotate or move correctly. Install the gauze filter cover with its gasket as described in Sect. D 4.
Fit the filter cartridge (Sect. D 4).
Install the oil seal (8) on the gearbox output shaft.



Fit on the output shaft the socket of tool part no. **88713.2060**. Lubricate the new oil seal (8) and guide it into its seat. Using the tool's drift, drive the oil seal fully home so it seats against the crankcase bearing.



Operation	Section reference
Refit the clutch assembly	N 6.1
Refit the right-hand crankcase cover	N 6.2
Refit the engine starter system	P 3
Refit the left-hand crankcase cover and alternator assembly	N 8
Refit the cylinder barrel/piston assemblies	N 5
Refit the cylinder head assemblies and the timing parts	N 4.2
Refit the cooling system	N 3
Refit the lubrication system	N 2.1
Install the engine in the frame	N 1

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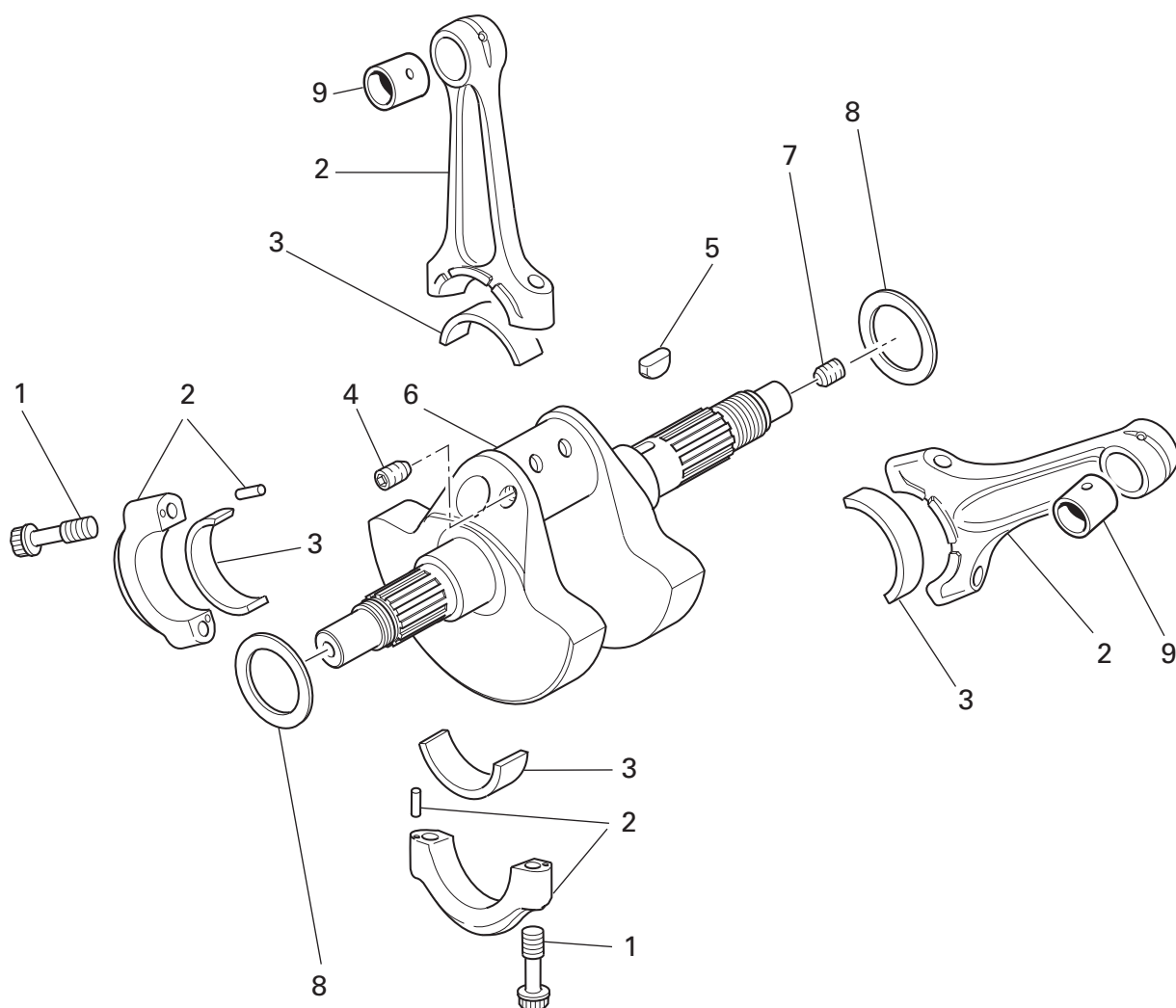
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9.3 - Crankcase assembly: connecting rods



- 1 Special screw
- 2 Connecting rod assembly
- 3 Half bearing
- 4 Grub screw
- 5 Key
- 6 Crankshaft
- 7 Grub screw
- 8 Shim
- 9 Bushes



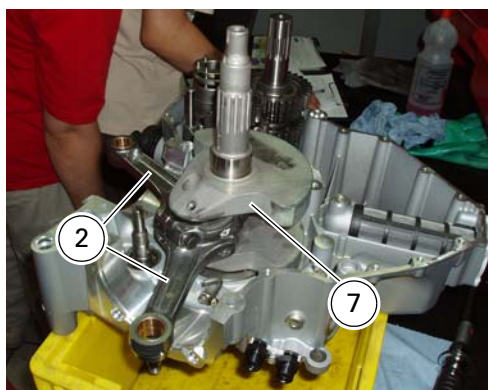
Important

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

Removal of the connecting rods assembly

Operation	Section reference
Remove the engine from the frame	N 1
Remove the lubrication system	N 2.1
Remove the cooling system	N 3
Remove the cylinder head assemblies and the timing parts	N 4.2
Remove the cylinder barrel/piston assemblies	N 5
Remove the left-hand crankcase cover and alternator assembly	N 8
Remove the engine starting system	P 3
Remove the right-hand crankcase cover	N 6.2
Remove the clutch assembly	N 6.1
Separate the crankcase halves	N 9.2

After separating the crankcase halves, withdraw the crankshaft (7) complete with connecting rods (2).



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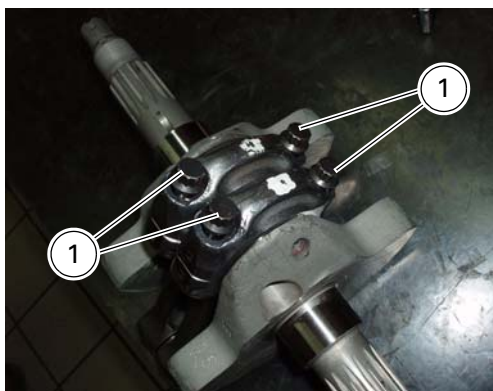
Disassembly of the connecting rods

To disassemble the connecting rod, undo the bolts (1) and separate the connecting rod from the crankshaft.



Important

Take care not to mix up components of different connecting rods and maintain the original orientation.



Overhaul of the connecting rods

Make the following dimensional checks on the connecting rods:

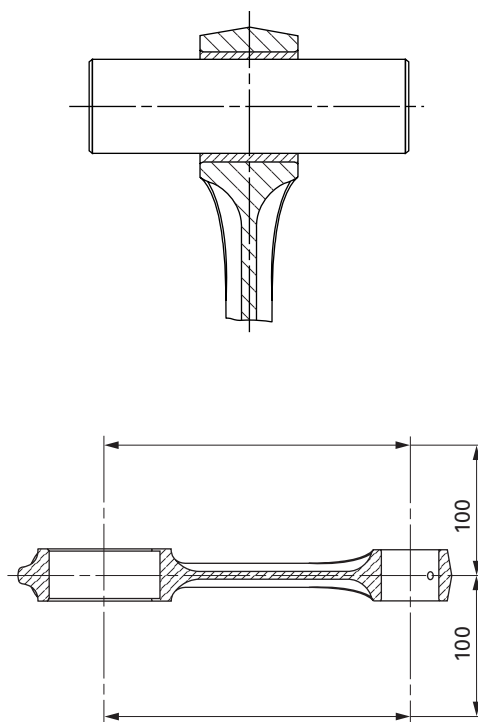
- *clearance with gudgeon pin on assembly.*

In the event of excessive wear (Sect. C 1.1), renew the connecting rod.

The small end bushing must be in good condition and firmly driven into its seat.

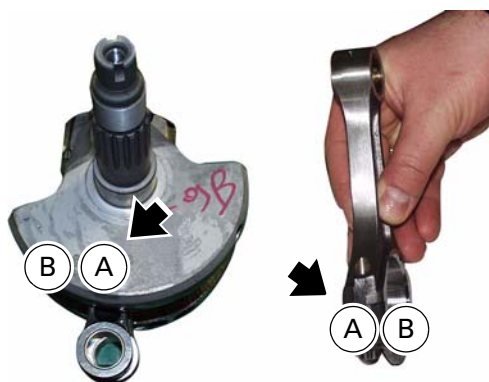
Check for parallelism error measured at **100** mm from the connecting rod longitudinal axis:

the value must be **H - h** less than **0.02** mm; otherwise, renew the connecting rod.



The connecting rod is supplied in two size classes **A** and **B** relative to the big end diameter (Sect. C 1.1) as punch marked on the side of the cap.

It is preferable to use crankshaft and connecting rods of the same size class.



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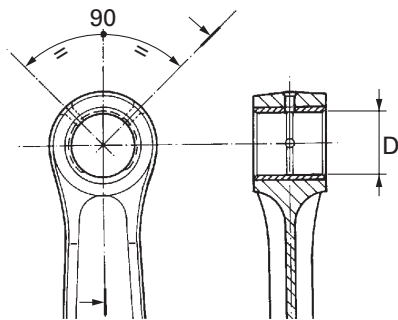
Renewal of the small end bushing

A

To remove the worn bushing, use a suitable drift and a press.
Drill lubrication holes into the new bushing in correspondence with the existing lubrication holes on the connecting rod small end.
Now ream out the bushing until the inside diameter (D) is **20.035** to **20.045** mm.

B

C



D

Connecting rod bearings

E

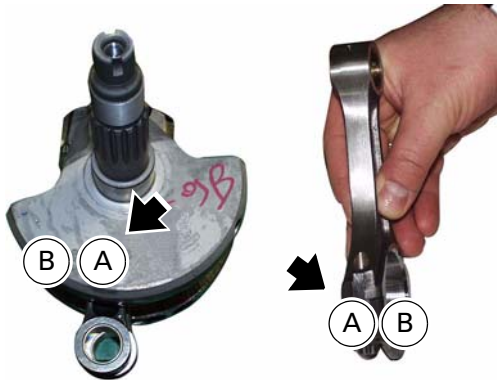
It is good practice to renew the bearings (3) each time the engine is overhauled.
Replacement bearings are supplied ready for assembly and they must not be reworked with scrapers or emery cloth.
The bearings may belong to two different size classes, each identified by a specific colour (YELLOW and BLUE).
The bearings are composed of an external steel ring, the inner face of which is electro-plated with a lead-based compound.
The table shows the appropriate bearings to be fitted according to the size class of the crankshaft and connecting rod.

Crankshaft class	Connecting rod class	Bearings colour
B	B	BLUE/YELLOW
B	A	YELLOW/YELLOW
A	B	BLUE/BLUE
A	A	BLUE/YELLOW

F

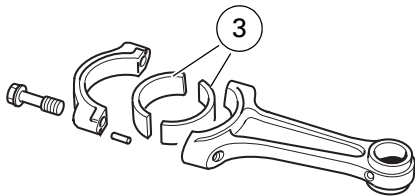
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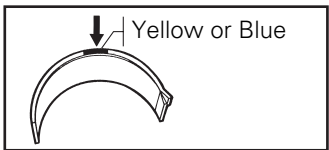


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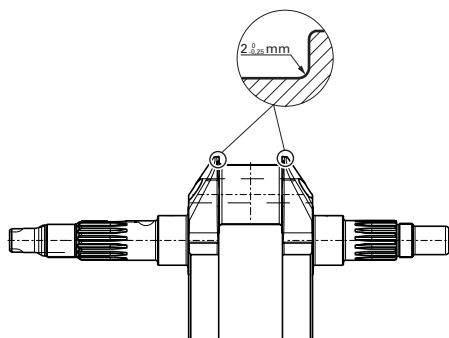
P

Crankshaft

The main bearing and big-end journals should not be scored or grooved; the threads, keyways, and slots must be in good condition.

Check for fretting or burrs in the fillet between journal and shoulder.

Fillet radius: **2 mm**.



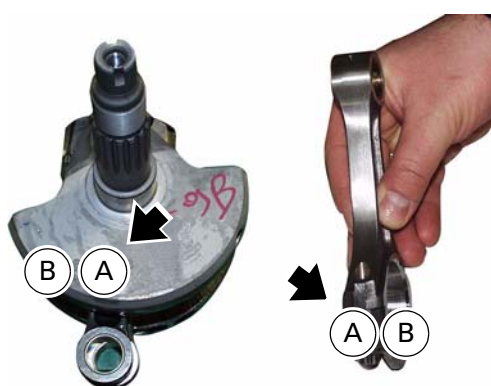
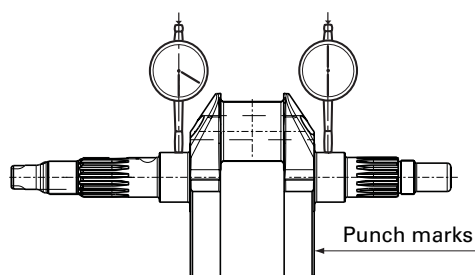
With the aid of a micrometer, measure the ovality and taper of the big-end journals, taking the measurements in various different directions.

Use a dial gauge to measure the alignment of the main journals by setting the crankshaft between two opposing centres.

At each overhaul it is strongly recommended to clean the crankshaft's internal oilways.

The prescribed values are given in Sect. C 1.1.

The crankshaft is supplied in two size classes (journals) **A** and **B**, as punch marked on the side of the crank web on the pinion side.



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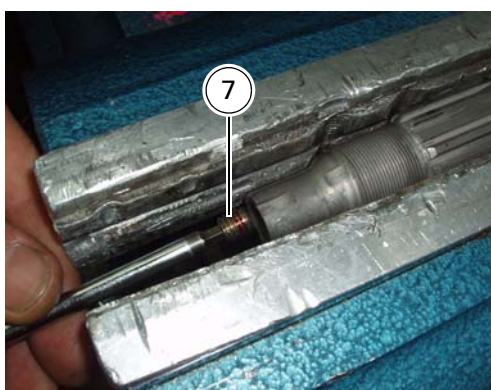
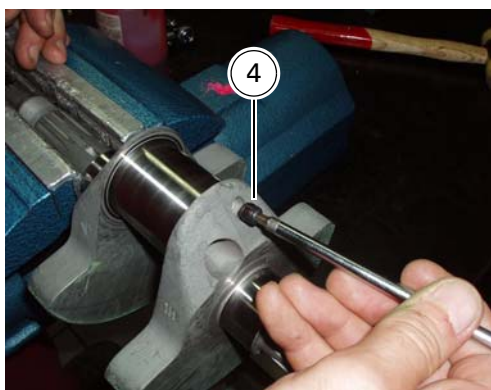
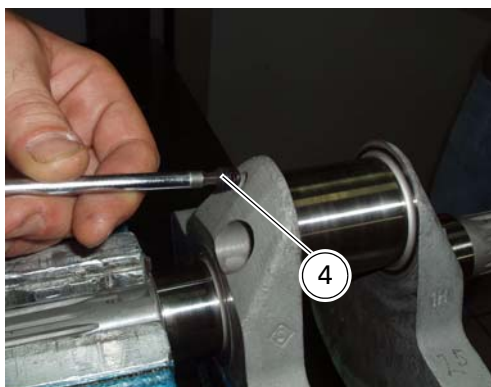
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Unscrew all the plugs (4) and (7) from the crankshaft, heating the crankshaft, if necessary, to release the threadlocker applied at the time of assembly.

Clean all the oilways using suitable diameter metal brushes and then blow with compressed air to remove any residues that have accumulated and are restricting the oil flow.

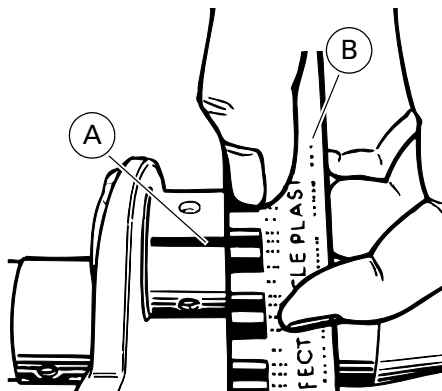
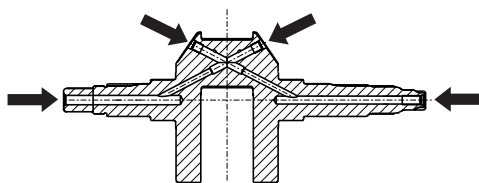
Apply THREE BOND 1375B liquid gasket to the plug threads (4) and (7) and reinstall them.

Tighten all the plugs to the specified torque (Sect. C 3).



Big-end bearing shell-journal clearance

To check the assembly clearance between the bearing shells and crankshaft journals you will lay a strip (A) of GREEN "Plastigage PG-1" on the journal. Fit the connecting rod with the original bearings and tighten the screws to a torque of **50 Nm**. Remove the connecting rod and compare the width of the Plastigage strip to the scale (B). If the width measured corresponding to the existing clearance is not within the prescribed limit (Sect. C 1.1), either the bearings or the crankshaft must be replaced.



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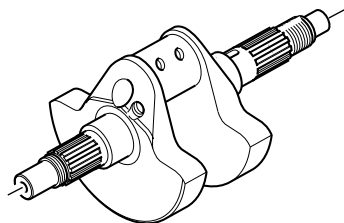
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Reassembly of the connecting rods

Before starting the work, check that the crankshaft main bearing journals and big-end journals are free of burrs or evident signs of machining: if necessary, clean the surfaces with very fine emery cloth and oil. Check that the grooves are in perfect condition with no signs of forcing.



Check that each connecting rod (2) and cap are fitted with their locating pins (D). Wash the pins and dry them with compressed air.

Clean and lubricate the journals and con-rod bearing shells (3) with engine oil and fit the connecting rods in their original mounting positions.

Use the recommended grease to lubricate the threads and underside of the heads of the new bolts (1) and the threaded hole in the connecting rod, packing in grease from both sides of the hole.



Warning

The grease utilised is an irritant in contact with the skin. Wear protective gloves.



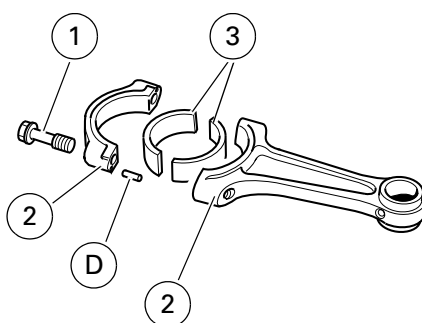
Important

Lubrication of connecting rod cap bolts is essential to obtain the correct coupling and to prevent breakage of the parts. Use the same connecting rod cap bolts a maximum **of three times**.

Tighten the bolts (1) by hand.

If this proves difficult or in the case of jamming, undo the bolts and lubricate them again.

Remove excess grease. Tighten the bolt by hand until the head seats against the connecting rod.



Fit the spacer of the tool **88713.2878** between the connecting rods and take up residual axial play with the fork feeler gauge part no. **88713.2878** which is available in the following thicknesses:

0.1 mm - 0.2 mm - 0.3 mm.

Temporarily fit the gudgeon pin to align the connecting rods, and then tighten the bolts.



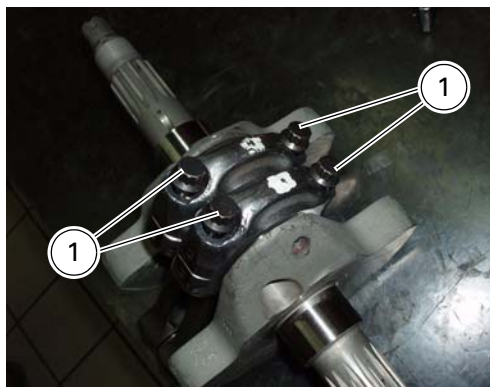
Tighten the bolts (1) with a torque wrench and angle reading (degree wheel) in accordance with the procedure described below (observe the same tightening sequence at each step as that of the previous step):

- 1 first torque each bolt to a value of **20 Nm**;
- 2 now carry out a second tightening stage applying a torque of **35 Nm** on each bolt;
- 3 now torque each bolt, reading the angle of rotation, to **85 Nm**, checking that the final angle is between **55°** and **90°**.



Important

If the final angle is less than **55°** or greater than **90°**, repeat the procedure using two new bolts.



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Refitting the connecting rods.

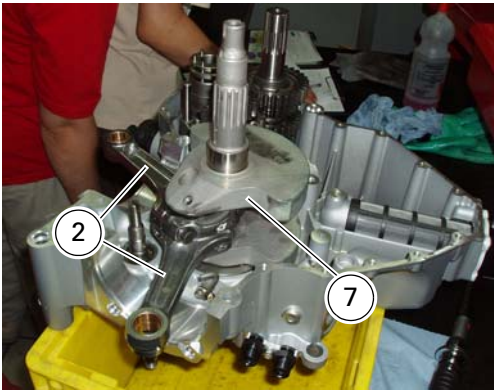
A

Install the connecting rod assembly (7) and (2) in the crankcase, carry out the shimming and crankcase reassembly procedure as described in Sect. N 9.2.

● Important

B

Make sure that the connecting rods (2) are correctly positioned in the respective cylinder seats. Incorrect positioning of the connecting rods at this stage will inevitably lead to the need to re-open the crankcase.



E

Operation	Section reference
Refit the right-hand crankcase cover	N 6.2
Refit the clutch assembly	N 6.1
Refit the engine starter system	P 3
Refit the left-hand crankcase cover and alternator assembly	N 8
Refit the cylinder barrel/piston assemblies	N 5
Refit the cylinder head assemblies and the timing parts	N 4.2
Refit the cooling system	N 3
Refit the lubrication system	N 2.1
Install the engine in the frame	N 1
Refit the right-hand crankcase cover	N 6.2

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Electric system

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	1 - Wiring diagram	4
A	Key to wiring diagram	5
	Wiring colour codes	6
	Key to fusebox	6
	Routing of wiring on frame	7
B	Plate 1	9
	Plate 2	9
	Plate 3	10
	Plate 4	10
	Plate 5	11
C	Plate 6	11
	Plate 7	12
	Plate 8	13
	Plate 9	14
	Plate 10	14
D	Plate 11	15
	Plate 12	15
	Plate 13	16
	Plate 14	17
	Plate 15	18
E	Plate 16	19
	Plate 17	20
	Plate 18	21
	Plate 19	22
	Plate 20	23
F	Plate 21	24
	Plate 22	24
	Plate 23	25
	Plate 24	26
	Plate 25	27
G	Plate 26	28
	Plate 27	29
	Plate 28	30
	Plate 28	31
	Plate 29	32
H	Plate 30	33
	Plate 31	34
	Plate 32	35
	Plate 33	36
	Plate 34	37
L	Plate 35	38
	2 - Battery charging system	39
M	Checking the battery charging system	39
	Recharging the battery	40
	Topping up the electrolyte	41
	Battery	44
	Alternator	46
Regulator/rectifier	49	
N	3 - Electric starting system	52
	Electric starting system	52
	Starter motor	53
	Starter contactor	56

4 - Lights and indicating devices	59	
Changing light bulbs	59	A
High beam headlights relay	62	
Headlight aim	64	
5 - Indicating devices	65	
Checking the indicating system components	65	B
Coolant temperature sensor	72	
Fan relay	73	
Checking operation of the fan relay	73	
Changing light bulbs	74	C
6 - Protection and safety devices	78	
Checking protection and safety device components	78	
Checking the fuses	80	
7 - Instruments	81	D
Instrument panel	81	
Instrument panel system	82	
Display settings and functions	84	E
8 - Immobilizer and transponder	102	
9 - Diagnostic instruments	110	
Using a multimeter to check the electrical systems	110	F
10 - USB Data Acquisition (DAQ) (for 1098S only)	112	

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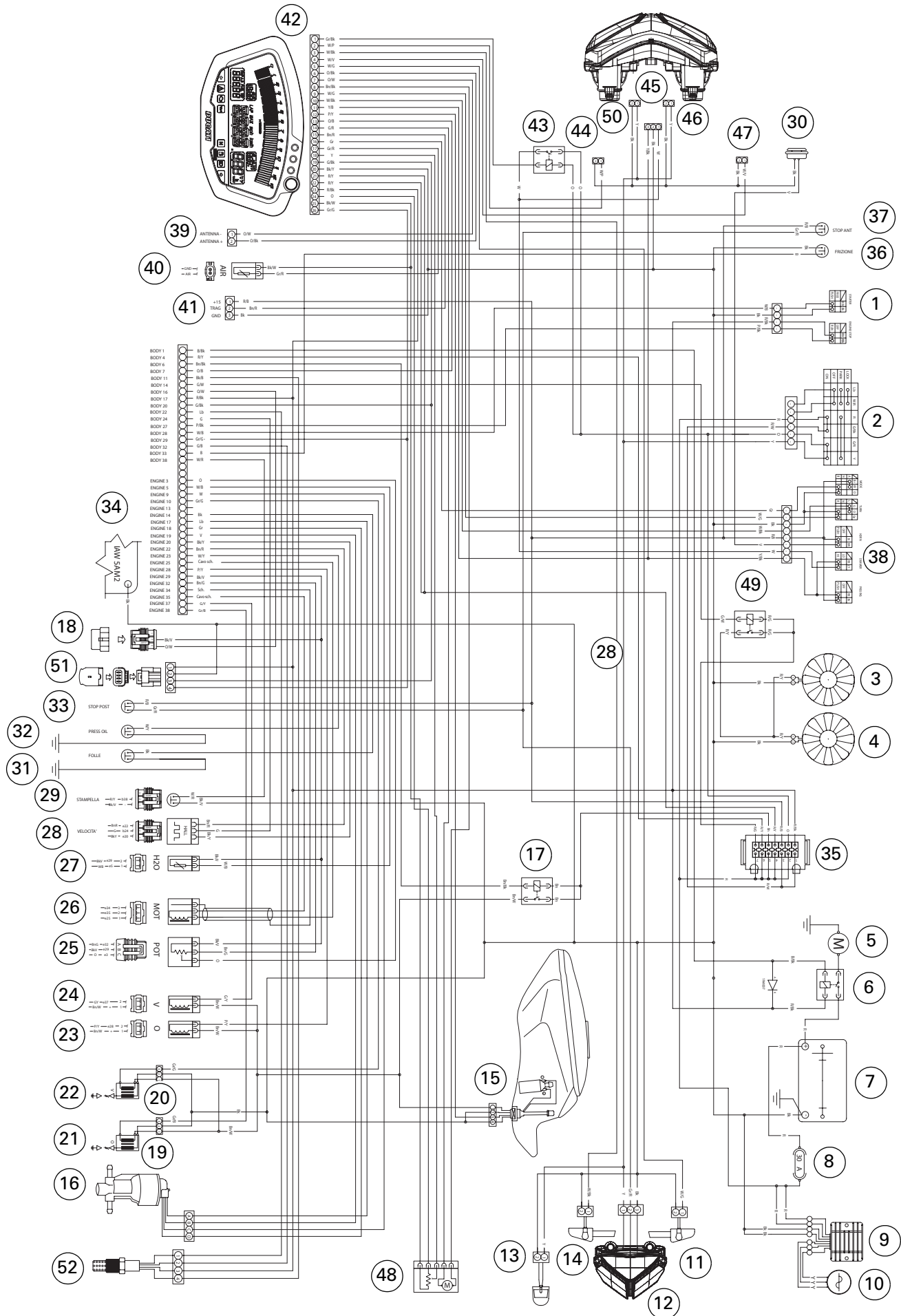
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1 - Wiring diagram



Key to wiring diagram

- 1 Right-hand handlebar switch
- 2 Key switch
- 3 Left cooling fan
- 4 Right cooling fan
- 5 Starter motor
- 6 Starter contactor
- 7 Battery
- 8 Regulator fuse
- 9 Regulator
- 10 Alternator
- 11 Rear right-turn signal
- 12 Tail light
- 13 Number plate light
- 14 Rear left-turn signal
- 15 Fuel tank
- 16 Stepper motor
- 17 Injection relay
- 18 Self-diagnosis
- 19 Horizontal cylinder coil
- 20 Vertical cylinder coil
- 21 Horizontal cylinder spark plug
- 22 Vertical cylinder spark plug
- 23 Horizontal cylinder injector
- 24 Vertical cylinder injector
- 25 Throttle position sensor
- 26 Rpm/timing sensor
- 27 Coolant temperature sensor
- 28 Speed sensor
- 29 Sidestand
- 30 Horn
- 31 Neutral switch
- 32 Oil pressure switch
- 33 Rear brake light switch
- 34 ECU
- 35 Fuses
- 36 Clutch switch
- 37 Front brake light switch
- 38 Left-hand handlebar switch
- 39 Transponder antenna
- 40 Air temperature sensor
- 41 Finish line sensor
- 42 Dashboard
- 43 Lights relay
- 44 Front left-turn signal
- 45 Headlight
- 46 Right sidelight
- 47 Front right-turn signal
- 48 EX-UP motor
- 49 Fan relay
- 50 Left sidelight
- 51 Data Acquisition
- 52 Lambda sensor

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Wiring colour codes

- B** Blue
- Bk** Black
- Bn** Brown
- G** Green
- Gr** Grey
- Lb** Light blue
- O** Orange
- P** Pink
- R** Red
- V** Violet
- W** White
- Y** Yellow

Key to fusebox



Pos.	Item	Val.
1	Key-on	10 A
2	Lights	15 A
3	Device	15 A
4	Instrument panel	5 A
5	Injection	20 A
6	Engine Electronic Control Unit	5 A
7	Fans	7.5 A

Routing of wiring on frame

Routing of 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 diagrams on the following pages show the origins ("O" points) for correct re-routing of cables and the locations of cable ties. Each figure includes references to the diagrams showing the cable routing or the item it must be connected to.

Position	Description
1 Plate 8	Air temperature sensor wiring
2 Plate 8	Lights relay wire
3 Plate 9	Instrument panel wiring
4 Plate 9	Right front indicator wiring branch
5 Plate 9	Left front indicator wiring branch
6 Plate 10	Headlight wiring
7 Plate 10	Right sidelight wiring
8 Plate 10	Left sidelight wiring
9 Plate 11	Finish line sensor wiring
10 Plate 12	Coolant temperature sensor wiring
11 Plate 13	Vertical cylinder coil wire
12 Plate 13	Main wiring rear branch
13 Plate 14	Horizontal cylinder coil connector
14 Plate 14	Main wiring branch
15 Plate 14	Fusebox
16 Plate 15	Right-hand handlebar switch wire
17 Plate 15	Front brake switch wire
18 Plate 16	Immobilizer antenna wiring
19 Plate 17	Right cooling fan wiring
20 Plate 18	Keyswitch wire
21 Plate 18	Left-hand handlebar switch connector.
22 Plate 18	Keyswitch connector
23 Plate 18	Clutch switch connector
24 Plate 18	Left-hand handlebar switch wire
25 Plate 18	Clutch switch wire
26 Plate 19	Left cooling fan connector
27 Plate 20	Horizontal cylinder injector
28 Plates 21-22	Pick-up connector (*)
29 Plates 21-22	Alternator connector (*)
30 Plates 21-22	Engine earth wire (*)
31 Plate 23	Horn wiring
32 Plate 24	Rear brake light switch wiring
33 Plate 25	Neutral sensor wiring
34 Plate 26	Oil pressure sensor wiring
35 Plate 27	Speed sensor wiring
36 Plate 28	Lambda sensor wiring
37 Plate 29	Stepper motor wiring branch
38 Plate 29	TPS wiring branch
39 Plate 30	Fuel tank flange wiring

A	40	Plate 31	Sidestand wiring (*)
	41	Plate 32	Vertical cylinder injector wiring
	42	Plate 33	Exhaust valve motor wiring
B	43	Plates 34-35	Data acquistion connector
	44	Plates 34-35	Tail light connector
	45	Plates 34-35	Number plate and rear turn signals conector

* Parts marked with this symbol are defined in “Refitting the battery support” in Sect. M 3.

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Plate 1

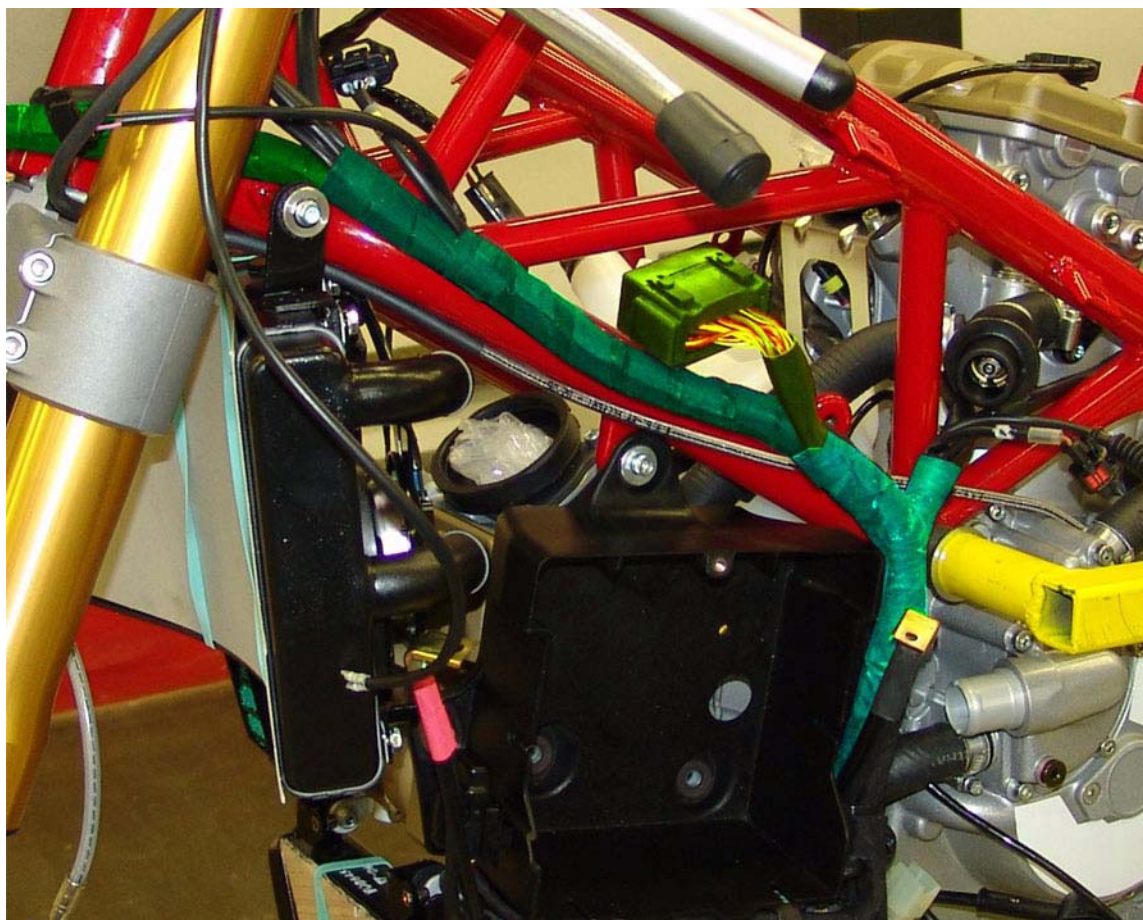
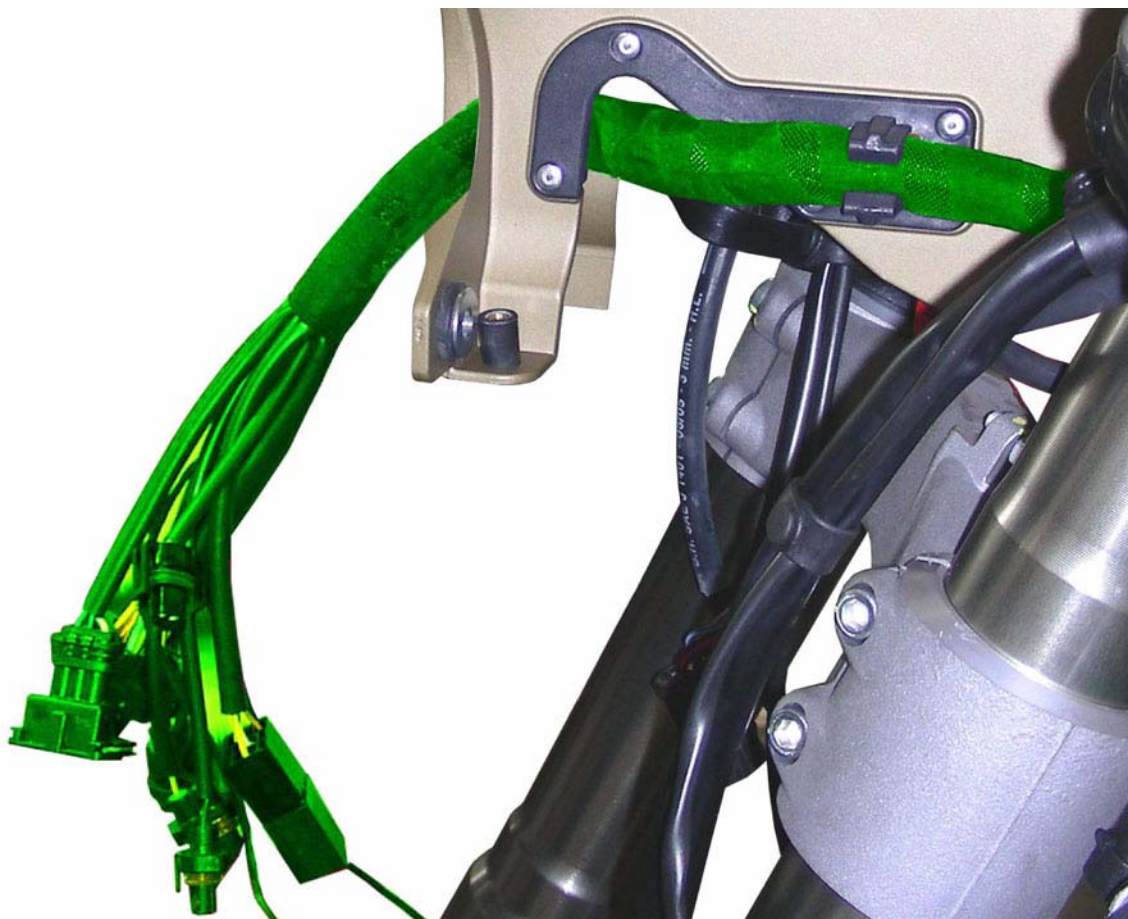


Plate 2



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Plate 3

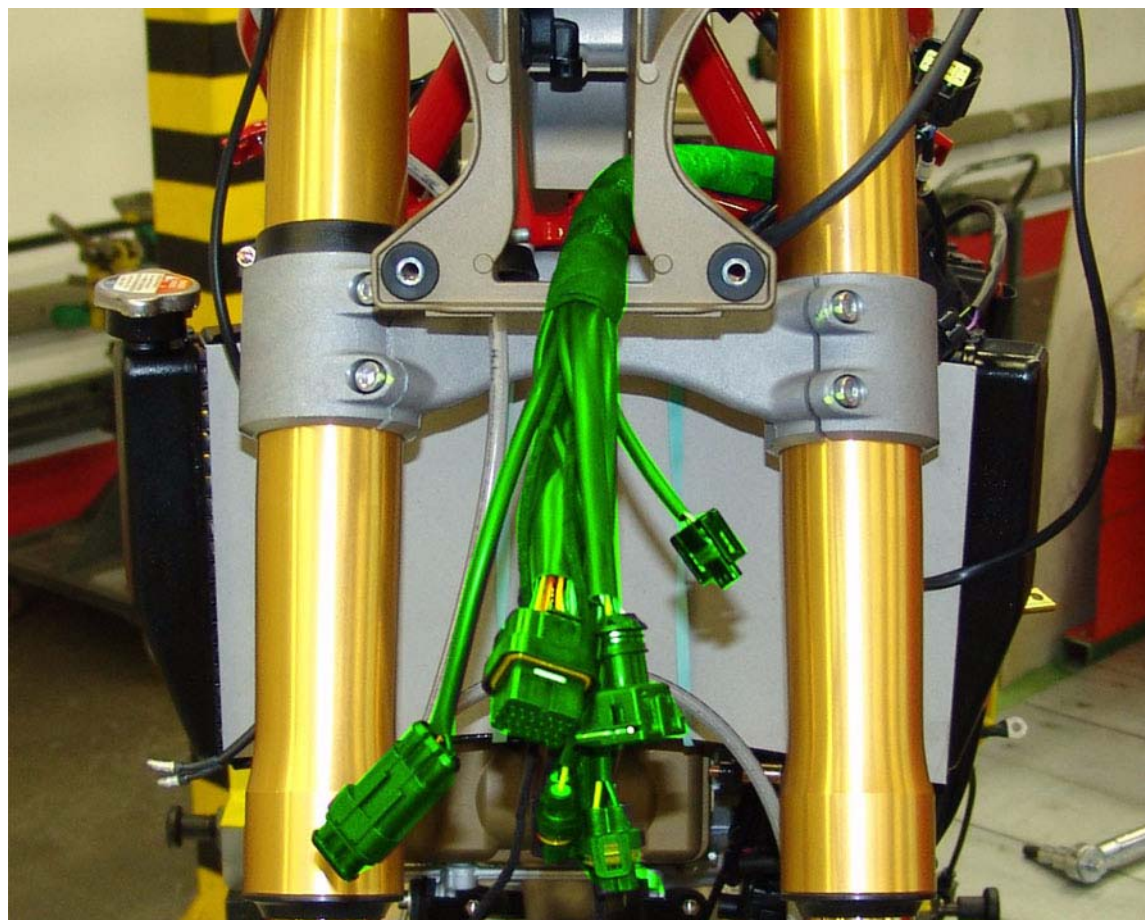


Plate 4

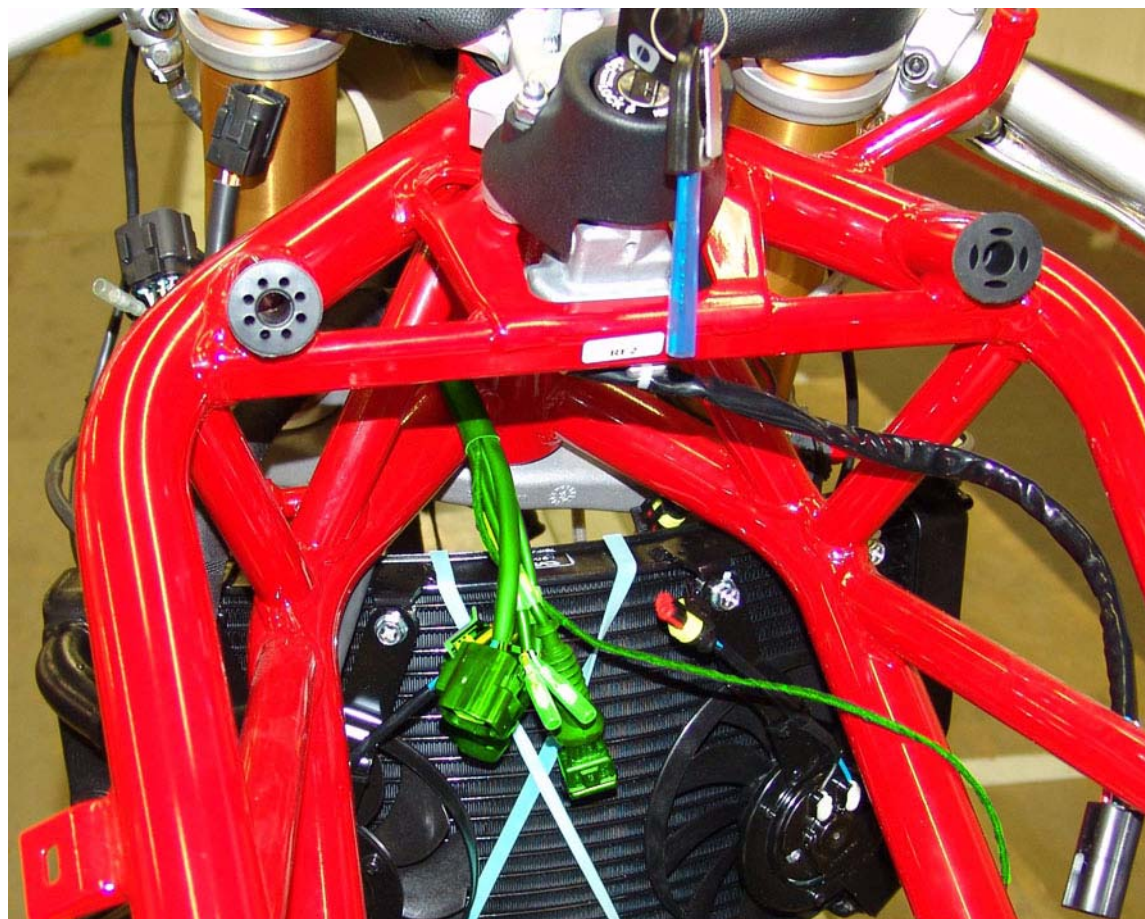


Plate 5



Plate 6



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Plate 7

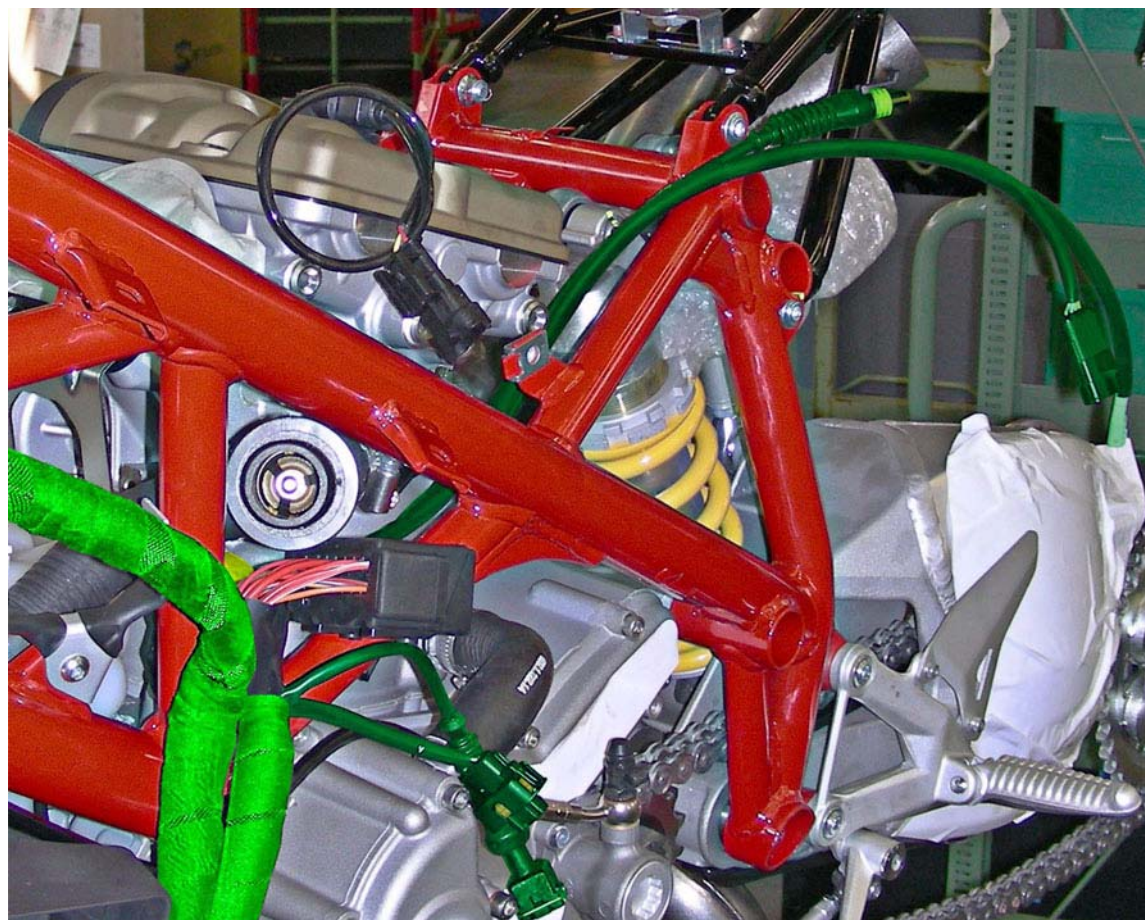
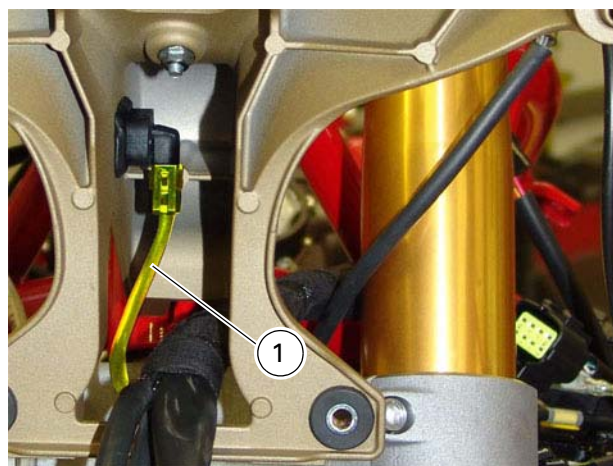
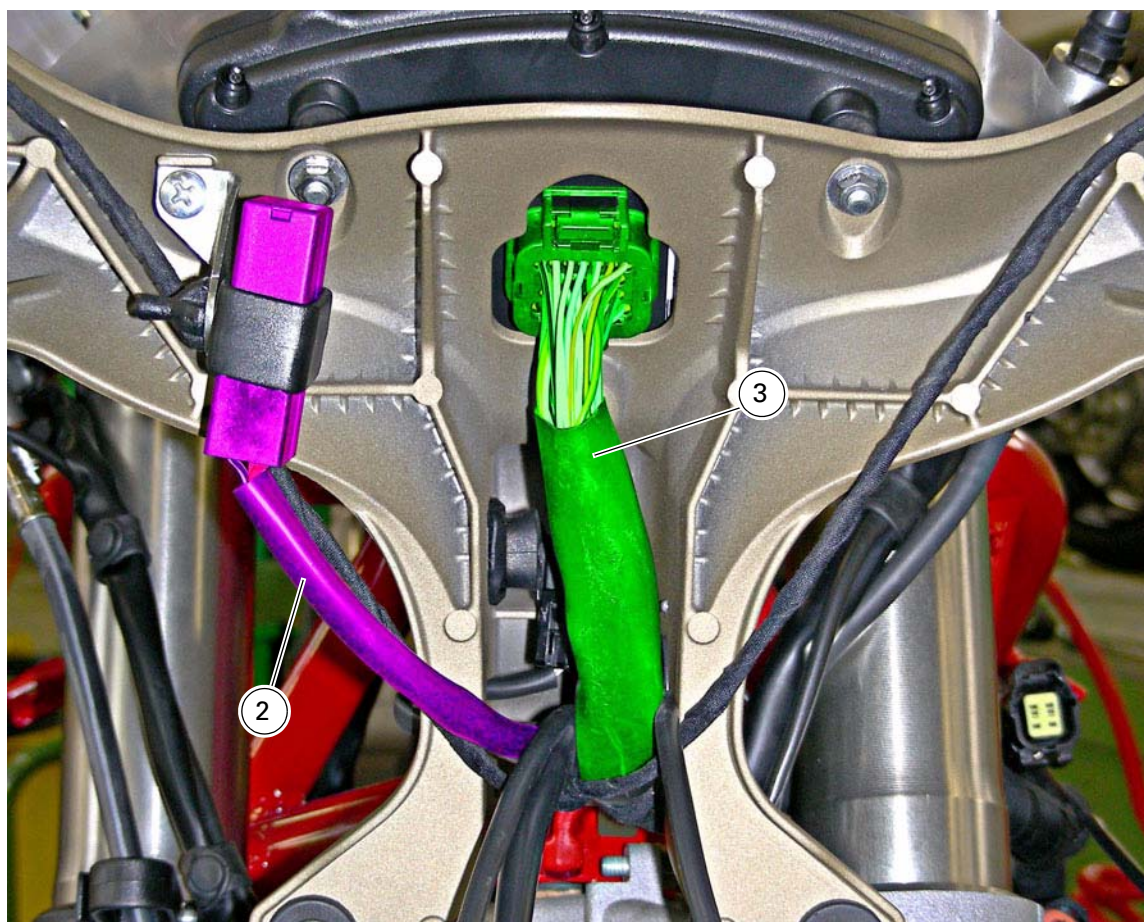


Plate 8



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Plate 9



Plate 10

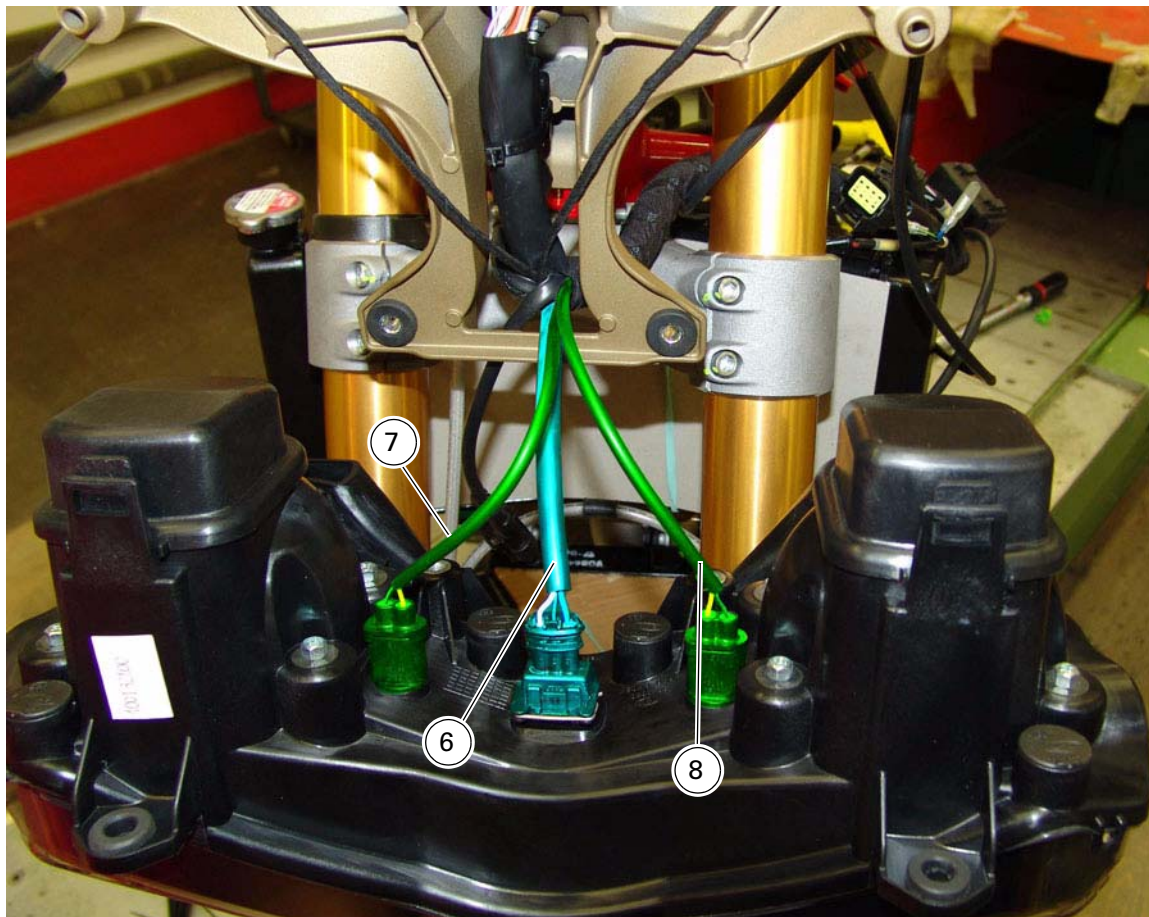


Plate 11

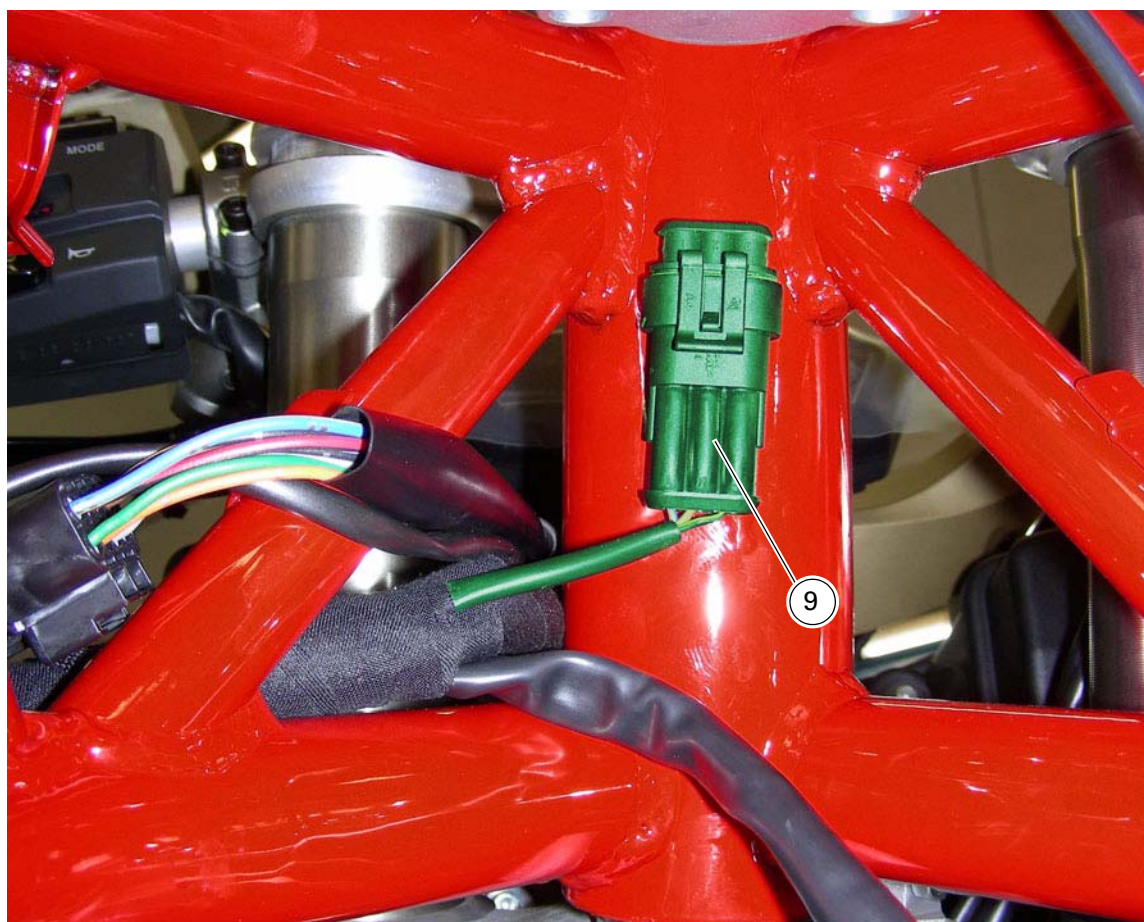
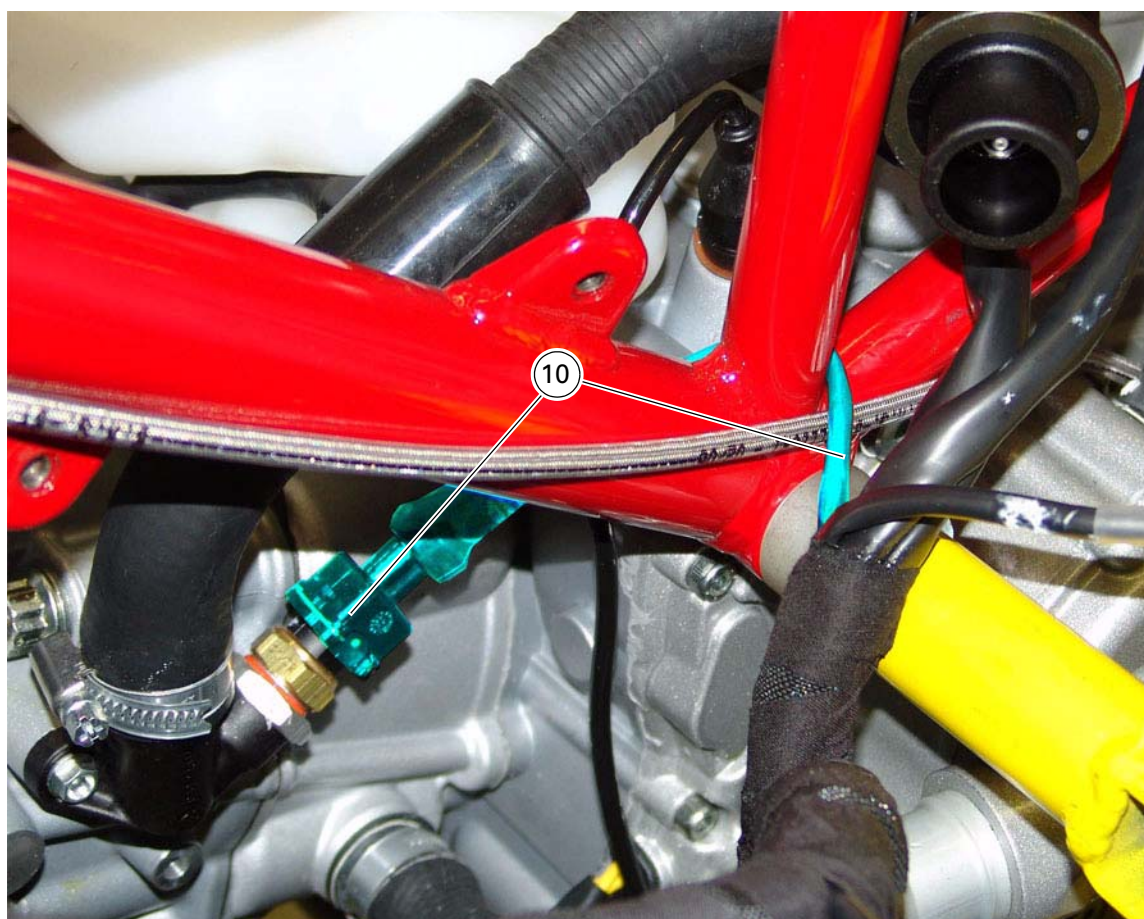


Plate 12



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Plate 13

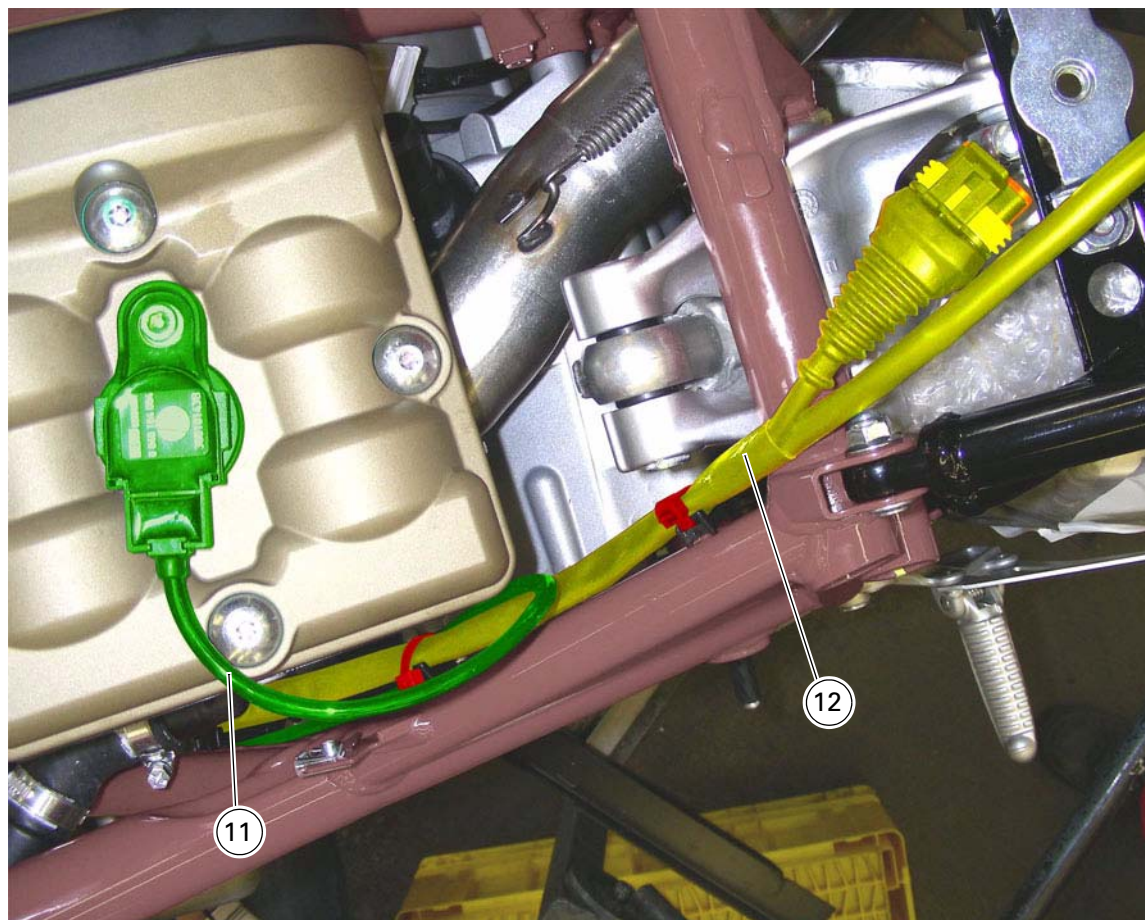
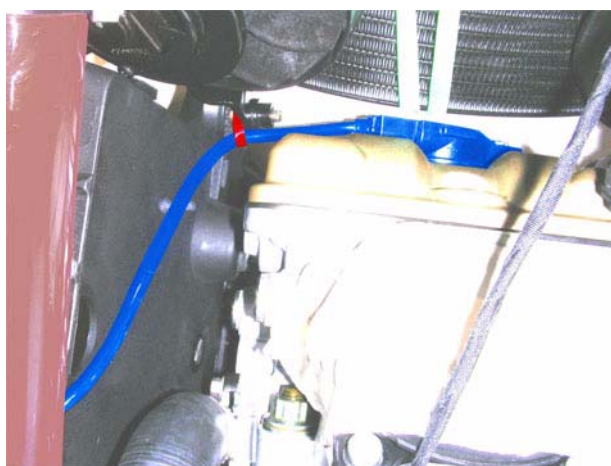
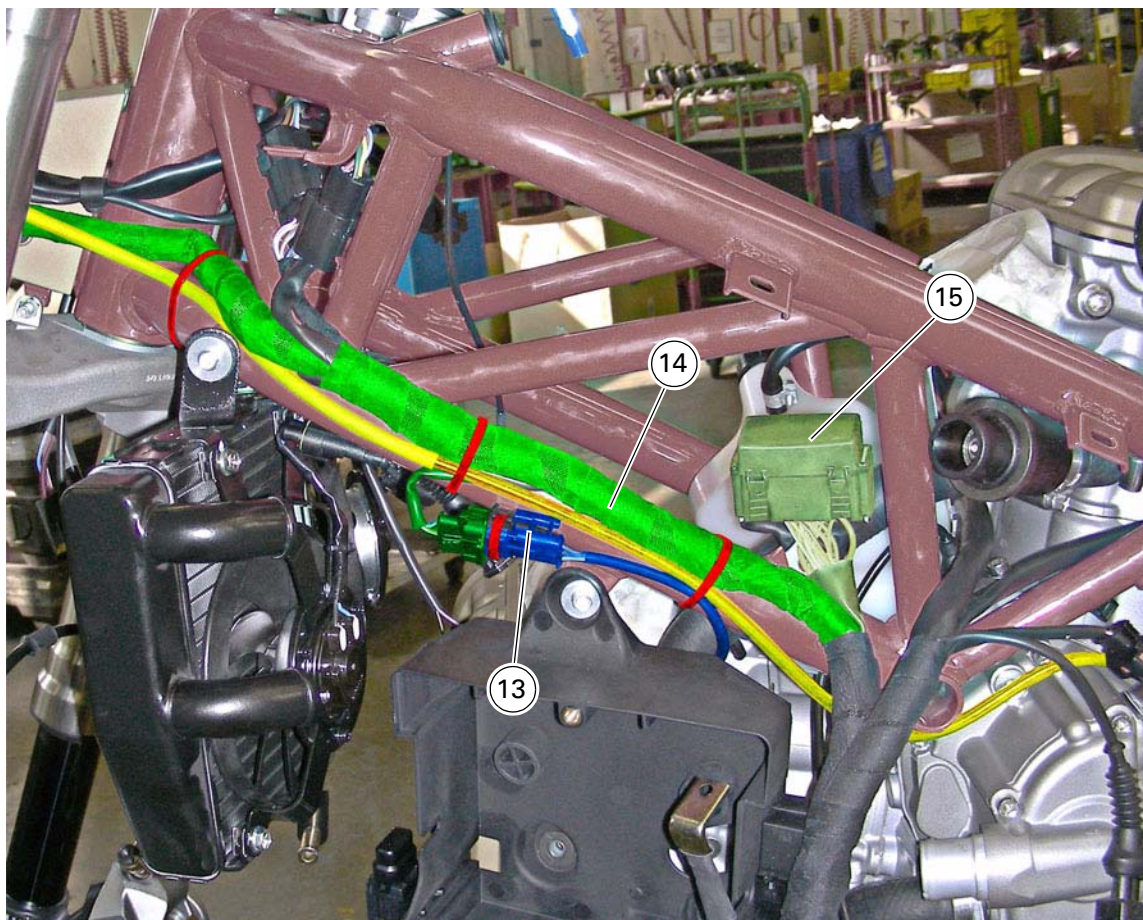


Plate 14



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Plate 15

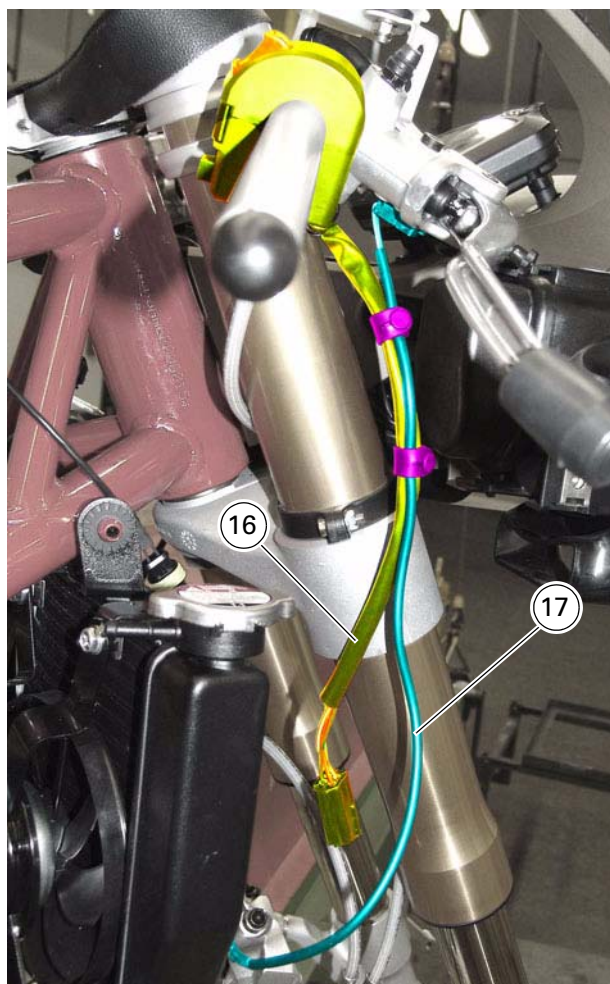
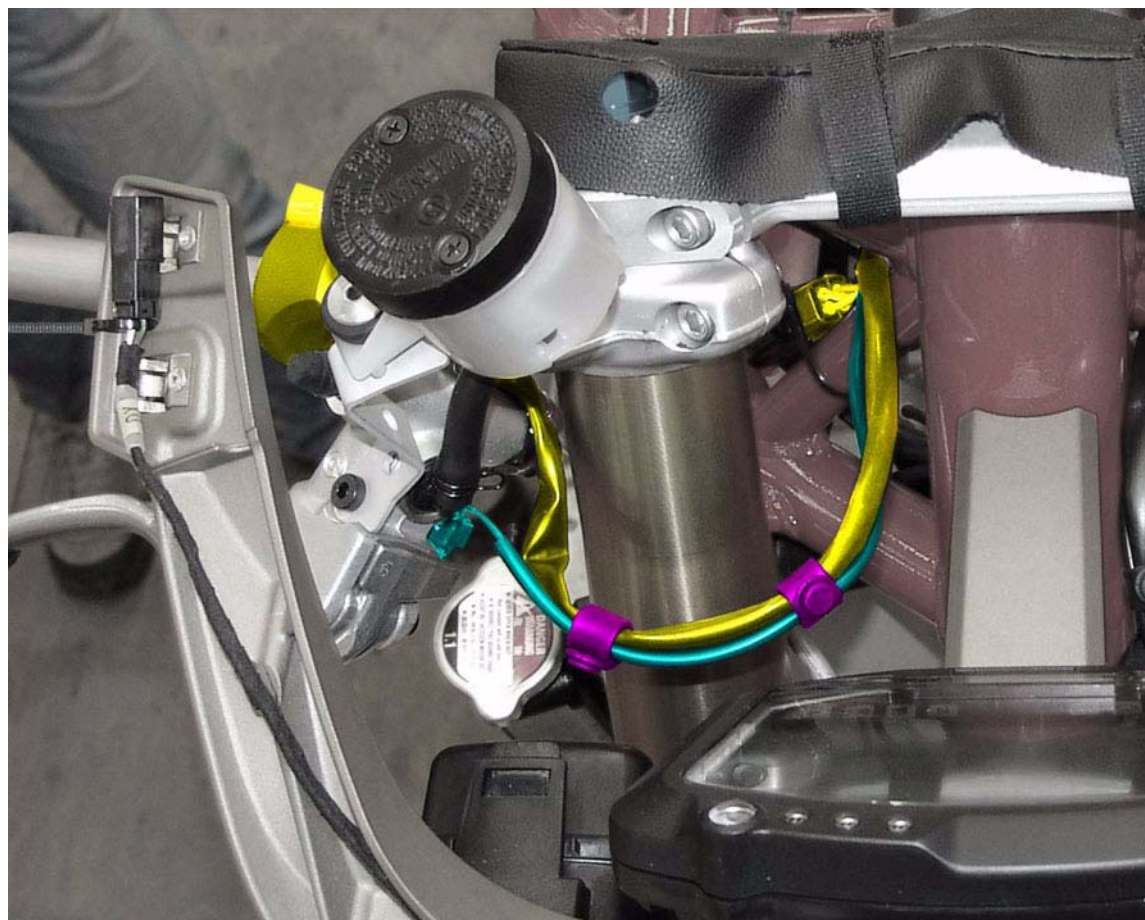
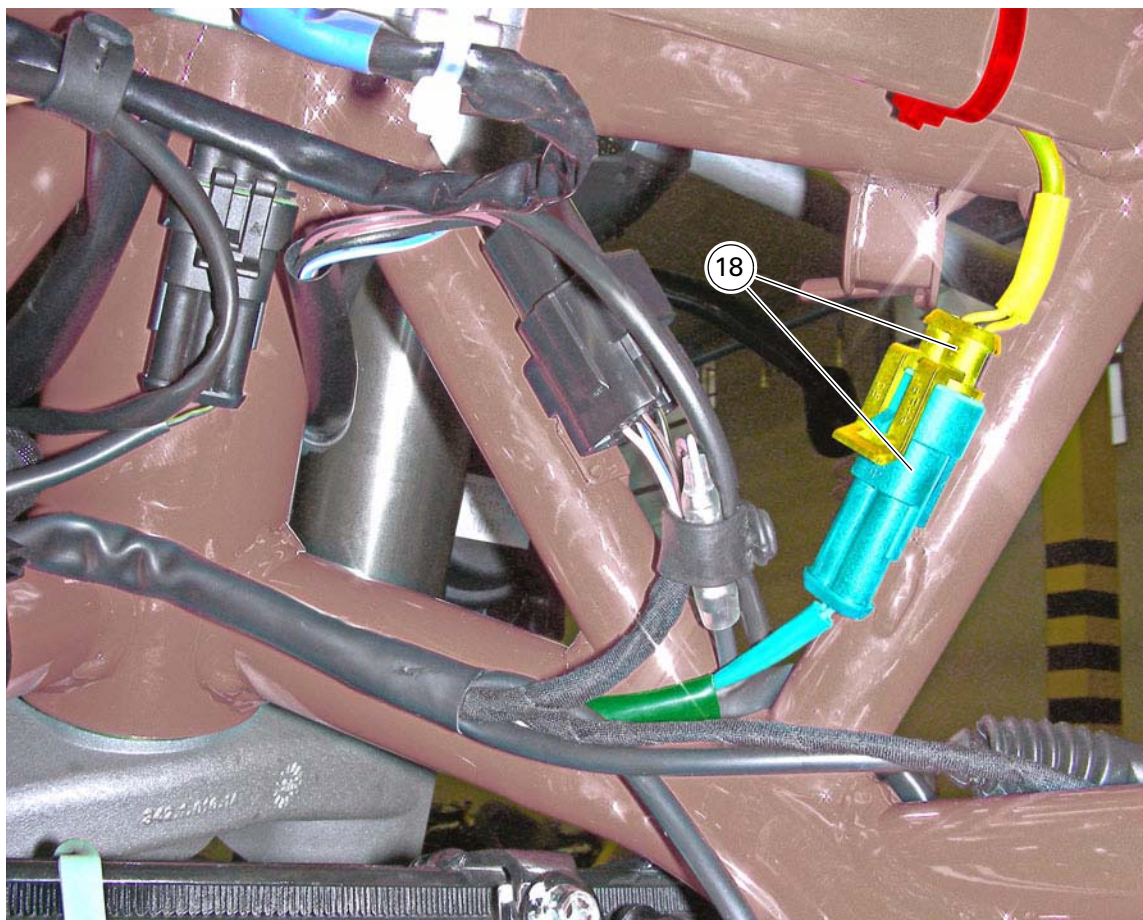


Plate 16



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Plate 17

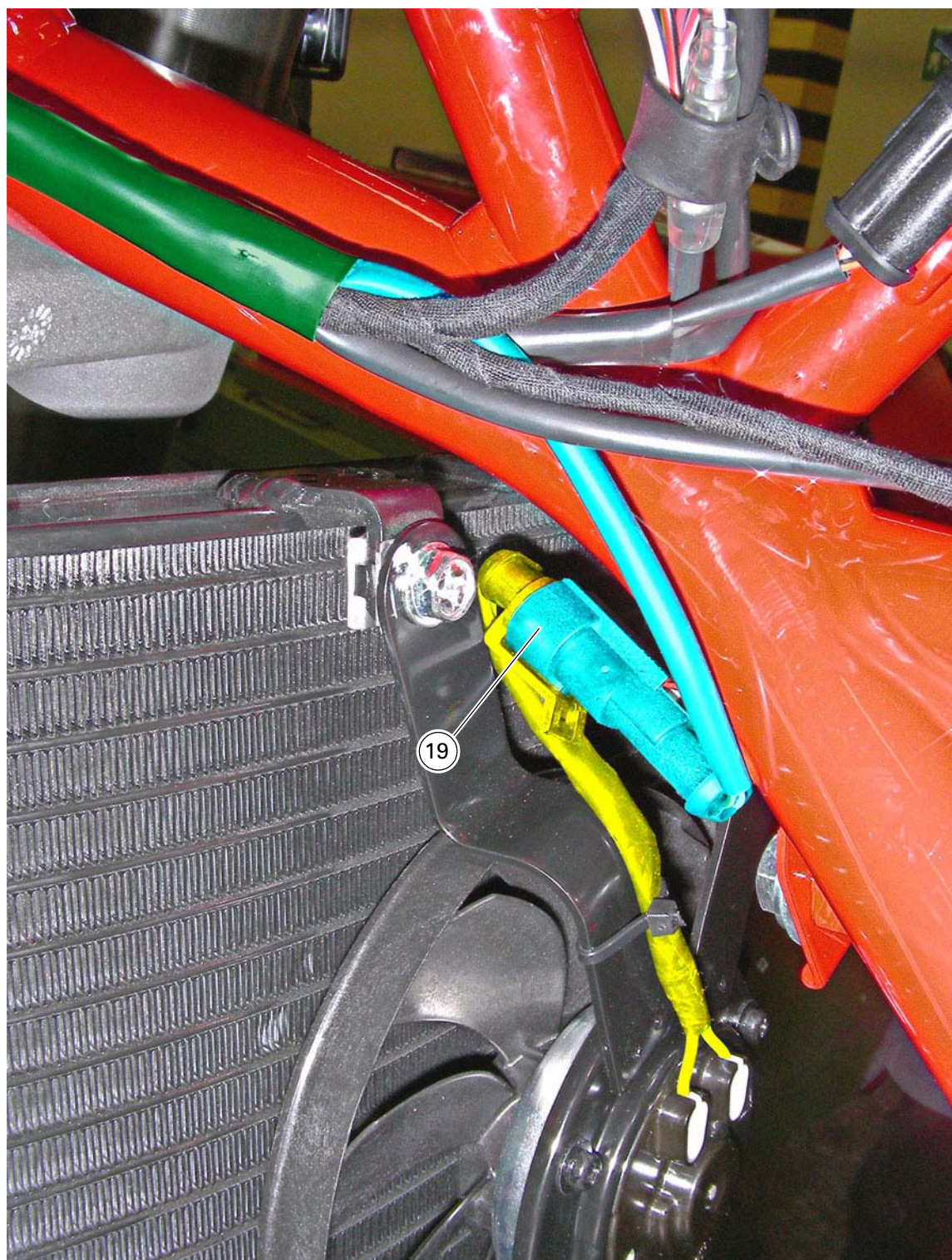
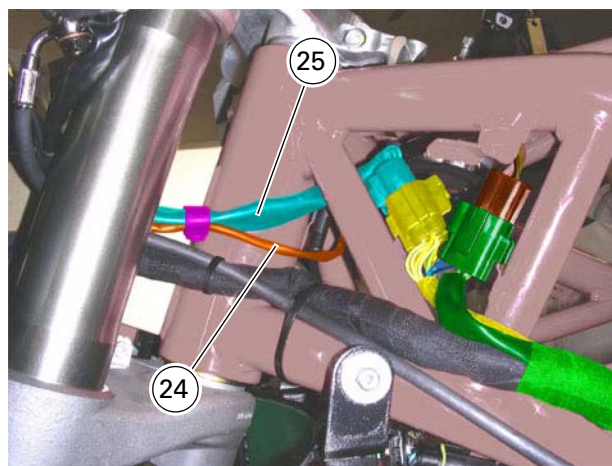
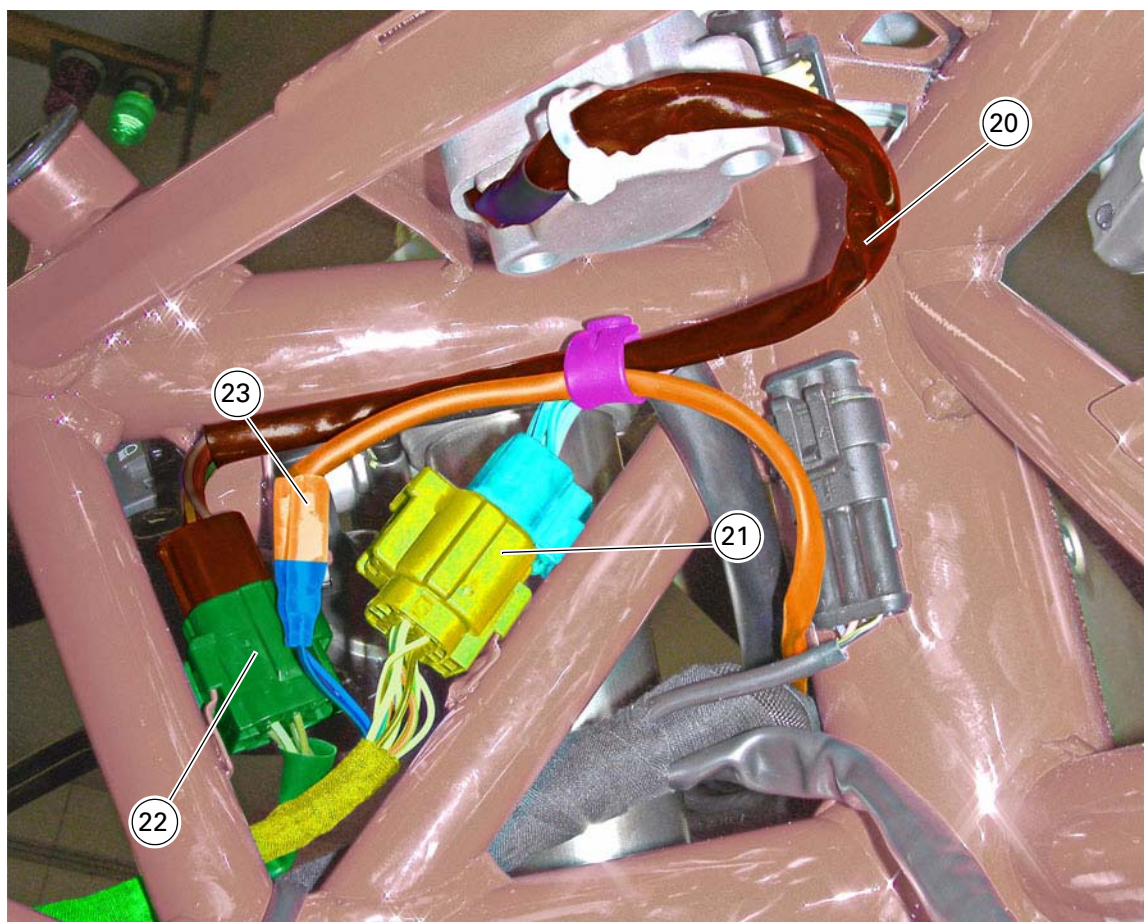


Plate 18



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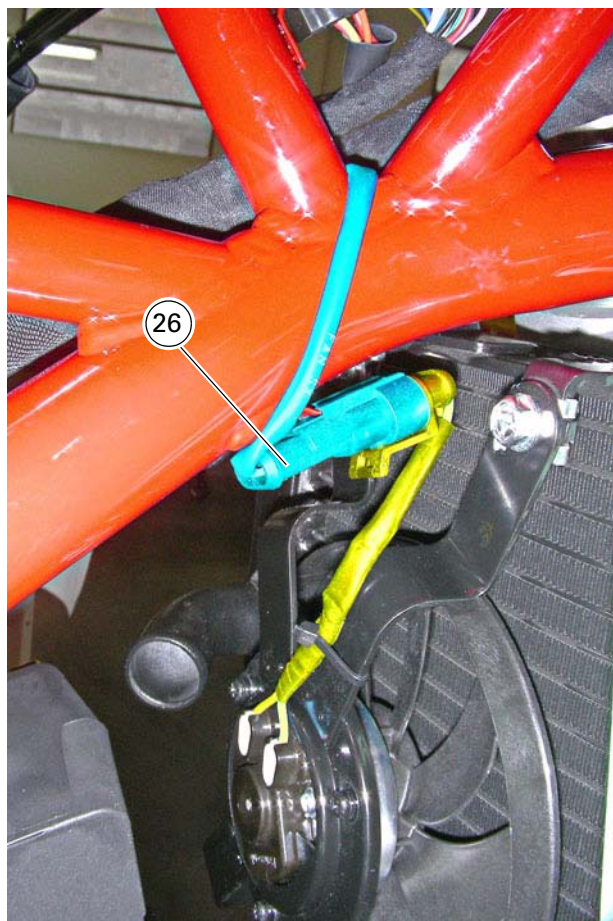
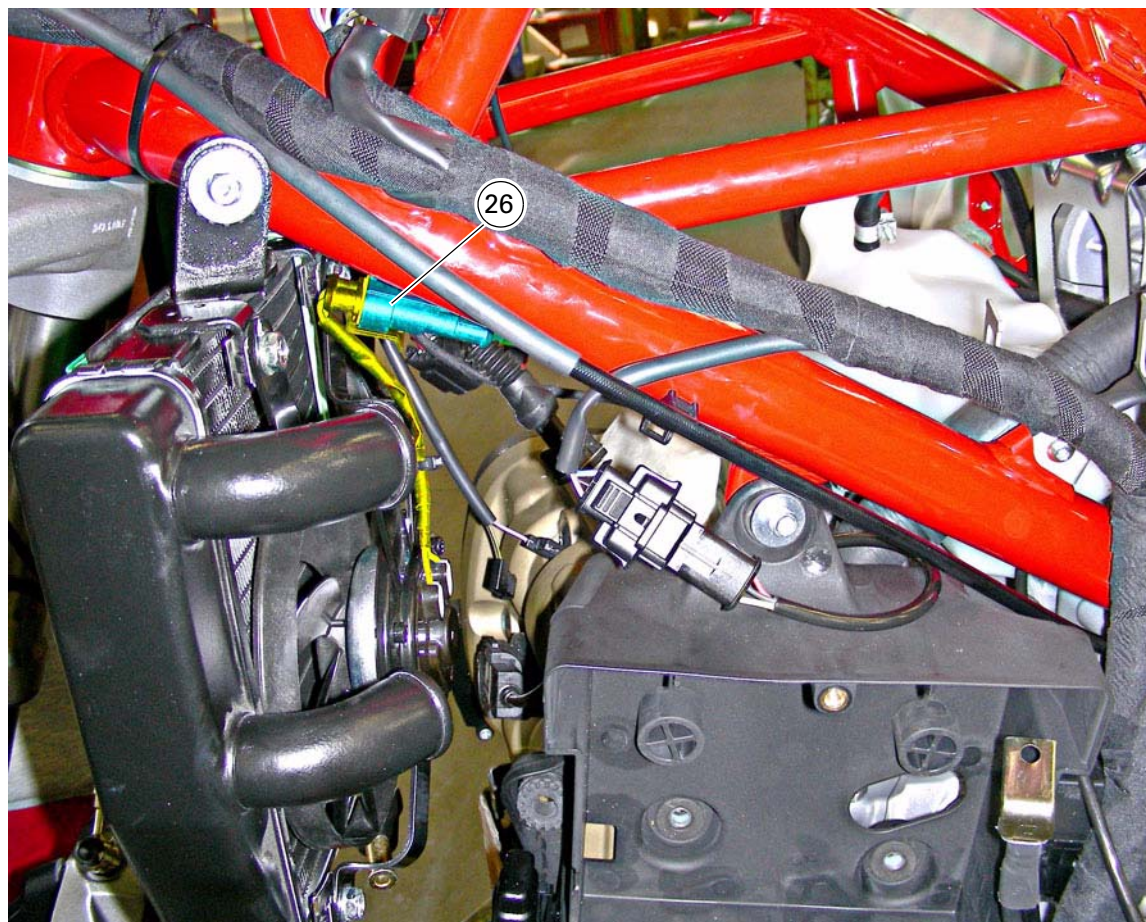
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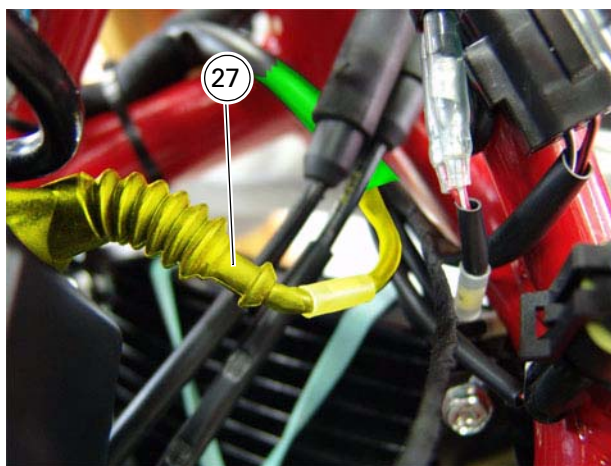
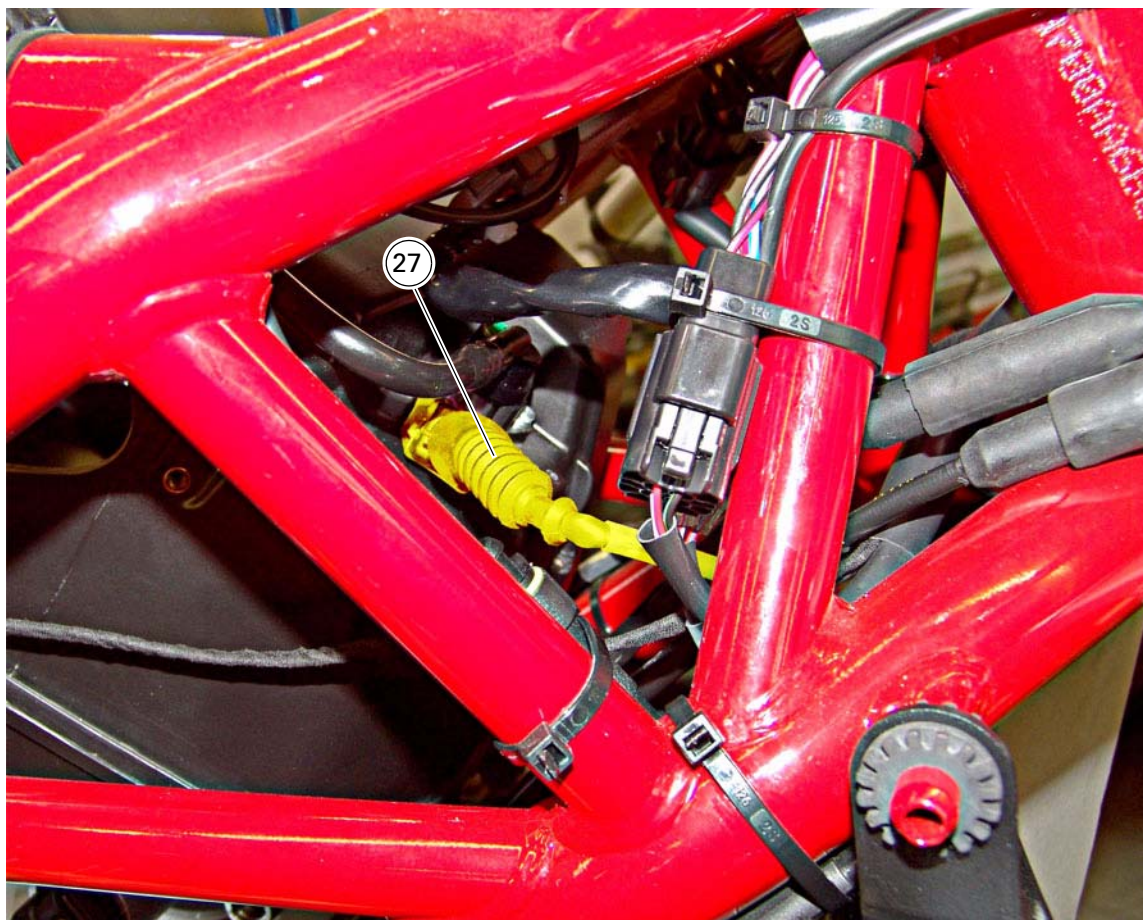
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Plate 19





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Plate 22

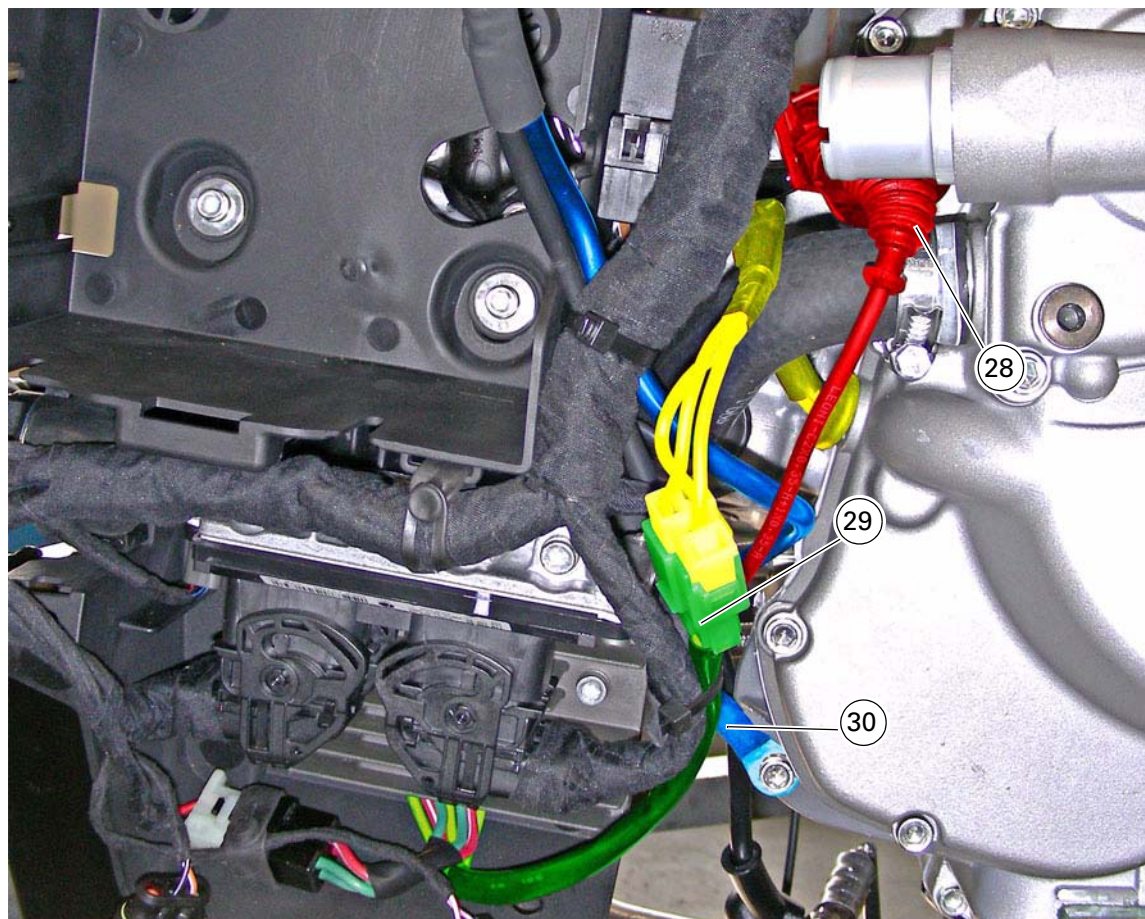
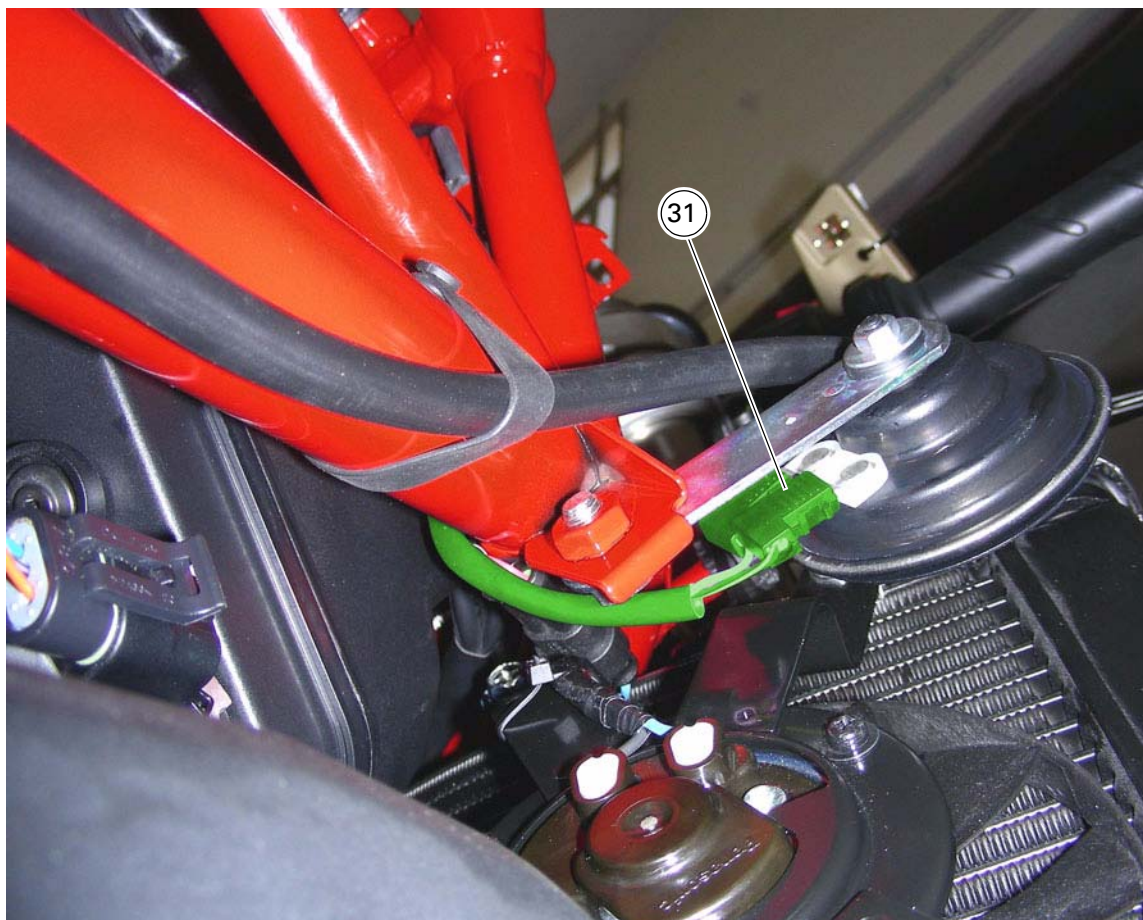


Plate 23



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Plate 24

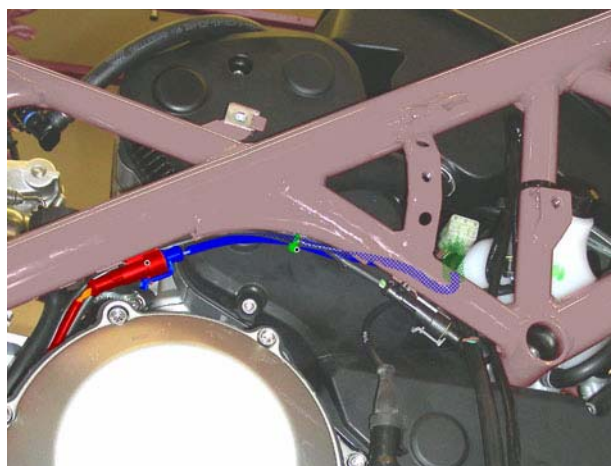
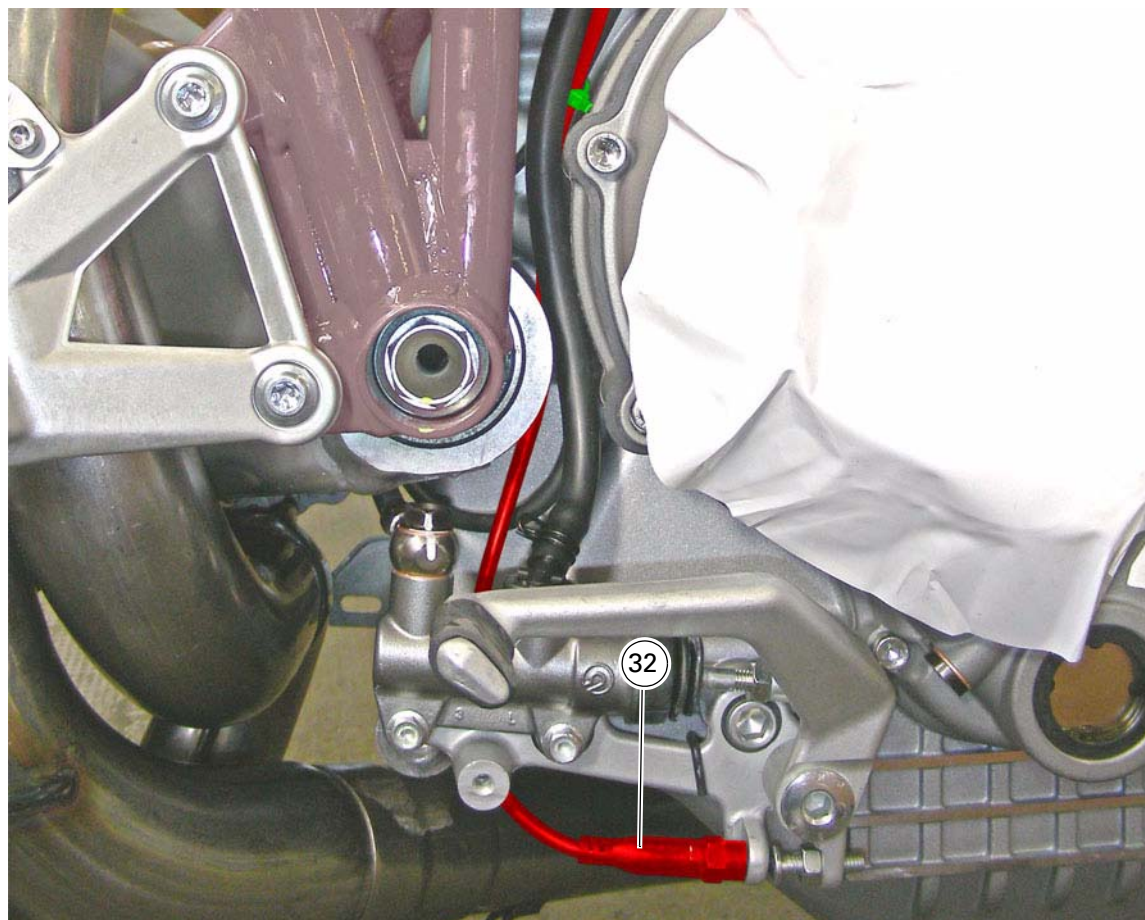
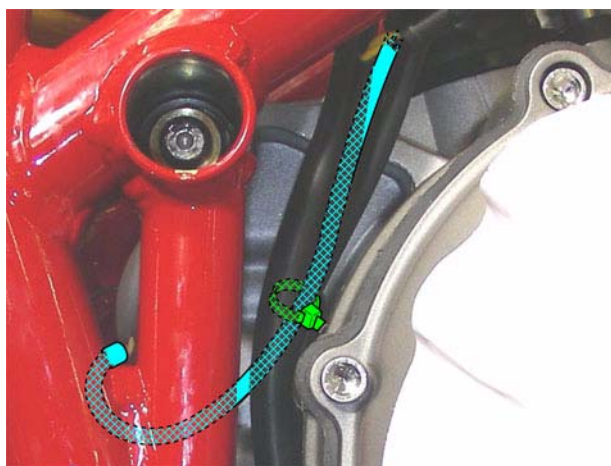
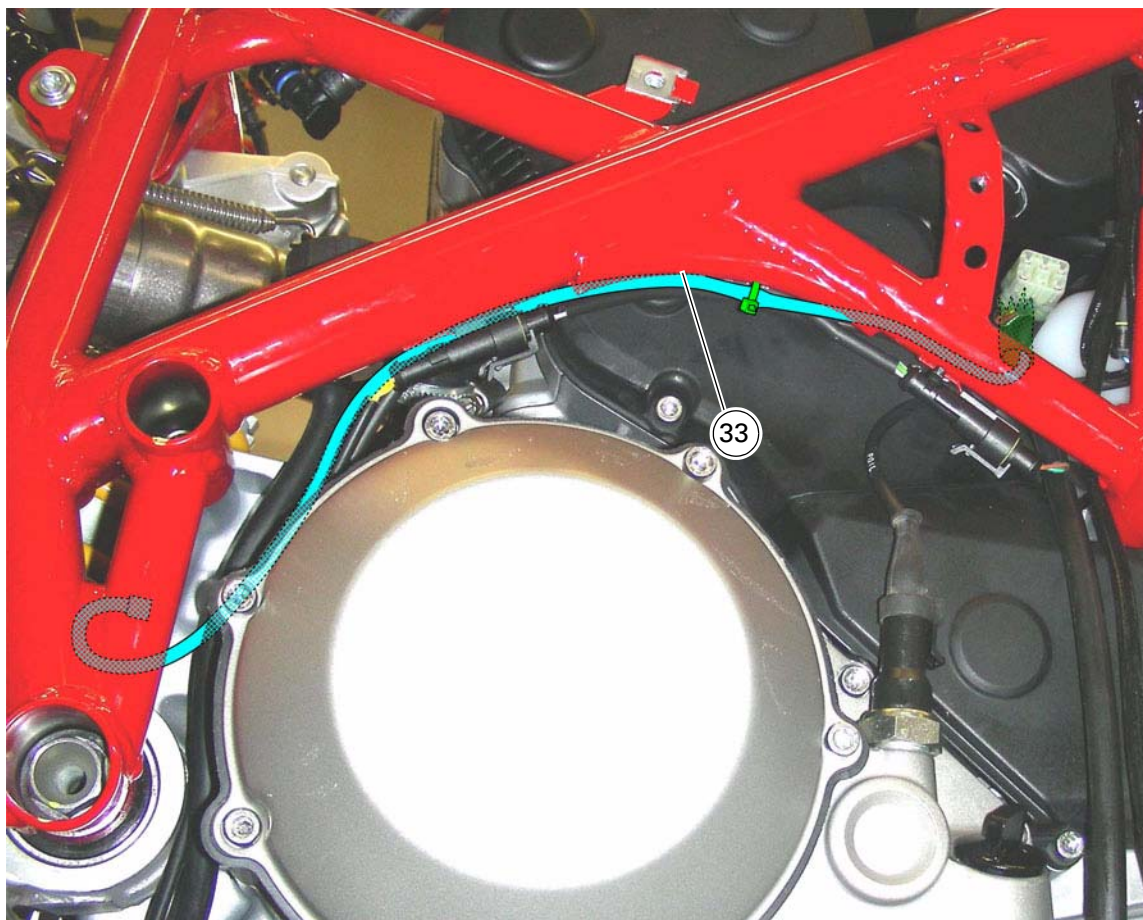


Plate 25



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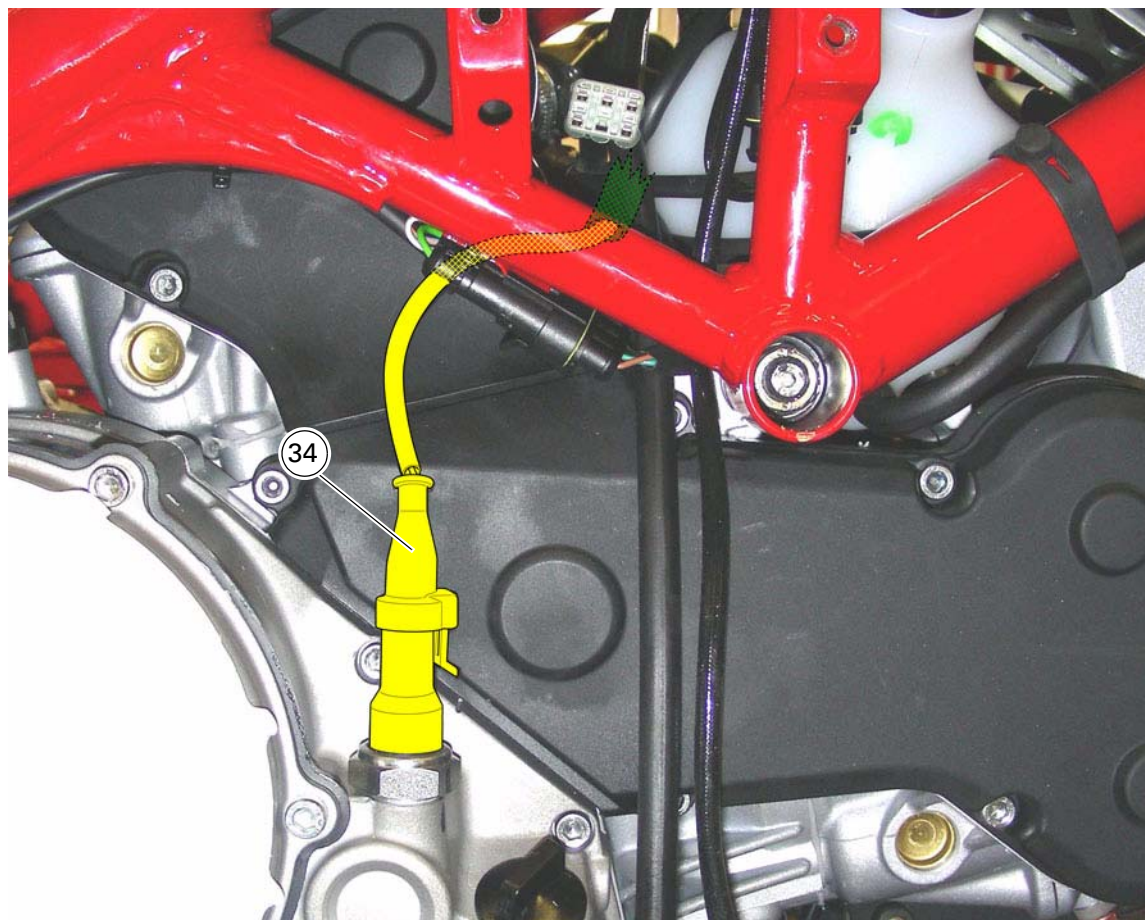
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Plate 26



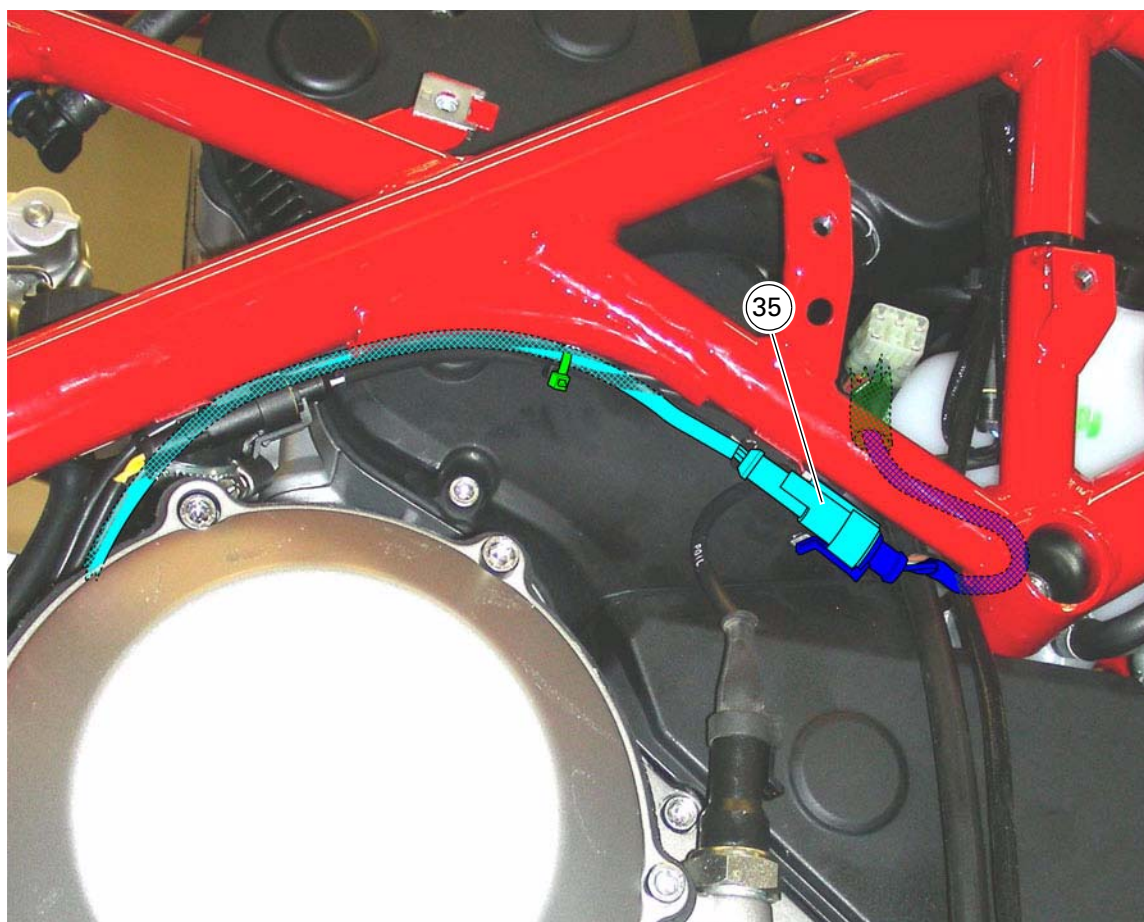


Plate 28

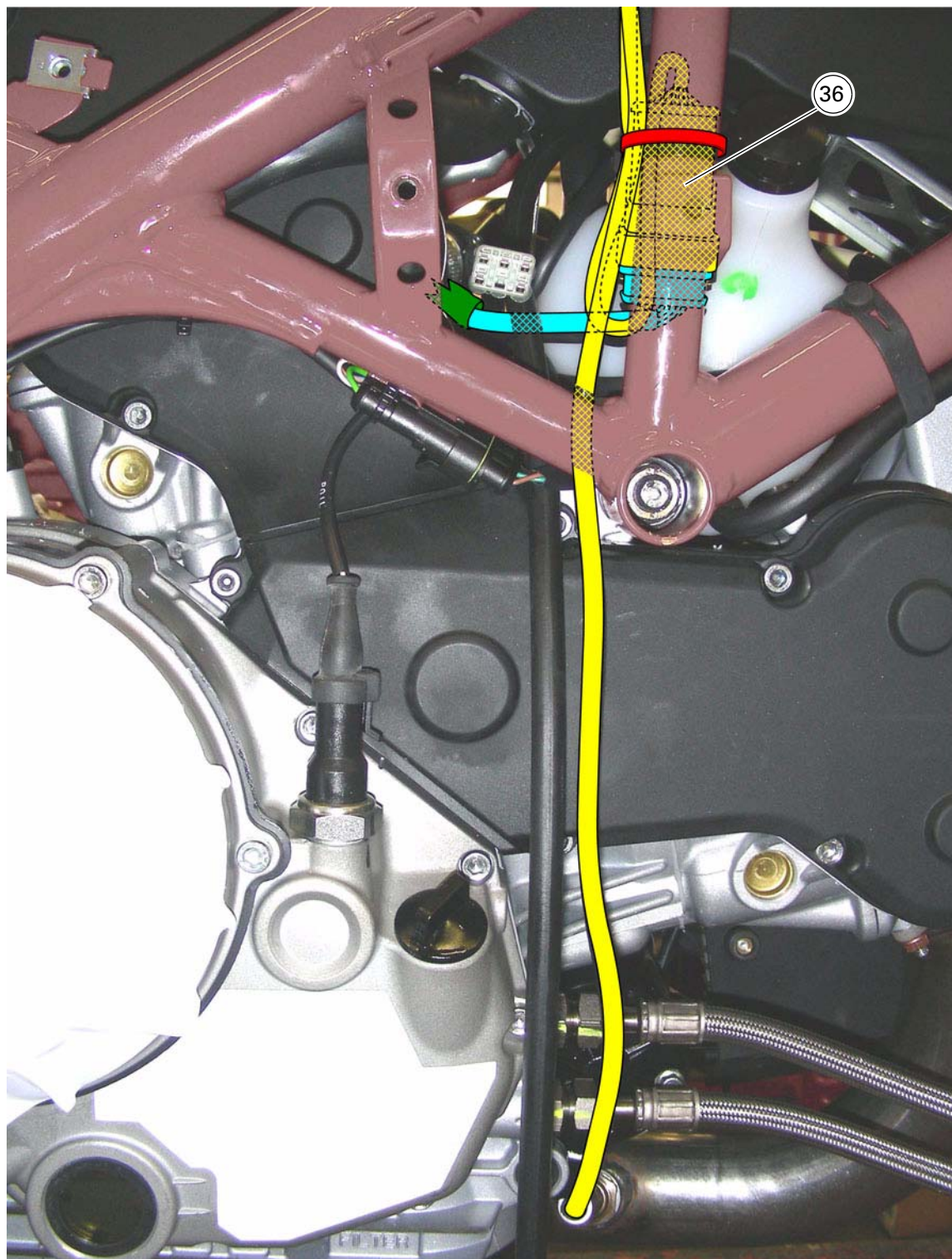
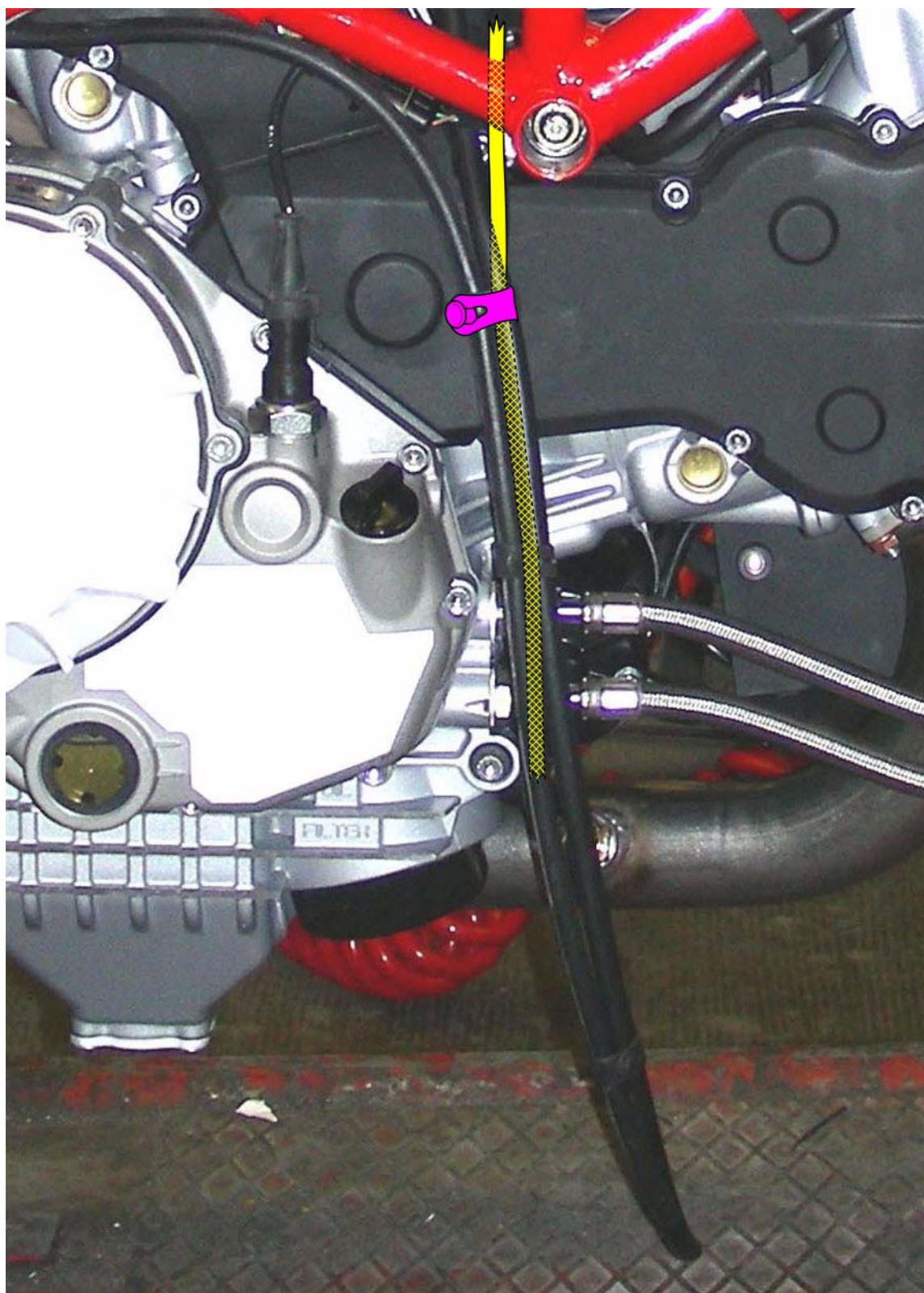


Plate 28



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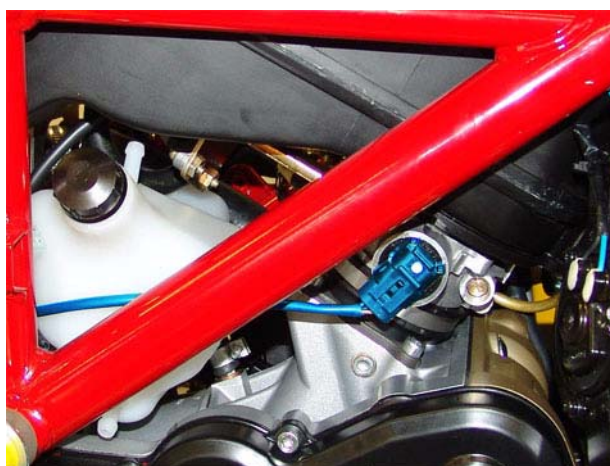
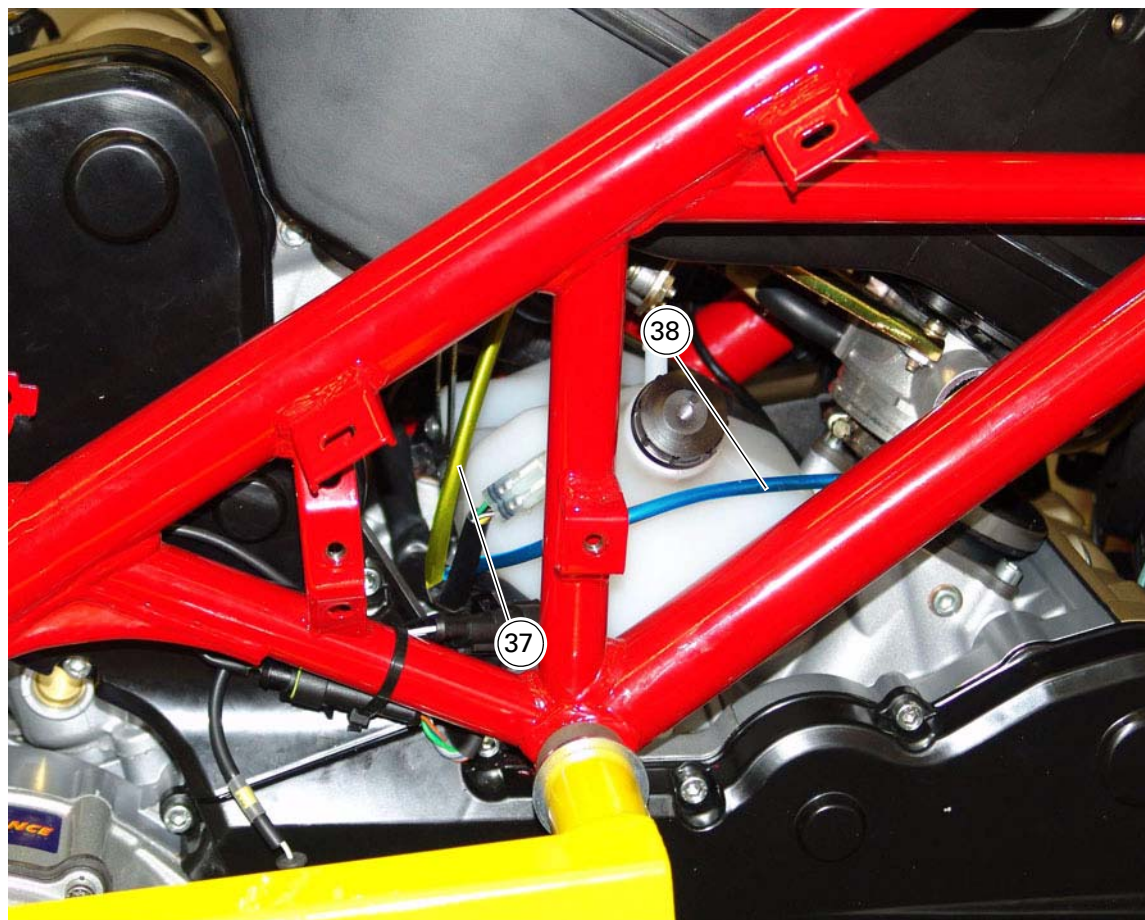
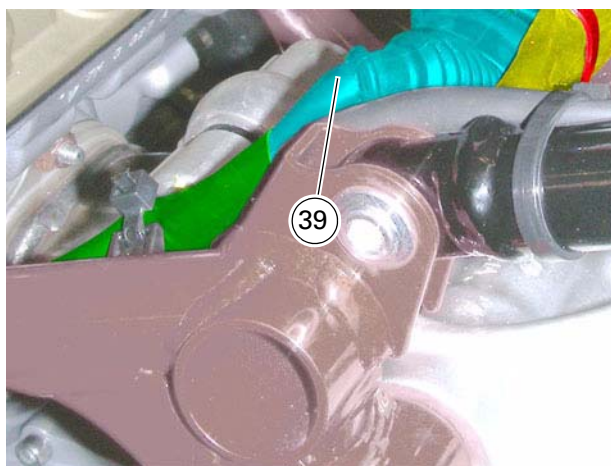
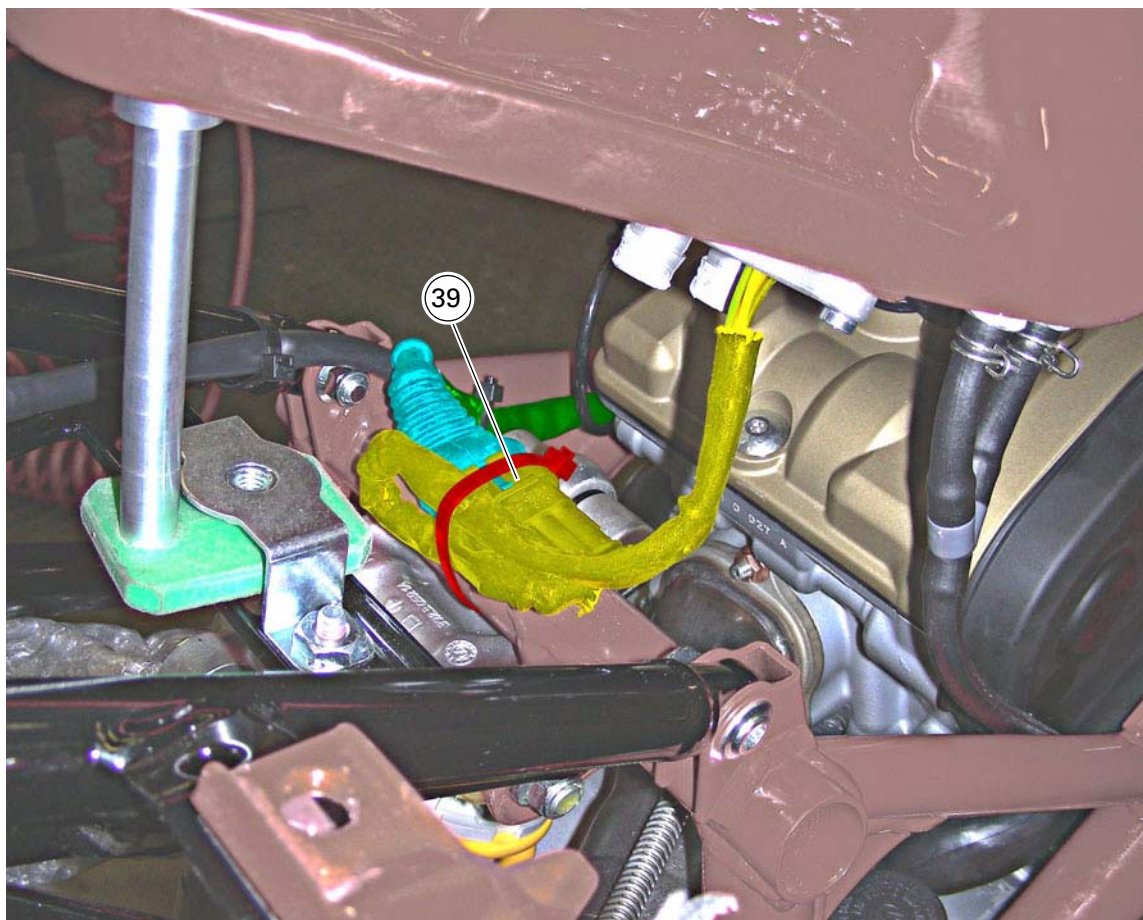


Plate 30



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Plate 31

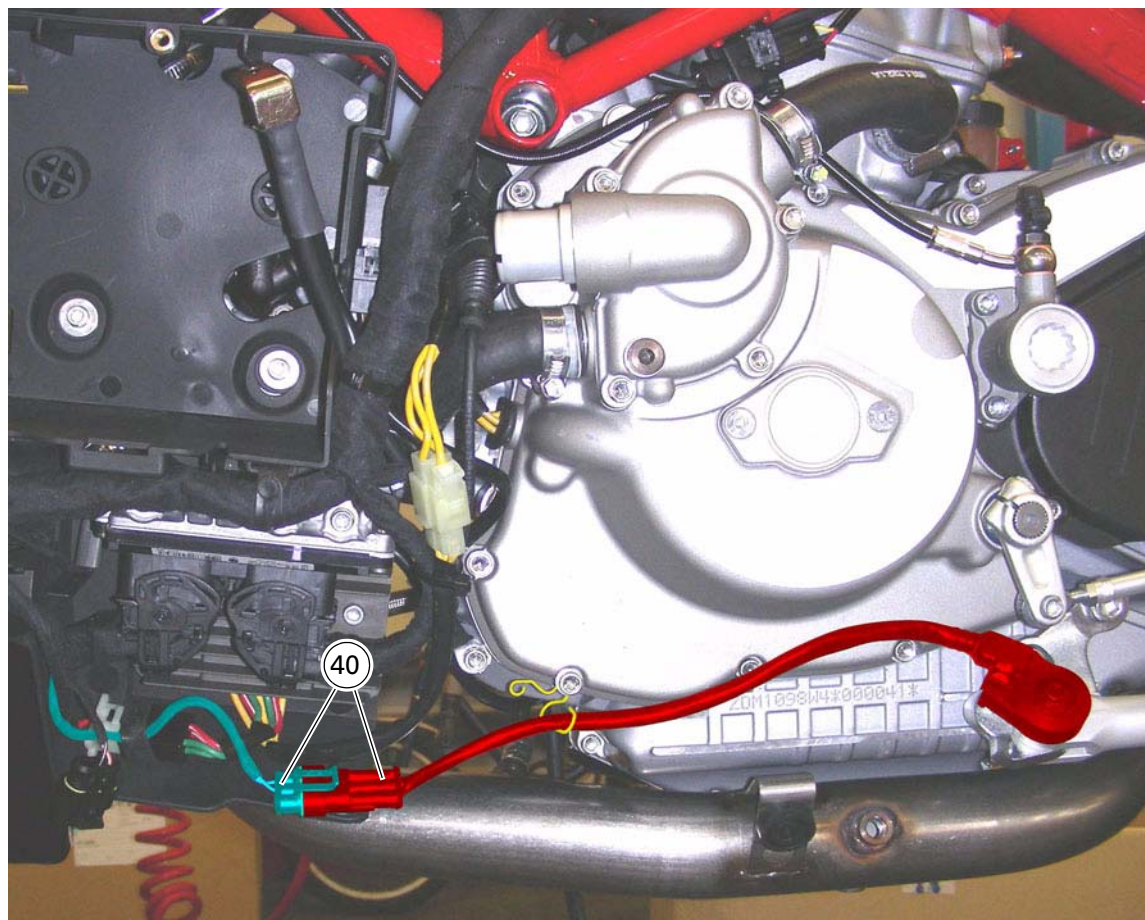
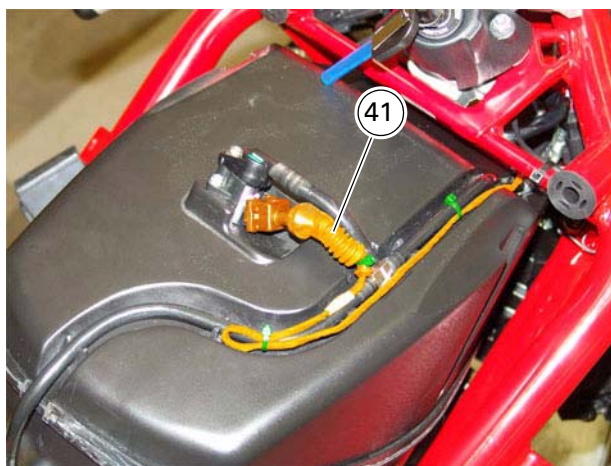


Plate 32



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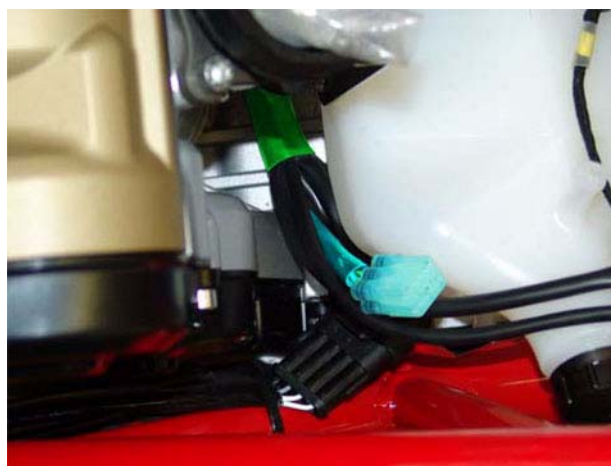
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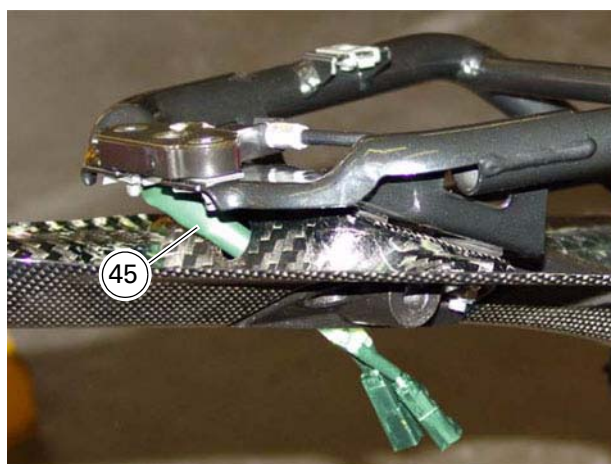
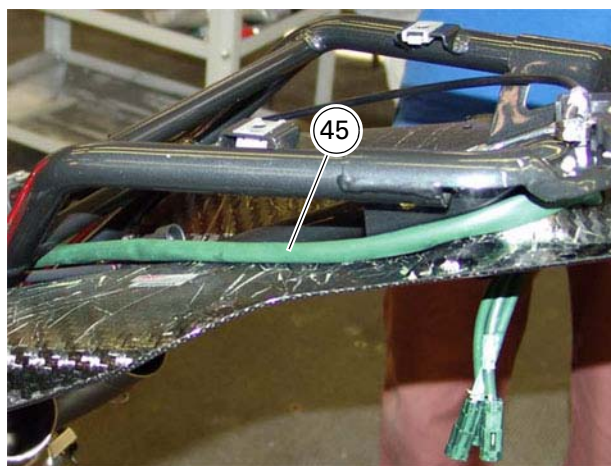
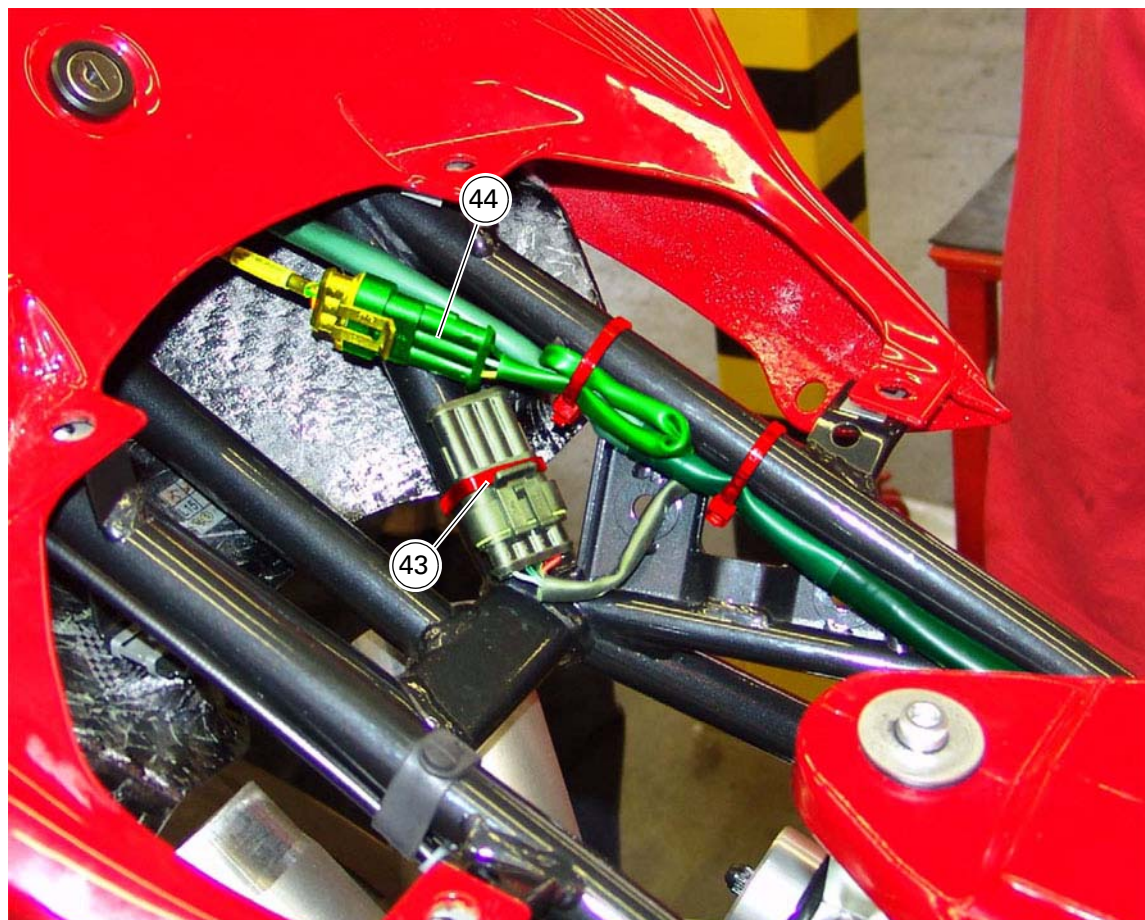
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Plate 33







2 - Battery charging system

Checking the battery charging system

To check the current flow in the charging circuit, use the “DDS” tester, which is equipped with an inductive clamp-type ammeter. see the chapter “Testing the battery charging system” Sect. D 5.

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

The tester performs an automatic calibration routine using its own transducer. If the measured current is a positive quantity, this means that alternator is powering all the electrical loads and charging battery at the same time. A negative value means that charging system is not powering the loads and a significant amount of current must be supplied by the battery, which is discharging at the time of the measurement.

Alternatively, a multimeter can be used (Sect. P 9, Diagnostic instruments): connect the multimeter probes to the battery terminals, select the DC scale on the instrument and check for the presence of **14.5 V $\pm$ 0.5** at an engine speed of 3000 rpm.



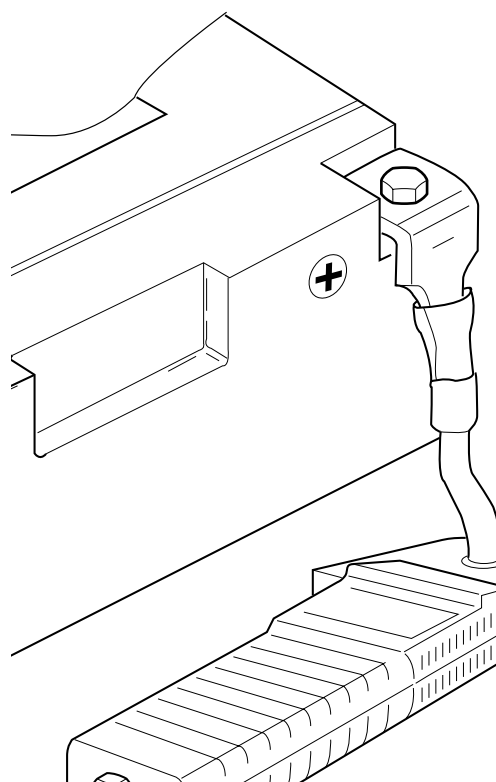
Notes

As well as this type of check, it is also possible to check the operation of the charging system directly from the instrument panel (Sect. P 7).



Important

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



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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. Interrupt charging immediately if the battery becomes too hot to the touch. Leave to cool before resuming charging.

Use only constant-voltage battery chargers.

Check that battery terminals are properly connected to the battery charger.

To charge the battery, proceed as follows:

Type of charging	Volt.	Ampere (A)	Time (Hours)
Normal	12	1.8	5-10
Fast	12	9	1

Use fast charging in emergencies only.

Storing the battery

If the battery voltage is less than or equal to 11.5 V, it must be recharged.

Connect the battery charger to the battery.

Use a voltage of 16-17 V.

If the ammeter shows no change, increase the voltage to the maximum of 25 V.

Charge for 5 minutes.

If the ammeter shows a change, return the voltage to 16-17 V; otherwise replace the battery.

Topping up the electrolyte

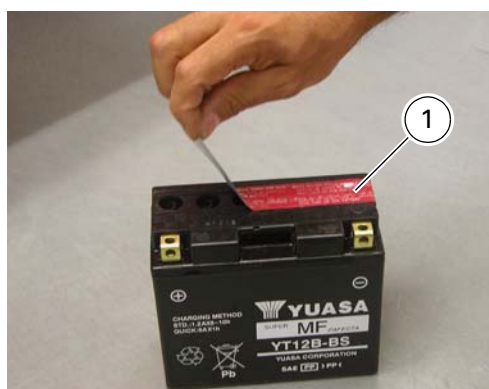
Remove the battery from the motorcycle.



Warning

Carefully read 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 near the battery, as it produces explosive gases. When recharging or using the battery indoors, make sure that the room is adequately ventilated. Do not inhale the gases produced during recharging. KEEP OUT OF REACH OF CHILDREN.

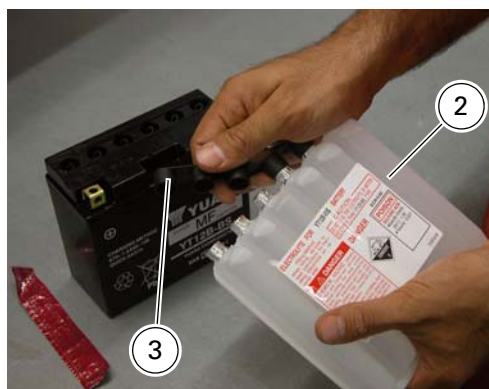
Place the battery on a flat surface. Remove the protective film (1).



Warning

Make certain that the electrolyte is of the specific type for your battery.

Remove the container with the electrolyte from the vinyl bag. Remove the strip with the caps (3) from the container (2).



Important

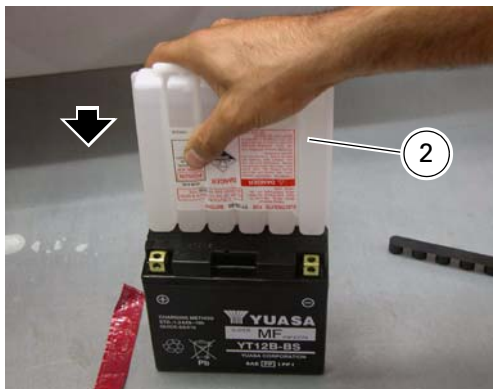
Keep the cap strip (3) to hand because it will be used later as plugs for the battery cells.



Warning

Do not peel or perforate the sealed areas.

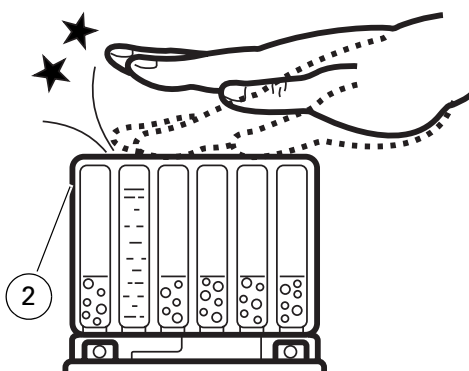
Place the electrolyte container (2) upside down. Align the six sealed elements with the six filler holes on the battery. Push the container (2) downwards with sufficient force to break the seals and allow the liquid to flow out.



Notes

Do not tilt the electrolyte container as this could interrupt the flow temporarily or even permanently.

Make certain that air bubbles emerge from all six filler holes. Leave the container in this position for at least twenty minutes. If no bubbles emerge from one of the holes, tap gently on the bottom of the respective container.



Important

Never move the container away from the battery. Do not cut or puncture the liquid container.

Make sure that all the electrolyte has flowed out. Carefully extract the container (2) from the battery.

Place the cap strip (3) previously removed from the electrolyte container (2) on the battery, making sure that the strip closes all the electrolyte filler holes correctly.



For 3-12 Ah batteries, leave to stand for at least 30 mins.

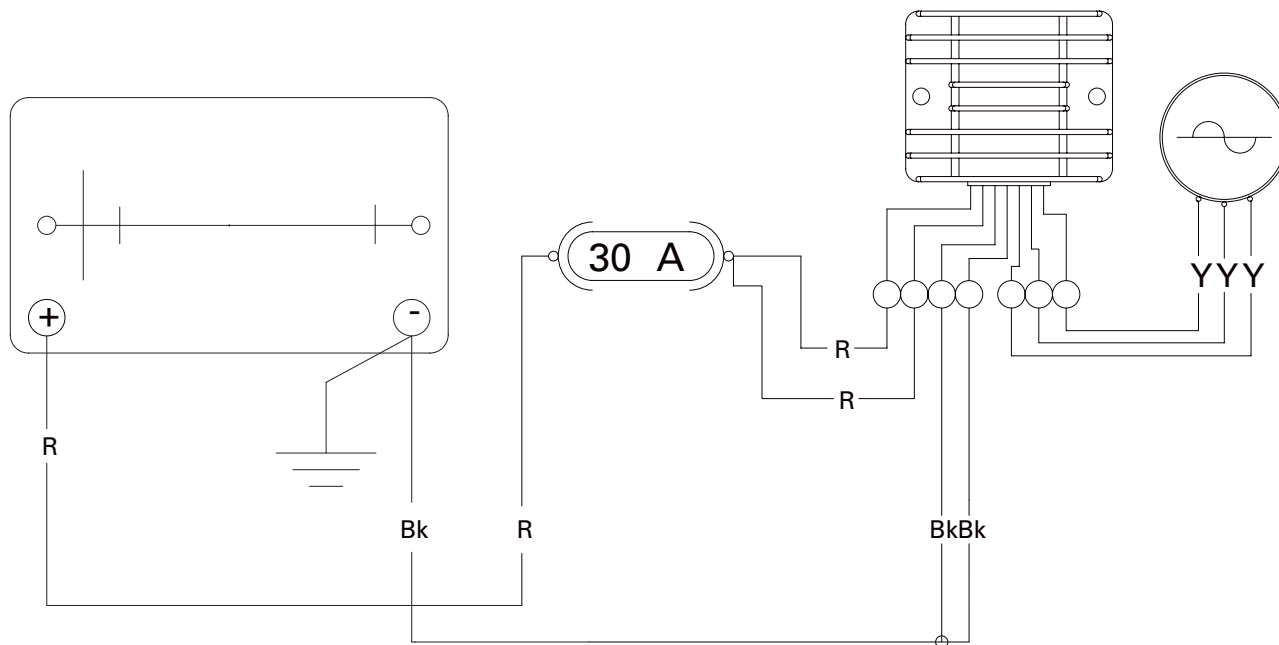
For batteries of over 12 Ah, leave to stand for at least 1 hour.

Rest the cap strip on the filler holes without fixing it. Recharge the battery as described in the paragraph "Recharging the battery".

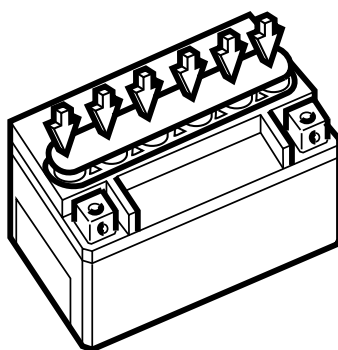


Notes

If using an automatic charge reducing battery charger, make certain that the charger current (amps) is greater than or equal to the standard (STD) recharging system indicated on the battery.



Press firmly downwards with both hands until the caps are firmly in place (do not use a hammer).



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Battery

A Battery safety rules



Warning

Carefully read the relevant safety rules before working on the battery (Sect. A 3, General safety rules). When under charge, batteries produce explosive gases. Keep batteries away from heat sources, sparks or open flames.

B Instructions for use

The battery is of the sealed, maintenance-free type and requires no work to be done on it at the time of installation.



Notes

Always keep the battery clean. Apply grease around the battery terminal clamps to prevent corrosion.



Warning

Never remove the valve cover located on top of the cover. If the block, cover or terminals are broken or if the valve cover has been tampered with **it is essential to change the battery**.



Important

If the motorcycle is left unused for more than 30 days, remove the battery and store it in a safe, cool place.

Always charge the battery before the first use and after long storage periods - such as before selling the vehicle.

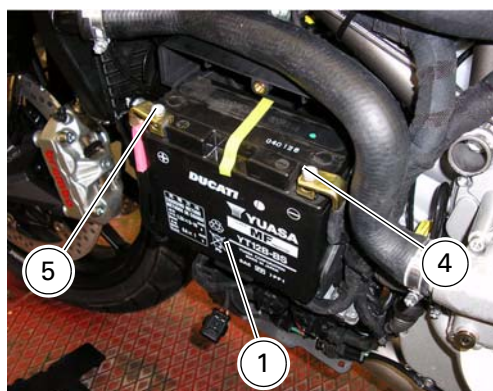
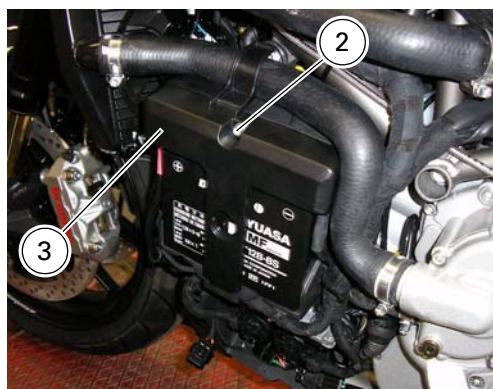
E Removal of the battery

Remove the left-hand side fairing (Sect. E 2).

Unscrew the bolt (2) and securing the bracket (3), then remove the bracket (A) and (5).

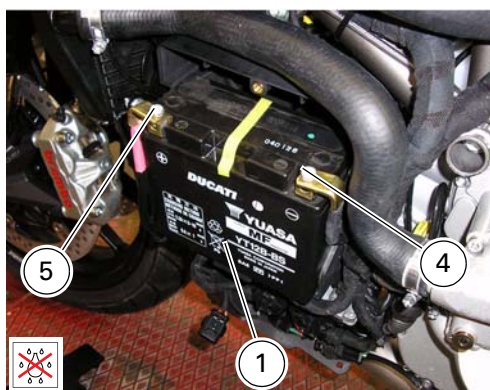
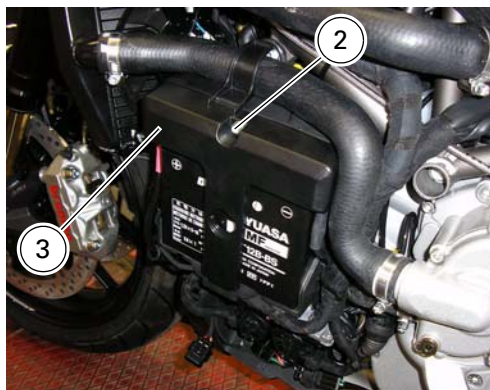
Undo the terminal bolts (4) and (5). Always start with the negative terminal.

Remove the battery (1).



Refitting the battery

Refitting is the reverse of removal. Pay particular attention to the terminals, which should not show any sign of oxidization. Tighten the terminal bolts to the specified torque (Sect. C 3) and apply a water repellent spray.



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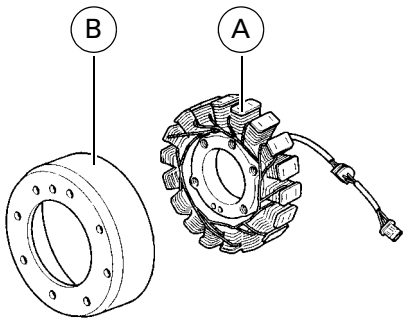
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Alternator

A

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.

B



C

D

 Notes

To check the charging system for possible faults, use the “DDS” tester (Sect. D 5, DDS tester).

E

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**)

F

 Important

Before testing, disconnect the alternator wiring from the electrical system when the ignition key is set to OFF.

Engine rpm	2000	6000
effective V	27±10	78±10

G

Values significantly lower than those indicated above can be due to:

- partially demagnetised rotor.
- short-circuited coil windings.

In the above cases the whole alternator assembly (rotor and stator) should be replaced.

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.

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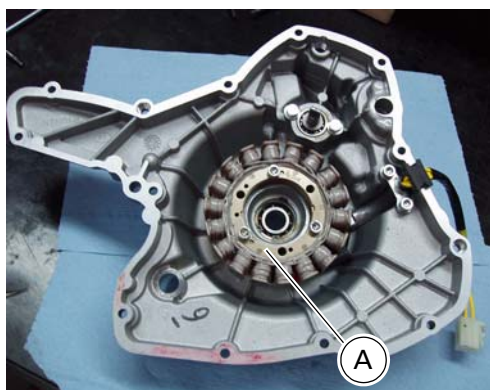
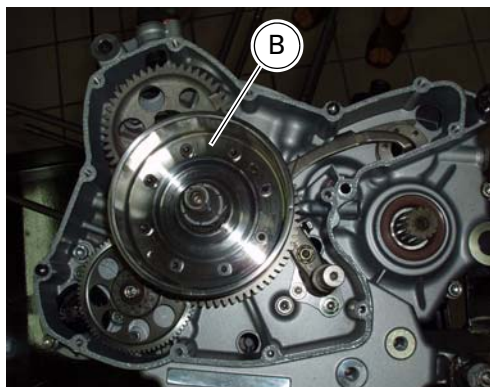
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Removal of the alternator

Remove the left-hand side fairing (Sect. E 2).

Disconnect the alternator wires from the electrical system (refer to plate in chapter "Routing of wiring on frame" Sect. P 1).

Remove the left-hand crankcase cover, the stator (A) and rotor (B) (Sect. N 8, Removal of the left-hand side crankcase cover).



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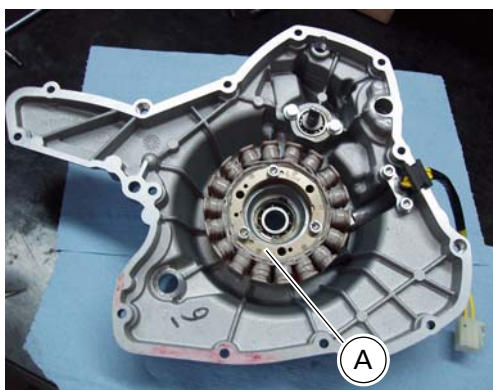
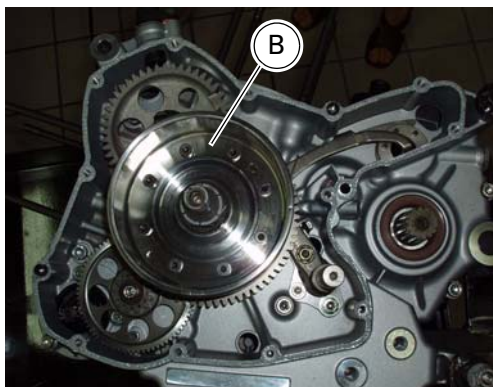
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Refitting the alternator

Fit the rotor (B), the stator (A) and the left-hand crankcase cover.

Reconnect the alternator wires to the electrical system (refer to plate in chapter "Routing of wiring on frame" Sect. P 1).

Refit the left-hand side fairing (Sect. E 2).



Regulator/rectifier

The regulator (2) is fixed to the battery support (3).

The regulator/rectifier unit 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 value will be high enough to restore normal battery operating conditions. In contrast, if the battery is fully charged, the current value will be lower.



Notes

Check the charging current using the "DDS" tester (Sect. D 5, DDS tester).

Removal of the regulator

Remove the left-hand side fairing (Sect. E 2).

To remove the voltage regulator, first remove the ECU (4) and disconnect the voltage regulator wiring (Sect. M 3).

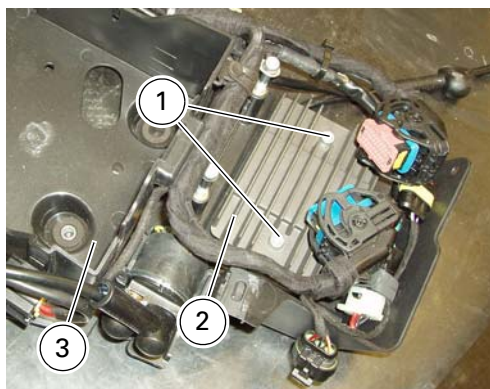
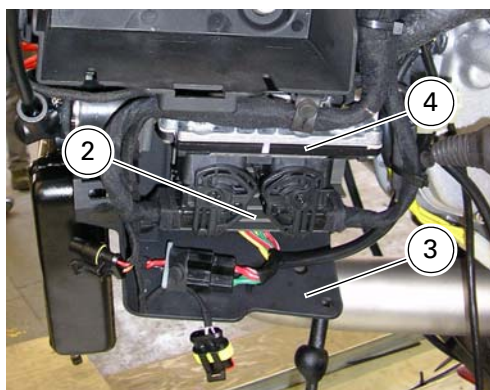
Undo the screws (1) securing the regulator (2) to the battery support (3).

Remove the regulator (2).



Important

Do not disconnect the battery cables when engine is running because this would cause irreparable damage to the regulator.



Refitting the regulator

Fit the regulator to the battery support (3).
Secure it with the screws (1) and tighten to the specified torque (Sect. C 3).



Notes

For the correct positioning of the regulator wiring, follow the indications given in the plates in the chapter "Routing of wiring on the frame" in Sect. P 1.

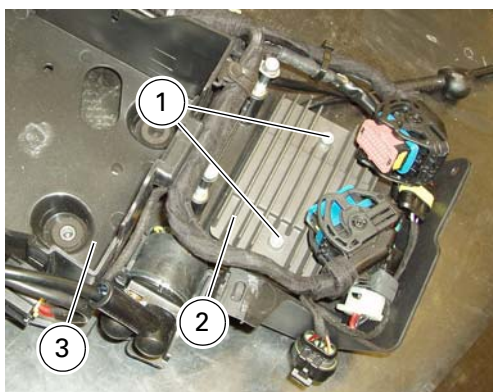
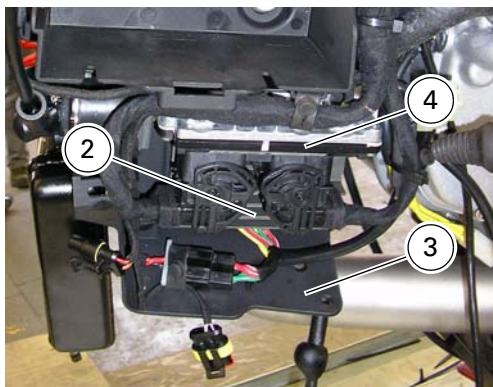
Refit the ECU (4) (Sect. M 3).



Important

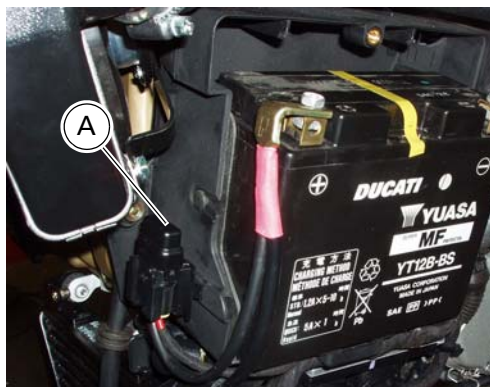
Do not disconnect the battery cables when engine is running because this would cause irreparable damage to the regulator.

Refit the left-hand side fairing (Sect. E 2).

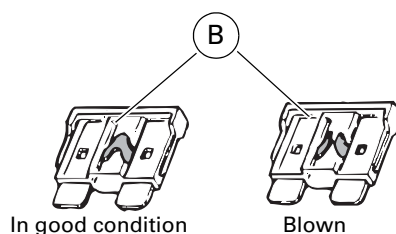


Regulator fuse

The **30 A**, fuse located at the side of the battery protects the electronic regulator. To gain access to the fuse, remove the left-hand fairing (Sect. E 2) and remove the protective cap (A).



A blown fuse can be identified by breakage of the inner filament (B).



Important

Switch the ignition key to **OFF** before replacing a fuse to avoid possible short circuits.



Warning

Never use a fuse with a rating other than the specified value. Failure to observe this rule may damage the electric system or even cause fire.

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3 - Electric starting system

Notes

The references of the elements shown below are to be found in the Wiring diagram” in Sect. P 1.

Electric starting system

- The key components of the electric starting system are a contactor (6) and a starter motor (5) fed by the battery (7). The engine starting strategy is managed entirely by the engine ECU (34), which monitors the following inputs:
- Engine Stop switch on right-hand handlebar switch (1)
 - Engine starter switch on right-hand handlebar switch (1)
 - Neutral sensor (31)
 - Sidestand sensor (29)
 - Clutch microswitch (36)

When these inputs are combined in the required manner, the engine control unit (34) enables engine starting.

The table lists possible engine starting combinations. In accordance with the status of specific engine control unit inputs and the indications given in the table, the control unit enables operation of the starter motor (ON status) when the START button is pressed. X = generic status of neutral sensor, clutch, and sidestand.

Safety device functions table

ECU INPUTS				ECU OUTPUTS
NEUTRAL	CLUTCH	STAND	ENGINE STOP	STARTER MOTOR
ECU ENGINE 14 PIN	ECU BODY 33 PIN	ECU BODY 38 PIN	ECU BODY 27 PIN	ECU BODY 1 PIN
X	X	X	OFF	OFF
NEUTRAL	PULLED	DOWN	ON	ON
NEUTRAL	RELEASED	DOWN	ON	ON
GEAR	RELEASED	DOWN	ON	OFF
GEAR	PULLED	DOWN	ON	OFF
NEUTRAL	PULLED	UP	ON	ON
NEUTRAL	RELEASED	UP	ON	ON
GEAR	RELEASED	UP	ON	OFF
GEAR	PULLED	UP	ON	ON

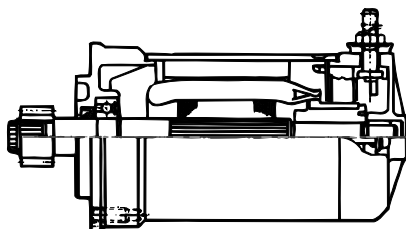
Starter motor

Power:

0.7 kw/12 V

Direction of rotation:

counterclockwise viewed from power take-off side.



The starter motor is highly compact and reliable and therefore rarely gives any type of problem. In case of malfunction, ensure that the starter motor wiring terminal is properly tightened under the nut and shows no sign of corrosion. If the terminal is properly tightened and free from corrosion, remove the starter motor and test it under no-load conditions (no load applied to the shaft). Secure the starter motor to a test bench, making sure you do not damage the casing. Use a fully charged 12 V battery for the test. Use battery-motor connection cables which are no longer than 70 cm and with the same cross-section as the cable on the motorcycle itself. Connect the negative terminal of the battery to an unpainted area of the starter motor casing and the positive terminal to its electrical terminal. The shaft of the starter motor should rotate freely and at high speed. Take care not to short-circuit the two cables connected to the battery.

Removal of the starter motor

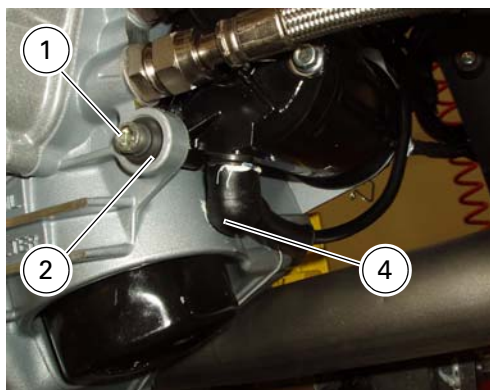
Remove the side fairings (Sect. E 2).

Remove the left-hand crankcase cover (Sect. N 8, Removal of the left-hand side crankcase cover).

If the whole starting gear assembly needs to be renewed, remove the timing gears and the starter motor idler gear (Sect. N 9.1, Removal of the starter motor idler gear).

Disconnect the starter motor/starter contactor cable (4) (see plates in Routing of wiring on frame", Sect. P 1).

Remove the fixing screw (1) and, if necessary, the insert (2).



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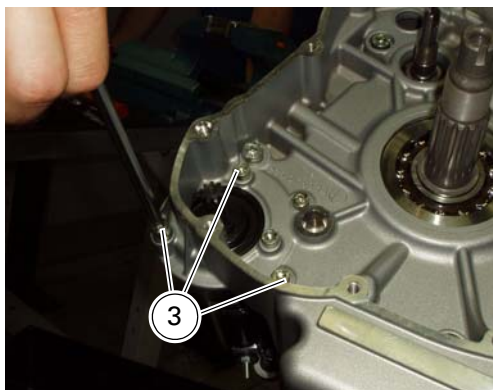
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Unscrew the retaining bolts (3).



Notes

The starter motor retaining bolts are assembled with threadlocker

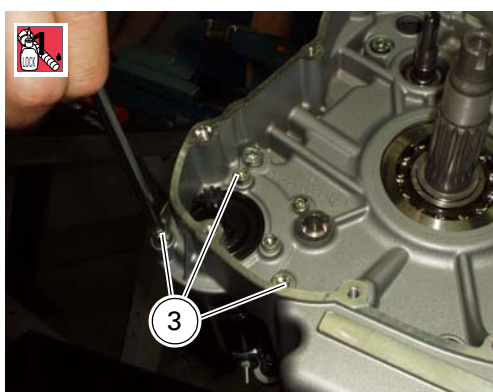
Slide out the starter motor and its gasket (5).



Refitting the starter motor

Inspect the condition of the gasket (5) and renew if necessary.

Place the gasket (5) and the starter motor on the crankcase and tighten the bolts (3) to the specified torque (Sect. C 3, Engine torque settings).

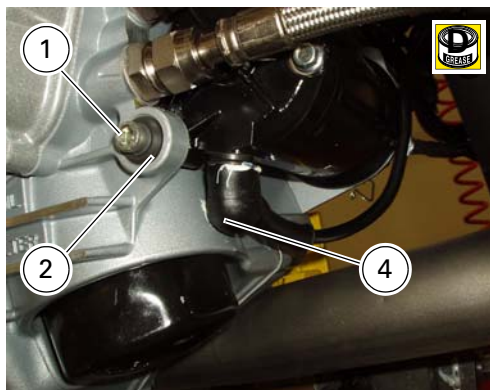


Locate the insert (2) (if removed) in the crankcase, fit the retaining screw (1) and tighten it to the specified torque (Sect. C 3). Connect the starter motor/contactor cable (4).



Important

Fill the cap with protective grease before fitting it on the starter motor



If the starting gears assembly has been renewed, refit the starter motor idler gear and the timing gears (Sect. N 9.1, Refitting the starter motor idler gear).

Refit the left-hand side crankcase cover (Sect. N 8, Refitting the left-hand crankcase cover).

Refit the side fairings (Sect. E 2).

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Starter contactor

The contactor is elastically mounted to the battery support.

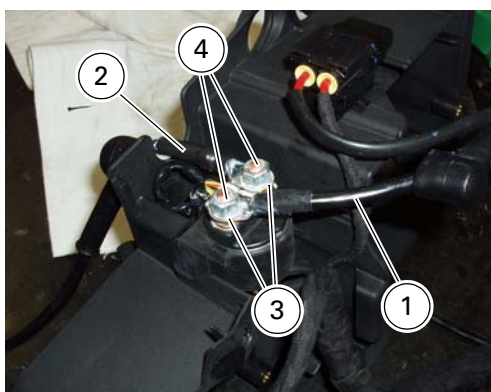
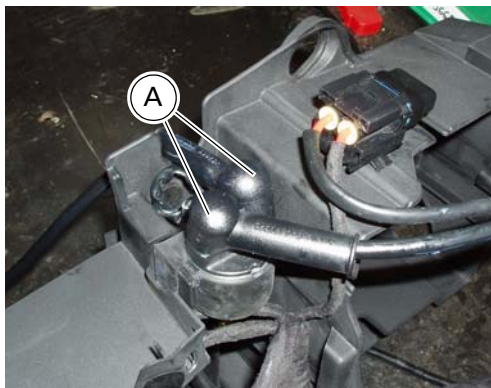
Disconnect the battery (Sect. P 2, Battery).

Remove the protective caps (A).

Unscrew the nuts (4), taking care to recover the spring washers (3).

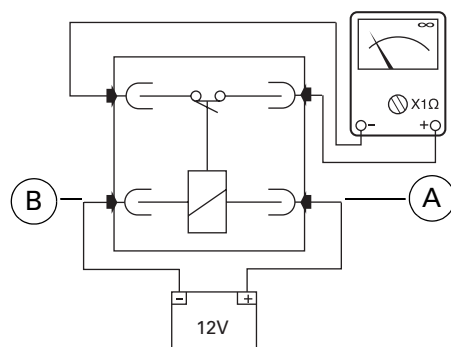
Remove the starter motor-contactor cable (2). Remove the contactor-battery cable (1).

Disconnect starter motor connector (5) from the wiring (see tables in chapter "Routing of wiring on frame", Sect. P 1).



Checking operation of the starter contactor

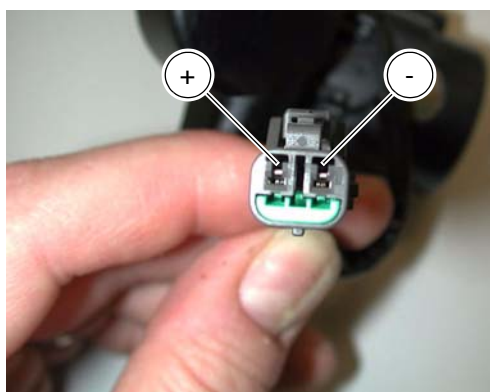
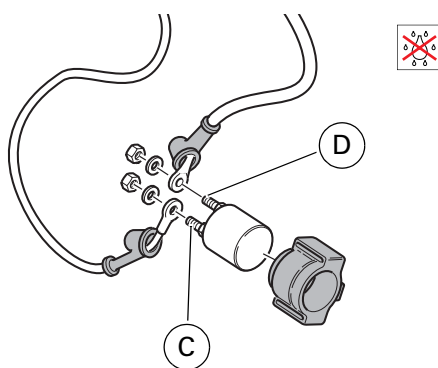
Apply **12 V** (battery voltage) across the positive terminal (A) and negative terminal (B) of the connector.



With a multimeter connected between the two poles (threaded studs (C) and (D)) of the contactor, check for electrical continuity (Sect. P 9). If there is no electrical continuity, renew the contactor.

Refit the contactor by reversing the steps of the removal procedure.

On refitting, ensure that studs (C) and (D) are not oxidized; apply water repellent spray.



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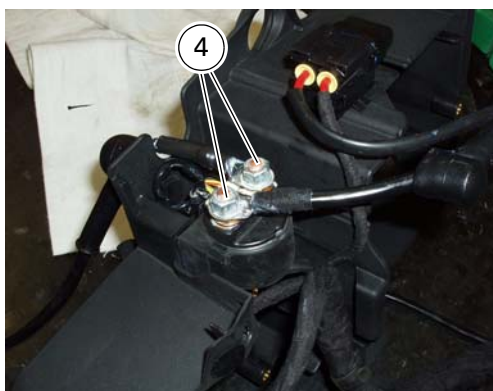
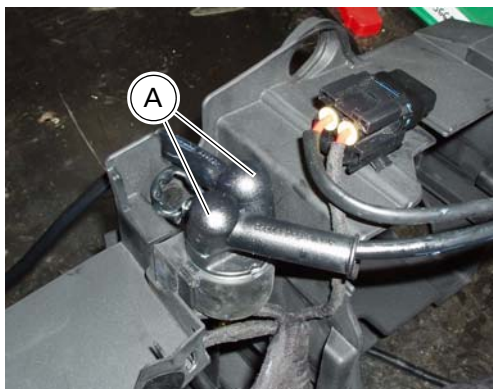
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Tighten the nuts (4) to the specified torque (Sect. C 3, Engine torque settings).
Refit the connector (5) to the wiring (see plates in "Routing of wiring on frame", Sect. P 1).
Refit the protective caps (A).



4 - Lights and indicating devices

Changing light bulbs

Changing the headlight bulbs

Before replacing a burnt out light bulb, ensure that the replacement bulb you intend to fit has the same voltage and power rating as specified for the lighting device in question (Sect. C 1.1, Lights/instrument panel).

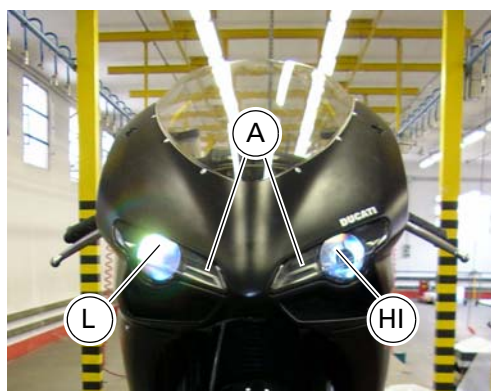


Warning

The halogen light bulbs in the headlight become hot when switched on and remain hot for some time after they are switched off. Allow bulbs to cool before replacing them.

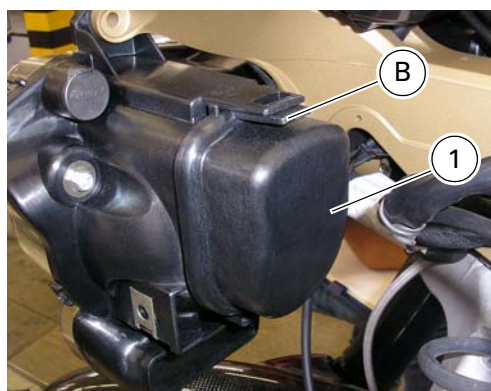
The position of the light bulbs in the headlight is as indicated below: low beam (LO), high beam (HI) and parking light (A).

To access the headlight bulbs, remove the air intake covers of the headlight shell (Sect. E 1).



High beam bulb (HI):

Remove the cover (1) by pressing the tab (B).



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Remove the bulb lead (2) and remove the bulb from the lead.



Notes

Do not touch the transparent part of the bulb with your fingers, this will darken it and cause a loss of brightness.

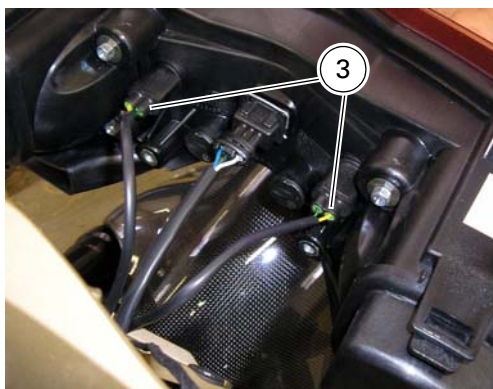


Low beam bulb (LO):

Repeat the operations for removal of the high beam bulb, but this time working on the right-hand side of the motorcycle.

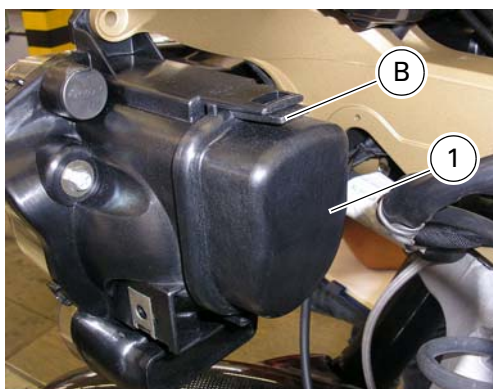
Parking lights (A):

To replace the parking light withdraw the bulb holder (3) from the rear of the headlight. Remove the bulbs and replace them.



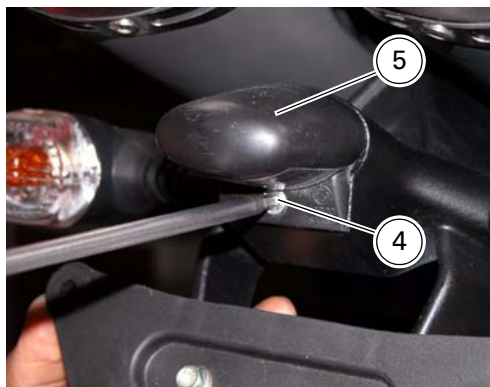
Refitting the bulbs

After replacing the bulbs as required, reconnect the bulb holders to the lights assembly. Reposition the covers (1) and secure them to the headlight assembly with the clips (B).



Changing the number plate light bulb

To access the number plate light bulb, unscrew the two screws (4) securing the cover (5).
Extract the bulb and renew it.



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High beam headlights relay

The headlights relay (1) is located on the front subframe. To gain access to this component you must first remove the headlight shell (Sect. E 1). A low beam lights relay (1) has been introduced into the system in order to reduce battery power consumption by automatically switching off the headlight.



The device is triggered in two cases:

- in the first case, if you turn the key from OFF to ON and do not start the engine, After 60 seconds the headlight will be deactivated and will only be reactivated the next time the key is turned from OFF to ON or the engine is started.
- in the second case, after normal use of the motorcycle with the lights on, if the engine is shut off using the ENGINE STOP switch (2). In this case, 60 seconds after the engine is stopped, the headlight will be turned off and will only be turned on again the next time the engine is started.



Notes

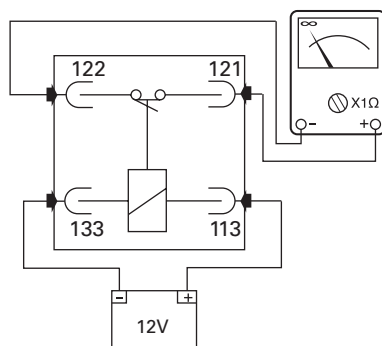
Also during engine starting, the system turns the headlight off and turns it back on once the engine has started.

If this strategy is not performed, check the correct operation of the various parts involved.

Checking operation of the high beam lights relay

Disconnect the relay (1) from the electrical system and apply 12 V (battery voltage) between contacts (113) and (133) (small contacts): you should hear a click that confirms that the internal electromagnet has switched.

Connect a multimeter to contacts (121) and (122) (big contacts) to check for the full scale reading (analogue tester) or buzzer (digital tester). If this does not occur, the part must be renewed.



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Headlight aim

The motorcycle must be perfectly upright with the tires inflated to the correct pressure and with a rider seated, perfectly perpendicular to the longitudinal axis.

Position the motorcycle 10 metres from a wall or a screen.

On the wall or surface, draw a horizontal line at the same height from the ground as the centre of the headlight and a vertical line aligned with the longitudinal axis of the motorcycle.



Notes

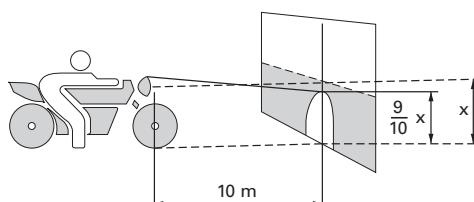
If possible, perform this check in conditions of low ambient light.

Switch on the low beam. The height of the upper limit between the dark area and the lit area must not be more than nine tenths of the height of the centre of the headlamp from the ground.

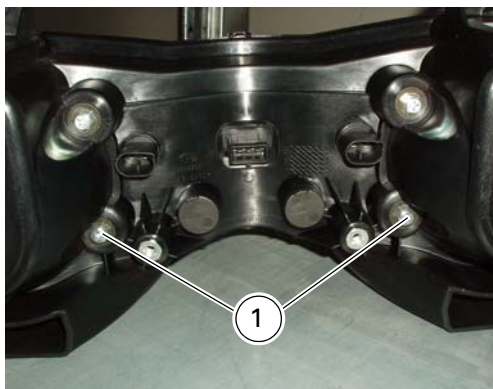


Notes

Note: this procedure is the one specified by Italian regulations for checking the maximum height of light beams.



Vertical alignment is adjusted by way of the adjuster screws (1) on the rear of the headlight.



5 - Indicating devices

Checking the indicating system components

In the event of a fault, the internal connections of the device must be checked in all operating conditions. To do this, disconnect the switch connector from the main wiring loom (Sect. P 1, Routing of wiring on frame).

Test the device using either an analogue or digital multimeter (Sect. P 9, Diagnostic instruments).



Notes

The same check can also be performed using the "DDS" tester (Sect. D 5, DDS tester).

Checking the left-hand handlebar switch

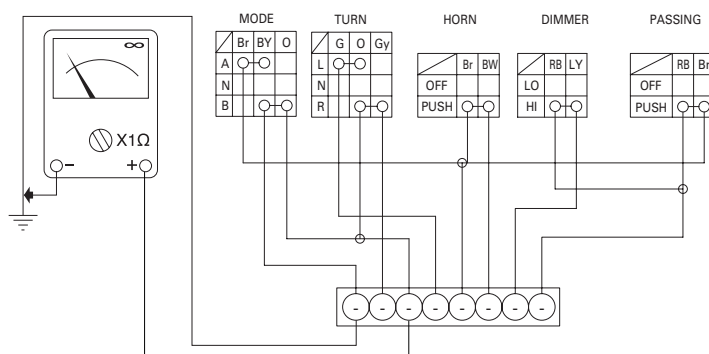
To remove the left-hand handlebar switch, undo the fixing screws (1) and disconnect it from the electrical system.



The colours mentioned in the following descriptions refer to the colours of the wires from the switch and not to the colours of the wires of the main electrical system.

HORN button

Connect the terminals of a multimeter to the Black/White and Brown wires to check for electrical continuity, which must be present when the HORN is pressed (see Sect. P 9, Diagnostic instruments, concerning operation of the multimeter). When the HORN button is pressed, the resistance value shown by the multimeter should be close to zero and, if available, a continuity beep should be heard. When the HORN button is not pressed, the resistance value should be infinite (there is no continuity as the electrical contacts inside the pushbutton are open) and no continuity beep should be heard. If these conditions are not met, the device must be replaced.



Turn signal switch (TURN)

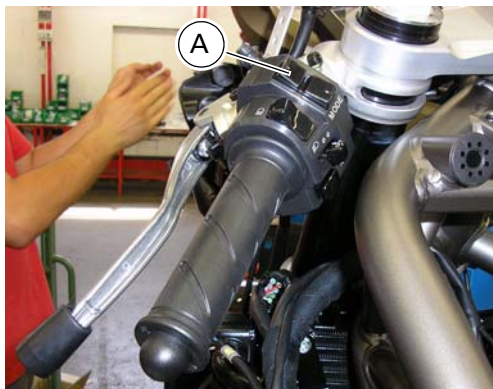
Connect the multimeter to the Orange and Green wires from the turn signal switch and check for electrical continuity when operating the right turn signals (see Sect. P 9, Diagnostic instruments concerning operation of the multimeter). Repeat the above procedure for the left turn signal but connect the multimeter to the Green and Orange wires. The above colours refer to the colour of wires from the switch and not to the colour of wires of the main electrical system.

Low and high beam headlights (DIMMER)

The test method is the same; connect the meter to the Red/Blue and Light blue/Yellow wires.

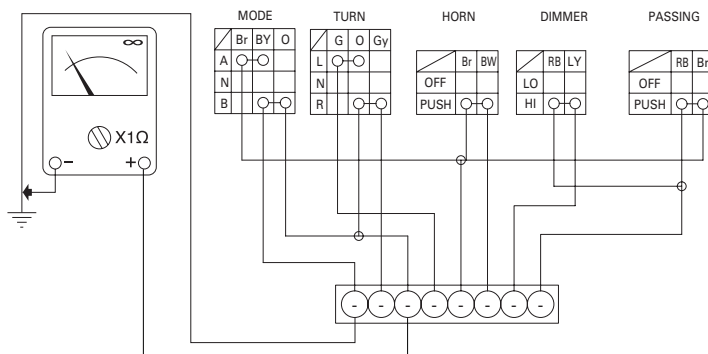
Control switch (MODE)

Connect the multimeter to the Blue/Yellow and Orange wires from the function selector switch and check that there is electrical continuity when the pushbutton (A) is pressed (Sect. P 9, Diagnostic instruments – multimeter operation). Repeat the same procedure, operating the pushbutton (A) in the remaining position and connecting the multimeter to the Brown and Blue/Yellow wires.



Flasher (PASSING)

Check for continuity across the Red/Blue and Brown wires.



Refit the left-hand handlebar switch and tighten the screws (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 screws (1) and disconnect the wiring connector from the electrical system.



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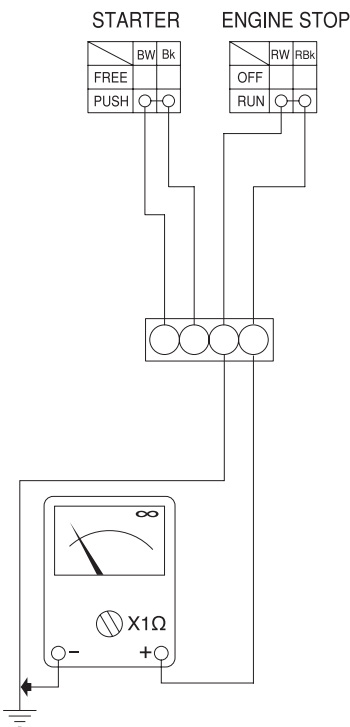
The colours mentioned in the following descriptions refer to the colours of the wires from the switch and not to the colours of the wires of the main electrical system.

ENGINE STOP button

Using a multimeter, check for continuity between the Red/Black and Red/White wires (see Sect. P 9, Diagnostic instruments for information on the operation of the multimeter). When the button is in RUN position, there should be electrical continuity between the two wires. When the button is in the OFF position, there should be no electrical continuity between the two wires. If these conditions are not met, the ENGINE STOP switch is not working correctly and must be renewed. The colours indicated above refer to the colour of wires coming from the switch and not to the colour of wires of the main electrical system.

STARTER switch

Proceed as described for the engine STOP button and check for continuity between the Blue/White and Black wires when the STARTER button is pressed (see Sect. P 9, Diagnostic instruments concerning operation of the multimeter). If there is no continuity, the STARTER button is faulty and must be renewed. The colours indicated above refer to the colour of wires coming from the switch and not to the colour of wires of the main electrical system.

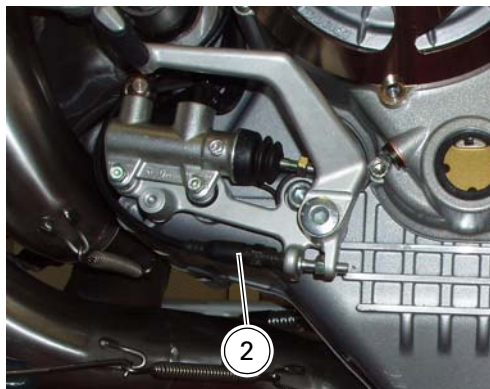


Refit the left-hand handlebar switch and tighten the screws (1) to the specified torque (Sect. C 3, Frame torque settings).

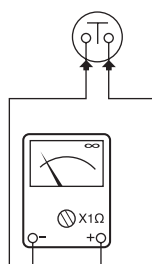
Checking the front and rear brake light switches, neutral light switch, oil pressure switch and clutch switch

Brake light switches

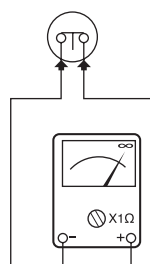
To check operation of the front (1) and rear (2) brake light switches, use a multimeter to check for electrical continuity (Pos. A) between the terminals of the corresponding switch when the front or rear brake is applied (see Sect. P 9, Diagnostic instruments on operation of the multimeter). When the brake is released, there must be no electrical continuity between the terminals of the corresponding switch (Pos. B). If these tests fail to produce positive results, the part in question must be renewed.



Pos. B



Pos. A



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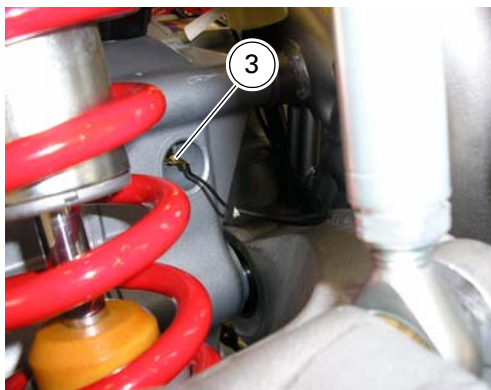
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Neutral indicator light

To check the neutral light switch (3) proceed as follows:



The neutral light does not illuminate on the instrument panel.

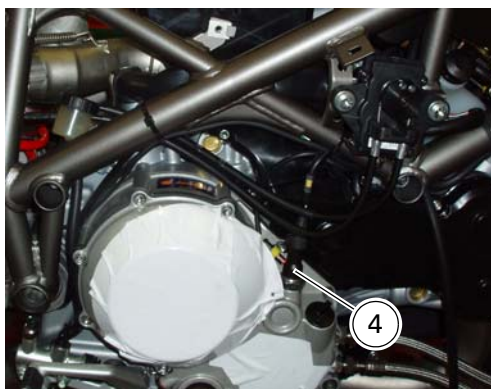
Remove the electric terminal connected to the neutral switch. Switch on the ignition switch (ignition key to ON position) and ensure that the light illuminates when the terminal is earthed. If the light switches on, the neutral light switch should be changed. If the light stays off, switch off the ignition (ignition key set to OFF) to switch off the instrument panel and check for electric continuity between neutral switch and 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 whether the section of circuit between neutral switch and engine control unit is earthed.

Oil pressure sensor

To test the operation of the engine oil pressure sensor (4), proceed as follows:



Use the tester to check that oil pressure into engine oil circuit complies with the specified values (Sect. D 5, Checking the engine oil pressure).

If the engine oil pressure value is outside the specified range, check the oil circuit components and service as necessary.

If engine oil pressure value is within the specified range and the oil pressure warning light on the instrument panel stays off, switch on the instrument panel (ignition key set to ON) without starting the engine, and disconnect the electrical terminal from the pressure sensor and connect it to earth. If the warning light now illuminates, this means the sensor is defective and must be replaced. If the 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 complies with the stated values and the engine oil pressure warning light on the instrument panel is continuously illuminated, switch on the instrument panel (ignition key set to ON) and start the engine, then disconnect the electrical terminal normally inserted on the pressure sensor. If the warning light now switches off, this means the sensor is defective. If the warning light 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 beginning of this paragraph).



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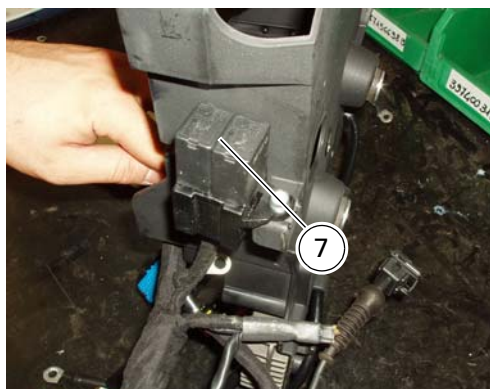
Coolant temperature sensor

A The coolant temperature sensor (6) sends an electrical signal to the engine ECU, which shares it with the instrument panel over the **CAN** line. To check that the sensor (6) is functioning correctly, connect the DDS tester to the diagnostics socket of the ECU and follow the instructions given under the heading "Guided diagnosis" (Sect. D 5). After making the correct selections from the menu, read the value of the coolant temperature from the parameters shown on the tester display. With the engine completely cold, the air temperature (also read using the DDS tester) should be similar to that of the coolant. With the engine hot and the radiator cooling fan just activated, the coolant temperature should be approximately equal to the cooling fan activation threshold (Sect. C 1.1). If these tests do not give a positive result, renew the coolant temperature sensor. If the DDS reads an error in the ECU memory of the type "coolant temperature sensor short circuit or open circuit", check the circuit connecting the sensor to the ECU. If this circuit is not faulty (not broken, not shorted and not earthed), renew the sensor.



Fan relay

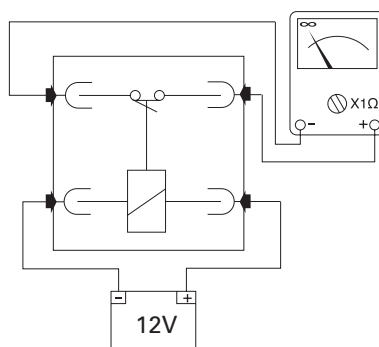
The fan relay (7) is located on the right-hand side of the battery support.
To gain access to the fan relay, first remove the left-hand side fairing (Sect. E 2).



Checking operation of the fan relay

Disconnect the relay from the electrical system and apply **12 V** (battery voltage) between the small contacts: you should hear a click that confirms that the internal electromagnet has switched.

Connect a multimeter to the big contacts to check for electrical continuity (Sect. P 9). The resistance reading should be near zero and, if present, the continuity sound signal should be emitted. If this does not occur, the part must be renewed.



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Changing light bulbs

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Changing the turn signal light bulbs

Rear turn signals

To gain access to the rear turn signal bulbs, undo the screw (2) and detach the cover (3) from the turn signal support.

Remove the bulb (1) from the bulb holder.

Fit a new bulb (1) into the bulb holder. Refit the cover (3) to the turn signal support.

Refit and tighten the screw (2).

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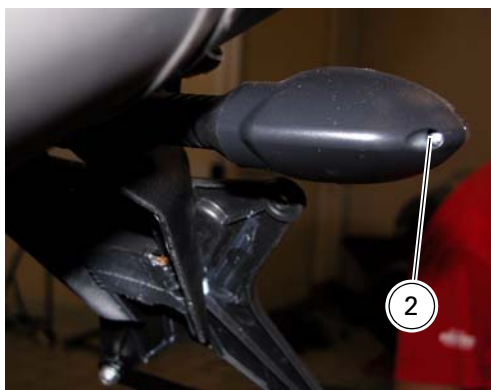
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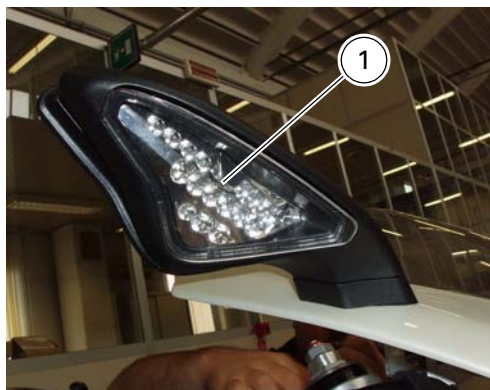
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Changing the front turn signals

The front turn signals (1) are integrated in the rear-view mirrors (Sect. E 1) and in the event of malfunction, the mirror/turn signal assembly must be renewed as a complete unit.



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Changing the rear turn signal bulbs

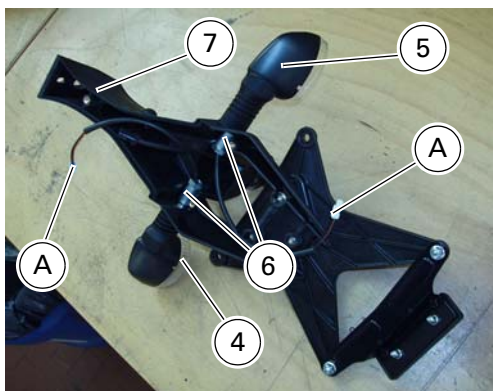
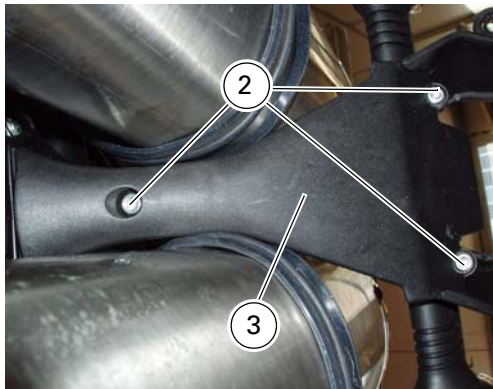
Undo the screws (2) and remove the cover (3).

Disconnect the wiring (A) of the turn signals (4) and (5). Unscrew the nuts (6) and remove the turn signals.

When refitting, position the turn signals by inserting the wires (A) through the relative apertures in the number plate holder (7). Slide the nuts (6) along the wires (A) and screw them onto the turn signals to secure them to the number plate holder.

Tighten the nuts (6) to the specified torque (Sect. C 3).

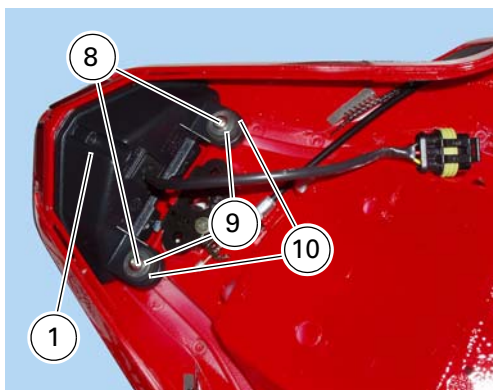
Refit the cover (3) and tighten the screws (2) to the specified torque (Sect. C 3).



Renewl of the rear parking light and brake light

Remove the seat cowling as indicated in Sect. E 3.

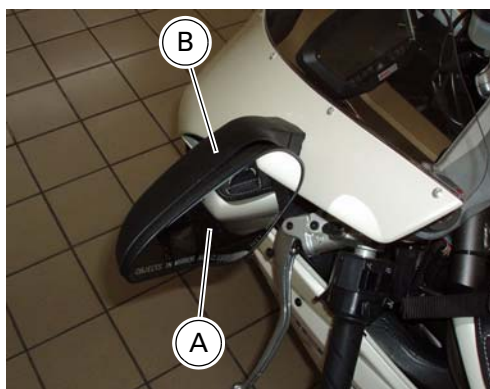
Unscrew the bolts (8) and remove the parking light and brake light unit (11). Remove the spacers (9) and grommets (10) from the old unit and fit them to the new unit (11). Fit the new parking light and brake light unit (11) to the seat cowling, tightening the bolts (8) to the specified torque (Sect. C 3).



Refit the seat cowling as indicated in Sect. E 3.

Rear view mirror adjustment

Grasp the outer part of the mirror surface (A) and move it manually to the required position relative to the mirror support (B).



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6 - Protection and safety devices

Checking protection and safety device components

Checking the ignition switch

Disconnect the ignition switch (A) from the wiring loom by opening its connector (see “Routing of wiring on frame”, Sect. P 1) and use a multimeter to check its internal connections as follows:

turn the key to **OFF** and connect a multimeter to contacts (1) and (4) to check electrical continuity (Sect. P 9, Diagnostic instruments on operation of the multimeter). The resistance reading should be near zero and, if present, the continuity sound signal should be emitted.

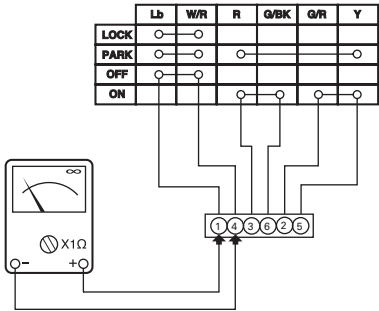
turn the key to **ON** and connect the multimeter to contacts (3) and (6) and then to (2) and (5) to check for electrical continuity. The resistance reading should be near zero and, if present, the continuity sound signal should be emitted.

turn the key to **PARK** and connect the multimeter to contacts (1) and (4) and then to (3) and (5) to check for electrical continuity. The resistance reading should be near zero and, if present, the continuity sound signal should be emitted.

turn the key to **LOCK** and connect the multimeter to contacts (1) and (4) to check for electrical continuity. The resistance reading should be near zero and, if present, the continuity sound signal should be emitted.

Notes

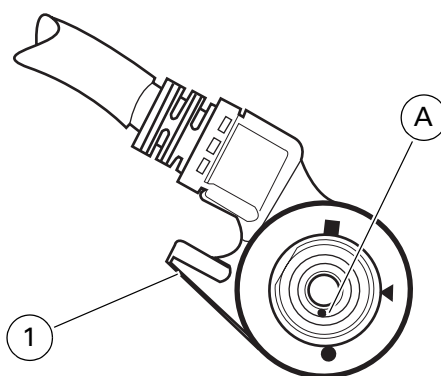
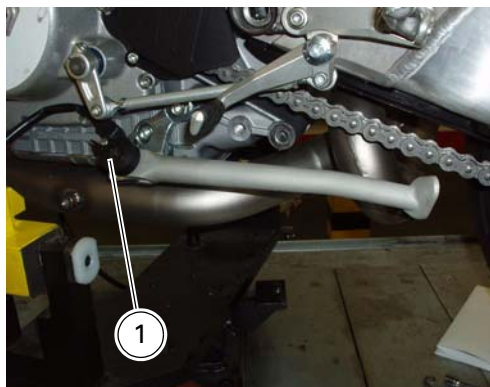
The same check can also be performed using the “DDS” tester (Sect. D 5, DDS tester).



Checking the sidestand switch

Remove the switch (1) from the sidestand and disconnect the main wiring loom connector from the switch (see "Routing of wiring on frame" Sect. P 1).

Use an analogue or digital multimeter (Sect. P 9, Diagnostic instruments) to check operation of the switch (see table).



Notes

The same check can also be performed using the "DDS" tester (Sect. D 5, DDS tester).

Pos. pin (A)	Device	Val.
● - ▲	0	X
▲ - ■	X	0
Multimeter pos.	Green/ Green White	Green/ Yellow Black

0 = open contact
X = Closed contact

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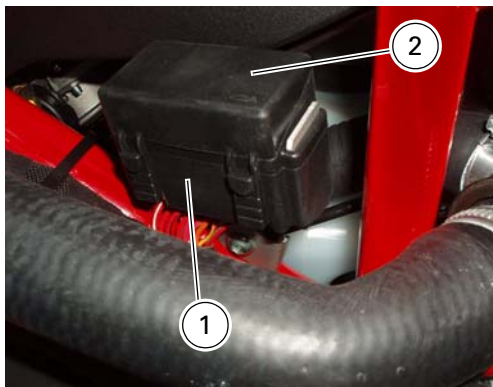
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Checking the fuses

The main fusebox (1) is located on the left-hand side of the motorcycle and is accessed by removing the left-hand side fairing (Sect. E 2).

The fuses are accessed by removing the cover (2), which shows the ampere ratings and mounting locations.



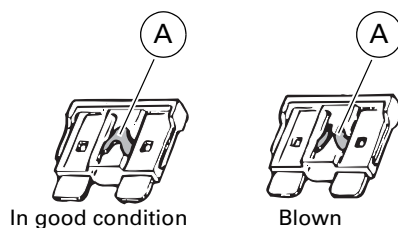
For ampere ratings, refer to the "Wiring diagram", Sect. P 1.



Important

Before replacing a damaged fuse with a new one of the same rating, identify the cause of the problem.

A blown fuse can be identified by the breakage of inner filament (A).



Important

Switch the ignition key to **OFF** before replacing a fuse to avoid possible short circuits.



Warning

Never use a fuse with a rating other than the specified value. Failure to observe this rule may damage the electric system or even cause fire.

As well as the fuses in the fusebox, the motorcycle has a **30 A** fuse located alongside the battery support to protect the electronic regulator (Sect. P 2, Regulator/rectifier).

7 - Instruments

Instrument panel

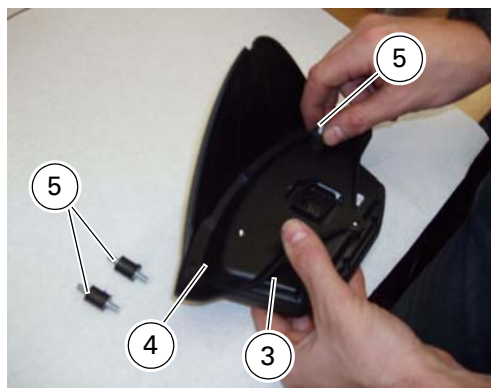
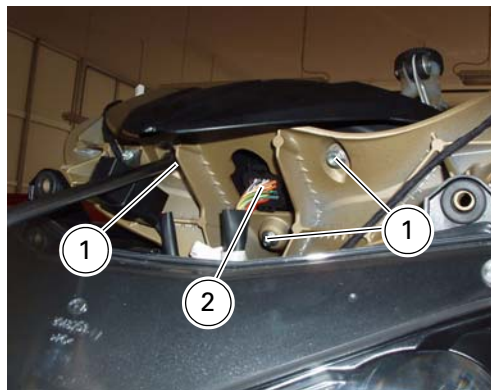
Remove the headlight shell (Sect. E 1, Removal of the headlight shell).

Unscrew the nuts (1). Disconnect the wiring to the instrument panel (2).

Remove the instrument panel (3) complete with the cover (4).

To remove the cover (4) from the instrument panel, remove the rubber mountings (5).

On refitting, tighten the nuts (1) to the specified torque (Sect. C 3, Frame tightening torques).



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.

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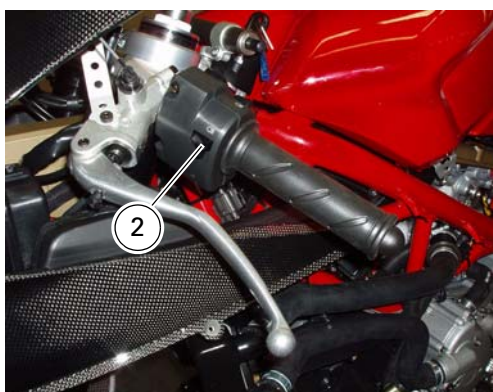
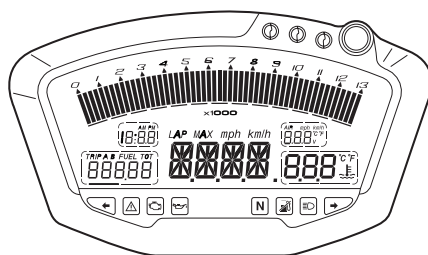
Instrument panel system

The instrument panel comprises a LCD digital display unit.

The information on the display can be accessed using a 2-position pushbutton (1) and the headlight flasher button (2) on the left-hand handlebar switch. Underneath the digital display there are eight indicator lights (four per side) and a further four auxiliary lights used to signal reaching of the limiter threshold.

The instrument panel is equipped with a luminosity sensor that detects the intensity of incident light. The control logic adjusts the illumination of the display and indicator lights for optimal readability in all lighting conditions.

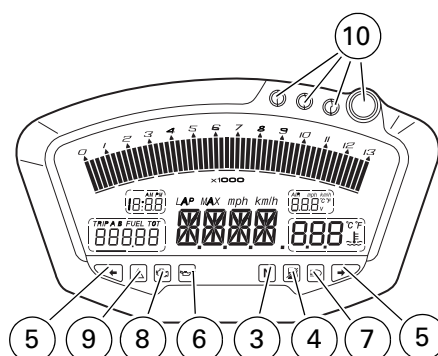
The instrument panel also houses the atmospheric pressure sensor: the engine ECU acquires this signal via the CAN (Controller Area Network) serial communication line.



Indicator lights

The following indicator lights are mounted on the instrument panel.

- 3) Neutral light (green): illuminates when the gearbox is in neutral.
- 4) Low fuel light (yellow): illuminates when there are about 3 litres of fuel left in the tank.
- 5) Turn signal lights (green). illuminate and flash when the corresponding turn signal is in operation.
- 6) Engine oil pressure light (red): illuminates when the engine oil pressure is too low. This light should come on when the ignition is switched to ON and normally goes out a few seconds after engine starts. It may come on briefly if the engine is very hot, but should go out again as engine speed increases.
- 7) High beam warning light (blue): illuminates when the high beam headlight is on.
- 8) EOBD light (amber): this light is lit steadily if the engine ECU has detected errors and consequently activated the engine lock. The light is also used as an indicator during the immobilizer override procedure using the throttle twistgrip. When no errors are present, the light should come on when the ignition switch is set to ON and should go out after a few seconds (normally after 1.8 to 2 sec.).
- 9) "Diagnostic" light: illuminates when the motorcycle diagnostics detects a problem.
- 10) Limiter indicator lights



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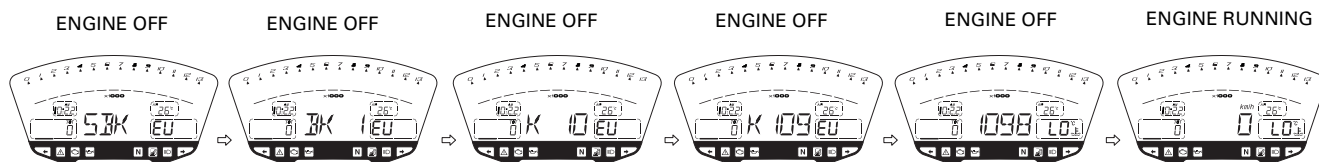
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Display settings and functions

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 the warning lights in sequence.

It then reverts to "normal" display mode and, in place of motorcycle speed, shows the model and, for 2 seconds, also the version (EU, UK, USA, CND, FRA, JAP).

The model is displayed cyclically until the engine is started.



At Key-On the instrument panel always shows the following information (de-activating any previously activated functions):

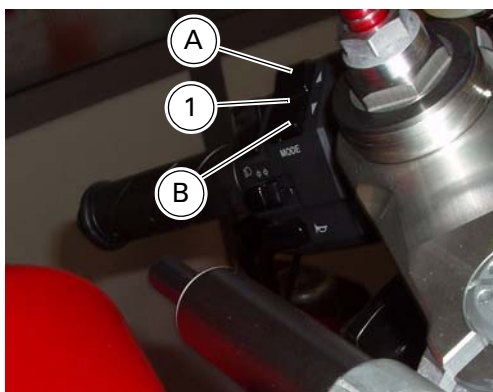
- Odometer
- Air temperature
- Clock
- Speed
- Coolant temperature
- Engine rpm

At this point, with button (1) in position A "▲" it is possible to switch from the odometer display function to the following functions:

- TRIP A
 - TRIP B
 - TRIP FUEL (only if active)
- before returning to Odometer.

If, however, you press button (1) in position B "▼" the system enters MENU mode and displays the following functions in sequence:

- Error (only if active)
- BATT
- RPM
- LAP (OFF or ON)
- LAP MEM
- USB (OFF or ON)
- Erase USB
- TIME Set
- CODE (only if active)



Important

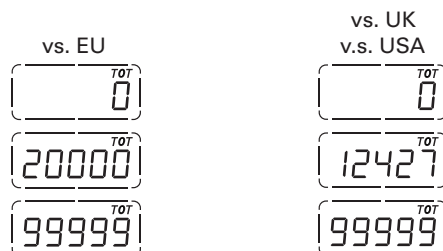
This menu is active only if the speed of the motorcycle is less than 20 km/h. If this menu is on the display and the speed of the motorcycle exceeds 20 km/h, the instrument automatically exits the menu and returns to the initial display. It is possible to exit the menu at any time, however, by pressing the button (1) in position A "▲" for 3 seconds.

Total distance travelled indicator (odometer)

At Key-On the system automatically enters this function.

The reading is saved permanently and cannot be reset.

If it exceeds 99999 km (or 99999 miles), the reading "99999" remains displayed permanently.

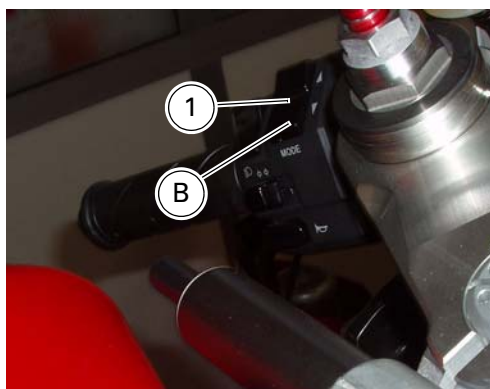
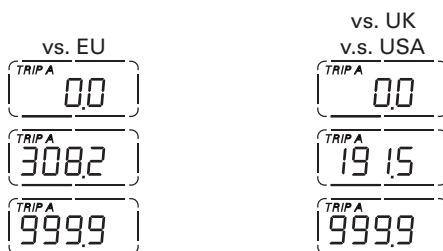


Trip meter "TRIP A"

While in this function, if you press button (1) in position B "▼" for 3 seconds, the reading is reset.

If the reading exceeds 999.9, it is reset 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 new unit of measurement.



Trip meter "TRIP B"

A

While in this function, if you press button (1) in position B "▼" for 3 seconds, the reading is reset to zero.
If the reading exceeds 999.9, it is reset to zero and the count restarts automatically.
If the system's units of measurement are changed at any time with the "Setting Special" function, the reading in this function is reset and the count restarts from zero in the new unit of measurement.

B

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D

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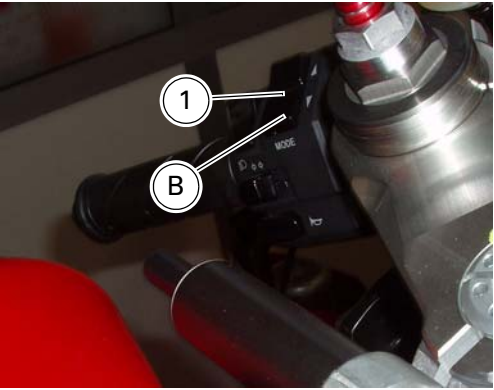
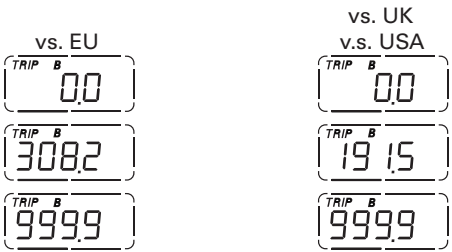
H

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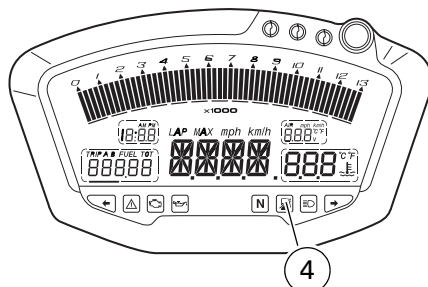


"TRIP FUEL" indicator (distance travelled on reserve fuel)

When the fuel warning light (4) comes on, the TRIP FUEL meter is activated automatically, regardless of the function displayed. If the fuel level remains in reserve, the reading is saved even after Key-Off.

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.



vs. EU	vs. UK v.s. USA
TRIP FUEL 0.0	TRIP FUEL 0.0
TRIP FUEL 308.2	TRIP FUEL 19.15
TRIP FUEL 999.9	TRIP FUEL 999.9

A

B

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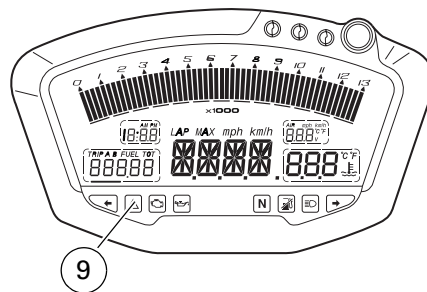
Air temperature indicator

Shows the outside air temperature.

Display limits: -39 °C to +124 °C.

In rge event of a FAULT with the sensor (-40 °C,+125 °C or disconnected) the series of dashes “- - -” is displayed (not flashing) and the Engine Diagnostics warning light (9) comes on.

vs. EU	vs. USA
AIR -39 °C	AIR -38 °F
AIR 20 °C	AIR 68 °F
AIR 124 °C	AIR 255 °F
AIR - - - °C	AIR - - - °F



Coolant temperature indicator

Displays the engine coolant temperature:

if the reading is less than or equal to -40°C (-104°F), the display shows a series of flashing dashes (“—”) and the Engine Diagnostics warning light comes on (9);

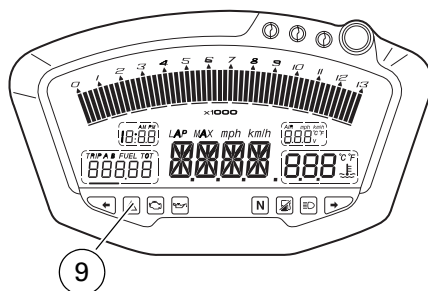
if the reading is between -39°C (-102.2°F) and $+39^{\circ}\text{C}$ ($+102.2^{\circ}\text{F}$), the word “LO” will be displayed steadily;

if the reading is between $+40^{\circ}\text{C}$ ($+104^{\circ}\text{F}$) and $+120^{\circ}\text{C}$ ($+248^{\circ}\text{F}$), the temperature value will be displayed steadily;

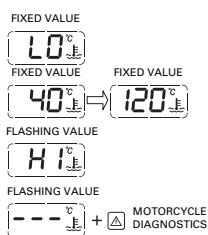
if the reading is between $+121^{\circ}\text{C}$ ($+249.8^{\circ}\text{F}$) and $+124^{\circ}\text{C}$ ($+255.2^{\circ}\text{F}$), the word “HI” will flash on the display;

if the reading is greater than or equal to $+125^{\circ}\text{C}$ ($+257^{\circ}\text{F}$), the display shows a series of flashing dashes (“—”) and the Engine Diagnostics warning light (9) comes on.

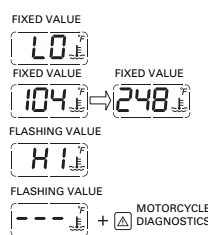
In the event of a sensor FAULT, a series of flashing dashes (“—”) appears and the Engine Diagnostics warning light (9) comes on.



vs. EU - vs. UK



v.s. USA



Service indicator (SERV)

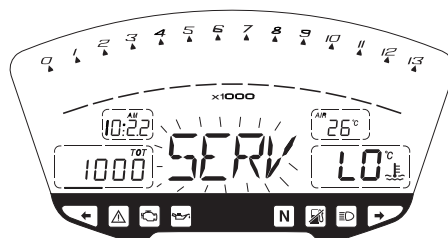
Indicates that the next service is due.

The message “SERV” appears on the display at the following intervals:

after the first 1000 km on the odometer;

every 12000 km on the odometer.

The message is displayed only at Key-On for 5 seconds.



Battery voltage indicator (BATT)

A

To display this function, go into the menu and select the “BATT” page.

The battery voltage reading is displayed as follows:

if the reading is between 12.1 and 14.9 Volts, it remains lit steadily;

if the reading is between 10.0 and 12.0 Volts or between 15.0 and 16.0 Volts, it flashes;

if the reading is less than or equal to 9.9 Volts, the flashing message “LO” appears on the display and the Motorcycle Diagnostics warning light (9) comes on;

B

if the reading is greater than or equal to 16.1 Volts, the flashing message “HI” appears on the display and the Motorcycle Diagnostics warning light (9) comes on.

C

D

E

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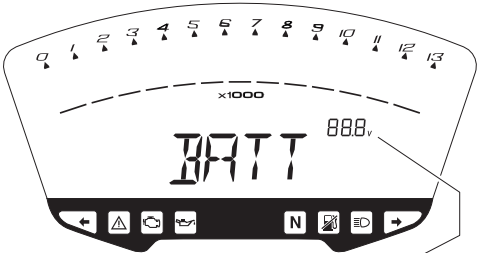
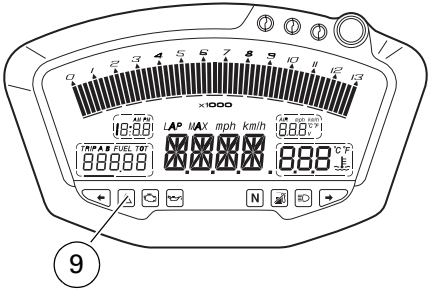
H

L

M

N

P

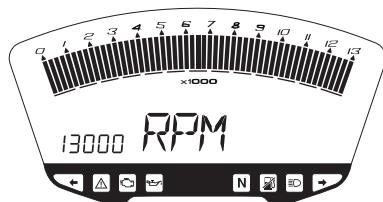
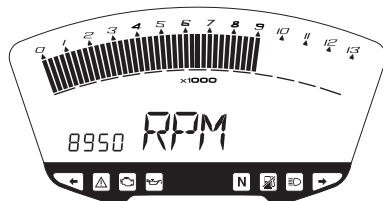
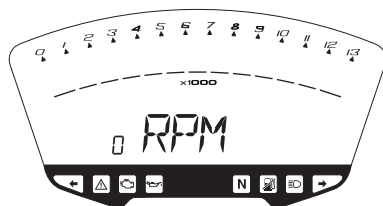


	FIXED		FIXED
STATUS 1	12.1 _v	⇄	14.9 _v
	FLASHING		FLASHING
STATUS 2	10.0 _v	⇄	12.0 _v
	FLASHING		FLASHING
STATUS 3	LO _v	⇄	HI _v

Adjusting the engine idle speed (rpm)

To display the function, go into the menu and call up the "RPM" page.

As well as the top rev counter scale, the display also shows engine rpm numerically so that you can adjust the idle speed more precisely.



A

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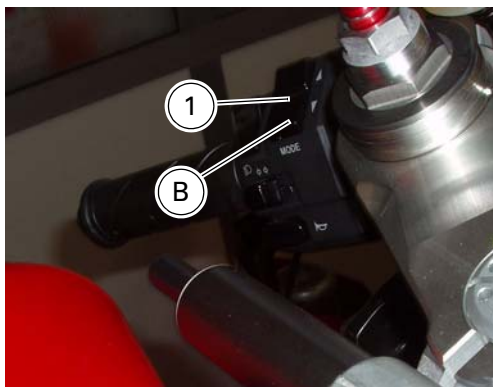
M

N

P

Lap time display

To activate this function, go into the menu and set the "LAP" function to "On" by keeping button (1) in position B "▼" for 3 seconds.



START and STOP the timer by pressing the high beam FLASH button (2) on the left-hand handlebar switch.

When the LAP function is active, each time you press the FLASH button, the display will show the lap time for 10 seconds, before reverting to normal mode.

You can save a maximum of 30 laps in the memory.

If the memory is full, each time you press the FLASH button, the display will not save any more lap times and will display the flashing message "FULL" for 3 seconds until the memory is reset.



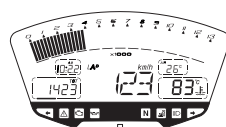
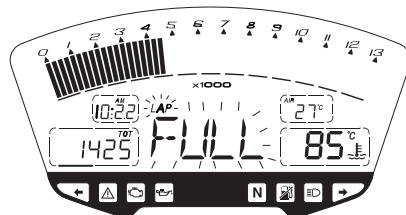
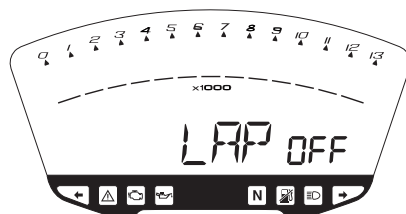
When you switch the LAP function off using the menu, the lap in progress is not saved.

If the LAP function is active and the display is suddenly switched off (Key-Off), the LAP function is switched off automatically (even if the timer was ON, the lap in progress is not saved).

If the timer is not stopped, when it reaches 99 minutes, 59 seconds and 99 hundredths of a second, it restarts from 0 (zero) and continues until the function is switched off.

If, however, the LAP function is switched on and the memory has not been cleared, but the less than 30 laps have been saved (e.g. 18 laps), the display will save any remaining laps until the memory is full (in this case, it will save a further 12 laps).

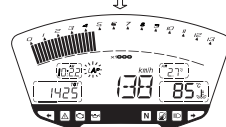
In this function, lap time only is displayed, but other data are also saved (MAX speed, MAX rpm, limiter if reached) for viewing at a later date in the Lap Memory function.



press C



after 10 sec.



press C



after 10 sec.



LAP Memory display

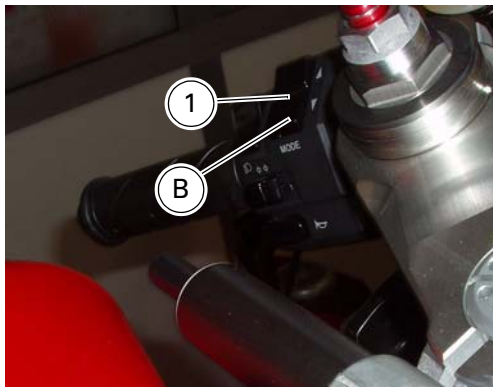
Displays the data saved with the LAP function: lap time, MAX speed and MAX rpm.

To display the saved times, go into the menu and select the "LAP MEM" page.

From this page, if you hold button (1) in position B "▼" for 3 seconds, the data for the first lap will appear. The display will show the lap number, lap time, MAX speed and the MAX rpm reached for the lap in question.

If you switch the button (1) to position B "▼", the display scrolls through the 30 saved times, before returning to the 1st lap.

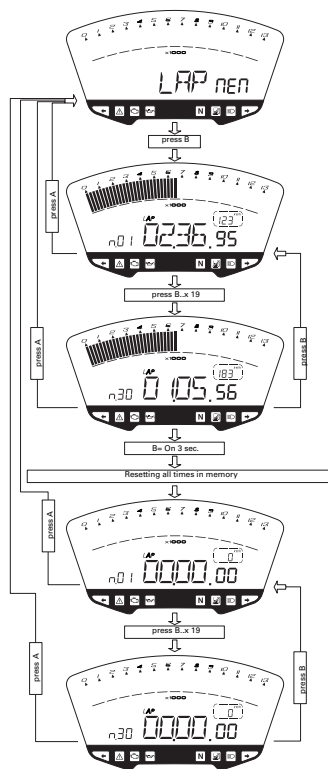
If you hold the button (1) in position B "▼" for 3 seconds while displaying the saved times, the display immediately resets all the saved times. In this case, if the LAP function was active, it is switched off automatically.



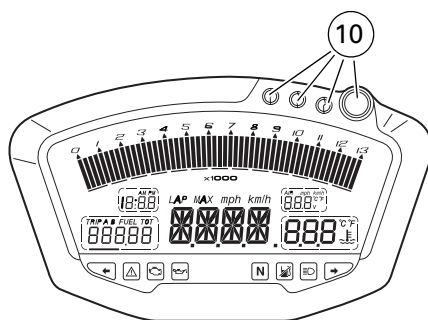
The MAX speed saved is the maximum speed indicated on the display in Lap function.

If when saving the MAX speed the indication exceeds 299 km/h (186 mph), the speed reached is displayed (e.g. 316 km/h).

If there is no reading in the memory, the 30 times are shown, with the timer displaying "00.00.00", MAX rpm = 0 and MAX speed = 0.



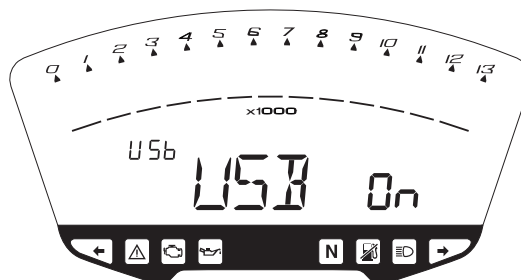
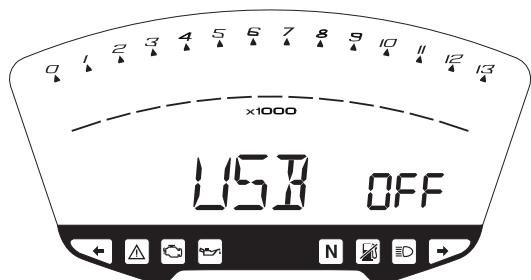
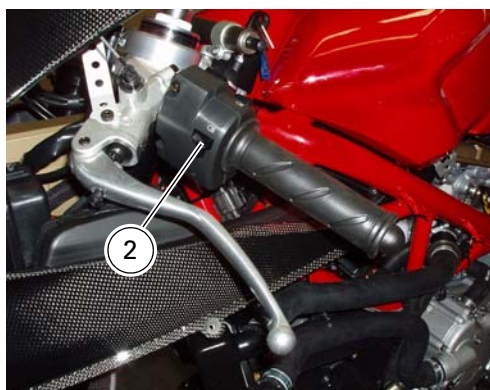
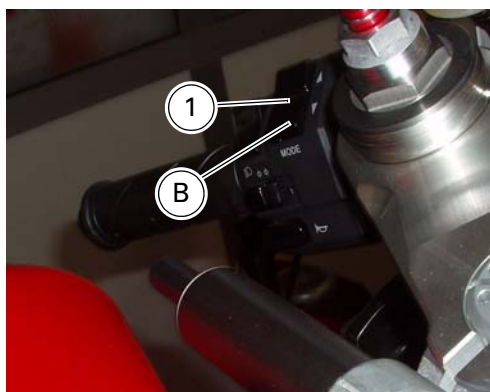
During the lap, if the engine reaches one of the two thresholds before the limiter or the limiter itself, the respective warning lights (10) come on during the display of the saved times.



USB DAQ

This function activates the USB Data Acquisition (DAQ) (Sect. P 10): the DAQ must be connected to the motorcycle wiring. To activate the DAQ, go into the menu and set the USB DAQ to "On" by holding the button (1) in position B "▼" for 3 seconds. START and STOP the lap separator by pressing the high beam FLASH button (2) on the left-hand handlebar switch.

If the USB function is active and the display is suddenly switched off (Key-Off), the function is switched off automatically.

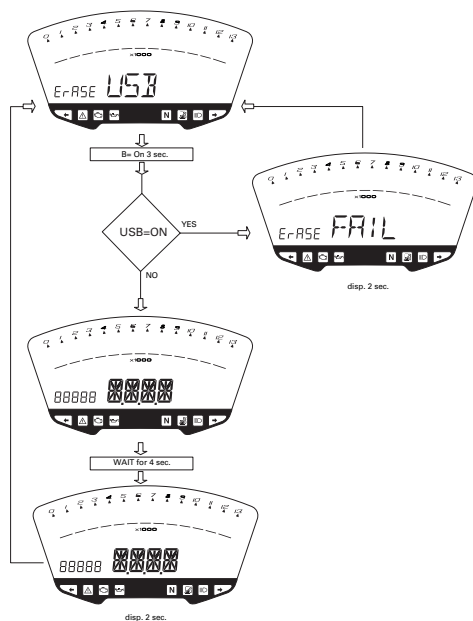
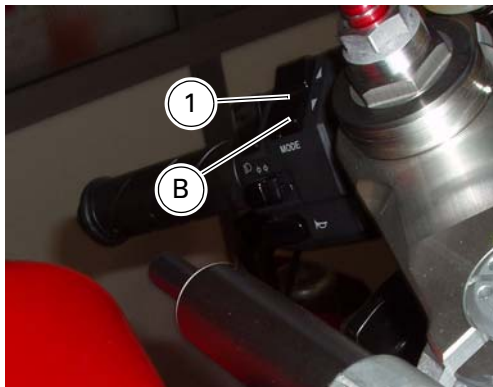


Erase USB

This function enables you to delete the data saved on the USB DAQ: the DAQ must be connected to the motorcycle wiring. To delete the data, go into the menu and select the "Erase USB" page.

If you hold the button (1) in position B "▼" for 3 seconds and the USB DAQ is not acquiring data, the message "WAIT..." appears on the display for 10 seconds. After 10 seconds, the message "OK" appears for 2 seconds, to confirm that the data has been deleted.

If you hold the button (1) in position B "▼" for 3 seconds and the USB DAQ is acquiring data, the DAQ memory is not cleared and the display shows the message "ERASE FAIL" for 2 seconds.



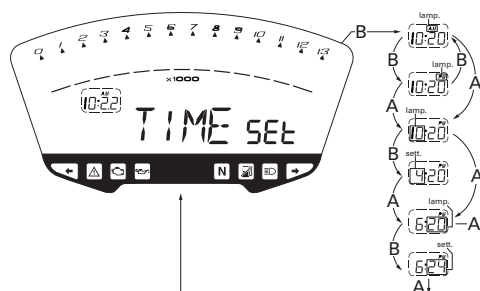
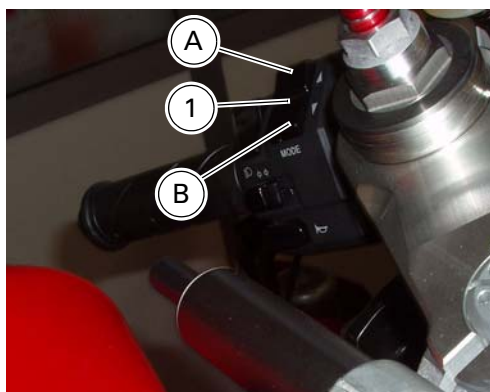
Clock setting

To set the clock, select the "TIME Set" page from the menu.

From this page, if you press the button (1) in position B "▼" for 3 seconds, you enter clock setting mode.

On entering this mode, the message "AM" will flash on the display; pressing the button (1) in position B "▼" will switch the display to "PM"; pressing the button (1) in position B "▼" will take you back to the previous display (if the time is exactly 00:00, when the display switches from AM to PM the time will appear as 12:00); press button (1) in position A "▲" to enter the hours setting mode (the hour digits flash). Each time you press the button in position B "▼", the hours digit increases cyclically in steps of 1 hour; hold the button pressed down in position B "▼" to scroll faster through the hours in steps of 1 hour every second (when the button is held pressed continuously, the hour digits do not flash).

If you press the button (1) in position A "▲", you enter the minutes setting mode and the minute digits will start flashing. Each time you press the button in position B "▼", the minutes increase cyclically in steps of 1 minute; hold the button down in position B "▼", to scroll faster through the minutes in steps of 1 minute every second. If the button is held in position B "▼" for more than 5 seconds, the minutes advance by 1 every 100 ms (when the button is held in position B "▼" continuously, the seconds do not flash). If you press the button in position A "▲", the system exits the clock setting mode and displays the newly set time.



Setting the special functions (vehicle model and units of measurement)

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 settings, press button (1) in position A “▲” and simultaneously turn the ignition keyswitch from OFF to ON.

This function allows you to select the units of measurement displayed on the instrument panel.

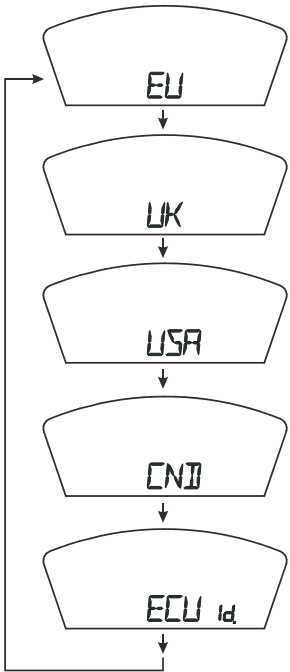
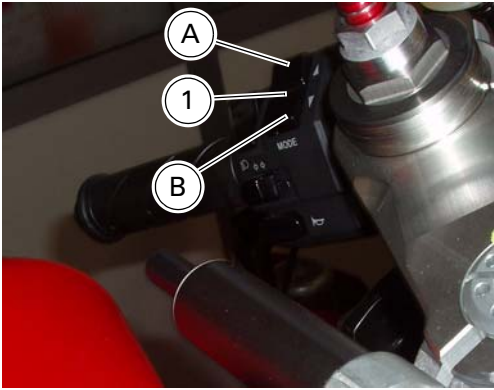
Each time you press button (1) in position B “▼”, the instrument panel scrolls through the following sequence of options, which flash on the display:

	Units of measurement		
STANDARD	Speed	H2O temperature	Counters
EU	km/h	°C	km
UK	Mph	°C	miles
USA	Mph	°F	miles
CND	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 button (1) in position B “▼” for 5 seconds, the option currently displayed will be saved to memory and the word “MEM” will appear.

The new parameter setting will applied at the next Key-On.



Instrument panel diagnostics


Important

The instrument runs the system diagnostics correctly 60 seconds after the last Key-Off.

Any anomalous behaviours of the motorcycle are displayed.

If there are several errors, they are displayed in rolling mode every 3 seconds.

The table below shows the errors that can be displayed.

Warning light	Error message	Error
	COIL 10.1	Horizontal cylinder coil error
	COIL 10.2	Horizontal cylinder coil error
	COIL 11.1	Vertical cylinder coil error
	COIL 11.2	Vertical cylinder coil error
	INJE 12.1	Horizontal cylinder injector error
	INJE 12.2	Horizontal cylinder injector error
	INJE 13.1	Vertical cylinder injector error
	INJE 13.2	Vertical cylinder injector error
	PUMP 16.0	Fuel pump relay error
	FAN 18.1	Fan relay error
	FAN 18.2	Fan relay error
	STRT 19.1	Starter contactor error
	STRT 19.2	Starter contactor error
	STEP. 21.1	Stepper motor error
	STEP. 21.2	Stepper motor error
	STEP. 21.3	Stepper motor error
	LAMB. 22.1	Lambda heater error
	LAMB. 22.2	Lambda heater error
	EXVL 23.1	Exhaust valve motor error
	EXVL 23.2	Exhaust valve motor error
	EXVL 23.3	Exhaust valve motor error
	EXVL 23.4	Exhaust valve motor error
	EXVL 23.5	Exhaust valve motor error
	TPS 1.1	Throttle position sensor error
	TPS 1.2	Throttle position sensor error
	PRESS 2.1	Pressure sensor error
	PRESS 2.2	Pressure sensor error
	T.WAT 3.1	Engine coolant temperature sensor error
	T.WAT 3.2	Engine coolant temperature sensor error

A	Warning light	Error message	Error
		AIR 4.1	Air temperature sensor error
B		AIR 4.2	Air temperature sensor error
		BATT 5.1	Battery voltage error
C		BATT 5.2	Battery voltage error
		LAMB 6.1	Lambda sensor error
		TILT 6.2	Lambda 2 sensor error
D		DTC 8.0	Traction control unit error (the error can only occur if the bike has been fitted with the traction control kit available from Ducati performance)
		ECU 30.0	Engine ECU error
		PK.UP 34.0	Pick-up sensor error
		SPEE. 36.0	Speed sensor error
E		IMMO 37.0	Immobilizer error
		IMMO 37.1	Immobilizer error
		IMMO 37.3	Immobilizer error
F		IMMO 37.4	Immobilizer error
		IMMO 37.5	Immobilizer error
		CAN 38.0	CAN line error

G Automatic operation of LCD and rev counter backlighting - automatic adjustment of indicator light brightness

The system automatically switches the instrument panel back lighting on and off in accordance with the ambient light conditions. In the same way, it also automatically adjusts the brightness of the indicator lights, however this function is only active when the lights switch is set to ON.

H Intelligent headlight switch-off

This function helps reduce battery use by automatically switching off the headlight. The device is triggered in 2 cases:

- in the first case, if you turn the key from OFF to ON and do not start the engine within 60 seconds, the headlight is turned off and will be turned on again only when the engine is next switched on.
- in the second case, after the normal use of the motorcycle with the lights on, if the engine is stopped using the RUN-STOP button on the right-hand handlebar switch. In this case, the headlight is switched off 60 seconds after the engine is switched off, and only switched on again the next time the engine is started.

M

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P

Intelligent headlamp switch-on

This function allows programmed headlight switch-on even with the motorcycle off (Key-Off).

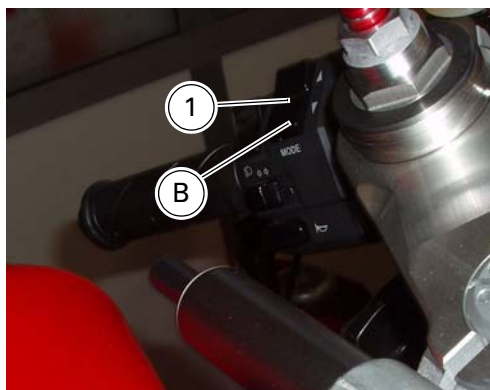
Immediately after key-off, the instrument panel remains active for 60 seconds, thus allowing the headlamp to be switched on if the button (1) is pressed in position B "▼".

During these 60 seconds, each time the button (1) is pressed in position B "▼", the instrument panel will activate the headlight for 30 seconds; each press of the button (1) in position B "▼" will add to the headlight activation time, up to a maximum of 6 presses (equivalent to a maximum activation time of 180 seconds).

After the first time you press the button (1) in position B "▼", the period of 30 seconds starts, thus switching on the headlight. Further activation time can be added only if you press the button again within these 30 seconds. If the 30 seconds have elapsed, no further multiples of 30 seconds can be added, and the instrument panel will switch off the headlight.

To return to this function, you must do at least one Key-On/Key-Off.

If the battery power is interrupted at any time while this function is active, when power is restored the instrument panel will deactivate the function (the instrument panel does not remain active for 60 seconds).



A

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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 black keys have the following characteristics:

- they contain the secret code used for programming the immobilizer and allowing the engine to be started;
- the key grip (which contains the electronic circuit for transmission of the secret code) can be removed and fitted to a different blade if the motorcycle locks and ignition lock are changed;

The transponder is fitted inside the key grip and consists of a power supply circuit, a ROM (Read-Only Memory) and a transmission circuit. The transponder is supplied with power by the magnetic field generated by the antenna which is enabled as soon as the instrument panel is switched on. Since the transponder is very compact and needs no external battery power supply, it is moulded permanently into the key grip.



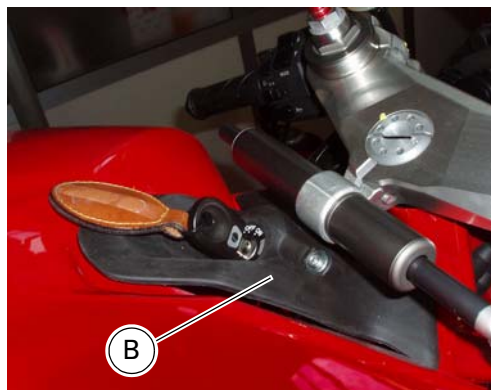
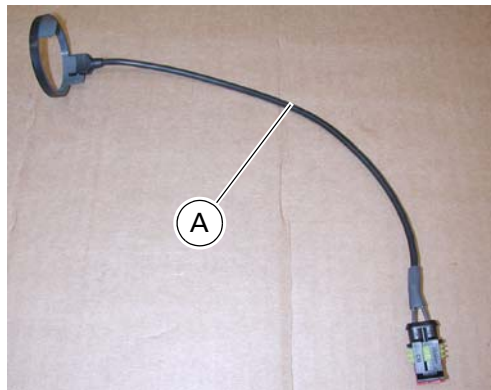
Warning

The circuits in the key grips are not shockproof and may therefore be damaged by violent impact.

Immobiliser 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

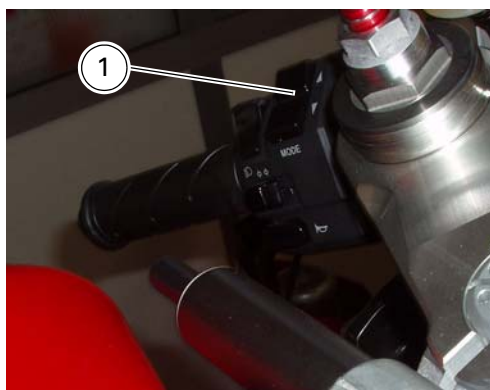
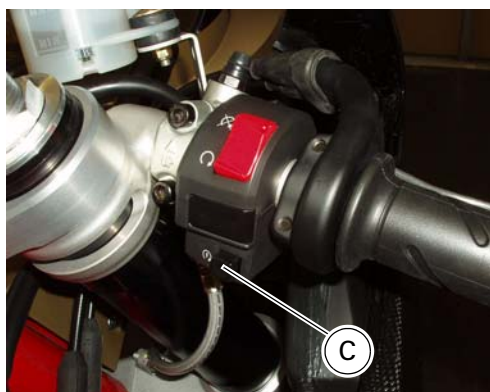
At key-on (switching on the instrument panel by turning the key) the decoder (incorporated in the instrument panel) activates the antenna, which emits an electromagnetic field that serves to power the transponder in the key grip. The transponder responds by transmitting the code that is stored on its 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 is positive, the decoder sends a further code to the engine ECU over a dedicated serial line (ISO 9141/5). The ECU checks the code received and, if the result of this check is positive, engine starting is enabled.

Warning light signals and immobilizer indications

Whenever the ignition key is turned from ON to OFF, the immobilizer system activates the engine start protection system.

When the engine is started and the key is turned from OFF to ON, the system generates the following signals:

- if the code is recognised, the protection system releases the engine lock. When you press the START button (C), the engine starts.
- pressing button (1) in position "▼" displays the "Error IMMO" message, indicating the the code has not been recognised. In this case, it is advisable to turn the ignition key back to OFF and then to ON again. If the engine still does not start, try using another black key.



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Programming the immobilizer

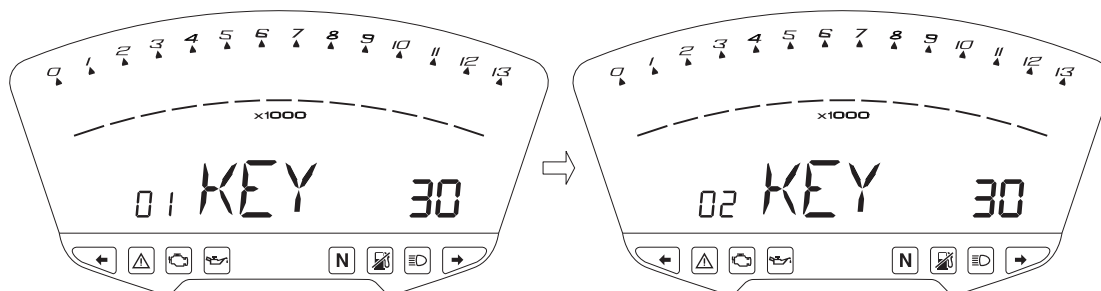
This instrument panel function enables programming of the Immobilizer System.



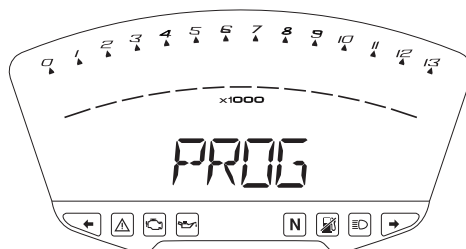
Notes

Only 2 keys may be programmed.

- insert KEY 1 (one of the two black keys) and turn the ignition switch from Off to On;
- within 3 seconds turn the ignition switch from On to Off;
- within 15 seconds insert KEY 2 (the other black key) and turn the ignition switch from Off to On;
- within 3 seconds turn the ignition switch from On to Off;
- within 15 seconds, insert again KEY X (either Key 1 or Key 2) and turn the ignition switch from Off to ON.

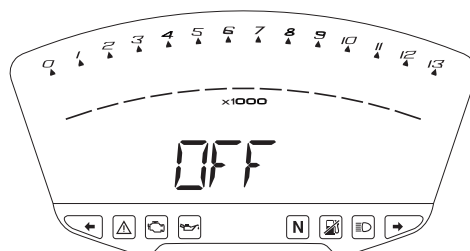


If the procedure was successful, the instrument panel will display the message "PROG" steadily for 3 seconds before returning to normal display mode.



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 memory, retrieves two "electronic" codes from insertion of KEY 1 (first key to be inserted) and KEY 2 (second key to be inserted).

If the Immobilizer is reprogrammed, the key codes will be erased and replaced with the new codes of the new keys; the two "electronic" codes, however, remain permanently in memory and cannot be deleted or overwritten.

The code on the Code Card corresponds to one of the two electronic codes and is used for Immobilizer Recovery and Immobilizer Reprogramming.

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Immobilizer override procedure

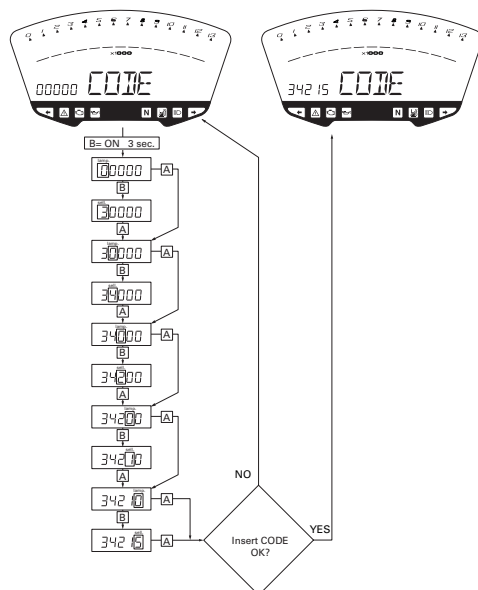
Should the immobilizer become locked, you can perform the “Immobilizer Override” procedure from the instrument panel by entering the respective function as follows:
Select the “CODE” page from the menu.



Notes

This menu should be active only if there is at least one immobilizer error.

With this page selected, the initial code is always displayed as "00000". If you hold the button (1) in position B "▼" for 3 seconds, you will access the procedure for entering the electronic code marked on the Code Card.



Entering the code:

on entering this function, the first digit on the left starts flashing.

Button (1):

each time you press the button in position B "▼", the number increases cyclically in steps of one digit every second;

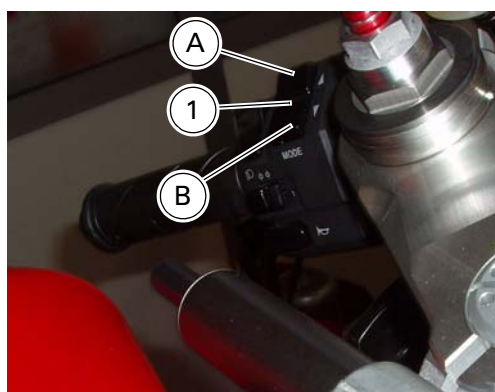
If you press the button in position A "▲", you can set the second digit, which will start flashing. Each time you press the button in position B "▼", the number increases cyclically in steps of one digit every second.

if you press the button in position A "▲", you can set the third digit, which will start flashing. Each time you press the button in position B "▼", the number increases cyclically in steps of one digit every second.

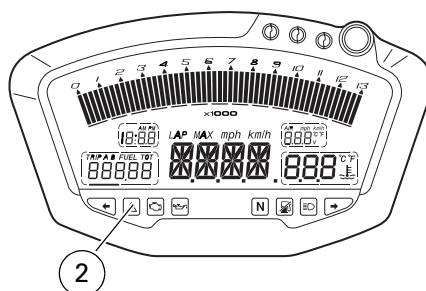
If you press the button in position A "▲", you can set the fourth digit, which will start flashing. Each time you press the button in position B "▼", the number increases cyclically in steps of one digit every second.

if you press the button in position A "▲", you can set the fifth digit, which will start flashing. Each time you press the button in position B "▼", the number increases cyclically in steps of one digit every second.

press the button in position A "▲" 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 motorcycle diagnostics warning light (2) 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 the code has been entered incorrectly, however, the instrument panel will automatically return to the "CODE" menu and display the code "00000".

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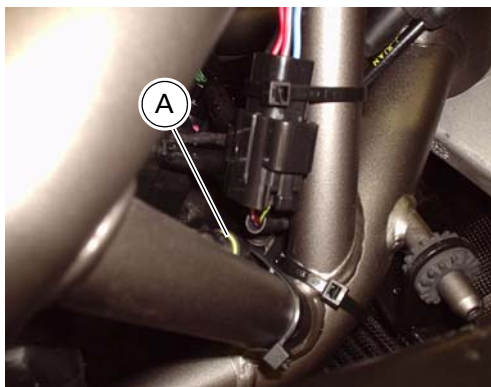
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Removal of the immobilizer

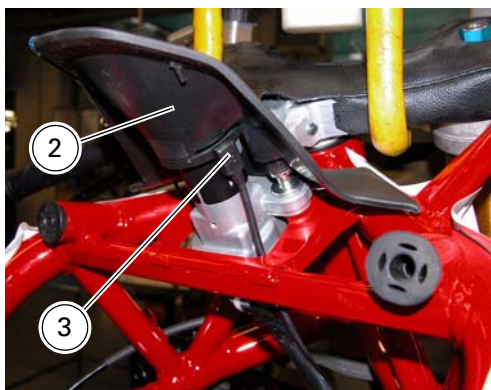
Set the ignition switch to **OFF**.

Remove the right-hand side fairing (Sect. E 3, Removal of the fairings).

Disconnect the antenna wiring connector (A) from the main wiring loom.



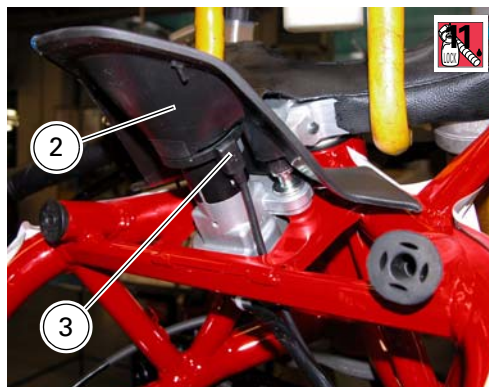
Unscrew the two nuts (1) and remove the keyswitch cover (2) with the immobilizer antenna (3).



Refitting the immobilizer

Apply the recommended threadlocker to the inside of the cover (2) in two points of the seat of the immobilizer antenna (3) and install the antenna (3) in the cover (2).

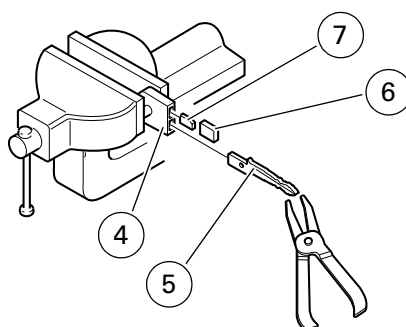
Position the cover to the keyswitch block and tighten the nuts (1) to the specified torque (Sect. C 3, Frame tightening torques).



Removal of the transponder from the key

Clamp the grip of the key (4) in a vice with protective jaw facings.

Using a pair of pliers, withdraw the key blade (5), remove the protections (6) and remove the transponder (7).
Replace the damaged parts and reassemble in reverse order.



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9 - Diagnostic instruments

For information on the "DDS" tester, refer to Sect. D 5, DDS tester.

Using a multimeter to check the electrical systems

Introduction

This instrument allows you to measure resistances, voltages, and current values. Multimeters can be divided into two basic types: those with an analogue display and those with a digital display. Units of the first type are equipped with a dial and needle. The dial is marked with the scales to be used for measurement of the various parameters. Digital units are equipped with a dial that displays numbers corresponding to the values of the measured parameters. The type of measurement to be carried out (voltage, current or resistance) is set by means of a selector or by means of several different sockets in which to insert the two test probe connector terminals. In certain cases it is essential to set the full scale value before proceeding. For example, in order to measure a 12 V signal, you need to set a full scale that is close to this value (e.g. 15 V or 20 V). It would be illogical to set a full scale value of 10 V; the same applies when setting current (Amps) or resistance (Ohms) full scale values. Sometimes the instrument can set the required full scale value automatically. Never exceed the maximum value allowed by the tester when measuring voltage or current signals.



Notes

The DDS tester (Sect. D 5, DDS tester) can perform the functions of a digital multimeter.

Voltage measurement

Voltage measurements must be carried out by connecting the terminals of the tester in parallel to the load (e.g. to the wires feeding a light bulb or a relay, the two battery terminals, or the two wires supplying power to a control unit). Voltages can be constant over time (DC voltage) or variable over time (AC voltage). In the first case, it is important to consider the negative and positive polarity of the application. It is therefore necessary to select on the multimeter the type of voltage you intend to measure. (DC voltage is shown by the symbol = while AC voltage is denoted by ~).

Current measurement

Current measurements must be made by connecting the multimeter terminals in series with the load (e.g. disconnect one of the wires feeding power to a light bulb and connect one terminal of the multimeter to the free end of wire and the other terminal to the light bulb. When the lights switch is set to ON, the bulb will illuminate normally and the tester will show the absorbed current, i.e. the amount of current passing through the wire. Warning: connections in series must be made and removed only when the power is switched off. Never attempt to make or break a series connection when a device is powered. Always make sure that the connection in series of the tester terminals on the electrical device is made in 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.

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10 - USB Data Acquisition (DAQ) (for 1098S only)

A USB DAQ (1) is supplied in kit form. To use it, position it under the seat with the cap (2) fitted and the connector (3) from the main wiring loom connected. Refer to the instrument panel functions (Sect. P 7, Display settings and functions).

