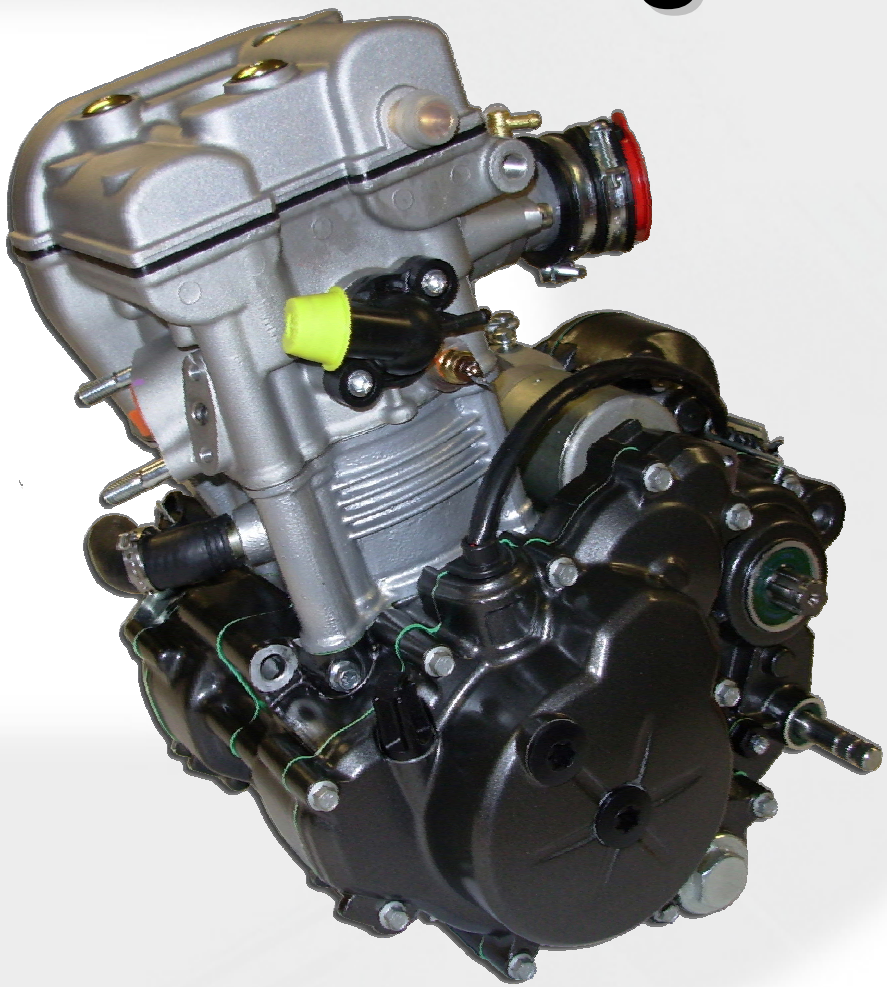
125 4T 4V Engine



19 VECES
CAMPEONA DEL MUNDO
TÍTULO PILOTOS 2008

125 4T 4V Engine

DERBI

1. Engine Technical Characteristics

- Type: 4-stroke and 4-valve single-cylinder, liquid-cooled engine (Euro3)
- Timing system: Double overhead camshaft, morse chain-driven
- Engine capacity: 124.2 cm^3
- Bore x stroke: 58 x 47 mm
- Compression ratio: 12 : 1
- Cylinder head material: Aluminium casting
- Cylinder material: Cast iron casting
- Idle: 1680 +/- 50 rpm
- CO value: 3.1 - 4.5 % (at idle and oil temperature at about 90º C)
- Power supply: Keihin CVK 30 carburettor
- Lubrication system: With semi-dry sump
- Transmission: With gears, and with 6 gear manual change, multi-disk wet clutch and final drive by chain

1. Engine Technical Characteristics

- **Ignition type:** Electronic CDI type (*Capacitive Discharge Ignition*)
- **Ignition advance:** Variable electronic advance
- **Current generator:** 190W three phase (13V, 14A at 8000 rpm)
- **Spark plug:** NGK CR8EB
- **Battery:** 12V 6Ah, maintenance free
- **Maximum nominal power:**

  bhp: 15.5 kW: 11.4 at 9250 rpm, at the crankshaft

  bhp: 14.0 kW: 10.3 at 9250 rpm, at the rear wheel
- **Maximum nominal torque:**

  kg·m: 1.22 N·m: 12 at 8500 rpm, at the crankshaft

  kg·m: 1.10 N·m: 10.8 at 8500 rpm, at the rear wheel

2.1. Valve clearance adjustment

- Valve clearance shall be adjusted at 6000, 24000, 48000, 72000Km…
- Valve clearance is adjusted by selection of the calibrated tappets.
- Tappets are available in various sizes, from 2.20 mm minimum to 2.75 mm, and within this range every 0.05 mm (see table).

Tappets inner surface shows two codes, a 4-digit one and a 3-digit one.

The 3-digit code indicates thickness, e.g.: 450 corresponds to 2.45 mm.

	REFERENCE	THICKNESS (mm)
1	CM222701	2,20
2	CM222702	2,25
3	CM222703	2,30
4	CM222704	2,35
5	CM222705	2,40
6	CM222706	2,45
7	CM222707	2,50
8	CM222708	2,55
9	CM222709	2,60
10	CM222710	2,65
11	CM222711	2,70
12	CM222712	2,75

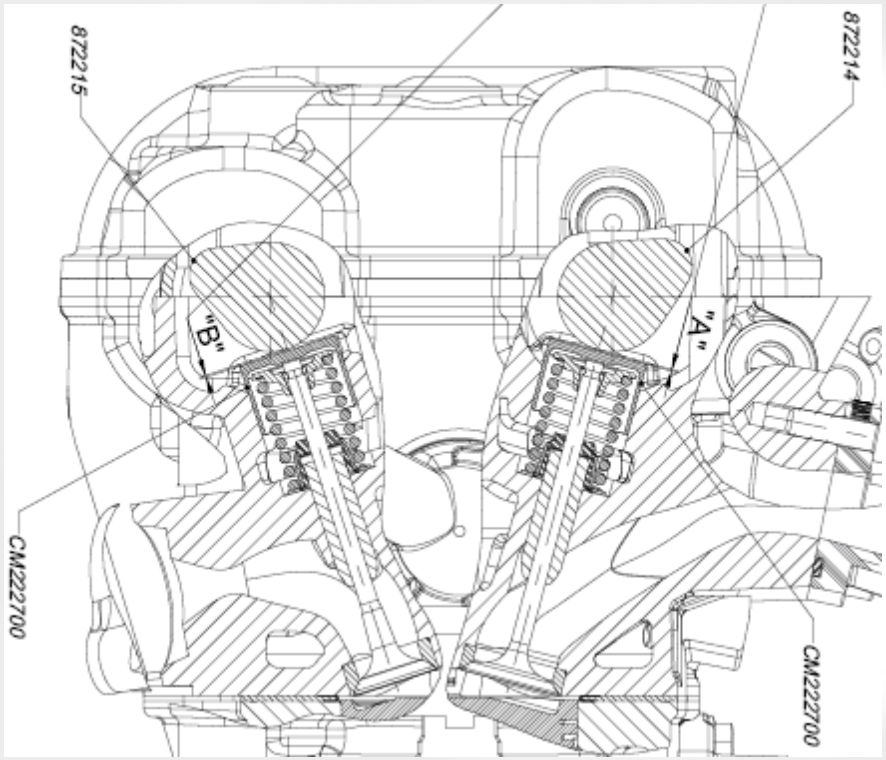
2.1. Valve clearance adjustment

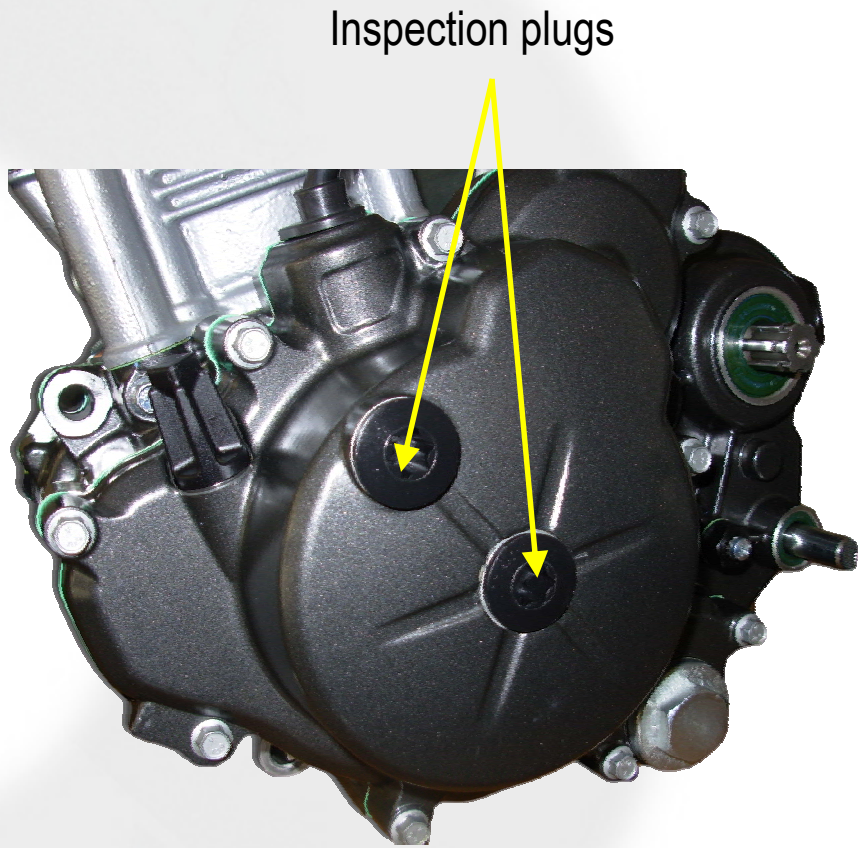
Procedure (with cold engine)

- Remove the plastic caps from flywheel-side cover.
- Set the piston at TDC in the compression stroke; to obtain this, turn the crankshaft counter clockwise (on flywheel side) and make sure the reference dot on flywheel matches with the reference on flywheel cover. In these conditions, cams must be divergent.
- Using a feeler gauge, check that clearance between cam and tappets complies with the values below:

Intake:	0.10 - 0.15 mm (Value A in the figure)
Exhaust:	0.15 - 0.20 mm (Value B in the figure)

2.1. Valve clearance adjustment





2.1. Valve clearance adjustment

- If clearance is not correct, disassemble the timing system:
  - Set the camshaft timing pins in their housing
  - Remove the timing chain tensioner
  - Using a calliper spanner, lock the camshaft sprockets and remove the screws
  - Remove the sprockets and chain
  - Remove the cam tower retaining screws, the cam tower and the camshafts
  - Remove the tappets and check its thickness by means of the 3-digit code




2.1. Valve clearance adjustment

- Now calculate the suitable required tappet thickness according to the following formula:

  – New tappet thickness = (B – A) + C [mm]

Where A = Required (intake or exhaust) clearance
B = Value measured with the feeler gauge
C = Thickness of installed tappets

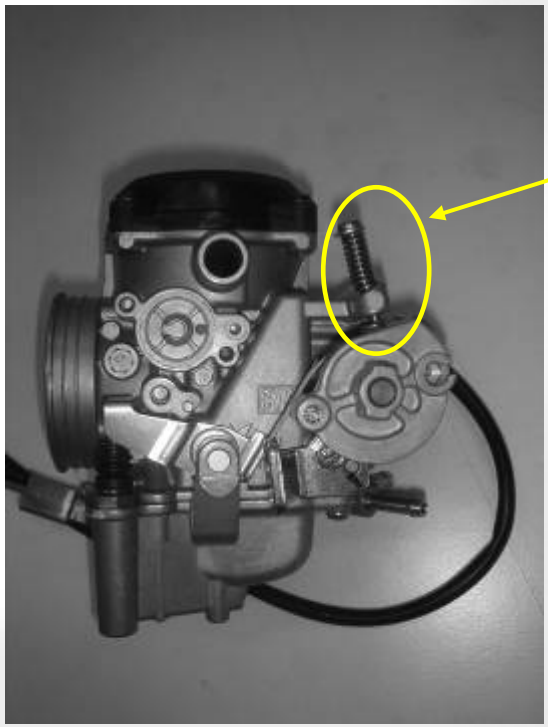
Example (exhaust valve): A= 0.20 B= 0.10 C= 2.40

  – New tappet thickness = (0.10 - 0.20) + 2.40 = 2.30 mm

- Once you select the suitable tappets, reassemble the timing system following the disassembly procedure in the reverse order. Smear some sealant on sprocket screw thread.

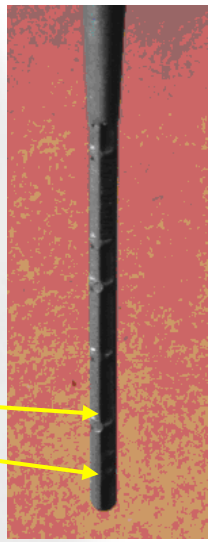
2.2. Idle speed adjustment

- Idling shall be 1680 + / - 50 rpm with warm engine
- Adjust by means of the carburettor screw



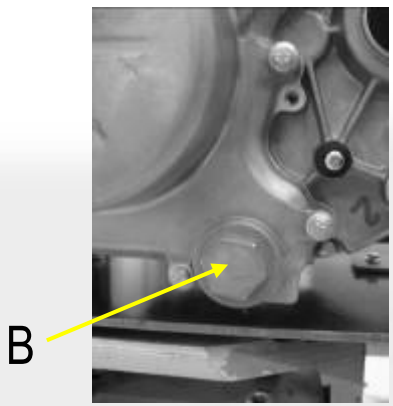
2.3. Engine oil change

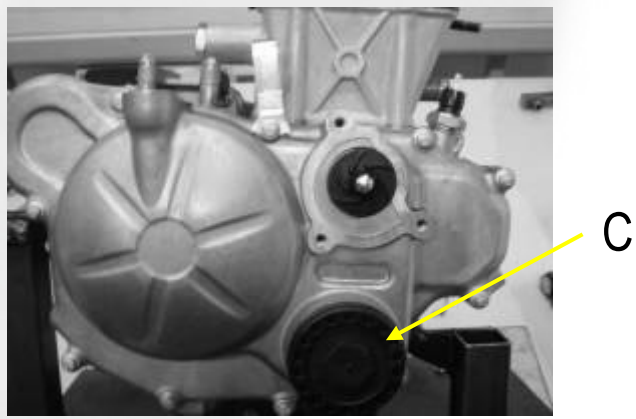
- Change at 1,000 km and then every 6,000 km.
- Oil type: AGIP TEC 4T (SAE 10W40)
- Oil + filter = 1150 cm^3 (check level by fully screwing up the dipstick)
- Total quantity in case of engine disassembly = 1200 cm^3



Replacement procedure (with engine warm):

- Slacken dipstick A to help oil drainage
- Remove screw B. Remove the oil pre-filter.
- Loosen the oil filter C.





2.4. Coolant replacement

- It is recommended to change it every 2 years.
- Remove the 2 sleeves connected to pump cover.
- Coolant quantity: 1130 ml
  - 770 ml: radiator + engine
  - 360 ml: expansion tank
- Recommended coolant: AGIP plus 30%.

2.5. Spark plug

Spark plug type:

- NGK CR8EB

Electrode gap:

- 0.7 ÷ 0.8 mm

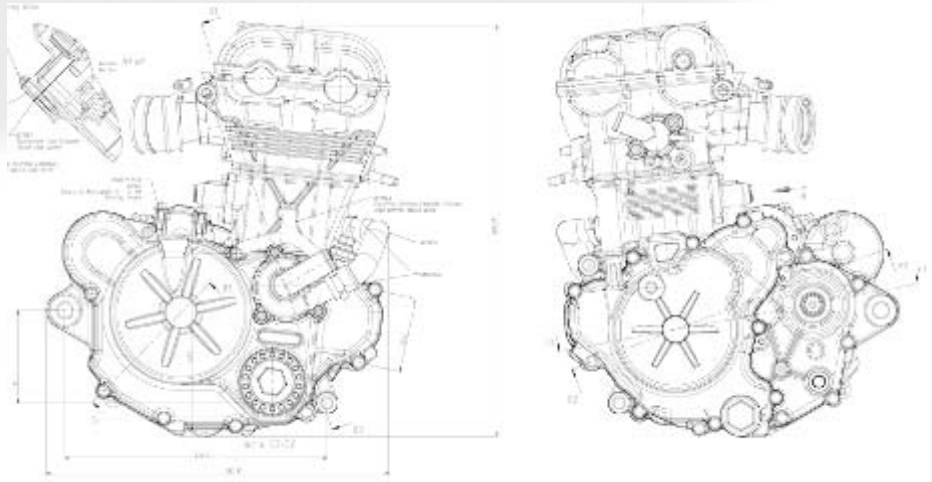
Inspection / Replacement:

- 6000 km/ 12000 km

3. Engine

3.1. Engine overview

Weight: 26 kg
Height: 385 mm
Width: 322 mm
Depth: 278 mm



3.2. Cylinder head - Camshafts

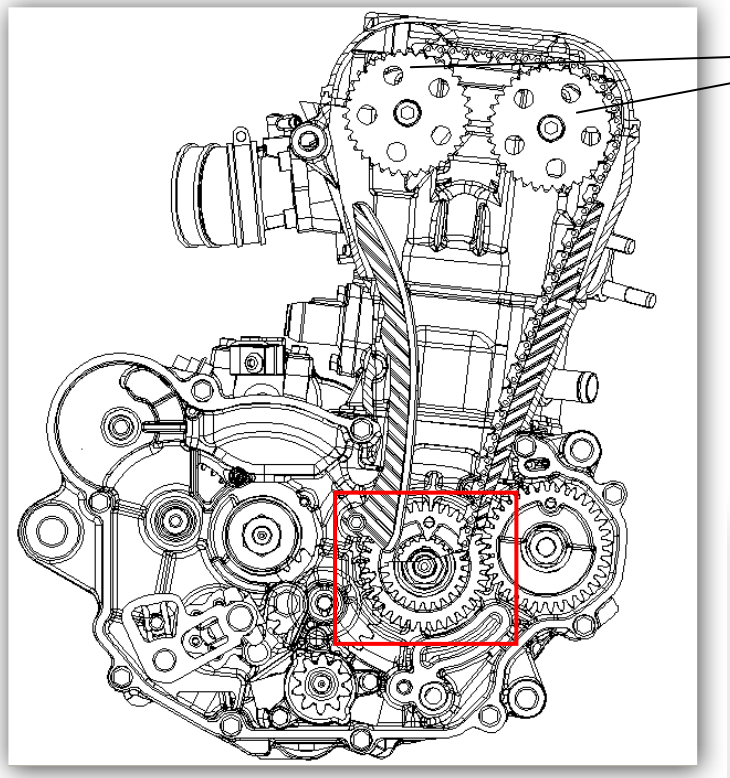
- Made in aluminium, it features four valves and double overhead camshaft. Camshafts are different, please identify them by making reference to the letter punched onto them: “A” or “S”
- Smear some oil onto the washers for the 4 screws retaining head to crankcase.

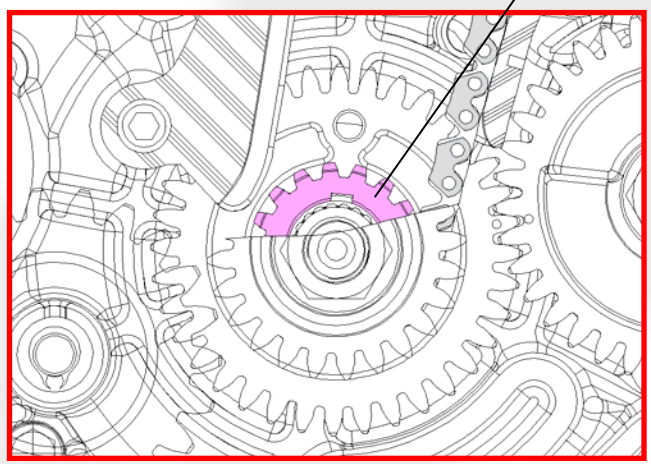
“A” = Intake

“S” = Exhaust

3.2. Cylinder head - Camshafts

- When installing any timing system components, make sure that the drive gear (sprocket) is correctly in place on the crankshaft.
- The punched dot must be facing outwards (visible). If it is installed with the dot inwards, gear (1) and timing sprockets (2) will be offset and not in line.

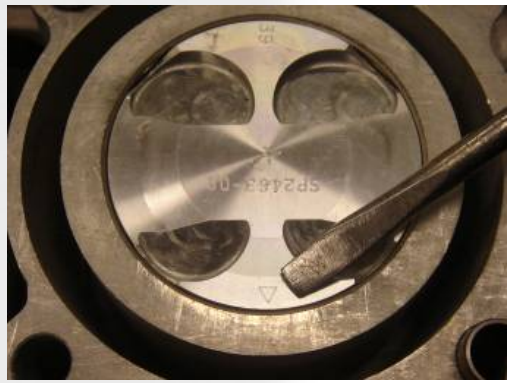




3.3. Cylinder – Piston

- The cylinder is made in cast iron and is available in four sizes (categories): M, N, O, P.
- The piston is also available in four sizes: M, N, O, P.
- In order to correctly position the piston, please refer to the arrow punched on piston crown that shall be pointing to the exhaust.

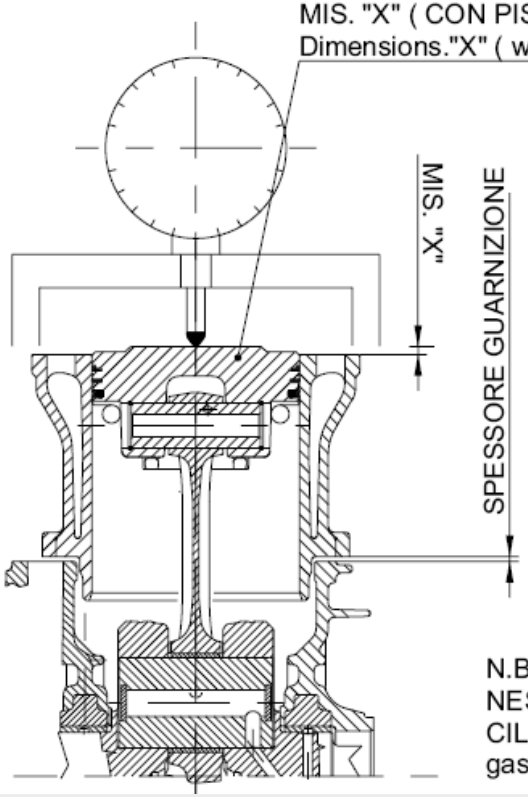
CATEGORY	CYLINDER		PISTON		
	MIN (mm)	MAX (mm)	MIN (mm)	MAX (mm)	PISTON CODE
M	58.010	58.017	57.953	57.960	8745340001
N	58.017	58.024	57.960	57.967	8745340002
O	58.024	58.031	57.967	57.974	8745340003
P	58.031	58.038	57.974	57.981	8745340004



Assembly clearance 0.050 - 0.064 mm

3.3. Cylinder – Piston

- Cylinder base gasket thickness shall be calculated in order to ensure the correct compression ratio. Three thickness sizes of base gasket are available: 0.3 / 0.4 / 0.5 mm
- Make this calculation using a dial gauge: do not install any gasket.



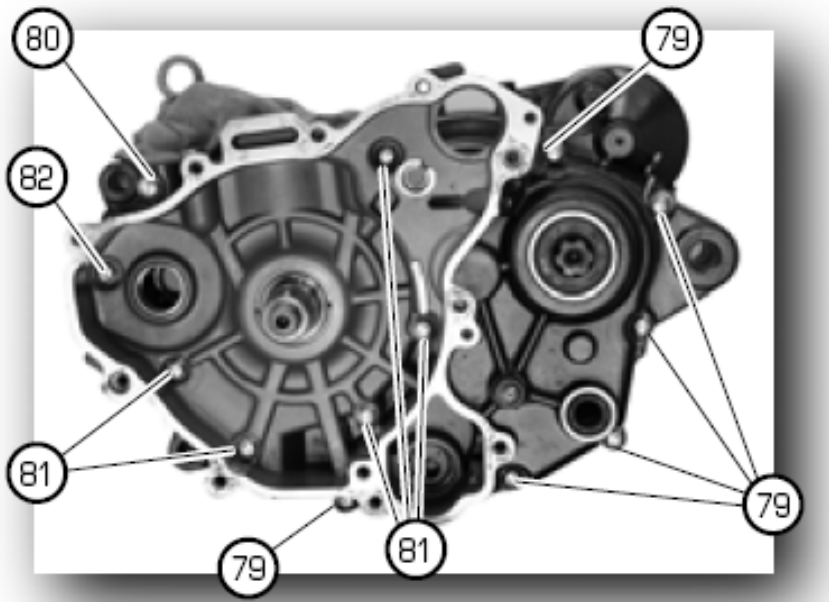
Rc=11,9-12,4

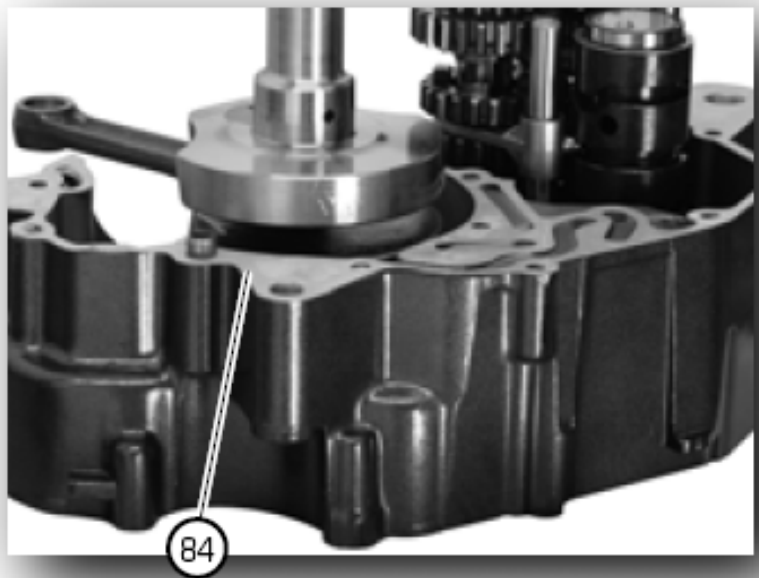
MISURA "X" Dimension "X"	*SPESS. GUARNIZIONE N° Gasket thickness*	*DIS. GUARNIZ. Gasket dwg*
0.95 / 1.09	*0.3±0.05*	*CM222801*
1.1 / 1.25	*0.4 ±0.05*	*CM222802*
1.26 / 1.45	*0.5±0.05*	*CM222803*

N.B.: LA MISURA "X" DEVE ESSERE RILEVATA SENZA NESSUNA GUARNIZIONE MONTATA FRA CARTER E CILINDRO Dimension "X" must be read without any gasket between sump and cylinder.

3.4. Crankshaft – Crankcase

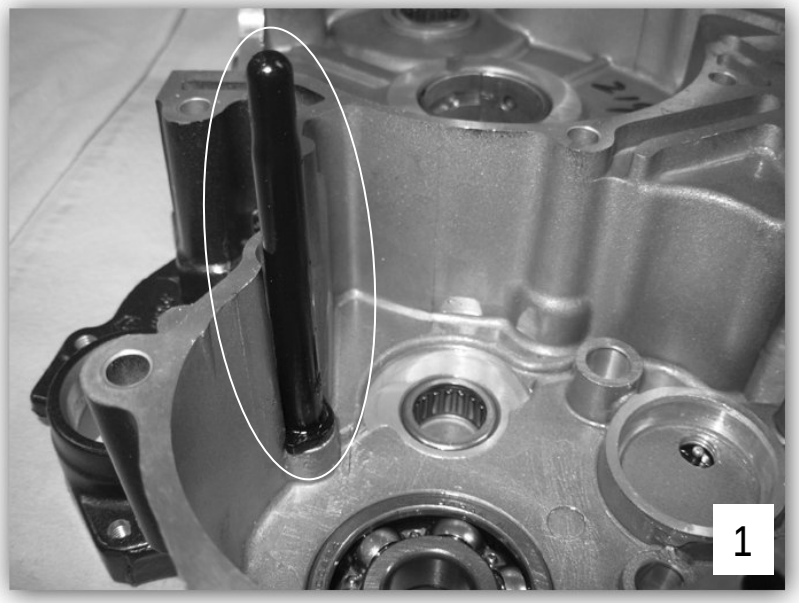
- The crankshaft is mated to the crankcase by means of duly sized bushings.
- To open the crankcase, remove the 13 coupling screws of the crankcase halves, working from flywheel side. Screws pos. 79 and 81 are of the same length; screw pos. 80 is the longest one while screw pos. 82 is the shortest.
- The crankcase to be removed is the one on the flywheel side.
- Gasket pos. 84 shall be replaced every time the crankcase is opened.

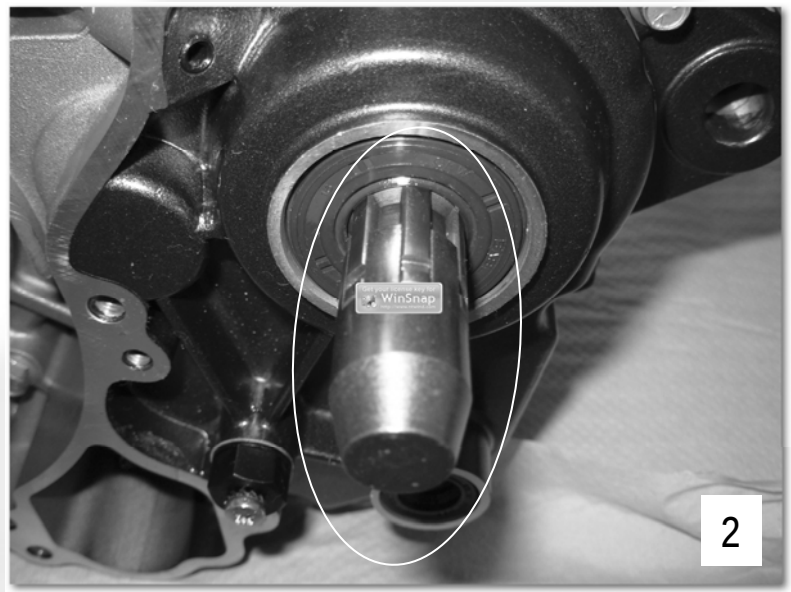




3.4. Crankshaft – Crankcase

- Before closing the crankcase, refit the plastic nozzle for gearbox lubrication (Figure 1)
- When closing the crankcase, use the suitable tool code 00H05600351 (50 2T gearbox secondary shaft oil seal tool) to avoid damaging the seal ring (Figure 2)

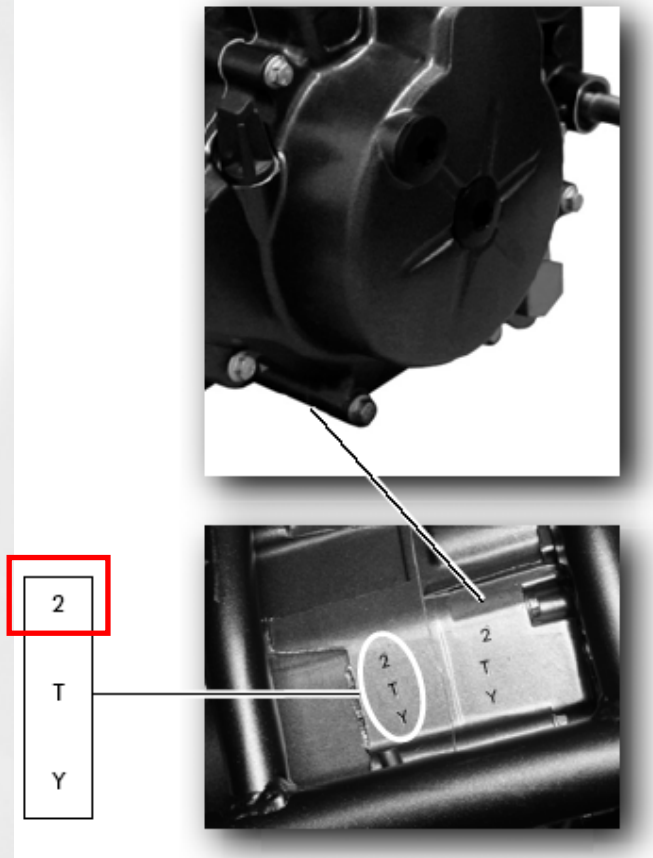




3.4. Crankshaft – Crankcase

- Crankcases are classified in two size classes, which differ in the diameter of the main bearing seat. The class 1 or 2 is indicated outside both crankcase halves, in the area shown in the figure, according to the sizes indicated in the table.

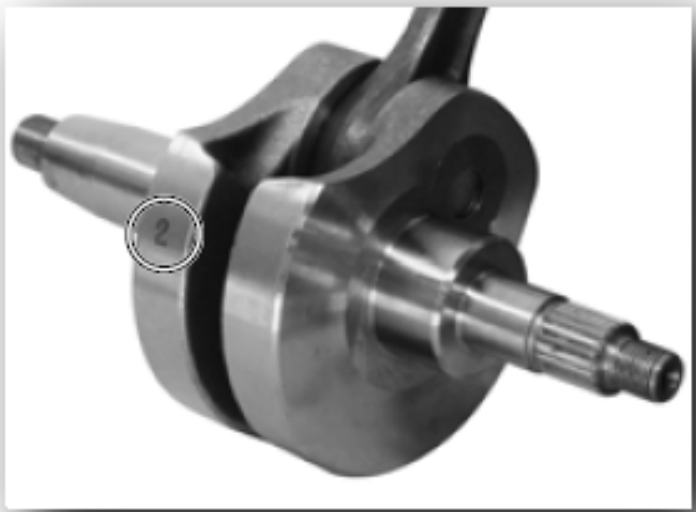
	MIN (mm)	MAX (mm)
TYPE 1	36.500	36.508
TYPE 2	36.508	36.516



3.4. Crankshaft – Crankcase

- Crankshafts are classified in two size classes, which differ in the diameter of the main journals. The class 1 or 2 is indicated on every counterweight (referred to its journal), in the area shown in the figure and according to the sizes indicated in the table.

	MIN (mm)	MAX (mm)	CRANKSHAFT CODE	CRANKCASE CODE
TYPE 1	32.480	32.485	8711475001	CM1569015001
TYPE 2	32.485	32.490	8711475002	CM1569015002



3.4. Crankshaft – Crankcase

- Crankcase and crankshaft classes determine the thickness of the main semi-bushings to be installed, i.e. their suitable colour.
- Please refer to the table below for selection.

CRANKCASE / SHAFT	TYPE 1	TYPE 2
TYPE 1	RED + BLUE	BLUE + BLUE
TYPE 2	RED + RED	RED + BLUE

NB: Diametral clearance between main journal and bushing: 0.020 - 0.050 mm

- Upper and lower semi-bushings of the same colour have different codes (see table)

	MIN (mm)	MAX (mm)	LOWER SEMI-BUSHING CODE (without oilways)	UPPER SEMI-BUSHING CODE (with oilways)
RED	2.005	2.010	864591	864589
BLUE	2.010	2.015	864590	864588

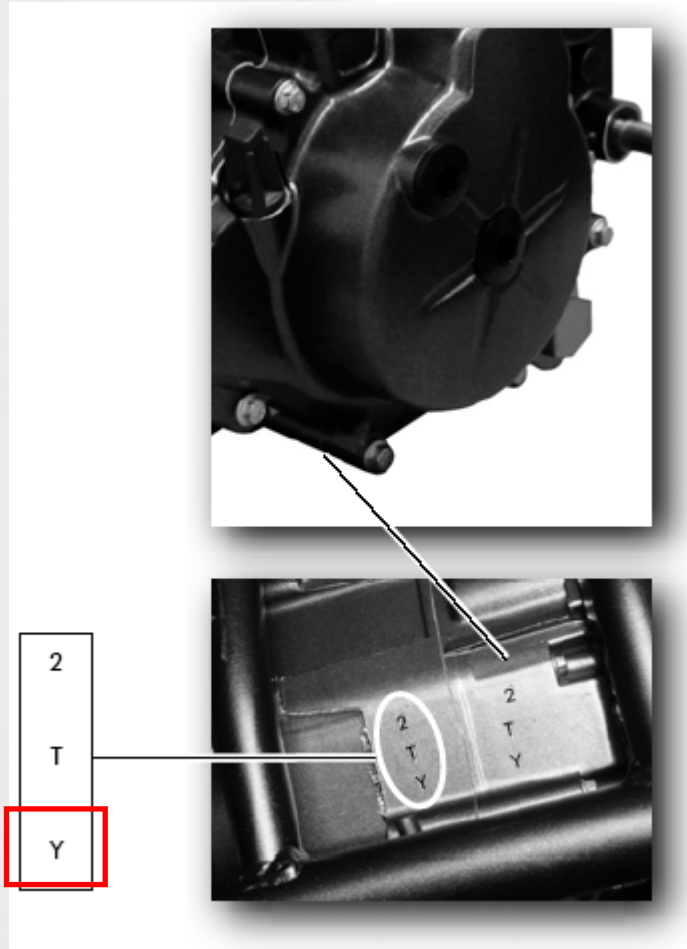
Example

- If an engine has class 1 crankcase (diameter between 36.500 and 36.508 mm) and class 2 crankshaft (diameter between 32.485 and 32.490 mm), you shall use two RED semi-bushings, code 864591 and 864589.
- If crankcases feature mixed semi-bushings, they can be swapped compared to their original position.

3.5. Clutch – Gearbox

- The clutch bell (and its drive gear) are classified in two classes according to the crankcase class, featuring a different centre distance between crankshaft and gearbox primary shaft.
- The class X or Y is indicated outside both crankcase halves, in the area shown in the figure, according to the sizes indicated in the table.

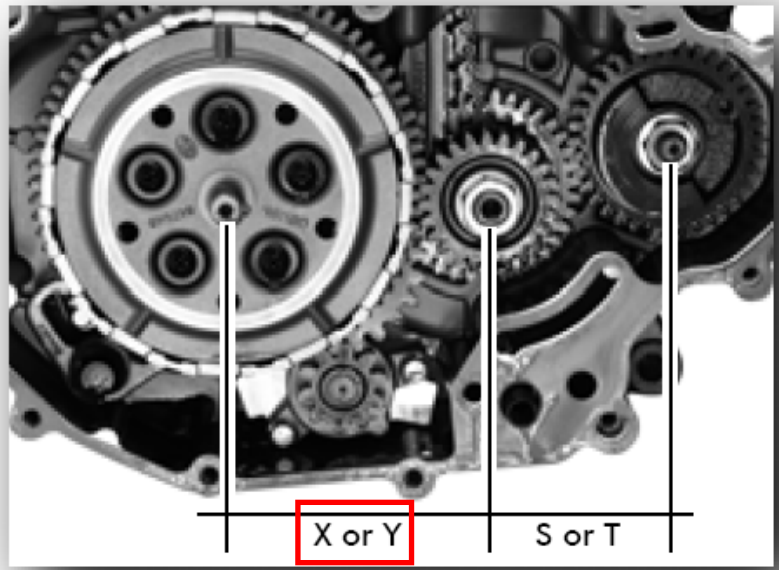
	MIN (mm)	MAX (mm)
TYPE X	86.00	86.04
TYPE Y	85.96	86.00



3.5. Clutch – Gearbox

- To reduce noise and friction between pinion and clutch bell, use the following data to find out the correct coupling parts according to crankcase class:

	BELL	PINION
TYPE X	X	X
TYPE Y	Y	Y



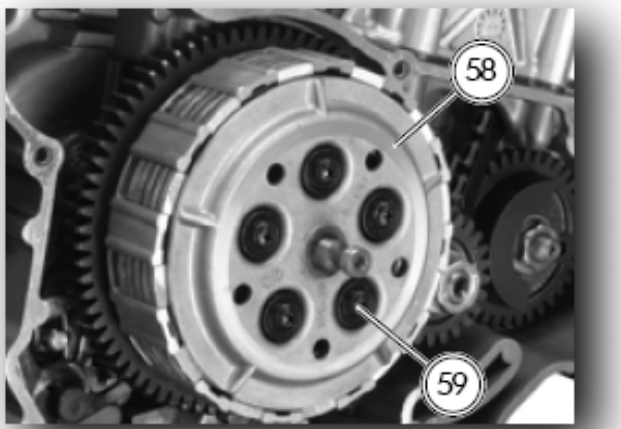
- Classes X and Y for clutch bell and pinion correspond to the codes indicated in the table

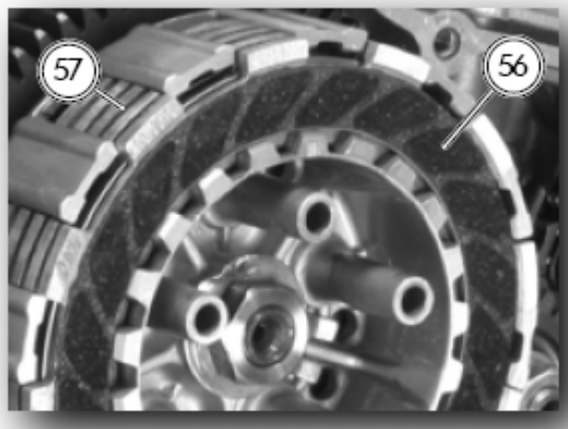
	PINION CODE	BELL CODE
TYPE X	8714475001	8714605001
TYPE Y	8714475002	8714605002

N.B.: Spare crankcases are always X class

3.5. Clutch – Gearbox

- There are 5 friction (drive) plates (56) and 4 steel (driven) plates (57)
- Pay attention upon friction plates installation: lubrication channels shall be facing back with respect to the direction of rotation (see figure)
- The thrust plate (58) features just one assembly position on drum and this ensures correct compression of the plates pack

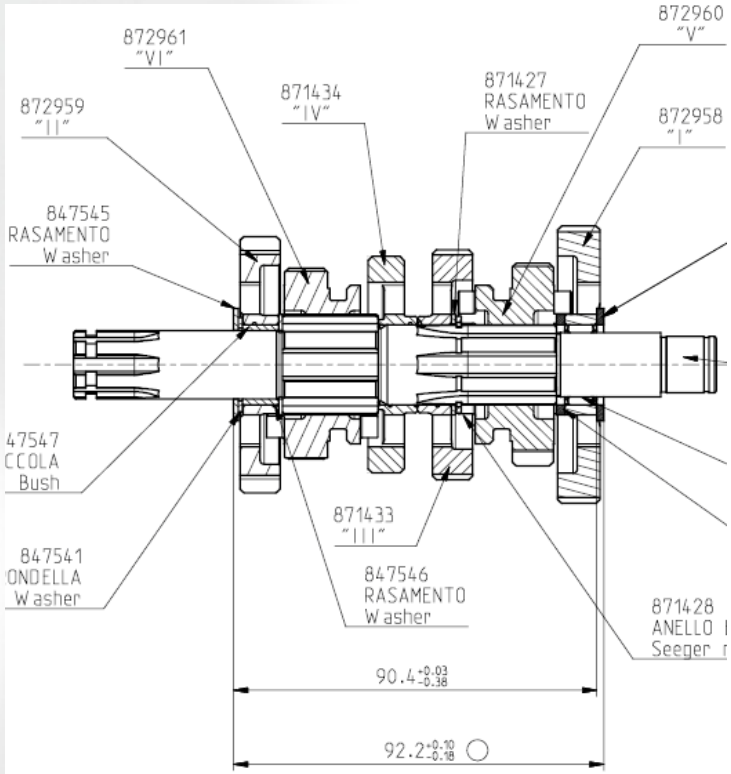




3.5. Clutch – Gearbox

- The gearbox features 6 speeds
- The primary shaft can not be overhauled
- The secondary shaft assembly length is 92.2 +0.10/-0.18 mm

TR 1st = 73/24
1st = 33/11
2nd = 30/15
3rd = 27/18
4th = 24/20
5th = 27/25
6th = 22/23

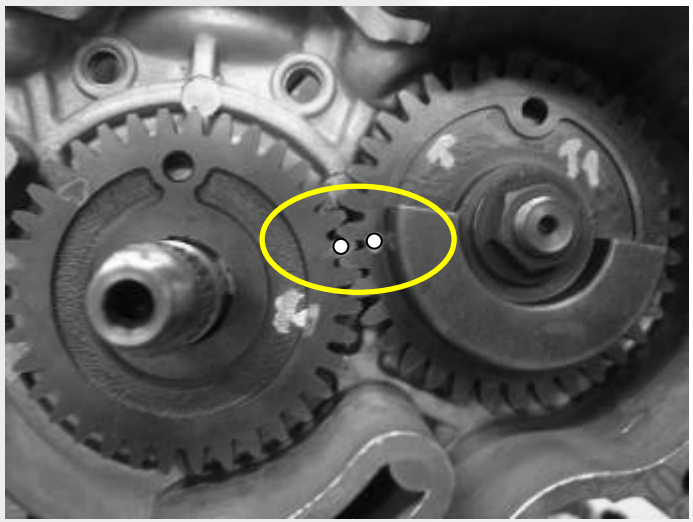


CODICE (part number)	H [mm]
CM157101	2.2
CM157102	2
CM157103	1.9
CM157104	1.8
CM157105	1.7
CM157106	1.6

In order to keep operation clearance within the specified limits, you shall select shim code CM15710X

3.6. Balancing countershaft

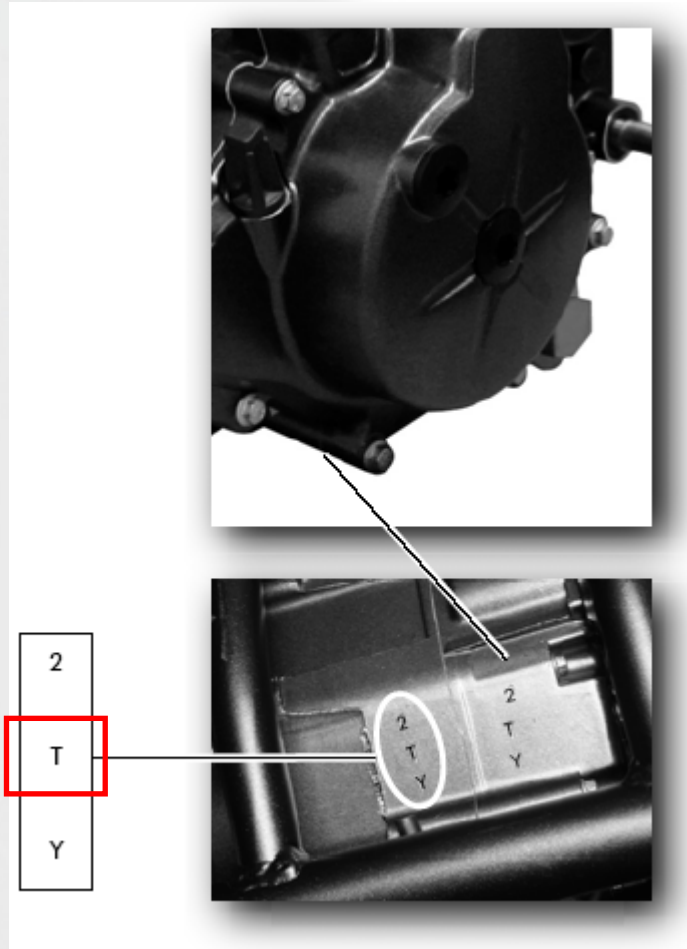
- To obtain correct timing, align reference mark on balancing countershaft gear with the one on crankshaft pinion.



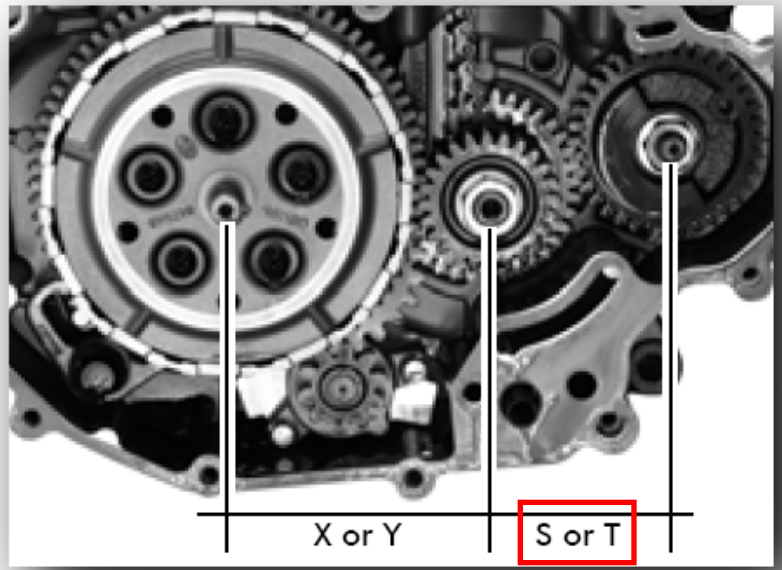
3.6. Balancing countershaft

- The balancing countershaft gears (and its drive gear) are classified in two classes according to the crankcase class, featuring a different centre distance between crankshaft and countershaft.
- The class S or T is indicated outside both crankcase halves, in the area shown in the figure, according to the sizes indicated in the table.

	MIN (mm)	MAX (mm)
TYPE S	64.00	64.03
TYPE T	63.97	64.00



3.6. Balancing countershaft



- To reduce noise and friction between pinion and countershaft gear, use the following data to find out the correct coupling parts according to crankcase class:

	COUNTERSHAFT	PINION
TYPE S	S	S
TYPE T	T	T

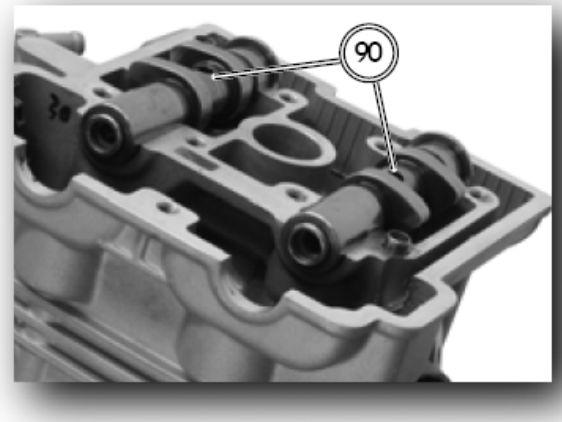
- Classes S and T for countershaft gear and pinion correspond to the codes indicated in the table

	PINION	COUNTERSHAFT
TYPE S	8714465001	8711565001
TYPE T	8714465002	8711565002

N.B.: Spare crankcases are always S class

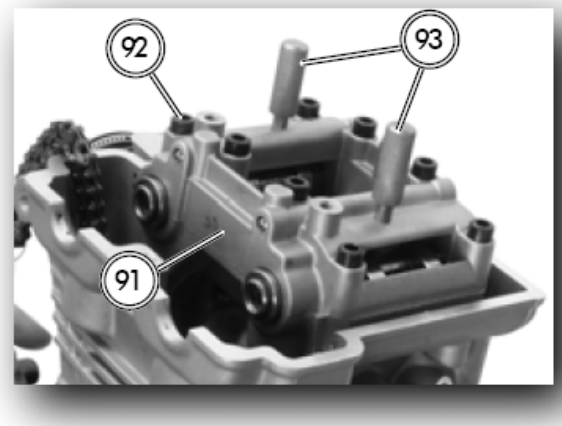
3.7. Timing

- Set the camshafts on their seats in the cylinder head so that timing holes (90) are facing upwards

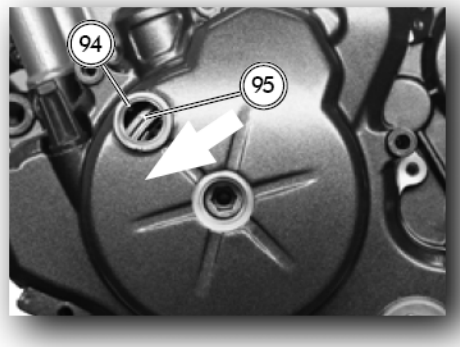


The camshaft are not the same and can be identified by means of the marking “A” or “S”

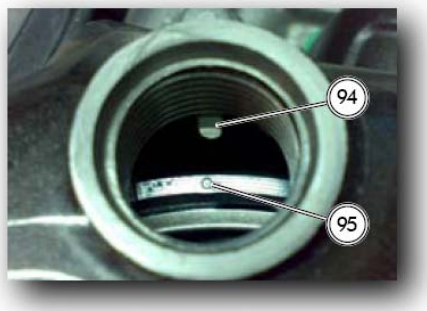
- Install the cam tower (91) and tighten the 8 screws (92) to a torque of 10 – 12 Nm, in a cross pattern.
- Fit the timing pins (93) in their reference holes on the cam tower, turn camshafts until they are aligned and locked in the correct position.

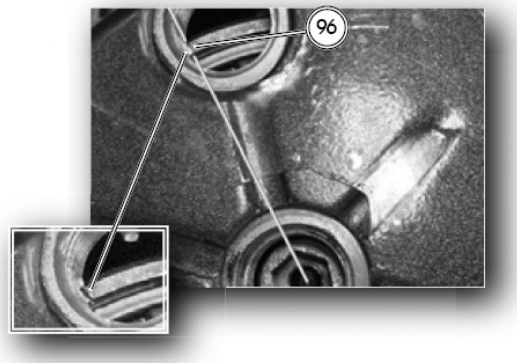


3.7. Timing

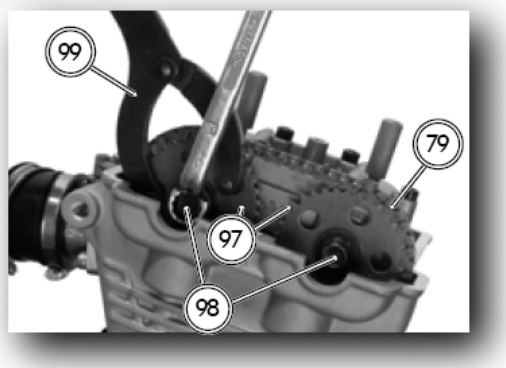


- Take the piston to TDC by turning the crankshaft **counter clockwise** with an Allen wrench, until aligning the notch on the flywheel (95) with reference mark (94) on the cover.





Up to engine no. 7015 the mark (95) is not there. For these engines (from 0001 to 7015), the mark (95) is a line (96) that shall be aligned with the edge of the sight glass.

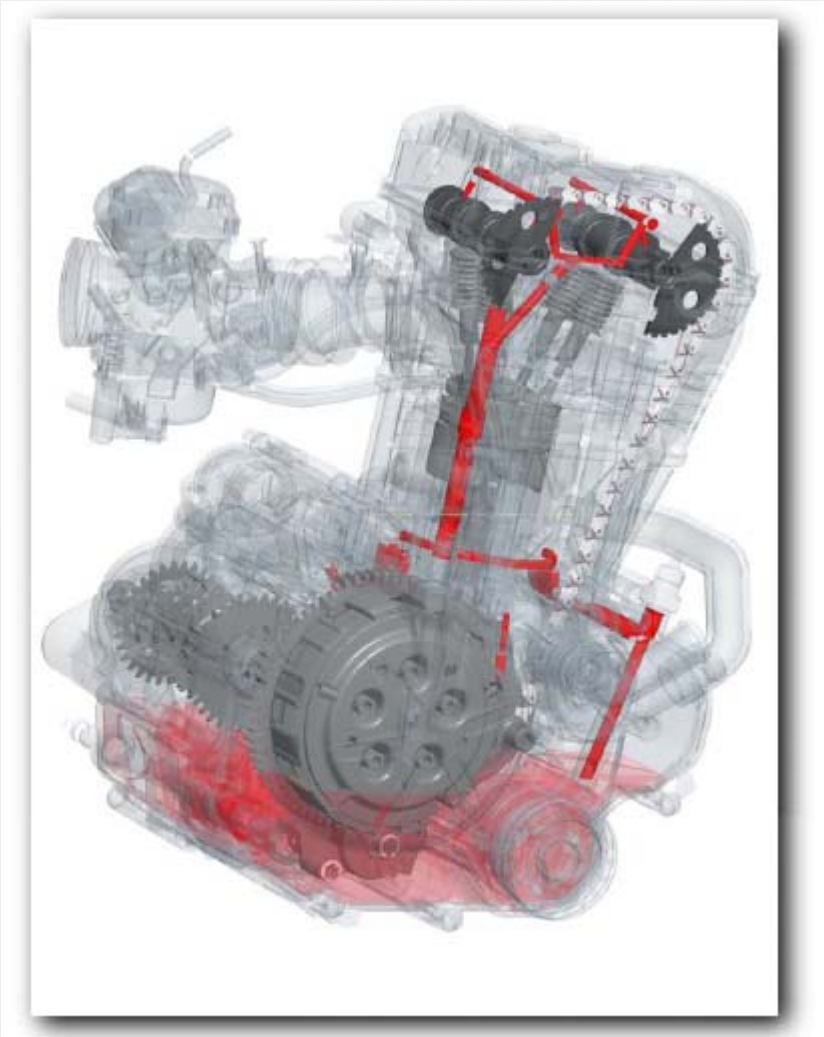


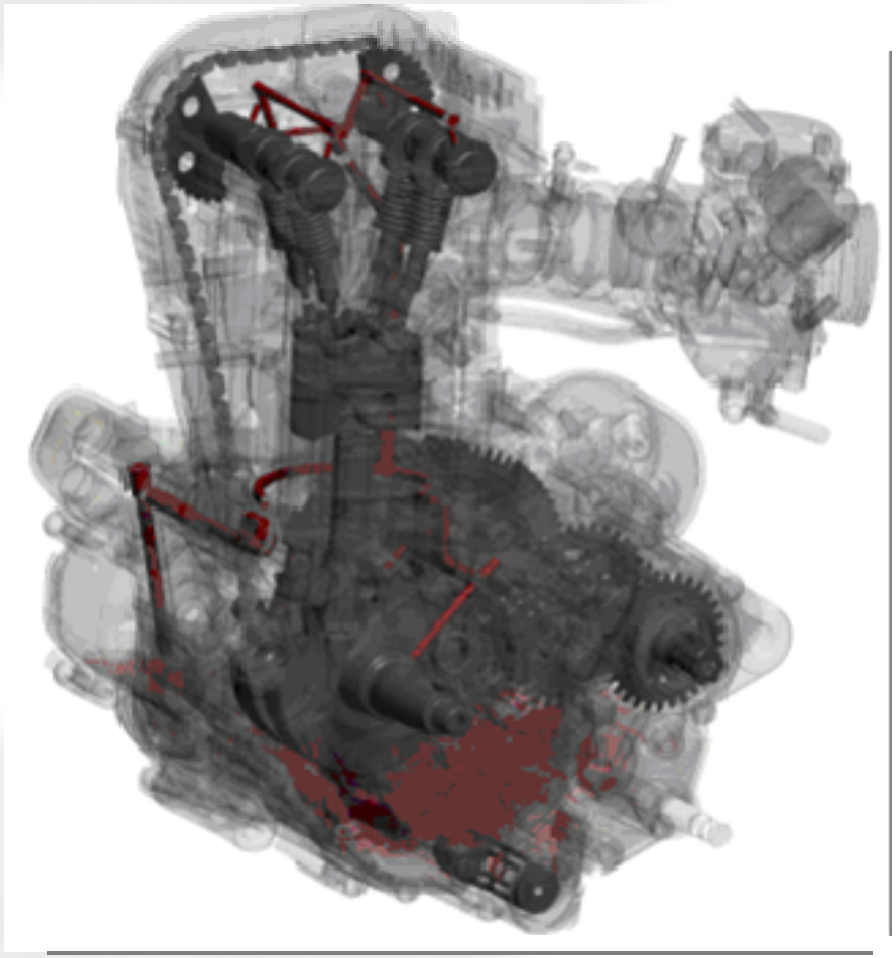
- Fit gears (97) and chain (79) onto the camshafts, start the 2 screws (98) in their holes after smearing their thread with Loctite 270; tension up the chain and tighten to a torque of 25 -27 Nm

3.8. Lubrication circuit

- Lubrication is with semi-dry sump.
- The gearbox/clutch compartment is used as oil reservoir.
- The pump is driven by the clutch bell and features two coaxial rotors each having trochoidal tooth profile (EATON) and made from sintered material:
  - one is 13 mm thick, and sucks oil from crankshaft compartment
  - one is 8.5 mm thick, and sends oil under pressure to the engine
- Maximum pressure is 4.2 bars and at engine top end it is 1 bar.

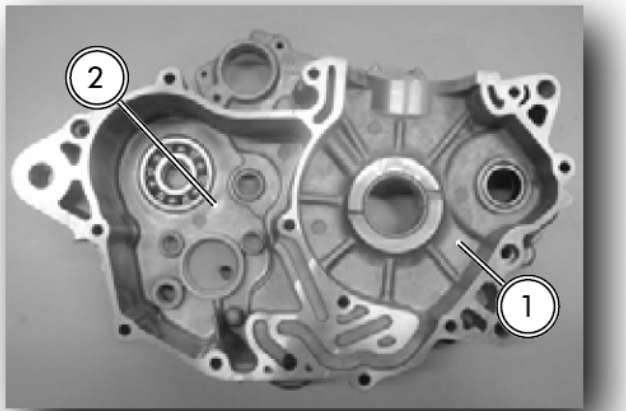
3.8. Lubrication circuit

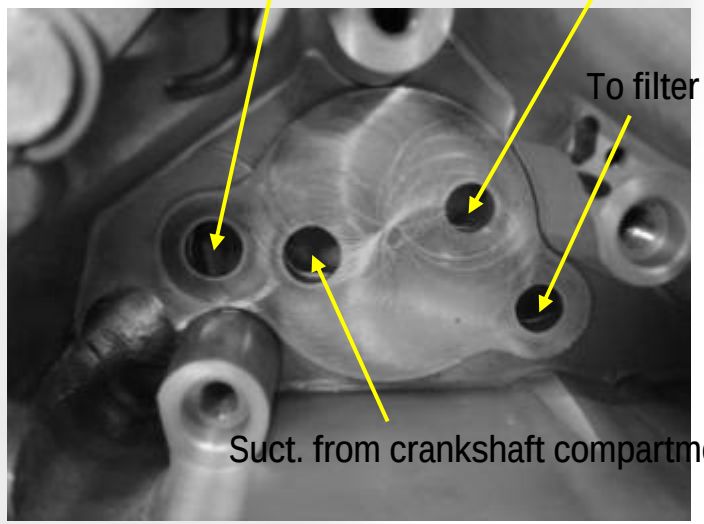




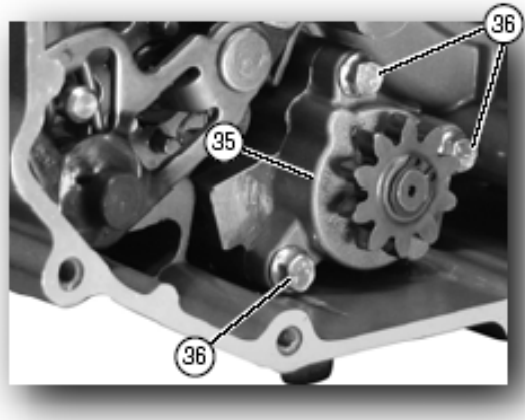
3.8. Lubrication circuit

- Pre-filter, filter, pressure-relief valve (by-pass) and oil minimum pressure sensor are also part of the circuit.
- Suction is performed from:
  - Crankcase front end (crankshaft compartment) – pos. 1
  - Crankcase rear end (gearbox compartment) – pos. 2
- Delivery is performed toward:
  - Gearbox compartment
  - Oil filter (traditional circuit)



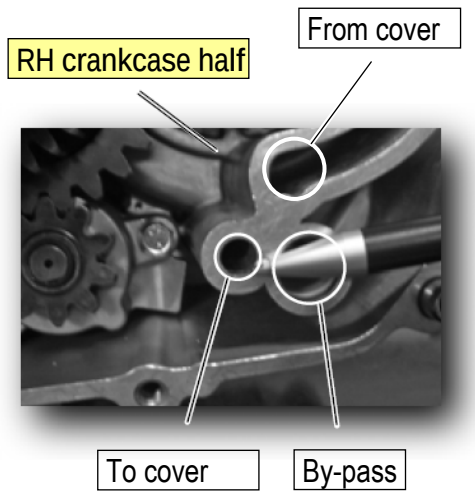


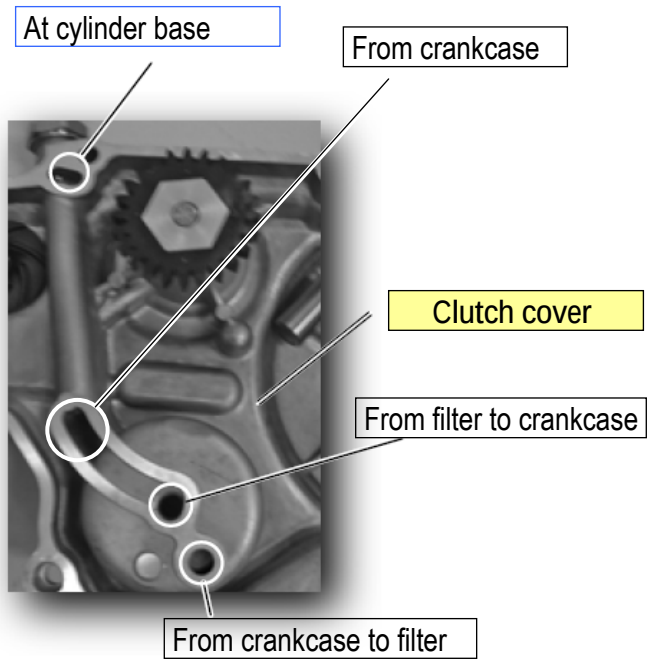
3.8. Lubrication circuit



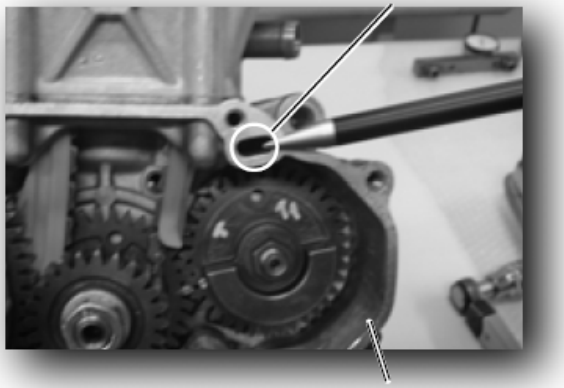
- Tighten the 3 screws (36) to a torque of 3.5 Nm applying some Loctite 242
- After tightening, check that rotors can turn freely without forcing

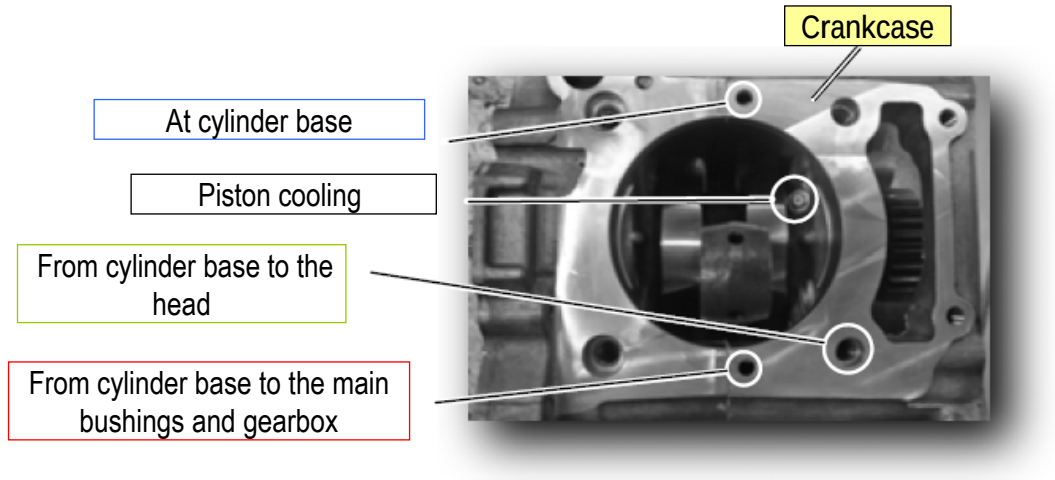
Oilways

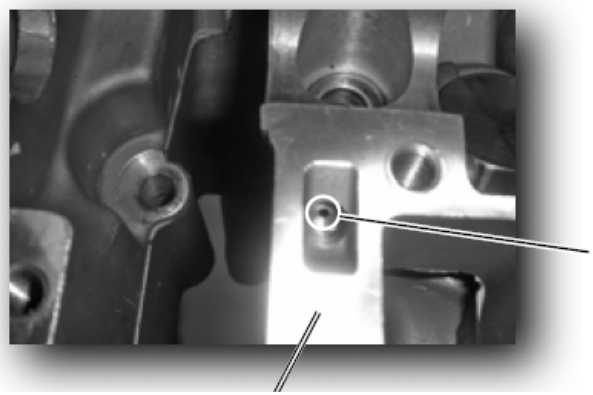


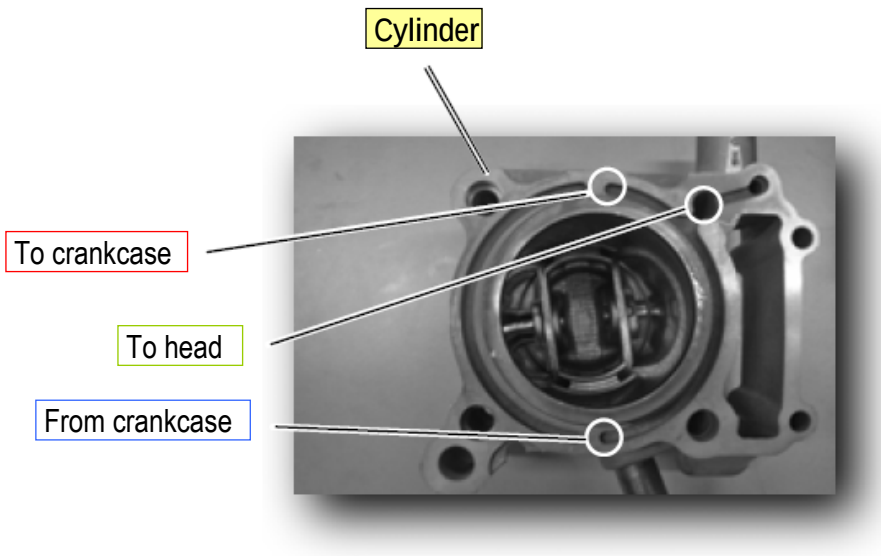


3.8. Lubrication circuit

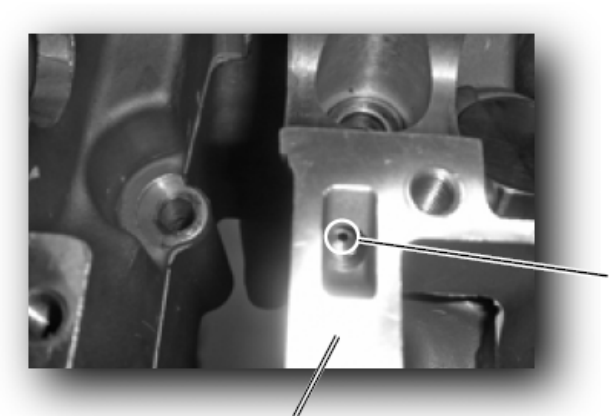


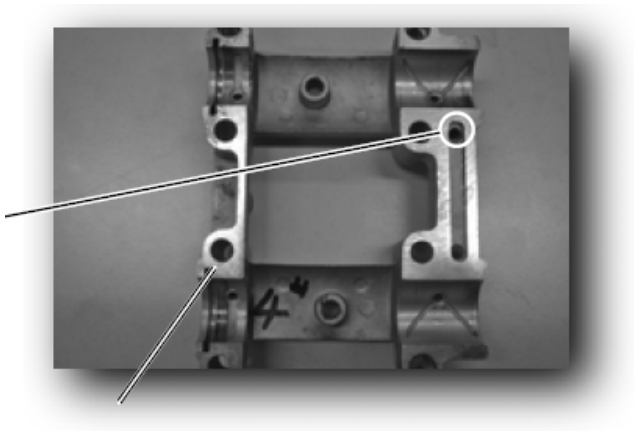


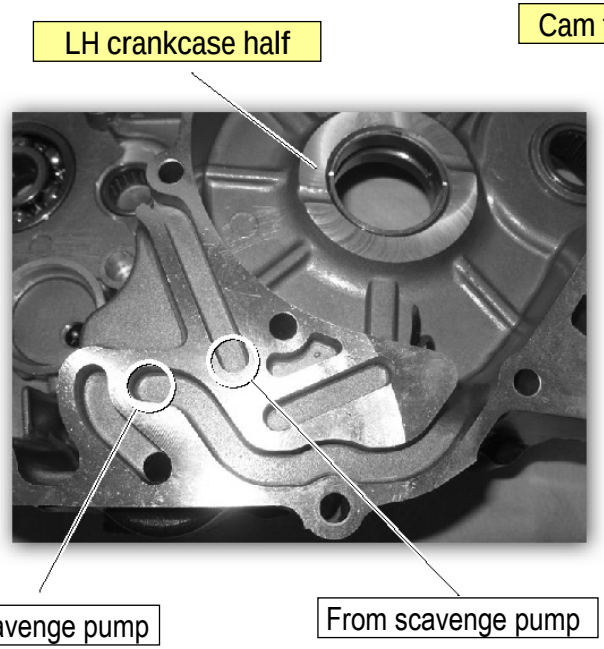




3.8. Lubrication circuit

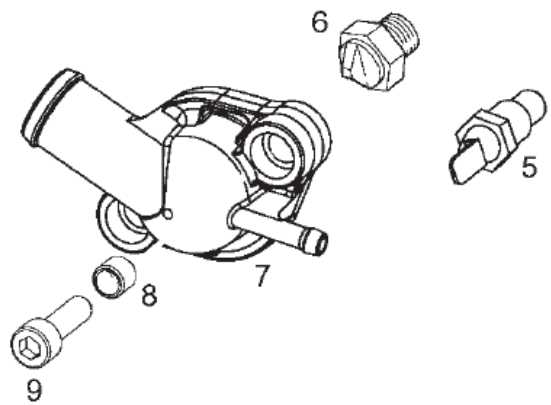






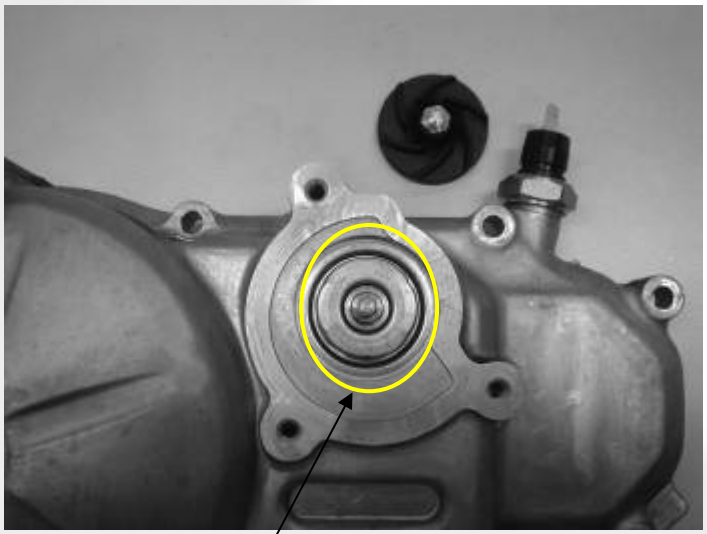
3.9. Cooling circuit

- There is a small by-pass to warm up the carburettor.
- The pump features an integral ceramic seal.
- Thermostat (6) opens between 80º C and 85º C
- The radiator features a fan and expansion tank.

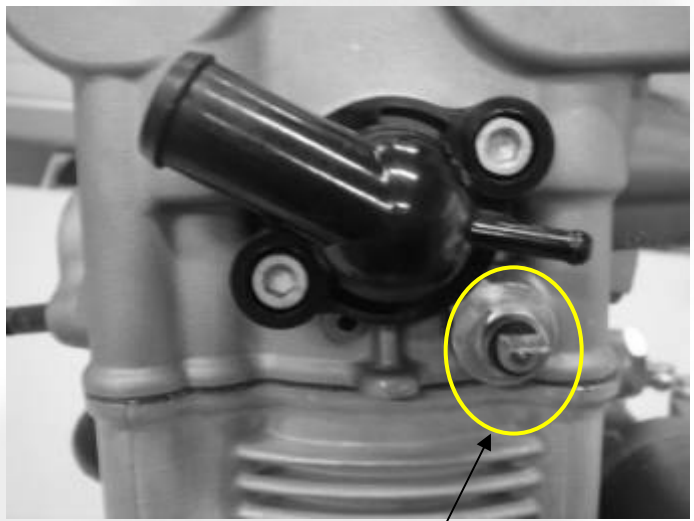


3.9. Cooling circuit

- Temperature sensor resistance (NTC):
  - At 60° C = 600-470 Ω
  - At 90° C = 215-175 Ω
  - At 120° C = 93-73 Ω

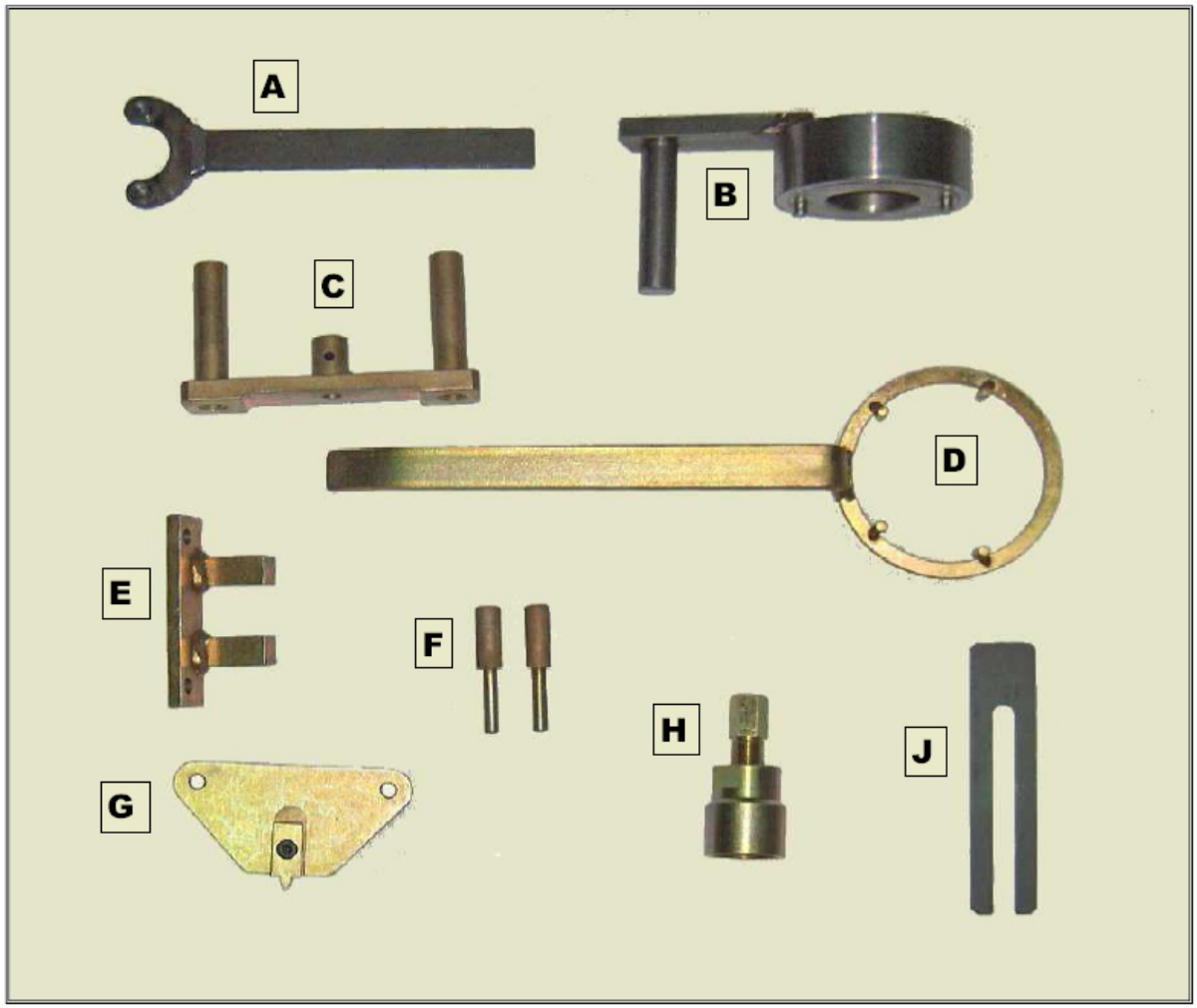


See Service Communication nr. 008-2009



NTC

3.10. List of special tools (code 865207)



Pos.	Code	DESCRIPTION
A	865260	CAMSHAFT SPROCKET LOCKING TOOL
B	865259	MAGNETO FLYWHEEL LOCKING TOOL
C	864592	DIAL GAUGE SUPPORT
D	00H05300041	CLUTCH LOCKING TOOL
E	864486	COUNTERSHAFT LOCKING TOOL
F	864567	CAMSHAFT TIMING/LOCKING PINS
G	864487	CRANKSHAFT PINION LOCKING TOOL
H	864868	FLYWHEEL EXTRACTOR
J	865261	FORK FOR PISTON FITTING

3.11. Tightening torque settings

COMPONENT TO BE TIGHTENED	DESCRIPTION	THREAD	QUANT.	TIGHT.TORQUE	
				Kgf.m	N.m
Spark plug		M10	1	1.2-1.4	12-14
Head cover	Screw	M6	4	1-1.2	10-12
Camshaft bearing	Screw	M6	8	1-1.2	10-12
Timing system gear 1	Screw	M8	1	2.5-2.7	25-27
Timing system gear 2	Screw	M8	1	2.5-2.7	25-27
Cylinder head	Screw	M8	4	2.7 +90°	27 +90°
Cylinder head	Screw	M6	2	1.1-1.3	11-13
Carburettor hose - air filter box	Flange	-	1	1.2-1.8	12-18
Inlet nozzle	Screw	M6	3	1.1-1.3	11-13
Thermostat cover	Screw	M6	2	1-1.2	10-12
Coolant temperature sensor	-	M10	1	0.8-1.0	8-10
Timing chain tensioner	Screw	M6	2	1.1-1.3	11-13
Timing chain tensioner spring	Cover	-	1	0.8-1	8-10
Water pump cover	Screw	M5	3	0.5-0.6	5-6
Water pump impeller	-	M5	1	0.4-0.6	4-6
Clutch control lever	Screw	M6	1	0.8-1.0	8-10
Oil filter cover	-	M56x1.5	1	2.4-2.6	24-26
Oil pressure sensor	-	M10	1	1.2-1.4	12-14
Clutch cover	Screw	M6	10	1.1-1.3	11-13
Clutch spring	Screw	M5	5	0.35-0.45	3.5-4.5

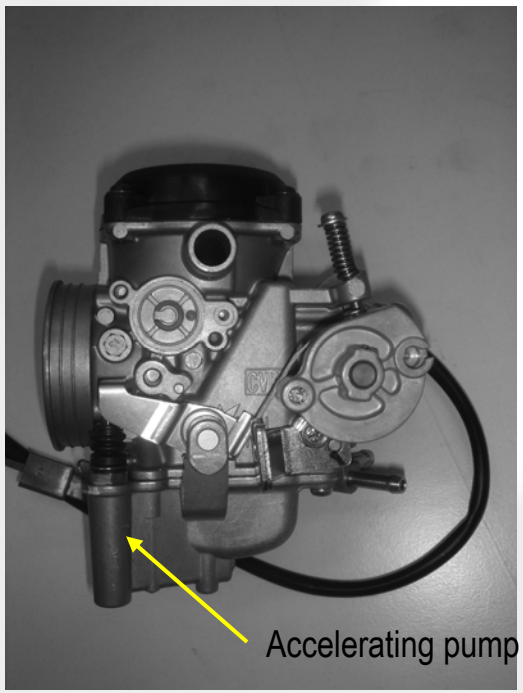
3.11. Tightening torque settings

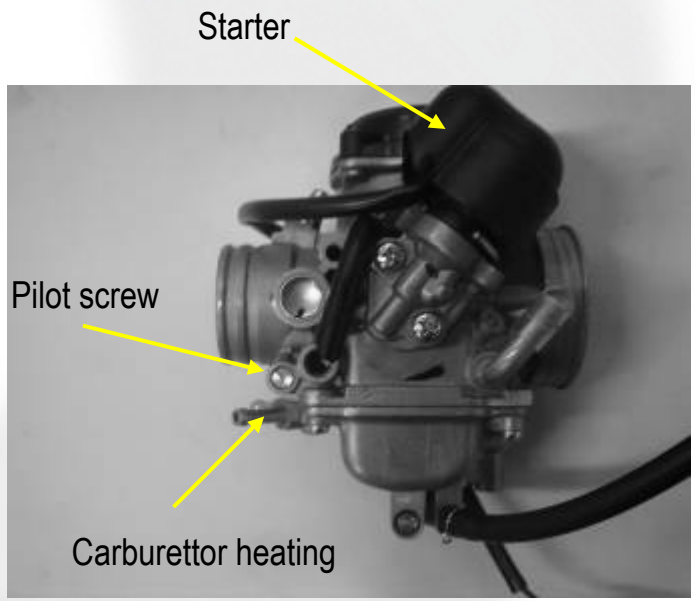
COMPONENT TO BE TIGHTENED	DESCRIPTION	THREAD	QUANT.	TIGHT.TORQUE	
				Kgf.m	N.m
Clutch bell - hub	Nut	M12	1	3.5-4.5	35-45
Balancing shaft	Nut	M10	1	3.5-4.5	35-45
Clutch bell - crankshaft pinion	Nut	M12	1	7.5-8.3	75-83
Timing chain slider	Screw	M6	1	1-1.2	10-12
Oil pump	Screw	M5	3	0.35	3.5
Fiore del tamburo selettore	Screw	M5	1	0.35-0.45	3.5-4.5
Leva innesto fiore del tamburo selettore	Screw	M6	1	0.8-1.0	8-10
Starter motor	Screw	M6	2	1.1-1.3	11-13
Timing adjuster cover	-	M18X1.5	1	0.35-0.45	3.5-4.5
Flywheel-side oil filter cover	-	M28X1	1	2.4-3.0	24-30
Magneto flywheel cover	Screw	M6	10	1.1-1.3	11-13
Oil sensor cable fastener	Screw	M4	1	0.3-0.5	3-5
Neutral sensor indicator	-	M10x1.25	1	0.8-1.0	8-10
Oil level dipstick	-	M12x1.5	1	0.4-0.6	4-6
Magneto flywheel stator	Screw	M5	2	0.5-0.7	5-7
Pick-up (R.P.M. sensor)	Screw	M5	2	0.3-0.4	3-4
Starter sprocket clip	Screw	M6	1	0.5-0.6	5-6
Magneto flywheel rotor	Nut	M14x1.5	1	8.3-9.0	83-90
Magneto flywheel rotor-starter clutch	Screw	M6	6	1.1-1.3	11-13
Crankcase jointing fasteners	Screw	M6	12	1.1-1.3	11-13

4. Fuel system - Emissions

4.1. Carburettor

- Vacuum-type carburettor, Keihin CVK30 model
- It features automatic starter and accelerating pump
- It is heated through the cooling circuit

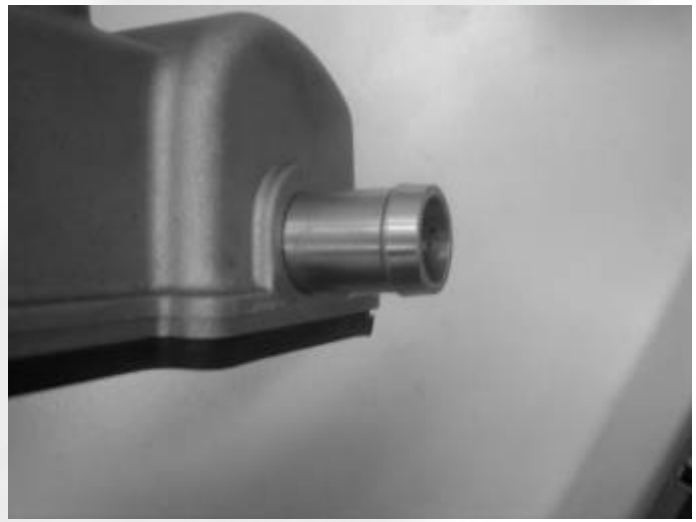




4.2. Secondary air system – Catalytic converter

- The vehicle features a secondary air system (S.A.S.) to reduce CO and HC emissions.
- CO rate (oil at 90º C) = 3.1 – 4.5%. Manually adjustable via the pilot screw.
- 2-way catalytic converter in the silencer.
- It features oil vapours blow-by system from the head cover to the air filter box.

Secondary air system



Oil vapours blow-by system

5. Ignition

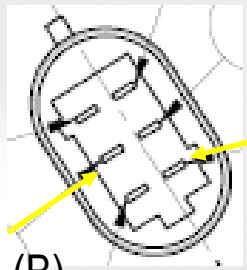
5.1. System description

System operation

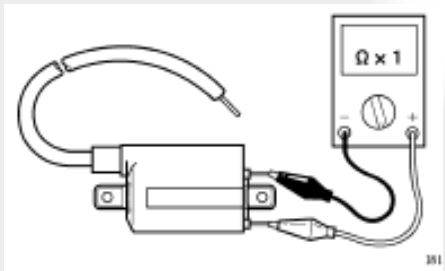
- The basic value is the rpm measured through the pick-up.
- Using the information from this sensor, the CDI calculates when to trigger the spark in the spark plug.

5.2. Components

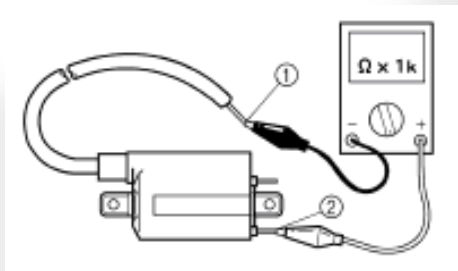
- Engine speed sensor (pick-up)
- Sensor resistance: 105-124 Ω at 20º C (flywheel side connector, across R and B cables)



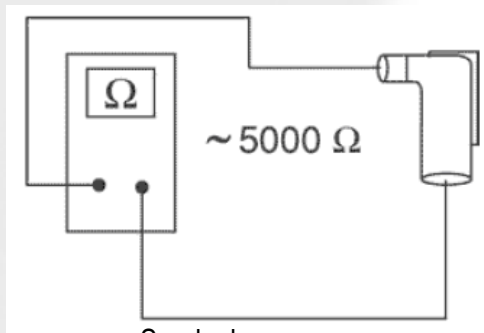
- Ignition coil
- Primary coil resistance 0.21 Ω +/- 0.025 Ω at 25+/-5 ºC
- Secondary coil resistance 3.1 KΩ +/- 0.31 KΩ at 25+/-5 ºC
- Spark plug cap resistance 5 KΩ at 20 °C



Primary coil



Secondary coil



Spark plug cap