

Manuale d'officina Reparaturhandbuch Repair Manual

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Tipo, Typ, Type
655/97
655 EFI

Versione albero a gomiti con boccole
Version with crankshaft bushings
Ausführung mit Kurbelbuchsen

933

aprilia part # 8140139

Prefazione

Il presente manuale contiene i dati e le istruzioni essenziali per una manutenzione e riparazione qualificata del motore ROTAX tipo 655/97 e tipo 655 EFI modello 2001, e si basa sulle conoscenze disponibili al momento della sua edizione.

- ▲ **Avviso.** Dove non specificato, il testo è riferito ad entrambi i modelli.
Le varianti specifiche di un motore sono evidenziate e precedute dai simboli:
-  = ROTAX 655/97;
 -  = ROTAX 655 EFI modello 2001.

La ditta BOMBARDIER- ROTAX si riserva il diritto di apportare modifiche tecniche al motore alla luce di ulteriori sviluppi senza aggiornare contemporaneamente il manuale.

Una riparazione qualificata richiede l'utilizzo di ricambi originali, degli attrezzi specifici, dei dispositivi di sicurezza, delle guarnizioni di tenuta e dei lubrificanti prescritti.

Tutte le indicazioni e procedure del presente manuale di officina sono state elaborate sulla base delle cognizioni e delle esperienze più aggiornate, escludendo tuttavia qualsiasi responsabilità. La ditta si riserva inoltre il diritto di apportare modifiche tecniche e la possibilità di errori.

La riproduzione, la traduzione o copie anche parziali del presente manuale sono possibili solo con l'autorizzazione scritta di:

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Vorwort

Das vorliegende Handbuch, welches sich auf die Kenntnisse zum Zeitpunkt seiner Ausgabe unterstützt, enthält wesentliche Angaben und Anweisungen für eine fachgerechte Wartung bzw. Reparatur des ROTAX-Motors Typ 655/97 und Typ 655 EFI Modell 2001.

- ▲ **Achtung.** Falls nicht anders angegeben, bezieht sich der Text auf beide Motorversionen.
Die spezifischen Motorversionen werden mit entsprechenden Symbolen davor hervorgehoben:
-  = ROTAX 655/97;
 -  = ROTAX 655 EFI Modell 2001.

Die Firma BOMBARDIER-ROTAX behält sich alle Rechte vor im Zuge der Weiterentwicklung technische Änderungen am Motor vorzunehmen, ohne gleichzeitig dieses Reparatur-Handbuch entsprechend zu ergänzen.

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Preface

This manual contains the essential data and instructions for qualified service and maintenance of engine ROTAX type 655/97 and type 655 EFI model 2001 and is based on the knowledge available at the moment of its publication.

- ▲ **Warning.** If not specified otherwise, the text refers to both models.
The specific variants of an engine are marked and preceded by the symbols:
-  = ROTAX 655/97;
 -  = ROTAX 655 EFI model 2001.

BOMBARDIER-ROTAX reserves the right to make technical modifications to the engine in view of further development without updating this manual.

A professional repair requires the use of genuine spare parts as well as the employment of the specified securing, sealing and lubricating agents.

All data and procedures in this Repair Manual are described to the best of our knowledge, however excluding any liability.

We reserve all rights including technical modification and possibility of errors.

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Informazioni importanti

Simboli ricorrenti

Il presente manuale di officina mette in evidenza le indicazioni per la sicurezza ed informazioni affidabili attraverso le parole e i simboli di seguito elencati, da rispettare scrupolosamente.

- ▲ **Avviso:** il mancato rispetto delle avvertenze può provocare lesioni o la morte del conducente, del meccanico addetto alla manutenzione o di terzi.
- **Attenzione:** questa dicitura indica specifiche misure di sicurezza da osservare per evitare danni al motore. Il mancato rispetto può creare circostanze pericolose per la salute.
- ◆ **Nota:** informazioni utili per realizzare e spiegare più facilmente determinati procedimenti.
- :
- ⇒ :

Precauzioni e misure di sicurezza generali



- **Attenzione:** Il motore è previsto solo per l'uso su veicoli della casa produttrice **aprilia**. Qualsiasi applicazione estranea a tale prescrizione è considerata non conforme e solleva il produttore da responsabilità per i danni risultanti.
- **Attenzione:** Le informazioni e le istruzioni per la sicurezza contenute nel manuale di officina si basano su dati ed esperienze che il tecnico può applicare in condizioni di lavoro normali. Queste direttive sono integrazioni utili e necessarie per la preparazione, ma non possono mai sostituire la specializzazione teorica e pratica.

Wichtige Informationen

Wiederkehrende Symbole

Dieses Reparaturhandbuch betont Sicherheitshinweise und gewisse Informationen durch folgende Worte und Symbole die unbedingt beachtet werden müssen.

- ▲ **Warnung:** Nichtbeachtung der Warnung kann zu Verletzungen oder zum Tod des Fahrers, Wartungsmechanikers oder anderer, dritter Personen führen.
- **Achtung:** Unter Achtung sind besondere Vorsichtsmaßnahmen aufgeführt, die eingehalten werden müssen, um Beschädigungen am Motor zu verhindern. Bei Nichtbeachtung könnte es unter Umständen zu gesundheitlichen Schäden führen.
- ◆ **Hinweis:** Nützliche Informationen, um bestimmte Vorgänge einfacher zu gestalten bzw. zu erläutern.
- :
- ⇒ :

Allgemeine Vorsichtsmaßnahmen und Sicherheitsbestimmungen



- **Warnung:** Der Motor ist nur für die Verwendung in Motorrädern des Motorradherstellers **aprilia** vorgesehen. Jeder darüber hinausgehender Einsatz gilt als nicht bestimmungsgemäß, und der Hersteller haftet nicht für daraus resultierende Schäden.
- **Achtung:** Die im Reparaturhandbuch gegebenen Informationen und Sicherheitshinweise basieren auf Daten und Erfahrungen, die für den Fachmann unter normalen Arbeitsbedingungen als anwendbar gelten. Die im Reparaturhandbuch gegebenen Richtlinien sind sinnvolle und notwendige Ergänzungen zu Schulungen, können aber keinesfalls fachgerechte, theoretische und praktische Unterweisungen ersetzen.

Important Information

Repeating symbols

Pay attention without fail to the following symbols throughout the Manual emphasizing particular information:

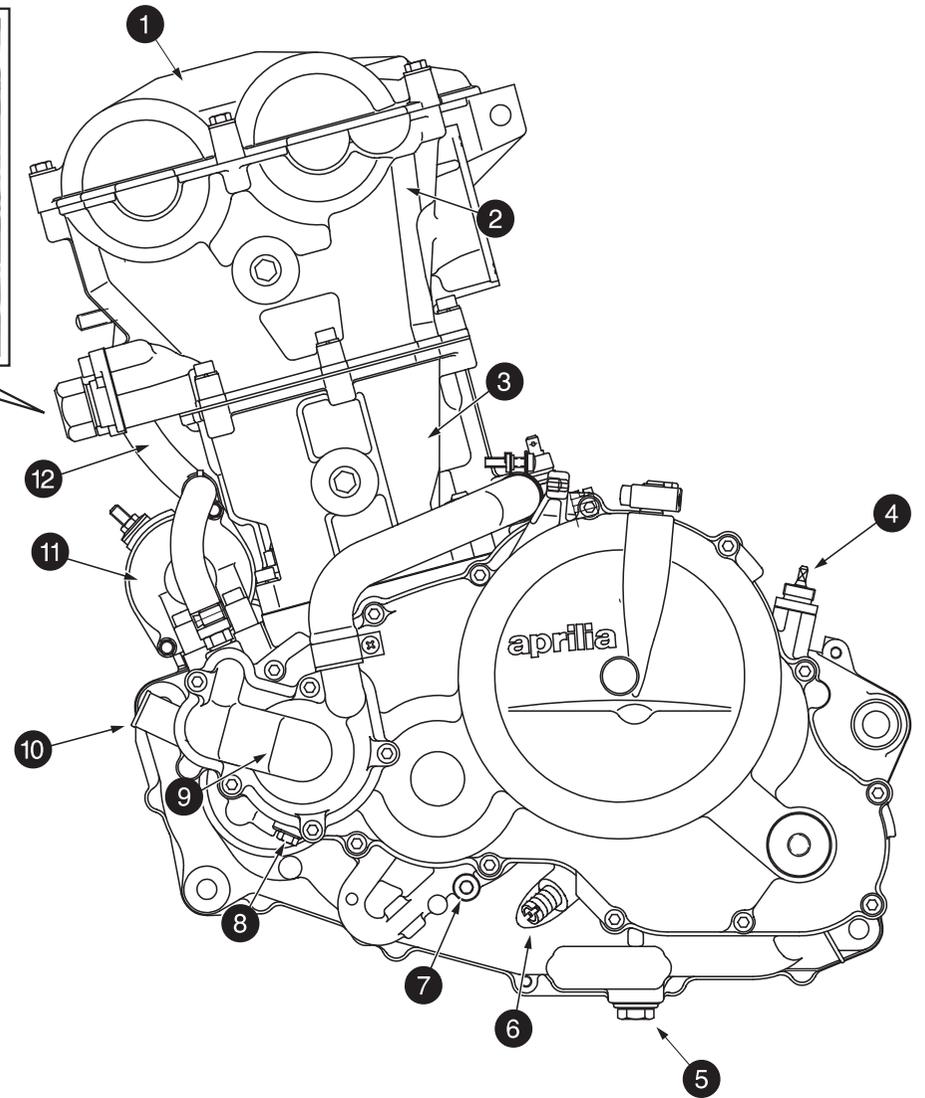
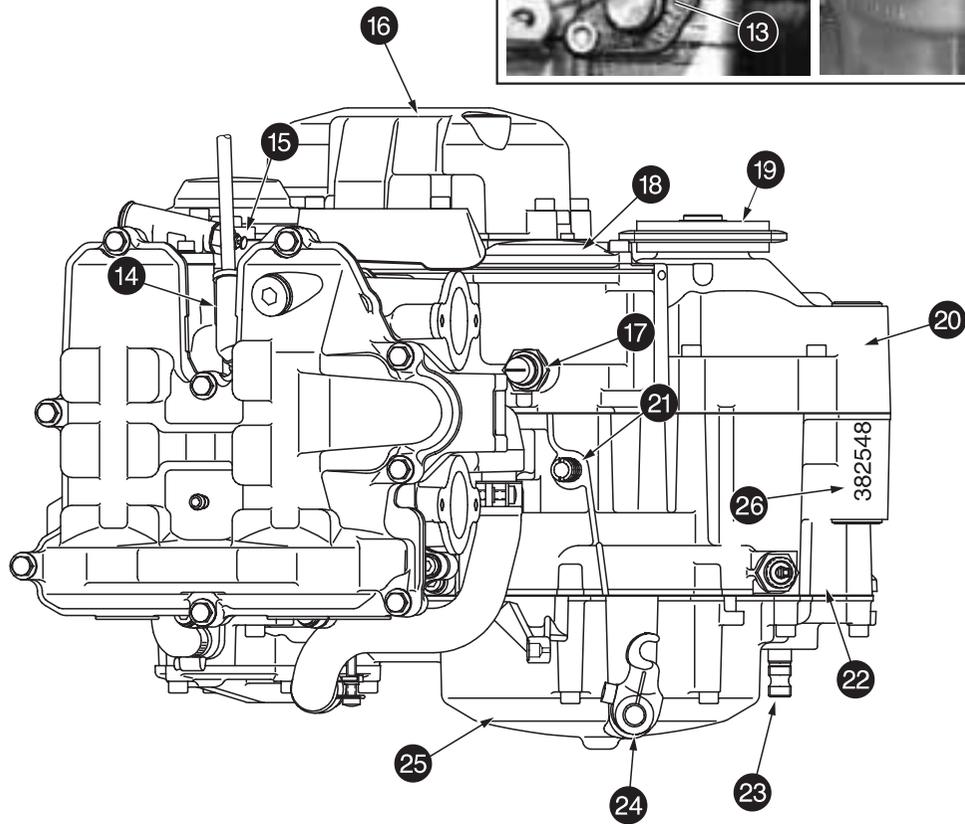
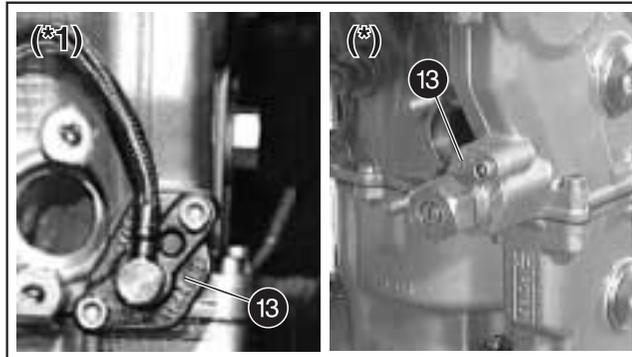
- ▲ **Warning:** Identifies and instruction, which if not followed may cause injury or endanger the life or the rider, mechanic or third party.
- **Attention:** Denotes an instruction which if not followed may severely damage the engine. Noncompliance might lead under certain conditions to health hazards.
- ◆ **Note:** Information useful for better execution and understanding of instructions.
- :
- ⇒ :

General precaution and safety information



- **Warning:** The engine is planned solely for the use in **aprilia** motorcycles. Any application besides that is not as agreed and releases the manufacturer of any liability.
- **Attention:** Information stated in this Manual is based on data and experience of experts, applicable at standard working condition. These guidelines are useful and necessary but they are never a substitute for proper theoretical and practical training.

- ▲ Avviso:** I ricambi devono soddisfare tutti i requisiti tecnici stabiliti dal produttore. Ciò è possibile solo con ricambi e/ o accessori ORIGINALI ROTAX (vedere elenco dei pezzi di ricambio). Il mancato utilizzo di ricambi e/ o accessori originali ROTAX rende nulle tutte le garanzie ROTAX.
- Attenzione:** Le modifiche al motore e degli elementi ad esso collegati (silenziatore di ammissione, carburatore, scappamento, sospensioni, presa di moto ecc.) non approvati da ROTAX sollevano la casa produttrice da qualunque responsabilità o garanzia.
- Attenzione:** Decisivo per la durata in esercizio e per condizioni stabili di immediato funzionamento del motore è il rispetto scrupoloso degli intervalli di manutenzione e dei vari documenti tecnici.
- Attenzione:** Rettificando subito eventuali difetti di lieve entità è possibile evitare guasti più gravi del motore.
- Attenzione:** Eseguire tutte le operazioni di manutenzione o riparazione anche sul motore installato ma inattivo e con l'accensione disinserita in posizione "☒".
- Attenzione:** Avviare il motore dopo aver completato il cablaggio e collegato la candela d'accensione.
- ▲ Avviso:** Durante operazioni di manutenzione e riparazione è necessario osservare tutte le norme generali di sicurezza e rispetto dell'ambiente. Il manuale fa riferimento separatamente anche a disposizioni speciali. E' altresì indispensabile osservare altre norme di sicurezza della casa produttrice.
- Attenzione:** Durante l'evacuazione del refrigerante alla temperatura di esercizio o aprendo il tappo del radiatore, lasciar raffreddare il motore per evitare il rischio di ustioni!
- ▲ Warning:** Ersatzteile müssen den vom Hersteller festgelegten technischen Anforderungen entsprechen. Dies wird nur bei ORIGINAL-RO-TAX Ersatzteilen und / oder Zubehör garantiert (siehe Ersatzteile-Liste)! Bei Nichtverwendung von Original ROTAX-Ersatzteilen und / oder Zubehör erlischt jegliche Gewährleistung durch ROTAX.
- Achtung:** Änderungen am Motor sowie am Umfeld des Motors (Ansauggeräuschkämpfer, Vergaser, Auspuffanlage, Motoraufhängung, Abtrieb, etc.), die nicht von ROTAX genehmigt wurden, entbinden die Herstellerfirma von jeder Haftung sowie Gewährleistung.
- Achtung:** Entscheidend für die Lebensdauer und ständige Einsatzbereitschaft des Motors ist die richtige Einhaltung der vorgeschriebenen Wartungsintervalle, sowie die Beachtung der sonstigen technischen Unterlagen.
- Achtung:** Beheben Sie auch kleine Defekte sofort, Sie vermeiden dadurch größere Motorausfälle.
- Achtung:** Sämtliche Wartungs- oder Reparaturarbeiten am Motor auch im eingebauten Zustand nur bei Stillstand und unterbrochener Zündung durchführen in Stellung "☒".
- Achtung:** Motor nur bei kompletter Verdrahtung bzw. angeschlossener Zündkerze starten.
- ▲ Warning:** Beachten Sie bei Wartung- und Reparaturarbeiten sämtliche allgemeinen Sicherheitsbestimmungen und Umweltauflagen. Im Handbuch werden noch gesondert auf spezielle Richtlinien hingewiesen. Weitere Sicherheitsbestimmungen des Motorradherstellers sind unbedingt zu beachten.
- Achtung:** Um mögliche Verbrühungen vermeiden zu können, den Motor beim Entleeren der Kühlflüssigkeit bei Betriebstemperatur oder beim Öffnen des Kühlerschlusses abkühlen lassen!
- ▲ Warning:** Spare parts must meet all requirements defined by the engine manufacturer. This is only warranted by use of GENUINE ROTAX spare parts and /or accessories (see spare parts list). If using other than GENUINE ROTAX spare parts and /or accessories any warranty granted by ROTAX will lapse.
- Attention:** Modifications on engine and changes to sphere of engine (intake silencer, carburator, exhaust system, engine suspension, power take off, etc.), not approved by ROTAX releases the manufacturer of any liability and warranty.
- Attention:** Decisive for life span and instant troublefree operation is to meet the specified schedule of maintenance and to observe sundry technical data.
- Attention:** Rectify minor defects without delay, thus preventing engine failure.
- Attention:** Perform any maintenance or repair work on the engine even with engine installed in bike on the non-running engine and with ignition switched in "☒" position.
- Attention:** Do not start engine until wiring is complete and spark plug connected.
- ▲ Warning:** During maintenance and repair work observe all generally valid safety directives and ecological requirements as well as safety notes of the motorcycle manufacturer. Take note of further separate safety directives in the Manual.
- Attention:** When draining coolant at operating temperature or opening the radiator cap, let the engine cool down in order to avoid the risk of burns!



(*) Fino al motore # 472690
 (*1) Dal motore # 472691

(*) Bis Motor # 472690
 (*1) Beim Motor # 472691

(*) Up to engine # 472690
 (*1) As of engine # 472691

Prospetto componenti

- 1 Coperchio valvole
- 2 Testa, albero a camme e valvole
- 3 Cilindro, pistone
- 4 Azionamento del contagiri
- 5 Tappo magnetico per lo scarico dell'olio
- 6 Attacco tubo olio
- 7 Vite di fermo per il fissaggio al punto morto superiore
- 8 Vite esagonale per lo scarico del liquido refrigerante
- 9 Pompa dell'acqua
- 10 Termostato e alimentazione refrigerante
- 11 Starter elettrico
- 12 Attacco tubo liquido refrigerante, by-pass
- 13 Tensionatore della catena di distribuzione
- 14 Candela d'accensione
- 15 Sensore termico
- 16 Impianto di accensione e coperchio
- 17 Sensore pressione olio
- 18 Coperchio del filtro dell'olio
- 19 Pignone catena
- 20 Semiscatola lato magnete
- 21 Attacco tubo flessibile per alimentazione olio
- 22 Semicarter lato frizione
- 23 Perno della leva del cambio
- 24 Leva di disinnesto frizione
- 25 Coperchio frizione

Posizione del numero motore

Il numero del motore 26 è impresso nel semicarter lato frizione. Il numero del motore è richiesto per la registrazione della motocicletta, per tutte le richieste di informazioni o per ordinare ricambi, come pure in caso di reclami in garanzia.

Bauelemente - Übersicht

- 1 Ventildeckel
- 2 Zylinderkopf - Nockenwellen und Ventile
- 3 Zylinder - Kolben
- 4 Drehzählerantrieb
- 5 Magnetschraube für Ölablaß
- 6 Schlauchnippel für Ölablauf
- 7 Gewindestift für OT-Fixierung
- 8 Sechskantschraube für Kühlmittelablaß
- 9 Wasserpumpe
- 10 Kühlmittel-Zulauf und Thermostat
- 11 Elektrostarter
- 12 Bypass-Kühlmittelschlauch
- 13 Steuerkettenspanner
- 14 Zündkerze
- 15 Temperatugeber
- 16 Zünderdeckel und Zündanlage
- 17 Öldruckschalter
- 18 Ölfilterdeckel
- 19 Kettenrad
- 20 Magnetseitige Gehäusehälfte (MS)
- 21 Schlauchnippel für Ölzulauf
- 22 Kupplungsseitige Gehäusehälfte (KS)
- 23 Schaltwelle
- 24 Ausrückhebel für Kupplung
- 25 Kupplungsdeckel

Motornummer - Lage

Die Motornummer 26 ist in die kupplungsseitige Gehäuse-hälfte eingestanzt. Die Angabe der Motornummer ist zur Anmeldung des Motorrades, für sämtliche Anfragen oder die Bestellung von Ersatzteilen sowie im Falle eines Garantieantrages erforderlich.

Engine components

- 1 Valve Cover
- 2 Cylinder Head, Crankshaft And Valves
- 3 Cylinder, Piston
- 4 Rev.-counter Drive
- 5 Magnetic Plug For Oil Draining
- 6 Hose Nipple For Oil Draining
- 7 Crankshaft Locking Screw
- 8 Hex. Hd. Screw For Coolant Draining
- 9 Water Pump
- 10 Coolant Inlet And Thermostat
- 11 Electric Starter
- 12 Coolant By-pass
- 1 Camshaft Chain Tensioner
- 2 Spark Plug
- 3 Temperature Sensor
- 4 Ignition Cover And Ignition Unit
- 5 Oil Pressure Switch
- 6 Oil Filter Cover
- 7 Final Drive Sprocket
- 8 Magneto Side Crankcase Half
- 9 Hose Nipple For Oil Inlet
- 10 Clutch Side Crankcase Half
- 23 Gearshift Shaft
- 24 Clutch Release Lever
- 25 Clutch Cover

Engine number — location

The engine number 26 is imprinted on the clutch side crankcase half at the top rear engine suspension. The engine number is required for the bike registration, on inquiries, when ordering spare parts and in case of a warranty claim.

Circuito di lubrificazione

Il motore è dotato di una lubrificazione a carter secco. Questo sistema comprende due pompe dell'olio, cioè una pompa a pressione ① e una di aspirazione ⑮.

La pompa a pressione ① convoglia l'olio dal serbatoio ② nel telaio del veicolo attraverso il filtro del telaio ③ e una valvola di mantenimento della pressione ④ fino al filtro dell'olio ⑤. Successivamente l'olio viene distribuito in un circuito ad alta e bassa pressione, mediante una valvola sferica caricata a molla ⑥ che, ad una pressione dell'olio di circa 3,5 bar, apre il circuito a bassa pressione.

Il circuito a bassa pressione lubrifica le ruote dentate attraverso i fori ⑦ nel basamento e la frizione tramite un altro orificio ⑧ nell'albero secondario.

Il sensore pressione olio ⑨ apre il contatto non appena raggiunta la pressione minima dell'olio di circa 0,4 bar; in questo momento la spia luminosa della pressione dell'olio si spegne.

Il circuito ad alta pressione alimenta il cuscinetto di banco dell'albero a gomiti ⑩, il cuscinetto di biella ⑪, il cuscinetto dell'albero a camme ⑫ e uno spruzzatore ⑬ per il raffreddamento del cielo dello stantuffo e la lubrificazione dell'occhio di biella.

La pompa di aspirazione ⑮ trasporta l'olio dalla coppa ⑭ del motore attraverso il filtro ⑯ di nuovo nel serbatoio ②.

Schmierölkreislauf

Der Motor ist mit einer Trockensumpfschmierung ausgestattet. Bei dieser Bauart werden zwei Ölpumpen benötigt, und zwar eine Druckpumpe ① und eine Saugpumpe ⑮.

Die Druckpumpe ① fördert das Öl vom Öltank ② im Fahrzeugrahmen durch das Rahmenölsieb ③ und über ein Druckhalteventil ④ zum Ölfilter ⑤. Nach dem Ölfilter wird das Öl in einen Hochdruck und einen Niederdruckkreislauf aufgeteilt. Dies erfolgt über ein federbelastetes Kugelventil ⑥, welches bei einem Öldruck von ca. 3,5 bar den Niederdruckkreislauf frei gibt.

Der Niederdruckkreislauf schmiert über Bohrungen ⑦ im Gehäuse die Getrieberäder und durch eine Bohrung ⑧ in der Vorgelegewelle die Kupplung.

Der Öldruckschalter ⑨ öffnet den Kontakt bei Erreichen des Mindestöldruckes von ca. 0,4 bar; in diesem Augenblick erlischt die Öldruckkontrollleuchte.

Der Hochdruckkreislauf versorgt die Pleuellager ⑩, das Pleuellager ⑪, die Pleuellager ⑫ sowie eine Spritzdüse ⑬ zur Pleuellagerkühlung und Schmierung des oberen Pleuellagers.

Die Saugpumpe ⑮ fördert das Öl aus dem Ölsumpf ⑭ des Motors durch das Ölsieb ⑯ wieder zurück in den Öltank ②.

Lubrication system

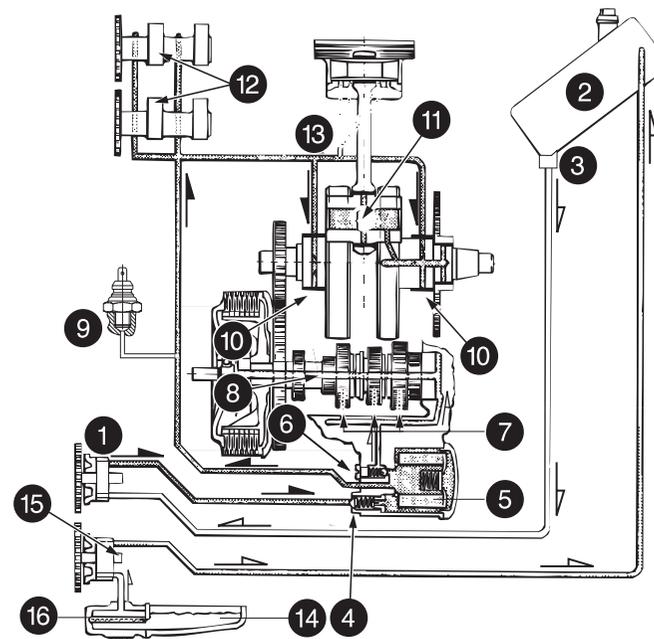
The engine is equipped with a dry sump forced flow lubrication system. The system comprises 2 oil pumps, a pressure (feed) pump ① and a suction (return) pump ⑮.

The pressure pump ① draws the oil from the oil tank ② on the motorcycle frame and passes it on via a coarse filter and pressure retaining valve ④ to the oil filter ⑤. The flow of oil is then divided into a high and a low pressure circuit. This is achieved by a spring loaded ball valve ⑥, which opens to release oil to the low pressure circuit as soon as a pressure of approx. 3,5 bar is reached.

The low pressure circuit lubricates and cools the gearbox via ducts ⑦ in the crankcase and the clutch is lubricated via a bore ⑧ in the clutch shaft.

The oil pressure switch ⑨ breaks the contact as soon as the minimum oil pressure of approx. 0,4 bar is reached and the oil pressure control lamp extinguishes. The high pressure circuit delivers oil to the crankshaft main bearings ⑩, to the conrod bearing ⑪, the camshaft bearings ⑫ as well as to oil splash jet ⑬ for piston underside cooling and lubrication of the conrod small end.

Oil drains into the oil sump ⑭ through the screen ⑯ and is then returned to the oil tank ② by the suction pump ⑮.



Circuito di raffreddamento

Il motore è raffreddato a liquido.

Il liquido refrigerante circola attraverso il cilindro, la testa del cilindro e il radiatore.

Una pompa centrifuga ❶ agisce come pompa dell'acqua ed è azionata dal contralbero attraverso gli ingranaggi.

Nella fase di riscaldamento il termostato ❷ è chiuso, così il liquido refrigerante ritorna alla pompa dell'acqua attraverso la tubazione di by-pass ❸, deviando così rispetto al radiatore.

Quando la temperatura del refrigerante aumenta a circa 60° C, e all'apertura della valvola del termostato, si stabilisce il flusso normale del refrigerante attraverso il radiatore.

Kühlkreislauf

Der Motor ist flüssigkeitsgekühlt. Die Kühlflüssigkeit zirkuliert dabei durch Zylinder, Zylinderkopf und Kühler.

Als Wasserpumpe dient eine Kreiselpumpe ❶, welche von der Ausgleichswelle über Zahnräder angetrieben wird.

In der Warmlaufphase ist der Thermostat ❷ geschlossen, sodaß die Kühlflüssigkeit über die Bypass-Leitung ❸ wieder zurück zur Wasserpumpe gelangt; der Kühler wird somit umgangen.

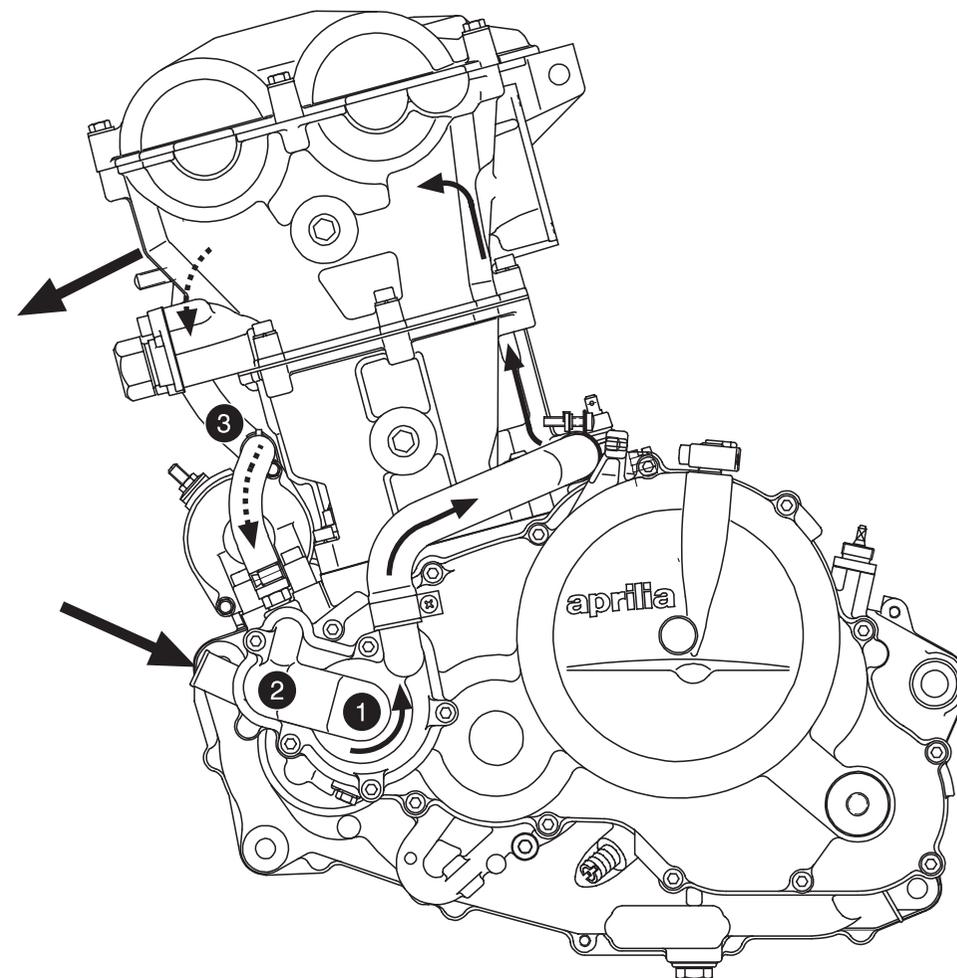
Bei Anstieg der Kühlmitteltemperatur auf ca. 60C und Öffnung des Thermostatventils ist der normale Kühlmittelfluß über den Kühler gegeben.

Cooling circuit

The engine is liquid cooled. The coolant passes through cylinder, cylinder head and radiator.

The water pump, a centrifugal pump ❶, is driven via gears by the balance shaft. During the warming up period the thermostat ❷ is closed so that the coolant bypasses ❸ the radiator and returns straight to the water pump.

At a rise of the coolant temperature to approx. 60C the thermostat will open and thus the normal coolant circuit via the radiator is established.



Dati tecnici 655/97

Motore tipo	655/97
Alesaggio/corsa	100 mm/83 mm
Cilindrata	651,88 cm ³
Potenza nominale	34 kW a 6750 giri/min
Coppia massima	56 Nm a 5500 giri/min
Numero di giri minimo	1400 giri/min
Massimo numero di giri ammissibile	7500 giri/min
Numero di giri continuo ammissibile	7000 giri/min
Rapporto di compressione	9,1 : 1
Albero a camme in entrata	225° (apertura con gioco valvola 1 mm)
Albero a camme in uscita	234° (apertura con gioco valvola 1 mm)
Fasatura (con gioco valvola 1 mm)	Ammissione aperta: 5° prima del PMS.
	Ammissione chiusa: 40° dopo il PMI
	Scarico aperto: 47° prima del PMI
	Scarico chiuso: 7° dopo PMS
Impianto di accensione	Unità con condensatore ad alta tensione senza contatti, con variazione del punto di accensione elettronica e un alternatore trifase.
Anticipo accensione	Anticipo accensione statico: 10° prima del PMS fino a circa 2500 giri/ min
	Anticipo accensione dinamico: 39° prima del PMS a partire da circa 4000 giri/ min
Potenza del generatore	12V 280W

Technische Daten 655/97

Motor-Type	655/97
Bohrung / Hub	100 mm / 83 mm
Hubraum	651,88 cm ³
Nennleistung (max.)	34 kW bei 6750 1/min
Max. Drehmoment	56 Nm bei 5500 1/min
Leerlaufdrehzahl	1400 1/min
Zulässige Höchstdrehzahl	7500 1/min
Zulässige Dauerdrehzahl	7000 1/min
Verdichtungsverhältnis	9,1 : 1
Einlaßnockenwelle	225° (Öffnung bei 1 mm Ventilspiel)
Auslaßnockenwelle	234° (Öffnung bei 1 mm Ventilspiel)
Steuerzeiten (bei 1 mm Ventilspiel)	Einlaß öffnet: 5° vor OT
	Einlaß schließt: 40° nach UT
	Auslaß öffnet: 47° vor UT
	Auslaß schließt: 7° nach OT
Zündanlage	kontaktlose Hochspannungs Kondensator Zündanlage mit elektronischer Zündverstellung und einem 3-Phasen-Wechselstromgenerator
Vorzündung	Startvorzündung: 10 ° vor OT bis ca. 2500 1/min
	Vollastvorzündung: 39 ° vor OT ab ca. 4000 1/min
Generatorleistung	12V 280W

Technical Data 655/97

Engine type	655/97
Bore / stroke	100 mm / 83 mm
Displacement	651,88 c.c.
Max. performance	34 kW bei 6750 r.p.m.
Max. torque	56 Nm bei 5500 r.p.m.
Idle r.p.m.	1400 r.p.m.
Max. admissible r.p.m.	7500 r.p.m.
Max. admissible continuous r.p.m.	7000 r.p.m.
Compression ratio	9,1 : 1
Inlet camshaft	225° (opening at 1 mm valve clearance)
Exhaust camshaft	234° (opening at 1 mm valve clearance)
Ignition timing (at 1 mm valve clearance)	Inlet opens: 5° before TDC
	Inlet closes: 40° after BDC
	Exhaust opens: 47° before BDC
	Exhaust closes: 7° after TDC
Ignition unit	breakerless capacitor discharge ignition unit with electronically variable advance and 3-phase AC generator
Ignition timing	Starting advance: 10° before TDC up to approx. 2500 r.p.m.
	Advance at full load operation: 39° before TDC from approx. 4000 r.p.m.
Generator output	12V 280W

Candela di accensione	1 candela di accensione, 12 mm, NGK DR 8 EA - NGK DR 8 ES
Distanza tra gli elettrodi	0,6-0,7 mm
Starter elettrico	0,9 kW
Carburante	Super senza piombo ROZ (min.) = 95 ottani
Raffreddamento	Raffreddamento a liquido, circuito di raffreddamento con pompa dell'acqua integrata
Miscela refrigerante	50% antigelo e 50% acqua
Quantità di refrigerante	Secondo le indicazioni del produttore del veicolo
Termostato	Temperatura di apertura circa 60°C
Pompa dell'olio	2 pompe trocoidali
olio motore - Specifica	Specifica API: SF o SG Specifica CCMG: G4
olio motore - Viscosità	Si consiglia 15W - 40
Quantità di olio motore	Secondo le indicazioni del produttore del veicolo
Frizione	Frizione a dischi multipli in bagno d'olio
Trasmissione	Cambio a 5 velocità, innesto a denti
Riduzione primaria	72/37 = 1,946
Rapporto del cambio	1° marcia: 33/12 = 2,750 2° marcia: 28/16 = 1,750 3° marcia: 21/16 = 1,313 4° marcia: 23/22 = 1,045 5° marcia: 21/24 = 0,875
Trasmissione dal cambio alla trazione posteriore	Attraverso il pigone per catena, 16 denti
Dimensione della catena	Catena O-Ring, 5/8" x 1/4"
Peso (a secco)	Circa 49 kg

Zündkerze	1 Zündkerze, 12 mm, NGK DR 8 EA - NGK DR 8 ES
Elektrodenabstand	0,6-0,7 mm
Elektrostarter / Leistung	0,9 kW
Kraftstoff	SUPER-Kraftstoff unverbleit ROZ (min.) = 95 Oktan
Kühlung	Flüssigkeitskühlung, Kühlkreislauf durch integrierte Wasserpumpe
Kühlmittelmischung	50% Frostschutzmittel und 50% Wasser
Kühlmittel-Füllmenge	nach Angabe des Fahrzeugherstellers
Thermostat	Öffnungstemperatur ca. 60°
Ölpumpe	2 Trochoidpumpen
Motoröl - Spezifikation	It. Spezifikation API: SF oder SG It. Spezifikation CCMC: G4
Motoröl - Viskosität	Empfehlung 15W - 40
Motoröl-Füllmenge	nach Angabe des Fahrzeugherstellers
Kupplung	Mehrscheibenkupplung im Ölbad
Getriebe	5-Gang Getriebe, klauengesaltet
Primäruntersetzung	72/37 = 1,946
Getriebeabstufung	1. Gang : 33/12 = 2,750 2. Gang : 28/16 = 1,750 3. Gang : 21/16 = 1,313 4. Gang : 23/22 = 1,045 5. Gang : 21/24 = 0,875
Kraftübertragung vom Getriebe zum Hinterradantrieb	über Kettenrad, 16 Zähne
Kettendimension	O-Ring Kette 5/8"x 1/4"
Gewicht (trocken)	ca. 49 kg

Spark plug	1 spark plug, 12 mm, NGK DR 8 EA - NGK DR 8 ES
Electrode gap	0,6 - 0,7 mm
Electric starter, performance	0,9 kW
Fuel	SUPER gasoline, unleaded, RON (min.) = 95 octane
Cooling	liquid cooling, circuit by integrated water pump
Coolant mixture	50% anti-freeze, 50% water
Coolant, quantity	as per motorcycle manufact. specifications
Thermostat	opening temperature approx. 60° C
Oil pumps	2 trochoidal pumps
Motor oil specifications	as per specification API: SF or SG as per specification CCMC: G4
Motor oil viscosity	recommendation 15W - 40
Motor oil quantity	as per motorcycle manufact. specifications
Clutch	multi-disk clutch in oil bath
Gearbox	5-speed gearbox, dog engagement
Primary drive ratio	72 / 37 = 1,946
Gear ratios	1 st speed : 33/12 = 2,750 2 nd speed: 28/16 = 1,750 3 rd speed: 21/16 = 1,313 4 th speed: 23/22 = 1,045 5 th speed: 21/24 = 0,875
Final drive from gearbox to rear wheel	via chain sprocket, 16 teeth
Chain dimension	O-ring chain 5/8"x 1/4"
Weight (dry)	ca. 49 kg

Dati tecnici 655EFI

Motore tipo	655 EFI
Tipo di costruzione	motore a scoppio monocilindrico a 4 tempi, gestione DOHC con trasmissione a catena dentata, 5 valvole disposte radialmente
Alesaggio/corsa	100 mm/83 mm
Cilindrata	651,88 cm ³
Potenza nominale	36 kW a 6750 giri/min
Coppia massima	60 Nm a 5500 giri/min
Numero di giri minimo	1400 giri/min
Massimo numero di giri ammissibile	7500 giri/min
Numero di giri continuo ammissibile	7000 giri/min
Rapporto di compressione	9,1 : 1
Valvola di aspirazione	piatto valvola Ø 30 mm, 3 valvole di aspirazione
Valvola di scarico	piatto valvola Ø 32 mm, 2 valvole di scarico
Albero a camme in entrata	225° (apertura con gioco valvola 1 mm)
Albero a camme in uscita	234° (apertura con gioco valvola 1 mm)
Fasatura (con gioco valvola 1 mm)	Ammissione aperta: 5° prima del PMS. Ammissione chiusa: 40° dopo il PMI Scarico aperto: 47° prima del PMI Scarico chiuso: 7° dopo PMS
Gioco valvola a motore freddo (max. 35°C)	Valvola di aspirazione: 0,1 – 0,19 mm Valvola di aspirazione centrale: 00,7 – 0,10 mm misurati tra rullo ed albero a camme Valvola di scarico: 0,1 – 0,19 mm
Impianto di accensione	Sagem a scarica induttiva.
Anticipo accensione	Anticipo accensione statico: 10° prima del PMS fino a circa 2500 giri/ min Anticipo accensione dinamico: 39° prima del PMS a partire da circa 4000 giri/ min

Technische Daten 655EFI

Motor-Type	655 EFI
Fahrposition	Einzylinder-Viertakt-Verbrennungsmotor, DOHC-Steuerung mit Zahnkettenantrieb, 5 radial angeordnete Ventile
Bohrung / Hub	100 mm / 83 mm
Hubraum	651,88 cm ³
Nennleistung (max.)	34 kW bei 6750 1/min
Max. Drehmoment	56 Nm bei 5500 1/min
Leerlaufdrehzahl	1400 1/min
Zulässige Höchstdrehzahl	7500 1/min
Zulässige Dauerdrehzahl	7000 1/min
Verdichtungsverhältnis	9,1 : 1
Einlaßventil	Ventilteller Ø 30 mm, 3 Einlassventile
Auslaßventil	Ventilteller Ø 32 mm, 2 Auslassventile
Einlaßnockenwelle	225° (Öffnung bei 1 mm Ventilspiel)
Auslaßnockenwelle	234° (Öffnung bei 1 mm Ventilspiel)
Steuerzeiten (bei 1 mm Ventilspiel)	Einlaß öffnet: 5° vor OT Einlaß schließt: 40° nach UT Auslaß öffnet: 47° vor UT Auslaß schließt: 7° nach OT
Bei kaltem Motor Auslaßventil (max. 35°C)	Einlaßventil: 0,1 – 0,19 mm Zentraleinlaßventil: 00,7 – 0,10 mm gemessen zwischen Rolle und Nockenwelle Auslaßventil: 0,1 – 0,19 mm
Zündanlage	Sagem mit induktiver Entladung.
Vorzündung	Startvorzündung: 10° vor OT bis ca. 2500 1/min Vollastvorzündung: 39° vor OT ab ca. 4000 1/min
Generatorleistung	12V 280W

Technical Data 655EFI

Engine type	655 EFI
Type of construction	one-cylinder, 4-stroke combustion engine, DOHC, with toothed chain drive, 5 valves arranged radially
Bore / stroke	100 mm / 83 mm
Displacement	651,88 c.c.
Max. performance	34 kW bei 6750 r.p.m.
Max. torque	56 Nm bei 5500 r.p.m.
Idle r.p.m.	1400 r.p.m.
Max. admissible r.p.m.	7500 r.p.m.
Max. admissible continuous r.p.m.	7000 r.p.m.
Compression ratio	9,1 : 1
Intake valve	valve plate Ø 30 mm, 3 inlet valves
Exhaust valve	valve plate Ø 32 mm, 2 exhaust valves
Inlet camshaft	225° (opening at 1 mm valve clearance)
Exhaust camshaft	234° (opening at 1 mm valve clearance)
Ignition timing (at 1 mm valve clearance)	Inlet opens: 5° before TDC Inlet closes: 40° after BDC Exhaust opens: 47° before BDC Exhaust closes: 7° after TDC
Valve clearance with cold engine (max. 35°C)	Intake valve: 0,1 – 0,19 mm Centre inlet valve: 00,7 – 0,10 mm measured between roller and camshaft Exhaust valve: 0,1 – 0,19 mm
Ignition unit	SAGEM - inductive ignition system.
Ignition timing	Starting advance: 10° before TDC up to approx. 2500 r.p.m. Advance at full load operation: 39° before TDC from approx. 4000 r.p.m.
Generator output	12V 280W

Potenza del generatore	12V 280W
Candela di accensione	1 candela di accensione, 12 mm, NGK DR 8 EB
Distanza tra gli elettrodi	0,6-0,7 mm
Starter elettrico	0,9 kW
Carburante	Super senza piombo ROZ (min.) = 95 ottani
Gestione motore	Elettronica
Preparazione miscela	Iniezione in funzione dei consumi specifici
Accensione	Accensione a batteria, angolo di accensione in funzione dei consumi specifici
Raffreddamento	Raffreddamento a liquido, circuito di raffreddamento con pompa dell'acqua integrata
Miscela refrigerante	50% antigelo e 50% acqua
Quantità di refrigerante	Secondo le indicazioni del produttore del veicolo
Termostato	Temperatura di apertura circa 60°C
Pompa dell'olio	2 pompe trocoidali
Olio motore - Specifica	Specifica API: SF o SG Specifica CCMC: G-4
Olio motore - Viscosità	Si consiglia 5W - 40
Consumo d'olio ammesso	0,5 l/1000km
Quantità di olio motore	Secondo le indicazioni del produttore del veicolo
Frizione	Frizione a dischi multipli in bagno d'olio: # 7 dischi di acciaio 1,5 mm # 7 dischi di attrito 3,5 mm
Trasmissione	Cambio a 5 velocità, innesto a denti
Riduzione primaria	72/37 = 1,946
Rapporto del cambio	1° marcia: 33/12 = 2,750 2° marcia: 28/16 = 1,750 3° marcia: 21/16 = 1,313 4° marcia: 23/22 = 1,045 5° marcia: 21/24 = 0,875
Trasmissione dal cambio alla trazione posteriore	Attraverso il pignone per catena, 16 denti
Dimensione della catena	Catena O-Ring, 5/8" x 1/4"
Peso (a secco)	Circa 49 kg

Zündkerze	1 Zündkerze, 12 mm, NGK DR 8 EA - NGK DR 8 ES
Elektrodenabstand	0,6-0,7 mm
Elektrostarter / Leistung	0,9 kW
Kraftstoff	SUPER-Kraftstoff unverbleit ROZ (min.) = 95 Oktan
Motorssteuerung	Elektronische
Gemischaufbereitung	Durch die spezifischen Verbrauchsmengen bedingte Einspritzung
Zündung	Batteriezündung, durch die spezifischen Verbrauchsmengen bedingter Zündwinkel
Kühlung	Flüssigkeitskühlung, Kühlkreislauf durch integrierte Wasserpumpe
Kühlmittelmischung	50% Frostschutzmittel und 50% Wasser
Kühlmittel-Füllmenge	nach Angabe des Fahrzeugherstellers
Thermostat	Öffnungstemperatur ca. 60°
Ölpumpe	2 Trochoidpumpen
Motoröl - Spezifikation	lt. Spezifikation API: SF oder SG lt. Spezifikation CCMC: G4
Motoröl - Viskosität	Empfehlung 15W - 40
Zulässiger Ölverbrauch	0,5 l/ 1000 km
Motoröl-Füllmenge	nach Angabe des Fahrzeugherstellers
Kupplung	Mehrscheibenkupplung im Ölbad # 7 Stahlscheiben 1,5 mm # 7 Reibungsscheiben 3,5 mm
Getriebe	5-Gang Getriebe, klauengesaltet
Primäruntersetzung	72/37 = 1,946
Getriebeabstufung	1. Gang : 33/12 = 2,750 2. Gang : 28/16 = 1,750 3. Gang : 21/16 = 1,313 4. Gang : 23/22 = 1,045 5. Gang : 21/24 = 0,875
Kraftübertragung vom Getriebe zum Hinterradantrieb	über Kettenrad, 16 Zähne
Kettendimension	O-Ring Kette 5/8"x 1/4"
Gewicht (trocken)	ca. 49 kg

Spark plug	1 spark plug, 12 mm, NGK DR 8 EA - NGK DR 8 ES
Electrode gap	0,6 - 0,7 mm
Electric starter, performance	0,9 kW
Fuel	SUPER gasoline, unleaded, RON (min.) = 95 octane
Engine management	Electronic
Mixture preparation	Injection according to specific consumption
Ignition	Battery ignition, ignition angle according to specific consumption
Cooling	liquid cooling, circuit by integrated water pump
Coolant mixture	50% anti-freeze, 50% water
Coolant, quantity	as per motorcycle manufact. specifications
Thermostat	opening temperature approx. 60° C
Oil pumps	2 trochoidal pumps
Motor oil specifications	as per specification API: SF or SG as per specification CCMC: G4
Motor oil viscosity	recommendation 15W - 40
Allowed oil consumption	0,5 l/ 1000 km
Motor oil quantity	as per motorcycle manufact. specifications
Clutch	multi-disk clutch in oil bath # 7 steel disc 1,5 mm # 7 friction discs 3,5 mm
Gearbox	5-speed gearbox, dog engagement
Primary drive ratio	72 / 37 = 1,946
Gear ratios	1 st speed : 33/12 = 2,750 2 nd speed: 28/16 = 1,750 3 rd speed: 21/16 = 1,313 4 th speed: 23/22 = 1,045 5 th speed: 21/24 = 0,875
Final drive from gearbox to rear wheel	via chain sprocket, 16 teeth
Chain dimension	O-ring chain 5/8"x 1/4"
Weight (dry)	ca. 49 kg

Maintenance schedule 655/97

Component / Operating liquid	1st check at: 1000 km	Maintenance intervals every:			
		6000 km	12000 km	at least once a year	everykm
Check coolant level	x				1000
Change coolant			x		every 2 years
Check motor oil level	x				500
Change motor oil and oil filter	x	x		x	6000
Check idle r.p.m., adjust if necessary	x	x		x	6000
Clean magnetic screw	x	x		x	6000
Check valve clearance, re-adjust if necessary	x	x		x	6000
Clean and check spark plug	x	x		x	6000
Renew spark plug			x		12000
Check clutch play, readjust if necessary	x	x		x	6000
Check camshaft chain tension, adjust if necessary	x	x		x	6000
Check water hoses, renew if necessary	x		x	x	6000
Renew water hoses					30 000 at least every 3 years
Check final drive chain tension and lubricate, adjust or renew if necessary					500
Check final drive chain sprocket, renew together with final drive chain if necessary		x		x	6000

Maintenance schedule 655EFI

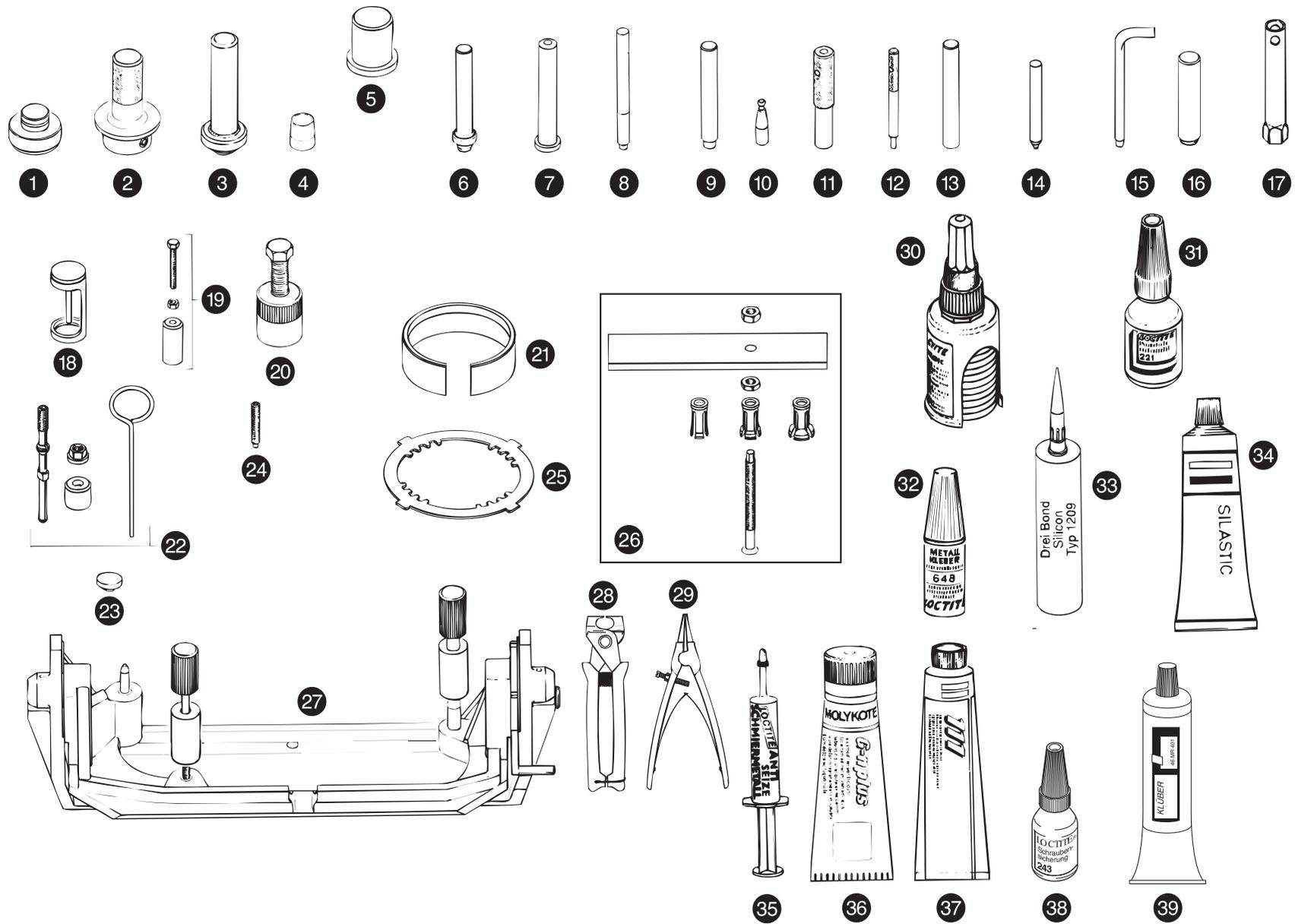
Component / Operating liquid	1st check at: 1000 km	Maintenance intervals every:			
		7500 km	15000 km	at least once a year	everykm
Check coolant level	x				1000
Change coolant			x		every 2 years
Check motor oil level	x				1000
Change motor oil and oil filter	x	x		x	6000
Check idle r.p.m., adjust if necessary	x	x		x	6000
Clean magnetic screw	x	x		x	6000
Check valve clearance, re-adjust if necessary	x	x		x	6000
Clean and check spark plug	x	x		x	6000
Renew spark plug			x		12000
Check clutch play, readjust if necessary	x	x		x	6000
Check camshaft chain tension, adjust if necessary	x	x		x	6000
Check water hoses, renew if necessary	x		x	x	6000
Renew water hoses					30 000 at least every 3 years
Check final drive chain tension and lubricate, adjust or renew if necessary					500
Check final drive chain sprocket, renew together with final drive chain if necessary		x		x	6000

Requirements for maintenance and engine repair

- ▲ **Warning:** Maintenance of engines and systems requires know how and special tools.
- ▲ **Warning:** All maintenance and repair work to be performed only by technicians especially trained on this ROTAX engine.
- ▲ **Warning:** We inform you explicitly that parts and equipment not supplied by ROTAX are neither tested nor released by ROTAX. The installation and use of such products can possibly change or impair design specific characteristics of engine. For damage caused by employment of non-genuine ROTAX parts and equipment the engine manufacturer will not accept any liability.
- ▲ **Warning:** Besides the advice given in this manual observe also the generally valid safety and accident preventive prescriptions and legal regulations.

General notes to procedure of maintenance and repair work

- **Attention:** Do not use highly inflammable or caustic cleaning agents.
- ▲ **Warning:** Disconnect battery only with ignition off! Detach first minus terminal and then plus terminal. Caution when handling battery acid - caustic! At accidents consult a doctor.
- **Attention:** At draining of hot operating fluids - danger of scalds. Let the engine cool down first. Disposal of all operating fluids, cleaning agents, filter elements etc. as per local ecological requirements.
- ▲ **Warning:** Always attach engine removed from the motorcycle securely on trestle.
- **Attention:** When servicing the cooling system, the lubrication and fuel system make absolutely sure that no contamination, metal chips, foreign matter or dirt will enter the system.
- **Attention:** To warrant proper repair use of special tools, fixtures and lubricants as specified is required.
- ▲ **Warning:** Never tighten screws and nuts with a pair of pliers, always use the correct spanner.
- **Attention:** Use only screws and nuts of good order. Inspect contact face and thread for damage. If doubtful renew.
- **Attention:** Always renew self securing nuts once removed.
- ▲ **Warning:** Strictly adhere to tightening torques of screws and nuts as specified in table. Overtightening or loose connections might result in serious engine damage.
- **Attention:** At reassembly renew all sealing rings, gaskets, circlips, O-rings and oil seals.
- ▲ **Warning:** Use only securing agents, sealing and adhesive compounds, lubricants, cleaning agents and solvents as stated in the relevant chapter. Non-compliance can lead to consequent damage.
- **Attention:** Clean and check parts before re-use and refit them as per instructions.
- **Attention:** Prior to any assembling check for missing parts.
- **Attention:** After assembling check components for tight fit and flawless operation.



Special tools, securing-, sealing- and lubrication agents

Pos.	aprilia part#	Denomination	Function
1	0277520	insertion jig	removal of bearing bushes, crankshaft
2	0277525	insertion jig	fitting of bearing bushes, crankshaft
3	0277861	insertion jig	oil seal 25x40x7 (mainshaft) / fitting in disassembled engine
4	0277970	guide sleeve	mainshaft / splines for chain sprocket
5	0277304	insertion jig	oil seal 25x40x7 (mainshaft) / fitting in assembled engine
6	0277222	insertion jig	oil seal 15x24x7 (balance shaft)
7	0276770	insertion jig	oil seal 10x26x7 (water pump shaft)
8	0277235	insertion jig	needle bushing 8x12x8 (clutch release shaft)
9	0277230	insertion jig	needle bushing 12x16x10 (clutch release shaft)
10	0277300	installation sleeve	oil seal 12x18x4,5 / splines on clutch release shaft)
11	0277302	insertion jig	oil seal 12x18x4,5 (clutch release shaft)
12	0277510	insertion jig	valve guides / removal and fitting
13	0277210	insertion jig	valve stem seal 6x9x11,8
14	0277090	insertion jig	oil seal (rev. counter shaft)
15	0277270	locking	split gears of balance drive
16	0277250	removal tool M18x1,5	ignition cover
17	0276280	spark plug wrench 18	spark plug
18	0276477	valve spring compression tool	valve springs
19	0277205	puller	idle gear shaft, camshaft drive
20	0976235	puller M38x1,5	flywheel / ignition unit
21	0276357	piston ring clamp	piston / piston rings 100 mm dia.
22	0277280	needle bearing puller	needle bearings of clutch release shaft
23	0876557	protection mushroom	crankshaft, magneto side
24	0240880	thread bolt DIN 915, M8x50	locking of crankshaft in top dead center position

Pos.	aprilia part#	Denomination	Function
25	0277881	clutch hub locking tool	clutch
26	0277265	puller set	ball bearings / balance shaft, clutch shaft and mainshaft
27	0277919	trestle assembly	engine types 655, 654
28	0277295	hose clamp pliers	fitting of hose clamps / coolant hose
29	0277292	snap-ring pliers	removal and fitting of gearbox snap-rings
30	0899784	Loctite 574 orange	sealing compound, 50 c.c.
31	0899785	Loctite 221 violet	low strength bond, 10 c.c.
32	0899788	Loctite 648 green	high strength bond, 5 gr.
33	0297900	sealing compound	310 ml
34	0297386	Silastic 732 RTV	sealing compound, 100 gr.
35	0297431	Loctite-Anti-Seize 76710	to prevent metal galling, 10 gr.
36	0297433	Molykote G-N	slide paste, 50 gr.
37	0897161	Molykote 111	silicone grease, 100 gr.
38	0897651	Loctite 243 blu	Average resistance paste glue for screws and nuts, 10 cm ³
39	0297616	Paste Klueber 46 MR 401	Suitable for low speed contact points, bolts, nuts and screws
-	-	Multi purpose grease BP I S3	Multi-purpose grease
-	-	Engine oil	Lubricant

655/97 Tightening torques, securing and lubricating agents

Component	Component / fastener	Quantity	Tightening torque [Nm] *	Securing agent Lubricant
Balance shaft / split gears	split gears, bearing journal on balance shaft	1	-	Loctite Anti Seize
Clutch release shaft	clutch release shaft / bearing journal	1	-	oil
Electric starter	Allen screw M6 x 20	2	10	-
Electric starter	O-ring and splines	1	-	grease / BP Energrease
Rev. counter shaft	rev. counter shaft - bearing journals	1	-	oil
Crankcase	Allen screw M6 x 45	9	10	-
Crankcase	Allen screw M6 x 35	2	10	-
Crankcase	Allen screw M6 x 75	2	10	-
Crankcase	Allen screw M6 x 65	1	10	-
Crankcase / rev. counter	banjo bolt	1	**20	Loctite 574
Crankcase / main bearings	bearing bush 48x52x22,8 / at fitting in crankcase	2	-	Molykote G-N
Crankcase / main bearings	bearing bush 48x52x22,8 / for crankshaft journal	2	-	oil
Crankcase / neutral gear indication	contact screw M10	1	4	Loctite 574
Crankcase / oil draining	magnetic screw M18 x 1,5	1	30	-
Crankcase / oil pressure switch	oil pressure switch M10 x 1	1	15	Loctite 221
Crankcase / oil circuit	valve pin screw	2	24	-
Crankcase / oil sieve and oil guide	Taptite screw M5 x 16	2	8	Loctite 221
Crankcase / oil inlet and exit	hose nipple M12 x 1,5	2	manual tightening	Loctite 221
Crankcase / crankshaft locking at TDC	Allen screw with sealing ring M8 x 16	1	**17	-
Crankcase / tensioner guide	hex. screw M6 x 30	1	10	Loctite 221
Crankcase / idle gear shaft	idle gear shaft, bearing bore in crankcase	1	-	Molykote G-N
Crankcase / cylinder fastening	stud M10 x 62	2	10	Loctite 221
Crankcase / cylinder fastening	stud M10 x 78	2	10	Loctite 221
Gearbox / gear shafts	gear shafts - bearing journals	9	-	oil
Final drive sprocket	final drive sprocket - internal teeth	1	-	Loctite Anti Seize

 * Tolerance $\pm 12\%$

 ** Tolerance ± 2 Nm

Component	Component / fastener	Quantity	Tightening torque [Nm] *	Securing agent Lubricant
Piston	piston - bore for piston pin	1	-	Molykote G-N
Piston	piston - working surface and piston rings	1	-	oil
Ball bearing	ball bearing inner race at mounting of shafts	-	-	Loctite Anti-Seize
Clutch / clutch release lever	Allen screw M6 x 25	1	8	-
Clutch / clutch actuation rack	clutch actuation rack / teeth	1	-	oil
Clutch / clutch drive gear	clutch drive gear, bearing seat (needle bearing)	1	-	oil
Clutch / clutch hub on clutch shaft	clutch hub, teeth on clutch shaft	1	-	Loctite Anti-Seize
Clutch / clutch hub on clutch shaft	hex. nut M18 x 1,5	1	140	Loctite 221
Clutch / pressure plate on clutch hub	hex. screw M6 x 25	6	10	-
Clutch cover	Allen screw M6 x 30	10	10	-
Clutch cover	Allen screw M6 x 65	2	10	-
Clutch cover / bypass coolant inlet	hose nipple 12/8	1	manual tightening	Loctite 574
Clutch cover / rubber holder, clutch side	Taptite screw M5 x 8	3	7	Loctite 221
Clutch cover / water draining	hex. screw M6 x 14	1	10	-
Crankshaft	crankshaft, bearing journal for camshaft gear and drive gear	1	-	Loctite Anti-Seize
Primary drive on crankshaft	hex. nut M22 x 1,5	1	180	Loctite 221
Crankshaft / conrod	conrod small end bore, for piston pin	1	-	Molykote G-N
Oil filter cover	Allen screw M6 x 20	2	10	-
Oil pump cover	countersunk screw M5 x 16	6	6	Loctite 221
Gear shifting / shift drum	shift drum - bearing bores and tracks	2	-	oil
Gear shifting / gearshift shaft	gearshift shaft, bearing bore in crankcase, mag. side	1	-	oil
Camshaft intermediate gear	camshaft intermediate gear, bearing seat on idle gear shaft	1	-	oil
Gear shifting / gearshift shaft	gearshift shaft / bearing bore in clutch cover	1	-	grease / BP Energrease
Thermostat cover	Allen screw M6 x 20	2	10	-

* Tolerance $\pm 12\%$

** Tolerance $\pm 2 \text{ Nm}$

Component	Component / fastener	Quantity	Tightening torque [Nm] *	Securing agent Lubricant
Valve cover	hex. screw M6 x 35	9	10	-
Valve cover / profile seal (seal with cylinder head)	profile rubber seal	1	-	Loctite 574
Water pump / space between 2 oil seals	oil seal	2	-	Molykote 111
Water pump housing	Allen screw M6 x 20	4	10	-
Water pump housing	Allen screw M6 x 60	1	10	-
Oil seals (all)	oil seal / sealing lips	-	-	grease / BP Energrease
Ignition unit / external trigger	Taptite screw M5 x 16	2	8	Loctite 221
Ignition unit / sprag clutch	sprag clutch segments	1	-	oil
Ignition unit / sprag clutch	freewheel gear bush	1	-	oil
Ignition unit / sprag clutch housing on flywheel hub	hex. nut BM6	4	10	Loctite 648
Ignition unit / taper in flywheel hub	flywheel hub taper	1	-	Loctite 648
Ignition unit / flywheel hub - contact face to rotor	flywheel hub - contact face to rotor	1	-	Loctite 648
Ignition unit / flywheel hub on crankshaft	hex. nut M22 x 1,5	1	180	Loctite 221
Ignition unit / rotor on flywheel hub	Allen screw M6 x 16	8	22	Loctite 648
Ignition unit / electric starter gears	starter gears - bearing bores	2	-	oil
Ignition unit / stator	Allen screw M6 x 35	3	10	Loctite 221
Ignition cover	Allen screw M6 x 30	10	10	-
Ignition cover / rubber holder mag. side	Taptite screw M5 x 8	3	7	Loctite 221
Ignition cover / cable passage and rubber grommet	rubber grommet	2	-	Silastic 732 RTV
Ignition cover / inner cable cover	Taptite screw M4 x 8	2	3	Loctite 221
Cylinder	hex. nut M10	4	**53	-
Cylinder	Allen screw M6 x 30	2	10	-
Cylinder / gasket in chain tunnel area	gasket	1	-	Loctite 574
Cylinder / silencing rubber	plug screw M24 x 1	1	25	Loctite Anti Seize
Cylinder / coolant inlet	tube	1	manual tightening	Loctite 574

* Tolerance $\pm 12\%$

** Tolerance $\pm 2 \text{ Nm}$

Component	Component / fastener	Quantity	Tightening torque [Nm] *	Securing agent Lubricant
Cylinder / cylinder head fastening	stud M10 x 117	4	10	-
Cylinder / cylinder head fastening	stud M10 x 78	1	10	-
Cylinder head	hex. nut M10	5	**48	-
Cylinder head	Allen screw M6 x 30	4	10	-
Cylinder head / bent water socket	Allen screw M5 x 20	2	6	-
Cylinder head / exhaust flange	stud M8 x 58	4	10	-
Cylinder head / silencer rubber	plug screw M24 x 1	1	25	Loctite Anti-Seize
Cylinder head / rubber plug	rubber plug	3	-	Silastic 732 RTV
Cylinder head / adjustment shims	adjustment shims in cam contact area	4	-	Molykote G-N
Cylinder head / camshaft chain tensioner (Up to engine # 472690)	union nut M24 x 1	1	**20	Molykote G-N
Cylinder head / camshaft chain tensioner (As of engine # 472691)	union nut M24 x 1	1	**20	Molykote G-N
Cylinder head / camshaft chain tensioner	chain adjustment screw	1	-	Molykote G-N
Cylinder head / camshaft chain tensioner	compression spring for chain tensioner plunger	1	-	grease / BP Energrease
Cylinder head / chain tensioner housing (Up to engine # 472690)	Allen screw M6 x 22	2	10	-
Cylinder head / chain tensioner housing (As of engine # 472691)	Allen screw M6 x 22	2	10	-
Cylinder head / chain tensioner housing	chain tensioner housing, sealing surface	1	-	Loctite 648
Cylinder head / rocker arm adjustment screw	hex. nut M7	1	**15	-
Cylinder head / camshaft bearing caps	Allen screw M6 x 25	14	10	-
Cylinder head / camshaft bearing supports	camshaft, bearing supports	2	-	Molykote G-N
Cylinder head / camshaft sprockets	hex. screw M10 x 20	2	50	Loctite 648
Cylinder head / valve lifter buckets	valve lifter buckets, on outer diameter	4	-	Molykote G-N
Cylinder head / temperature sensor	temperature sensor with sealing ring	1	12	-
Cylinder head / valve	valve stem	5	-	oil
Cylinder head / valve guides	pressing valve guides into cylinder head	5	-	Molykote G-N
Cylinder head / valve stem seal	valve stem seal - sealing lips	5	-	grease / BP Energrease
Cylinder head / angular tube	angular tube 1/4-18NPT	1	manual tightening	Loctite 574
Cylinder head / spark plug	spark plug	1	20	-

* Tolerance \pm 12% ** Tolerance \pm 2 Nm

655EFI Tightening torques, securing and lubricating agents

Component	Component / fastener	Quantity	Tightening torque [Nm] *	Securing agent Lubricant
Countershaft/countershaft gear	Balance shaft gear, support on balance shaft	1	–	Paste Klueber 46 MR 401
Clutch release shaft	clutch release shaft / bearing journal	1	-	oil
Electric starter	Allen screw M6 x 20	2	10	-
Electric starter	O-ring	1	-	grease / BP Energrease
Starter motor	O-ring	1	–	Paste Klueber 46 MR 401
Rev. counter shaft	rev. counter shaft - bearing journals	1	-	oil
Crankcase	Allen screw M6 x 45	9	10	-
Crankcase	Allen screw M6 x 35	2	10	-
Crankcase	Allen screw M6 x 75	2	10	-
Crankcase	Allen screw M6 x 65	1	10	-
Crankcase / rev. counter	banjo bolt	1	20	Dreibond 1209
Crankcase / main bearings	bearing bush 48x52x22,8 / at fitting in crankcase	2	-	Molykote G-N
Crankcase / main bearings	bearing bush 48x52x22,8 / for crankshaft journal	2	-	oil
Crankcase / neutral gear indication	contact screw M10	1	3-4	Loctite 574
Crankcase / oil draining	magnetic screw M18 x 1,5	1	30	-
Crankcase / oil pressure switch	oil pressure switch M10 x 1	1	15	Loctite 243
Crankcase / oil circuit	valve pin screw	2	24	-
Crankcase / oil sieve and oil guide	Taptite screw M5 x 16	2	8	Loctite 243
Crankcase / oil inlet and exit	hose nipple M12 x 1,5	2	12	Loctite 243
Crankcase / crankshaft locking at TDC	Allen screw with sealing ring M8 x 16	1	18-20	-
Crankcase / tensioner guide	hex. screw M6 x 30	1	10	Loctite 243
Crankcase / idle gear shaft	idle gear shaft, bearing bore in crankcase	1	-	Klueber 46 MR 401
Crankcase / cylinder fastening	stud M10 x 62	2	10	Loctite 574
Crankcase / cylinder fastening	stud M10 x 78	2	10	Loctite 574
Reduction gear / countershaft	Idle gear support 4 ^a	1	–	oil
Final drive sprocket	final drive sprocket - internal teeth	1	-	Loctite Anti Seize

 * Tolerance $\pm 12\%$

 ** Tolerance ± 2 Nm

Component	Component / fastener	Quantity	Tightening torque [Nm] *	Securing agent Lubricant
Piston	piston - bore for piston pin	1	-	Klueber 46 MR 401
Piston	piston - working surface and piston rings	1	-	oil
Ball bearing	ball bearing inner race at mounting of shafts	-	-	Klueber 46 MR 401
Clutch / clutch release lever	Allen screw M6 x 25	1	8	-
Clutch / clutch actuation rack	clutch actuation rack / teeth	1	-	oil
Clutch / clutch drive gear	clutch drive gear, bearing seat (needle bearing)	1	-	oil
Clutch / clutch hub on clutch shaft	clutch hub, teeth on clutch shaft	1	-	Klueber 46 MR 401
Clutch / clutch hub on clutch shaft	hex. nut M18 x 1,5	1	140	Loctite 243
Clutch / pressure plate on clutch hub	hex. screw M6 x 25	6	10	-
Clutch cover	Allen screw M6 x 30	10	10	-
Clutch cover	Allen screw M6 x 65	2	10	-
Clutch cover / bypass coolant inlet	hose nipple 12/8	1	12	Loctite 243
Clutch cover / rubber holder, clutch side	Taptite screw M5 x 8	3	7	Loctite 243
Clutch cover / water draining	hex. screw M6 x 14	1	10	-
Crankshaft	crankshaft, bearing journal for camshaft gear and drive gear	1	-	Klueber 46 MR 401
Primary drive on crankshaft	hex. nut M22 x 1,5	1	180	Loctite 221
Crankshaft / conrod	conrod small end bore, for piston pin	1	-	Klueber 46 MR 401
Oil filter cover	Allen screw M6 x 20	2	10	-
Oil pump cover	countersunk screw M5 x 16	6	6	Loctite 243
Gear shifting / shift drum	shift drum - bearing bores and tracks	2	-	oil
Gear shifting / gearshift shaft	gearshift shaft, bearing bore in crankcase, mag. side	1	-	oil
Camshaft intermediate gear	camshaft intermediate gear, bearing seat on idle gear shaft	1	-	oil
Gear shifting / gearshift shaft	gearshift shaft / bearing bore in clutch cover	1	-	grease / BP Energrease
Thermostat cover	Allen screw M6 x 20	2	10	-

* Tolerance $\pm 12\%$ ** Tolerance $\pm 2 \text{ Nm}$

Component	Component / fastener	Quantity	Tightening torque [Nm] *	Securing agent Lubricant
Valve cover	hex. screw M6 x 35	9	10	-
Valve cover / profile seal (seal with cylinder head)	profile rubber seal	1	-	Loctite 574
Water pump / space between 2 oil seals	oil seal	2	-	Molykote 111
Water pump housing	Allen screw M6 x 20	4	10	-
Water pump housing	Allen screw M6 x 60	1	10	-
Oil seals (all)	oil seal / sealing lips	-	-	grease / BP Energrease
Ignition system/driving shaft position sensor	Cheese head screw M6 x 12	1	10	-
Ignition system/driving shaft position sensor	O-ring	1	-	Paste Klueber 46 MR 401
Ignition unit / sprag clutch	sprag clutch segments	1	-	oil
Ignition unit / sprag clutch	freewheel gear bush	1	-	oil
Ignition system/freewheel base	Cheese head screw M8 x 16	6	38	Loctite 648
Ignition system/magnetic wheel cone	Magnetic wheel cone	6	-	Loctite 648
Ignition unit / flywheel hub on crankshaft	hex. nut M22 x 1,5	1	180	Loctite 221
Ignition unit / electric starter gears	starter gears - bearing bores	2	-	oil
Ignition unit / stator	Allen screw M6 x 35	3	10	Loctite 221
Ignition cover	Allen screw M6 x 30	10	10	-
Ignition cover / cable passage and rubber grommet	rubber grommet	2	-	Silastic 732 RTV
Ignition cover / inner cable cover	Taptite screw M4 x 8	2	3	Loctite 221
Cylinder	hex. nut M10	4	52	Loctite 574 only for rear nut, clutch side
Cylinder	Allen screw M6 x 30	2	10	-
Cylinder / gasket	Cylinder base gasket	1	-	Loctite 574
Cylinder / silencing rubber	plug screw M24 x 1	1	25	Loctite Anti Seize
Cylinder / coolant inlet	tube	1	manual tightening	Loctite 574

* Tolerance $\pm 12\%$

** Tolerance $\pm 2 \text{ Nm}$

Component	Component / fastener	Quantity	Tightening torque [Nm] *	Securing agent Lubricant
Cylinder / cylinder head fastening	stud M10 x 117	4	15	-
Cylinder / cylinder head fastening	stud M10 x 78	1	15	-
Cylinder head	hex. nut M10	5	48	-
Cylinder head	Allen screw M6 x 30	4	10	-
Cylinder head / bent water socket	Allen screw M5 x 20	2	6	-
Cylinder head / exhaust flange	stud M8 x 58	4	8	-
Cylinder head / silencer rubber	plug screw M24 x 1	1	25	Klueber 46 MR 401
Cylinder head / rubber plug	rubber plug	3	-	Silastic 732 RTV
Cylinder head / adjustment shims	adjustment shims in cam contact area	4	-	Klueber 46 MR 401
Cylinder head / camshaft chain tensioner (Up to engine # 472690)	union nut M24 x 1	1	12-15	Klueber 46 MR 401
Cylinder head / chain tensioner housing (Up to engine # 472690)	Allen screw M6 x 22	2	10	-
Cylinder head / chain tensioner housing	chain tensioner housing, sealing surface	1	-	Loctite 648
Cylinder head / rocker arm adjustment screw	hex. nut M7	1	15	-
Cylinder head / camshaft bearing caps	Allen screw M6 x 25	14	10	-
Cylinder head / camshaft bearing supports	camshaft, bearing supports	2	-	Klueber 46 MR 401
Cylinder head / camshaft sprockets	hex. screw M10 x 20	2	50	Loctite 648
Cylinder head / valve lifter buckets	valve lifter buckets, on outer diameter	4	-	oil
Cylinder head / temperature sensor	temperature sensor with sealing ring	1	12	-
Cylinder head / valve	valve stem	5	-	oil
Cylinder head / valve guides	pressing valve guides into cylinder head	5	-	Klueber 46 MR 401
Cylinder head / valve stem seal	valve stem seal - sealing lips	5	-	oil
Cylinder head / angular tube	angular tube 1/4-18NPT	1	manual tightening	Loctite 275
Cylinder head / spark plug	spark plug	1	20	-

* Tolerance ± 12%

** Tolerance ± 2 Nm

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