VALTRA

205, 255, 305
355, 365, 405
455, 465, 555
565, 665, 865
600, 700, 800
900, 415M,
A75, A85, A95

Service Manual

Tractors

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Order no 39 200 212
ENGLISH

10. General

To the reader

The Service Manual for the Valtra – Valmet 205 – 900 tractors is intended to be a practical reference source to be used in workshop. The repair instructions in the manual are based on methods which have been worked out in practice during normal workshop conditions and which are based on the use of special tools from the manufacturer when stated in the instructions. The manual also contains descriptions of the design and function of the components.

Detailed maintenance instructions can be found in Operator's Manual.

The Service Manual will be continually updated with new revised pages which should be inserted in the manual. Alterations and additions will first appear as service bulletins.

Only genuine Valmet spare parts should be used to ensure the best possible function of the machine. Certain operations should be carried out with the aid of special tools designed by Valmet.

Valtra Inc.
Tractor Service

Note! *This Manual also includes tractors 600, 700, 800 and 900 as follows:*

- *The build – up of brakes, cab (not roof), front axles and hydraulic power lifts on 600 – 900 tractors is the same as on 865 – tractor. If no separate instructions are given, the instructions for 865 tractor are good for 600 – 900 tractors. Transmission on 600 – 900 tractors is the same as on 865, except that 600 – 900 tractors have a modified low gear and also an alternative Overdrive is available. These new components require some minor changes in the main gearbox and for these reasons 600 – 900 tractors have transmission 270 (865 has transmission 250).*
- *Electric system on 600 – 900 has been shown in section 31.*
- *Engine differences are described in sections 21, 22 and 23. 600 and 700 tractors have a Bosch in – line fuel injection pump and 800 – 900 a Stanadyne rotary distribution pump.*

The following supplements have been published for the Valmet 205–900 Service Manual:

	Ordering number	Date	Content
Service Manual	39 200 211	04/1986	First edition
Supplements	39 251 211	1.7.1989	– technical modifications – model 455 – new hydraulic power lift (610312–) – fitting instructions for optional equipment
	39 251 212	10.1.1992	– technical modifications – models 205, 355, 555 and 415M – Autocontrol power lift – Agrodata performance monitor – fitting instructions for optional equipment
	39 251 213	1.9.1992	– technical modifications – models 565 and 665 – 20–series engines – Sige front axle – Danfoss steering valve
	39 251 214	15.4.1994	– technical modifications – models 255 and 465 – 2–speed PTO unit – hydraulic system with priority valve – fitting instructions for optional equipment
	39 251 215	15.9.1995	– technical modifications – PTO shaft brake – front PTO unit – front lift – fitting instructions for optional equipment
	39 251 216	31.1.1996	– only for 665–4MOD models
	39 251 217	1.5.1996	– model 865 – Kontak valves for auxiliary hydraulics – technical modifications
	39 251 218	1.3.1997	– AD–instrument – Control Stop – AC power lift on 865 – technical modifications
	39 251 219	1.1.1998	– tractors 600, 700, 800, 900 – modified low gear – overdrive – technical modifications
	39 259 211	1.6.1998	– air conditioning – HiShift – technical modifications – latest fitting instructions for optional equipment
	39 259 212	15.4.1999	– ACB power lift – new front PTO – new E–engines for 700 and 800 – new control valve of ACB power lift – pressure ait brakes for trailer – technical modifications
	39 259 213	1.9.2001	– E–engine on 600 and 900 tractor – new coolant pump on 600–900 – expansion tank for engine coolant – Infoline and Agroline instruments – PTO HiShift – updated fitting instructions for optionl equipment – technical modifications
	39 259 214	10.10.2003	– 12+12R gearbox – shuttle – technical modifications
	39 259 215	1.4.2004	– Bosch VE rotary pump – wiring diagrams (M21101–) – technical modifications

	Ordering number	Date	Content
Service Manual	39 200 212	04/2006	Second edition

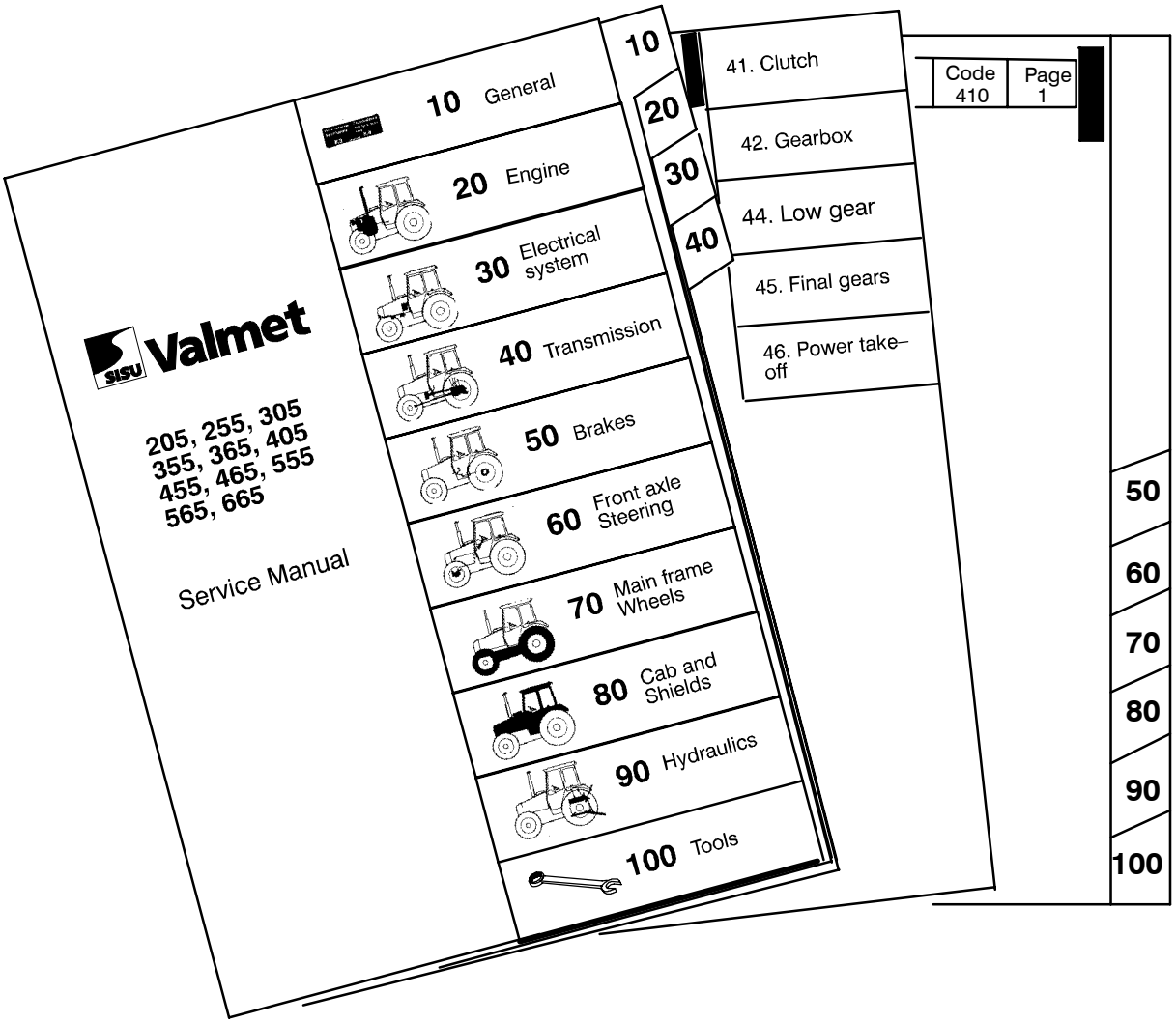
Layout of Service Manual

1. Division into groups

The manual is divided into groups (10 – 100) which are based on the make – up of the tractor. The groups are listed on the first index leaf.

Example. 10. General
20. Engine, fuel and cooling systems
30. Electrical system
40. Power transmission
a.s.o.

The number designation for each group is given in the top left box of the respective pages (and the first figure in the code designation).



2. Division into components or sub – groups

Each group is further divided into components or sub – groups. The number and the name of each component is given in the top left box on each page (and comprise the two first figures in the code designation).

Example. 41. Clutch
42. Gearbox
44. Low gear
45.Final drives etc.

3. Tractor model

At the top of each page it is indicated for which tractor the page is valid.

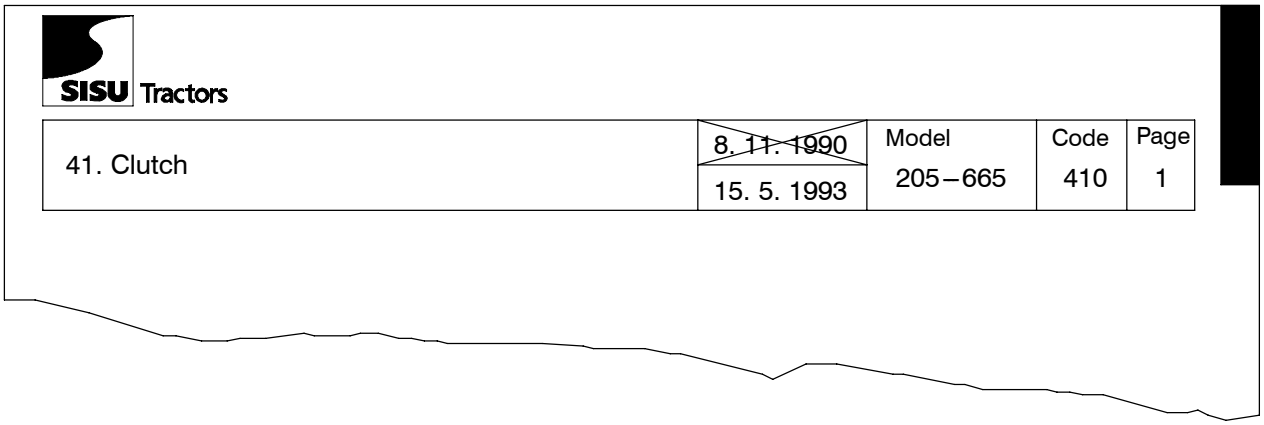
4. Code designation

Three–digit code designations are used to separate the different document groups for the respective components. The same code is also used in the Time list as a reference to the text in this manual. The code designation numbers appear in the box at the top of the page and also in the headings.

Example: Code 410
- Group: power transmission (4)
- Component: clutch (41)
- Document group: general (410)

5. Page numbers

The instructions for all components are numbered in consecutive order in the right–hand box at the top of the page. The page numbers begin with page 1 for each component.



6. Date

At the top of each page there are two boxes for dates. In a case of revised issue, the date of the earlier issue is printed in the crossed–over box and and the date of the current issue is printed in the proper date box.

7. Additions and amendments of the service manual

New and up–dated pages will be continuously added to the service manual. The new pages should be inserted as indicated by the code: the first digit (also the first digit on the index leaf) indicates the group:
- the two first digits indicate the component or sub–group.
- the third digit indicates the document group for the respective components
- the page number indicates the definite position of the page within the service manual.

If there are two pages with the same code and page number, it is the page with the later date in the date box and the old date in the crossed–over box which is valid or which is the current page.

When an entirely new set of repair instructions is issued, it will be accompanied by instructions on where the pages should be inserted in the file.

Code designations in the Service Manual

10. General
- 110 General, lay out
- 120 Maintenance

20 Engine

21. Engine
- 210 Technical data, description, tools
- 211 Cylinder block and flywheel housing
- 212 Cylinder head and valve mechanism
- 213 Crank mechanism
- 214 Auxiliary drive gears (timing gears)
- 215 Lubrication system and oil sump
- 216 Induction and exhaust system, turbocharger
- 219 Removing and fitting engine

22. Fuel system
- 220 Technical data, description, tools
- 222 Fuel feed pump and fuel filters
- 223 Injection pump and injectors

23. Cooling system
- 230 Technical data, description, tools
- 231 Cooling system

30 Electrical system
- 310 Tractor electrical system, wiring diagrams
- 320 Autocontrol hydraulic power lift
- 330 Agrodata performance monitor
- 331 AD–instrument

40 Power transmission

41. Clutch
- 410 Technical data, description, tools
- 411 Clutch assembly and pedal rods

42. Gearbox
- 420 Technical data, description, tools
- 421 Selector forks
- 422 Gear levers
- 423 Shafts and gear wheels in gearbox
- 424 Differential

43. Torque converter and shuttle on 415 M

44. Low gear
- 440 Technical data, description, tools
- 441 Low gear

45 Final drives
- 450 Technical data, description, tools
- 451 Final drives

46. Power take off
- 460 Technical data, description, tools
- 462 Power take off

50 Brake system
- 510 Technical data, description, tools
- 511 Service brakes
- 512 Parking brake

60. Front axle and steering system

61. Steering system
- 610 Technical data, description, tools
- 611 Steering valve
- 612 Priority valve
- 613 Steering cylinder

62. Non–powered front axle
- 620 Technical data, description, tools
- 621 Front axle

64. Powered front axle
- 640 Technical data, description, tools
- 641 Housing and central pivot bearings
- 642 Drive shafts
- 643 Hubs
- 644 Differential
- 645 Adjustments

70 Frame and wheels
- 710 Frame
- 720 Wheels

80 Cab and shields
- 810 Cab
- 820 Shields
- 830 Air conditioner

90 Working hydraulics, power lift

91 Working hydraulics and mechanical power lift
- 910 Technical data, description, tools
- 911 Pump and pipe system
- 912 Hydraulic power lift
- 913 Adjustments
- 914 Power lift, 610312–

92. Electro–hydraulic power lift

100 Special tools
- 101 Special tools ETV
- 102 Locally prepared tools ET

General instructions for repairs

Outer oil seals

The Service Manual contains instructions for changing all outer oil seals, (e.g. oil seals on the PTO shaft end, on the output shaft to the front wheel drive and on the pinion shaft on the powered front axle, and so on).

Sealing compound and glue

If sealing compounds or glue are required for the repair work, the instructions will specify a sealing compound or glue which is readily available through specialist dealers. Some seals should be greased before fitting and the space between the lips of the seal should be filled with universal grease. If the seal is to be pushed over splines or sharp edges the seal should be protected with for example a thin plastic foil.

Tightening torques and setting values

All necessary tightening torques and setting values for each repair operation are given at the beginning of each repair section under the heading Technical Data. The most important values can also be found in the repair instructions.

Table 1 later gives the tightening torques in order of dimension, quality and surface treatment. The values given in the table should be used if the tightening torque is not given in the repair instructions.

Safety

Always bear safety in mind when repairing or servicing the tractor. Use tools and lifting devices in the correct way . When you are removing tractor components or splitting the tractor, every tractor part must be supported in such a way, that no risk of accident exists. Avoid working under the supported tractor part if it is not absolutely necessary. When supporting the tractor the centre of gravity of the frame part must always be checked. For instance the wedges must always be fitted between front axle and engine to prevent axle oscillation when splitting the front frame of the tractor.

Trouble–shooting

The following procedure, combined with the information contained in the workshop manual will be helpful in tracing faults accurately. It consists of following a number of logical steps to locate and correct the problem:

a) Determine the problem

b) List possible causes

c) Differentiate the causes

d) Conduct checks in logical order to determine the exact cause

e) Consider approximate remaining service life against cost of parts and labour..

f) Make any necessary repairs.

g) Recheck the parts and functions for correct operation

Table

Table 1. Tightening torques, metric standard thread (ISO)

Dim.	Tightening torques Nm[1])									
	Quality, surface treatment, material and so on									
	8.8 lubr.	tol.±	8.8 Zne[2])	tol±	8.8 Znk[3])	tol. ±	10.9 lubr.	tol. ±	12.9 lubr	tol. ±
M4	–		–		–		–		–	
M5	6,4	0,6	5,7	0,5	–		9	1	11	1
M6	11	1	10	1	12	1,2	15	1,5	18	2
M8	25	2	23	2	30	3	35	4	45	5
M10	50	5	45	5	60	5	70	7	90	10
M12	90	10	80	8	100	10	125	10	151	15
M14	140	15	125	10	160	15	200	20	240	20
M16	220	20	195	20	250	25	300	30	370	40
M18	300	30	270	30	350	35	430	40	510	50
M20	430	40	380	40	480	50	600	60	720	70
M22	570	60	500	50	650	65	800	80	970	100
M24	740	70	660	70	830	80	1030	100	1250	120
M27	1100	100	950	100	1200	120	1500	150	1800	180
M30	1500	150	1300	130	1600	160	2040	200	2500	250

[1]) 1 Nm=0,102 kpm
[2]) Zne=zinc electroplating
[3]) Znk=hot galvanized

If the bolts differs from the standard range the values in the table must not be used.

Conversion table for common units

Quantities and units	Conversion factors
Overall and detail dimensions millimetres (mm)	100 mm=3,94 inches 1 inch=25,4 mm
Short distances e.g. turning circles metres (m)	1 m=3,28 ft 1 ft=0,305 m
Travel distances kilometres	1 km=0,62 mile 1 mile=1,61 km
Tractor weights, axle loadings kilograms (kg)	1 kg=2,2 lbs 1 lb=0,454 kg
Travel speed kilometres per h (km/h)	1 km/h=0,62 mph 1 mph=1,61 km/h
Drawbar pull kilonewtons (kN)	1 kN=224,8 lbs 1 lb=4,448 N
Power (identified by such terms as crankshaft power, pto power, belt power, drawbar power, indicating the point at which the measurement was taken) kilowatts (kW)	1 kW=1,34 hp 1 hp=0,746 kW
Engine torque newton metres (Nm)	1 Nm=0,74 ft lb 1 ft lb=1,356 Nm
Fuel consumption by weight (kilograms per hr, kg/h) (by volume) litres per hr (l/h)	1 kg/h=2,2 lb/hr 1 lb=0,454 kg 1 l/h=0,22 gal/hr 1 gal=4,54 l
Fuel economy (specific fuel consumption) grams per kilowatt hr (g/kWh)	304 g/kWh=0,5 lb/hp hr
Engine displacement litres (l)	1 l=61,02 m cu in 100 cu in=1,639 l
Hydraulic pump pressure–mecapascal (MPa) delivery–millimetres per sec (ml/s)	1 MPa=145 psi 1000 psi=6,9 MPa 100 ml/s=1,32 gpm 1 gpm=75,77 ml/s
Tyre pressure–kilopascal (kPa)	100 kPa=14,5 psi 1 psi=6,9 kPa
Area acres–hectare	To convert multiply by 0,404686
Volume bushel–litre	To convert multiply by 39,3687
Quantity pound per acre–kilogram per hectare	Multiply by 1,12085
Volume superficial foot–cubic metre	Multiply by 0,002360

Maintenance 205–900

Note! Detailed maintenance procedures are given in the Operator"s Manual.

When servicing:

– Always stop the engine before doing any servicing work.
– Apply the parking brake to ensure the tractor cannot move. If the ground is uneven the wheels should be scotched
– Always observe the utmost cleanliness in all maintenance work.
–Thoroughly wipe off filler caps and plugs as well as surrounding parts of the tractor before filling up with fuel or oil.
– Inspect the oil and filters when changing. Large amounts of dirt (e.g. heavily clogged filters) can point to a fault which could cause extensive and costly repairs if not corrected in time.
– When carrying out checks the tractor should stand on level ground.
– Levels should be checked in the morning when the oil is cold and has had time to run down to the bottom of the unit concerned.
– When changing the oil, bear in mind that the oil can be very hot when it drains from the tractor. Waste oil and oil filters should be handled carefully and disposed of properly.
– After completion of the service work always replace all safety covers etc.

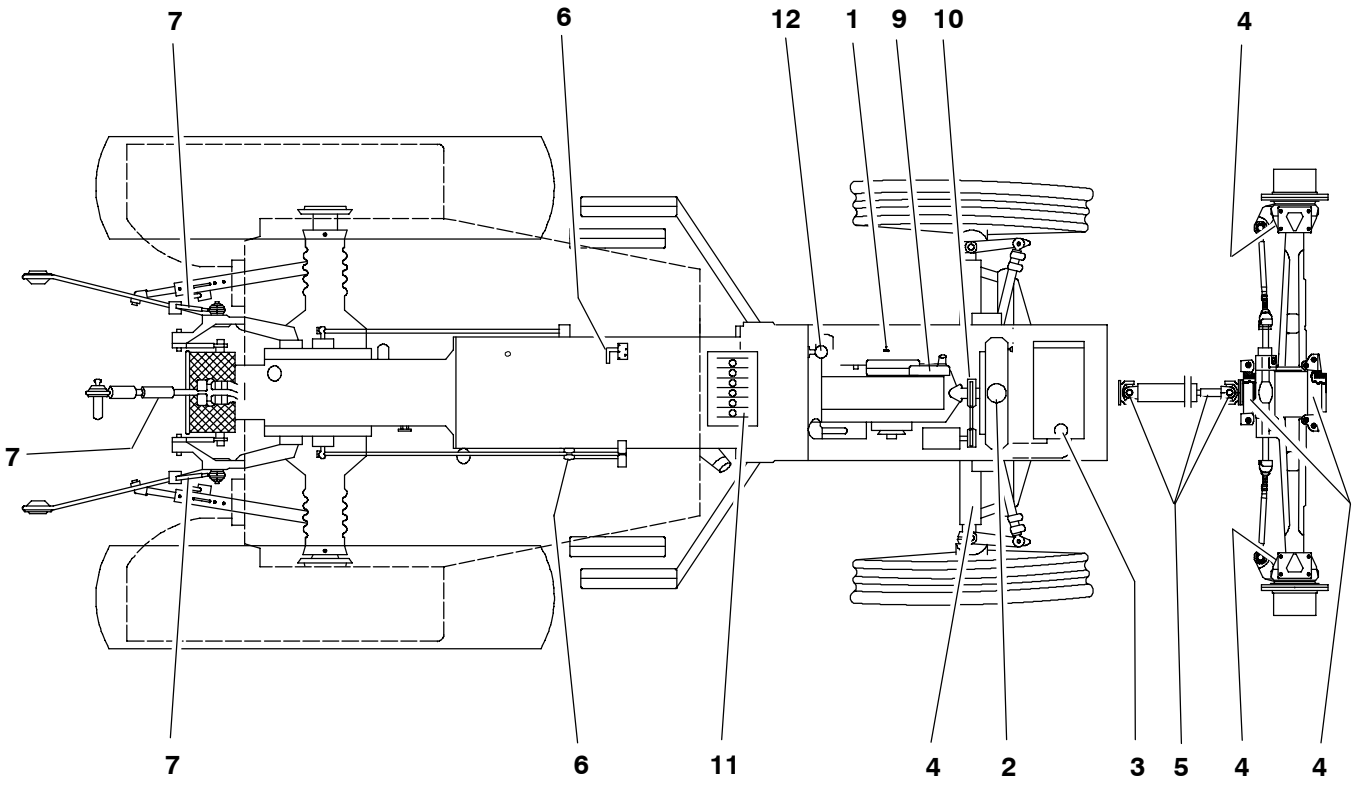
Lubrication of points provided with grease nipples

– Always clean the grease nipples before applying the grease gun.
– Pump in grease to the nipples until clean grease is squeezed out (unless otherwise instructed).
– Wipe off all surplus grease which has been squeezed out at the lubricating points.
– Preferably carry out lubrication with bearing points and joints unloaded and with the bearings in different position (e.g. lubricate the steering knuckle bearing on the steering axle with the wheels at both full left and right lock and with the front axle lifted up).

Lubrication and maintenance schedule

All intervals are counted from zero on the hour recorder. For example, 1000–hour service is carried out every 1000 and 2000 hours according to the hour recorder (yearly or every other year) even if the operates have been carried out at the guarantee service.

Example:
The 1000–hour service includes all operates listed under daily/every 10 hours,weekly/every 50 hours,250, 500 and 1000 hours.



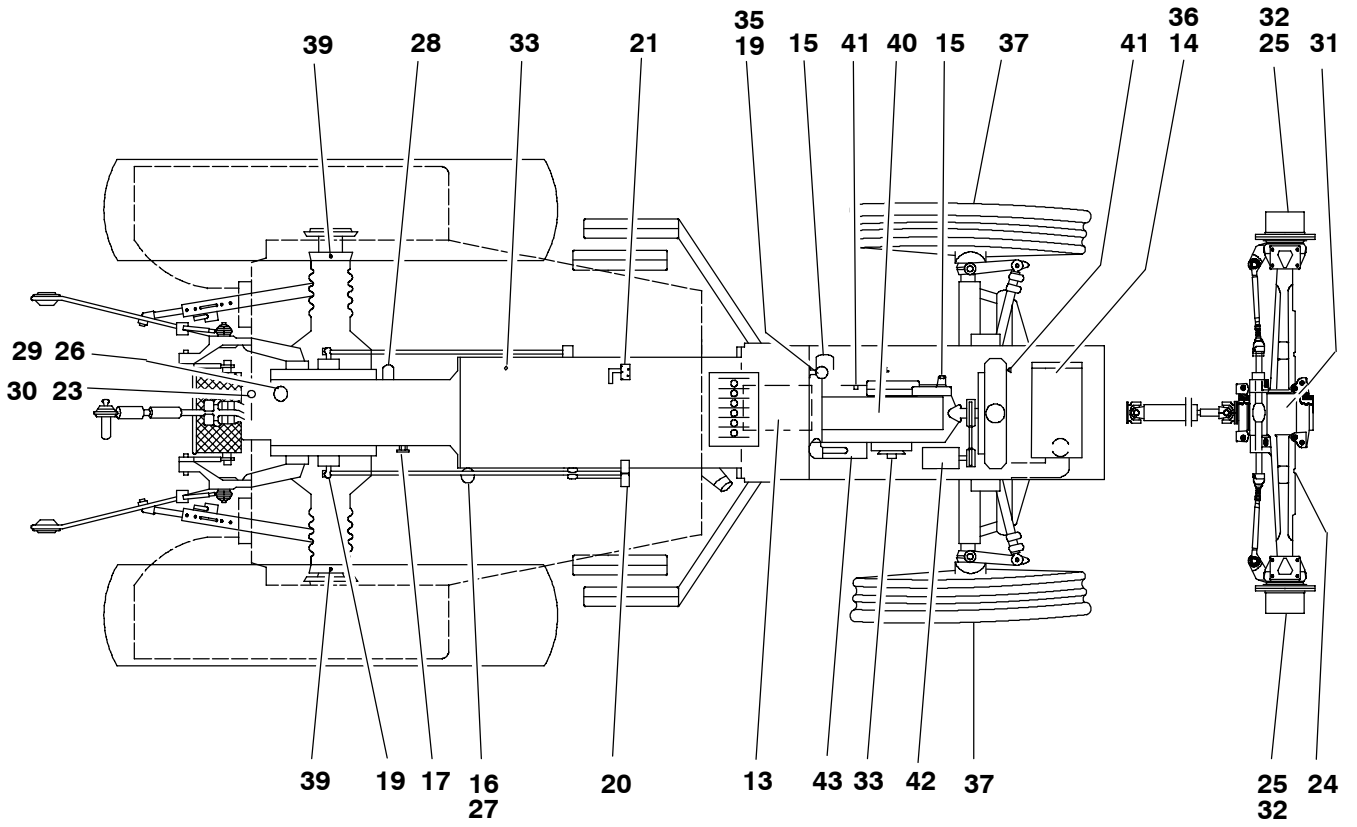
Maintenance daily/weekly

Daily/every 10 hours

1. Check engine oil level
2. Check coolant level
3. Clean the cyclone cleaner (check oil elevel in filter on 205). 865, 800 and 900 tractors have not a cyclone but an ejector pipe.

Weekly/every 50 hours

4. Lubricate front axle and steering nipples
   2–wheel drive
   – axle mountings (2 nipples)
   – steering knuckles (2 nipples)
   – tie–rod ends (4 nipples: not on later models)
   4–wheel drive
   – universal joints (ZF: 4 nipples, Sige: 2 nipples)
   – front axle mountings (ZF: 6 nipples, Sige: 4 nipples)
   – steering knuckles (on later models 4 nipples)
5. Lubricate propeller shaft, 4WD (3 nipples). On later models there are no grease nipples for propeller shaft.
6. Lubricate brake and clutch pedals (2 nipples)
7. Lubricate top link and lifting links (5 nipples)
8. Lubricate extra lifting cylinder nipples (if fitted)
9. Check fluid level in windscreen washer
10. Check fan and alternator belt
11. Check electrolyte level in battery
12. Drain water from fuel filter (20–series engines). 865, 800 and 900 tractors also have a separate water trap.



Every 250 hours

13. Clean heating system air filter. 600–900: Clean air filter of roof fan.
14. Clean air filter (change if necessary) (on 255 change oil in filter)
15. Change engine oil and oil filter
16. Change hydraulic system pressure filter. First change at 100 hours Service inspection. The second change at 250 running hours and the third at 500 hours. After that at intervals of 500 running hours.
17. Lubricate gear lever joints
18. Check tyre pressures and wheel nuts

Every 500 hours

19. Clean separate water trap on 865 (not 865, 800 and 900, if a Stanadyne water trap has been fitted).
20. Check brake pedal free travel
21. Check propulsion clutch pedal free travel
22. Check PTO lever free travel
23. Check oil level in power transmission
24. Check oil level in differential, 4–wheel drive
25. Check oil level in hub reduction gears, 4–wheel drive
26. Check oil level in hydraulic system
27. Change pressure filter in hydraulic system
28. Change oil filter in transmission

Every 1000 hours/yearly

29. Change oil in hydraulic system
30. Change oil in power transmission
31. Change oil in differential, 4–wheel drive
32. Change oil in hub reduction gears, 4–wheel drive
33. Clean hydraulic pump suction strainer
34. Drain fuel tank
35. Change fuel filter. 865, 800 and 900 with Stanadyne water trap: also change the water trap filter.
36. Change safety filter in air cleaner (om 255, clean the filter)
37. Check, adjust and lubricate front wheel bearings, 2–wheel drive
38. Check and adjust front wheel toe–in
39. Lubricate drive axle bearings (2 nipples)
40. Adjust valves
40a. 600–900: Change air filter of roof fan.
40b. 600–900: Change breather filter (in filling cap)

Every 2000 hours/every other year

41. Clean cooling system
42. Check alternator
43. Check starter motor
44. Check and clean injectors

Every 4000 hours (not 205, 355, 365 and 665)

45. Turbo unit checked at authorized workshop

Recommended fuel and lubricants

(All volumes are incl. of filters)

Part of machine	SAE class	API grade	Volume (litres)
Engine – 205, 255, 355, 365, 600 – 305, 405, 455, 465, 700, 555, 565 – 665, 800, 865, 900	 15W/40 (+40...–10˚C) 10W/30 (+30...–20˚C)	 CE CF/CF–4	 7 7 9
Working hydraulics	HT60: –30˚C...+30˚ HT100: –10C...+40C 32: –30 ˚C...+30˚C 46: –10˚C...+40˚C	 ISO VG 32 ISO VG 46	 35 (upper mark) 25 (lower mark)
Power transmission	HT60: –30˚C...+30˚ HT100: –10C...+40C	GL–4 (G2–98)	23 (865, 600–900: 27)
Powered front axle ZF: – differential – hubs **Powered front axle Sige (Dana):** – differential – hubs	 80W/90	 GL–5 (LS)	 4,5 2x0,5 6,5 2x0,8
Fuel tank – 205–865 – 600–900	Diesel fuel		73 79 (extra tank 103)
Cooling system without expansion tank: – 205–565, 600, 700 – 665, 865, 800, 900 **Cooling system with expansion tank:** 600–700 800–900	Anti–feeze agent+water (standard ASTM D3306–86a or BS 6580:1985)		 10 (600, 700: 11,5) 11,5 (800, 900: 13,5) 13,5 15.5
Windscreen washer	Washer fluid		1,5
Front PTO	See code 460.		

Note! The following Valtra oils are recommended:
Valtra Engine in engine
Valtra transmission in Power Transmission
Valtra Hydraulic in hydraulic system
Valtra Axle in Powered front axles.

Note! Recommended oil in front PTO, see code **460**.

415M–tractor

Oil specification in torque converter/reverse shuttle:
– automatic transmission fluid (ATF), which meets requirements: Dexron, type A Suffix A
Oil volume:
– total volume **8,3 litres**
– change volume **6 litres**

Other maintenance instructions and filling quantities are the same as on 405 tractor.

20. Engine

Contents

General (Op. no. 210):

Repair instructions

Cylinder block and flywheel housing (Op. no. 211):

Cylinder head and valve mechanism (Op. no. 212):

Crank mechanism (Op. no. 213):

Technical data

Tractor	**205**	**305**	**355**	**405**	**455**	**555**
Designation	D27D2	TD27DS3	TD33D	TD27DS4	TD33DS4	TD33DS 555
Turbocharger	no	yes	no	yes	yes	yes
No of cylinders	3	3	3	3	3	3
Displ. dm^3	2,7	2,7	3,3	2,7	3,3	3,3
Stroke mm	114	114	120	114	120	120
Cyl. bore mm	100	100	108	100	108	108
Compr. ratio	18:1	18:1	17:1	18:1	16:1	16:1
Output kW DIN	36/2350	39/2350	44,5/2350	45/2350	49/2350	53/2350
Torque Nm/rpm	175/1450	195/1400	220/1400	220/1450	240/1450	260/1450
Idling speed rpm	650	650	750	650	750	750
Valve clear. mm	0,30	0,30	0,30	0,30	0,30	0,30
Compr. press. bar	24 [1])	24 [1])	24 [1])	24 [1])	24 [1])	24 [1])

[1]) Minimum value at starter motor speed (warm engine). The greatest allowable difference between cylinders is **0,3 bar**.

Note!
From tractor no **656316** tractors 355, 455 and 555 have new 20–series engines. See sections 21A, 22A and 23 A.

Valves, rocker arms and tappets (205–555)

Valve timing

At a valve clearance of 0,30 mm:

– inlet valve opens at	10° B.T.D.C.
– inlet valve closes at	42° A.B.D.C.
– exhaust valve opens at	42° B.B.D.C.
– exhaust valve closes at	10° A.T.D.C.
Valve clearance, cold or warm engine:	
– inlet valve	0,30 mm
– exhaust valve	0,30 mm
Seat angle in cylinder head	30°±5’
Seat width	1,0–1,5 mm
Valve seat angle	29°30’±5’
Valve head diameter:	
– inlet valve	39 mm (45 mm, 355,455, 555)
– exhaust valve	39 mm (40 mm, 355, 455, 555)
Stem diameter, inlet valve	9.465–9.480 mm
Stem diameter, exhaust valve	9.445–9.460 mm
Clearance, valve stem–guide, inlet valve	0.040–0.070 mm
Clearance, valve stem–guide, exhaust valve	0.060–0.090 mm
Maximum wear limit, inlet valve	0.30 mm
Maximum wear limit, exhaust valve	0.35 mm
Valve guide I.D. (before fitting)	9.520–9.535 mm
Valve guide O.D	16.028–16.039 mm
Bore in cylinder head for valve guide	16.000–16.018 mm
Height of valve guide above cylinder head face	21 mm
Distance between cylinder head and valve head	1.2–1.4 mm
Valve spring, free length:	
– inner spring	57 mm
– outer spring	61 mm
Loading when valve spring is compressed to:	
– inner spring, 41.5 mm	70–90 N
– outer spring, 47 mm	190–210 N
Rocker arm shaft diameter	19.959–19.980 mm
Rocker arm bushing I.D. (bushing fitted)	19.990–20.010 mm
Rocker arm bushing O.D. (before fitting)	23.035–23.048 mm
Rocker arm hole diameter	23.000–23.021 mm
Pushrod length	231^{-1} (238^{-1}, 455)
Pushrods must be straight to within	0.4 mm
Rocker arm shaft spring, free length	80 mm
Loading when rocker arm shaft spring is compressedto 58 mm	80–100 N
Tappet O.D	29.939–29.960 mm
Bore in cylinder block for tappet	30.000–30.021 mm

Camshaft (205, 305, 405)

Bearing journal no. 1, diameter	49.925–49.950 mm
Bearing journal nos 2–4, diameter	49.885–49.910 mm
Bearing no. 1, bore	50.040–50.060 mm
Bearings nos 2–4, bore	50.000–50.025 mm
Radial clearance no. 1	0.090–0.135 mm
Radial clearance nos. 2–4	0.090–0.140 mm
Tolerance, 1st bushing in block	0.025–0.080 mm
Camshaft end float (with 0.5 mm gasket betweencylinder block and timing gear casing and betweentiming gear casing and front cover)	0.045–1.550 mm
Cam height (distance between cam lobe top and opposite side).	41.44 mm
Cam lift (lobe top height above the “circle”)	7.44 mm
Max. permissible figure for out–of–roundness	0.03 mm

Camshaft (355, 455, 555)

Bearing journal no. 1, diameter	49.905–49.930 mm
Bearing journal nos 2–4, diameter	49.885–49.910 mm
Bearing bores, diameter	50.000–50.025 mm
Radial clearance no. 1	0.070–0.120 mm
Radial clearance nos 2–4	0.09–0.140 mm
Tolerance, 1st bushing in block	0.023–0.072 mm
Camshaft end float (with 0.5 mm gasket between cylinderblock and timing gear casing and between timing gearcasing and front cover)	0.450–1.550 mm
Cam height (distance between cam lobe top and opposite side)	41.44 mm
Cam lift (lobe top height above the “circle”)	7.44 mm
Max. permissible figure for out–of–roundness	0.03 mm

Cylinder liners (205, 305, 405)

Height above block face	0.030–0.080 mm
Max. height difference between cylinder liners under thesame cylinder head	0.020 mm
Cylinder liner I.D	100.015–100.037 mm
Liner flange height, standard	8.03–8.05 mm
Liner flange height, 1st oversize, part no 8365 36828	8.08–8.10 mm
Liner flange height, 2nd oversize, part no 8365 36829	8.13–8.15 mm
Liner flange height, 3rd oversize, part no 8365 36830	8.23–8.25 mm
Cylinder liner flange, outer diameter	121.90–122.00 mm

Cylinder liners (355, 455, 555)

Height above block face	0.030–0.080 mm
Max. height difference between cylinder liners under thesame cylinder head	0.020 mm
Cylinder liner I.D	108.000–108.022 mm
Liner flange height, standard	9.03–9.05 mm
Liner flange height, 1st oversize, part no 8353 29829	9.08–9.10 mm
Liner flange height, 2nd oversize, part no 8353 29830	9.13–9.15 mm
Liner flange height, 3rd oversize, part no 8353 29831	9.23–9.25 mm
Cylinder liner flange, outer diameter	131.700–131.800 mm

Piston, piston rings and piston pin (205, 305, 405)

Minimum distance between piston and cylinder head, measured with a piece of lead wire through the injector location hole	0.900–1.150 mm
Piston diameter:– 26 mm from lower edge	99.873–99.887 mm
Piston pin hole, diameter	36.003–36.009 mm
Piston pin diameter	35.995–36.000 mm
Ring groove width:	
– groove	2.580–2.600 mm
– groove	3.040–3.060 mm
– groove 3	4.040–4.060 mm
Piston ring clearances in grooves:	
– upper compression ring, hard chromed	0.09–0.122 mm
– 2nd compression ring	0.05–0.082 mm
– oil control ring	0.05–0.082 mm
– maximum wear limit	0.15 mm
Piston ring widths:	
– ring 1	2.478–2.490 mm
– ring 2.	2.978–2.990 mm
– ring	3.978–3.990 mm
Piston ring gap:	
– compression rings	0.4–0.6 mm
– oil control ring	0.25–0.55 mm
– maximum wear limit	1.0 mm

Max permissible weight difference between pistons	25 g

Heat piston to 100°C before fitting piston pin.

Piston, piston rings and piston pin (355, 455, 555)

Piston diameter:	
– 19 mm from lower edge (CS)	107.853–107.867 mm
– 75 mm from lower edge (CS)	107.742–107.757 mm
– 93.5 mm from lower edge (CS)	107.580–107.600 mm
– 108.5 mm from lower edge (CS)	107.510–107.530 mm
Piston pin hole, diameter	40.000–40.006 mm
Piston pin, diameter	39.995–40.000 mm
Ring groove widths:	
– groove	2.560–2.580 mm
– groove 2	3.030–3.050 mm
– groove 3	5.040–5.060 mm
Piston ring clearance in grooves:	
– upper compression ring, hard chromed	0.07–0.102 mm
– 2nd compression ring	0.04–0.072 mm
– oil control ring	0.05–0.082 mm
– maximum wear limit	0.15 mm
Piston ring width:	
– ring 1.	2.478–2.490 mm
– ring 2	2.978–2.990 mm
– ring	4.978–4.990 mm
Piston ring gap, new ring kit no. 8363 39201:	
– upper compression ring	0.3–0.55 mm
– 2nd compression ring	0.75–1.00 mm
– oil control ring	0.3–0.6
– maximum wear limit, ring 1 and 3	1.0 mm
– maximum wear limit, ring 2	1.4 mm

Max. permissible weight difference between pistons . . . . . 25 g

Heat piston to 100°C before fitting piston pin.The combustion chamber should be turned towards the injectors.

Connecting rod (205, 305, 405)

Connecting rod bushing I.D. (fitted)	36.025–36.040 mm
Connecting rod bushing O.D. (standard)	40.060–40.076 mm
Connecting rod bushing, (oversize 8360 38605)	40.580–40.620 mm
Interference fit: connecting rod bushing/connecting rod	0.035–0.120 mm
Connecting rod bushing location, diameter	40.000–40.025 mm
Connecting rod bushing location, diameter (oversize)	40.500–40.525 mm
Big end bearing location, diameter	65.730–65.749 mm

Connecting rod (355, 455, 555)

Connecting rod bushing I.D. (fitted)	40.025–40.040 mm
Connecting rod bushing O.D. (standard)	44.082–44.120 mm
Connecting rod bushing O.D. (oversize 8353 28326)	44.580–44.620 mm
Interference fit: connecting rod/connecting rod bushing	0.057–0.120 mm
Connecting rod bushing location, diameter	44.000–44.025 mm
Big end bearing location, diameter	71.730–71.749 mm
Connecting rod end–float on crank shaft	0.200–0.312 mm

Weight marking (letter) at lower end.

Max. permissible weight difference between connectingrods in the same engine . . . . . 20 g

Crankshaft (205, 305, 405)

Big end journals, diameter:	
– standard	61.981–62.000 mm
– 1st undersize, 0.25 mm (bearing 8360 97266)	61.731–61.750 mm
– 2nd undersize, 0.50 mm (bearing 8360 97267)	61.481–61.500 mm
– 3rd underside, 1.00 mm (bearing 8360 97269)	60.981–61.000 mm
– 4th undersize, 1.50 mm (bearing 8360 97271)	60.481–60.500 mm
Big end journals, length	40.000–40.160 mm
Big end bearing clearance	0.046–0.098 mm
Main bearing journals, diameter:	
– standard	69.988–70.018 mm
– 1st undersize, 0.25 mm (bearing 8360 97273)	69.738–69.768 mm
– 2nd undersize, 50 mm (bearing 8360 97274)	69.488–69.518 mm
– 3rd undersize, 1.00 mm (bearing 8360 97276)	68.988–69.018 mm
– 4th undersize, 1.50 mm (bearing 8360 97278)	68.488–68.518 mm
Main bearing clearance	0.051–0.101 mm
Width of thrust bearing journal on crankshaft (nearest flywheel):	
– standard (2 std thrust bearings)	47.000–47.080 mm
– 1st undersize (one std and one 0.2 mm oversize thrust washer)	47.200–47.280 mm
– 2nd oversize (two 0.2 mm oversize thrust washers)	47.400–47.480 mm
Other bearing journals must not be ground so as to make them longer.	
Crank shaft end float	0.100–0.320 mm
Big end and main bearing journals, max. permissible figure for out–of–roundness or other deformity	0.03 mm
Crankshaft balancing accuracy, max	1.0 Ncm Max

Crankshaft (355, 455, 555)

Big end journals, diameter:	
– standard	67.981–68.000 mm
– 1st undersize, 0.25 mm	67.731–67.750 mm
– 2nd undersize, 0.50 mm	67.481–67.500 mm
– 3rd undersize, 1.00 mm	66.981–67.000 mm
– 4th undersize, 1.50 mm	66.481–66.500 mm
Big end journals, length	40.000–40.160 mm
Big end bearing clearance	0.046–0.098 mm
Main bearing journals, diameter:	
– standard	84.985–85.020 mm
– 1st undersize, 0.25 mm	84.735–84.770 mm
– 2nd undersize, 0.50 mm	84.485–84.520 mm
– 3rd undersize, 1.00 mm	83.985–84.020 mm
– 4th undersize, 1.50 mm	83.485–83.520 mm
Main bearing location (in block), diameter	91.000–91.022 mm
Main bearing clearance	0.050–0.127 mm
Width of thrust bearing journal on crankshaft (nearest flywheel):	
– standard (2 std thrust bearings)	45.000–45.080 mm
– 1st oversize (one std and one 0.1 mm oversize thrust washer)	45.100–45.180 mm
– 2nd oversize (one std and one 0.2 mm oversize thrust washer)	45.200–45.280 mm
– 3rd oversize (one 0.1 mm and one 0.2 mm oversize thrust washer	45.300–45.380 mm
– 4th oversize (two 0.2 mm oversize thrust washers)	45.400–45.480 mm
Other bearing journals must not be ground so as to make them longer.Crankshaft end float	0.100–0.350 mm
Big end and main bearing journals, max. permissible figure for out–of–roundness or other deformity	0.03 mm
Crankshaft balancing accuracy, maximum	1.0 Ncm Max

Flywheel (205–555)

Flywheel ring gear, number of teeth	128
Interference fit: ring gear–flywheel	0.422–0.600 mm
When fitting the ring gear should be heated to	150–200°C
Flywheel balancing accuracy, maximum	1.0 Ncm Max
Permissible throw of flywheel friction surface	0.06:ø200

Timing gears (205–555)

Tooth backlash:
– Crankshaft–idler gear . . . . . 0.05–0.25 mm
– Idler gear–camshaft gear . . . . . 0.05–0.25 mm
– Idler gear–fuel injection pump gear . . . . . 0.05–0.25 mm
All timing gears, max. radial throw . . . . . 0.05 mm
Idler gear shaft, diameter . . . . . 54.951–54.970 mm
Idler gear bushing I.D. (fitted) . . . . . 55.000–55.030 mm

Timing gear markings:

When the timing gear markings are opposite each other the piston in the first cylinder is at T.D.C. between the compression and power stroke.
On the crankshaft gear wheel . . . . . 2 punch marks on teeth.
On the idler gear:
– against the crankshaft gear . . . . . 0 on a tooth
– against the camshaft gear . . . . . 1 punch mark on a tooth
– against the fuel injection pump . . . . . 1 punch mark at a tooth gap
On the camshaft gear . . . . . 1 punch mark at a tooth gap
On the fuel injection pump gear . . . . . 1 punch mark on a tooth
Crankshaft must be rotated 6 turns before all gear markings fall into line again.

Lubrication (205–555)

Lubricating oil pressure at working temperature:
– at low idling speed, minimum . . . . . 150 kPa (1.5 kp/cm^2)
– at rated speed . . . . . 300–500 kPa (3–5 kp/cm^2)
Spring for oil relief valve, free length . . . . . 80 mm
Spring for oil relief valve, loading when 52 mm long . . . . . 54+5 N (5.4+0.5 kp)
Oil relief valve, diameter of valve cone . . . . . 19.602–19.635 mm
Oil relief valve, diameter of hole in insert . . . . . 19.700–19.752 mm
Oil filter by–pass valve opens at a pressure difference of. . . . . 20.5 bar

Lubrication oil pump (205–555)

Tooth backlash when crankshaft is resting on the main bearings:
– crankshaft gear–lubricating oil pump gear . . . . . 0.05–0.25 mm
– between the pump gears . . . . . 0.16–0.26 mm
Drive shaft clearance in housing . . . . . 0.016–0.052 mm
Holes in body and cover, diameter . . . . . 18.000–18.018 mm
Gear wheel I.D . . . . . 18.060–18.078 mm
Gear clearance on fixed drive shaft . . . . . 0.021–0.050 mm
Clearance of fixed shaft end–face of body . . . . . 0.5–1.0 mm
Gasket thickness . . . . . 0.06–0.08 mm
Pump gear O.D . . . . . 43.486–43.525 mm
Gear clearance in body . . . . . 0.125–0.264 mm
Gear location in body, diameter . . . . . 43.650–43.750 mm
Width of gear . . . . . 18.000–18.027 mm
Gear wheel end float . . . . . 0.03–0.11 mm
Oil pump body, depth . . . . . 18.000–18.043 mm
Number of teeth on gear 41

Coolant pump (205–555)

Bearings O.D	38.087–38.100 mm
Bearing location, diameter (in pump body)	38.058–38.083 mm
Shaft diameter	15.907–15.920 mm
Impeller hole diameter	15.881–15.899 mm
Seal location, diameter (in pump body)	36.450–36.489 mm
The impeller should be mounted on the shaft so thatthe distance between the rear face of the impeller and therear face of the pump body is	1–1.7 mm
The hub should be mounted on the shaft so that the distance between the contact face for the fan and the rear face of the pump body is	157 mm
Fan guide (shoulder) on hub, diameter	25.00–25.20 mm
Fan, max. balancing accuracy	0.3 Ncm max
Fan, max. throw	0.3 mm
At correct belt tension it should be possible to deflect the belts	15–20 mm

Thermostat (205–555)

Spare part number	Diam./Type	Opening commences	Fully open	Max. stroke mm
8360 15156	ø54/79° C	80°–3°C	94° C	7,5
8360 15486	ø54/83° C	83°–3° C	95° C	7,5

Cylinder block (205, 305, 405)

Holes for guide pins	13.000–13.043 mm
Main bearing location, diameter	76.000–76.019 mm
Cylinder liner location, diameter:	
– at upper end	116.012–116.047 mm
– at lower end	115.000–115.035 mm
Camshaft bearing bushing, I.D. when fitted	50.040–50.060 mm

Cylinder block (355, 455, 555)

Holes for guide pins	13.000–13.043 mm
Main bearing location, diameter	91.000–91.022 mm
Cylinder liner location, diameter:	
– at upper end	123.514–123.554 mm
– at lower end	122.000–122.040 mm
Camshaft bearing bushing, I.D. when fitted	50.000–50.025 mm

Cylinder head (205–555)

Seat for copper sleeve, diameter:	
– upper end	28.000–28.033 mm
– lower end	27.000–27.033 mm
Copper sleeve O.D.:	
– upper end	27.979–28.000 mm
– lower end	27.073–27.090 mm
Cylinder head thickness	104.90–105.10 mm
Cylinder head minimum thickness after machining	104.70 mm
Cylinder head bolts, tightening torque	160 Nm

Turbocharger Holset H1D (not 205 and 355)

Oil pressure at rated engine speed	min. 2 bar
Shaft end float	0.10–0.16
Shaft running clearance	0.30–0.46
Turbine housing mounting bolts (M8x12)	11.3 Nm
Compressor housing mounting bolts (M6x12)	5.7 Nm
Bearing housing mounting bolts (M6x16)	5.7 Nm
Nut at end of shaft (LH thread on shaft)	14.0 Nm

Turbocharger Schwitzer S2A (not 205 and 355)

Oil pressure at rated engine speed	min. 2 bar
Shaft end float	0.05–0.12 mm
Shaft running clearance	max 1.0 mm (dry)
Nut at end of shaft	10.5 Nm
V–band nut	7.0 Nm

Partial vacuum and counter pressure

Partial vacuum at air cleaner, maximum	5 kPa (500 mm, water gauge)
Counter pressure at exhaust pipe, maximum	6 kPa (600 mm, water gauge)

Tightening torques

Engine fixing bolts	80 Nm (8 kpm)
Exhaust manifold	60 Nm (6 kpm)
Exhaust pipe–turbocharger	23 Nm (2.3 kpm)
Big end bearing cap bolts	90 Nm (9 kpm)
Main bearing cap bolts	160 Nm (16 kpm)
Crankshaft nut	600 Nm (60 kpm)
Flywheel bolts	120 Nm (12 kpm)
Idler gear bolts:	
–M 10	60 Nm (6 kpm)
–M 14	140 Nm (14 kpm)
Cylinder head bolts	160 Nm (16 kpm)
Flywheel housing bolts:	
– outer ring, M12	110 Nm (11 kpm)
– inner ring, M10	60 Nm (6 kpm)

Special tools

21. Engine A

Part number	Description
1. 8360 97532	Lever for compressing valve spring (505–905)
2. 8360 97336	Counterhold nut for above (505–905)
3. 8361 97470	Milling tool for injector seat (505–905)
4. 8360 97463	Drift for fitting injector sleeve (505–905)
5. 8360 86085	Extractor for injector sleeve (505–905)
6. 8360 97315	Drift for fitting crankshaft rear seal (505–905)
7. 9030 15200	Drift for fitting crankshaft front seal (505–905)
8. 8360 85499	Puller for coolant pump impeller (505–905)
9. 8360 13091	Puller for coolant pump hub (505–905)
10. 9025 58000	Cylinder head spanner (505–905): earlier number 8360 97328

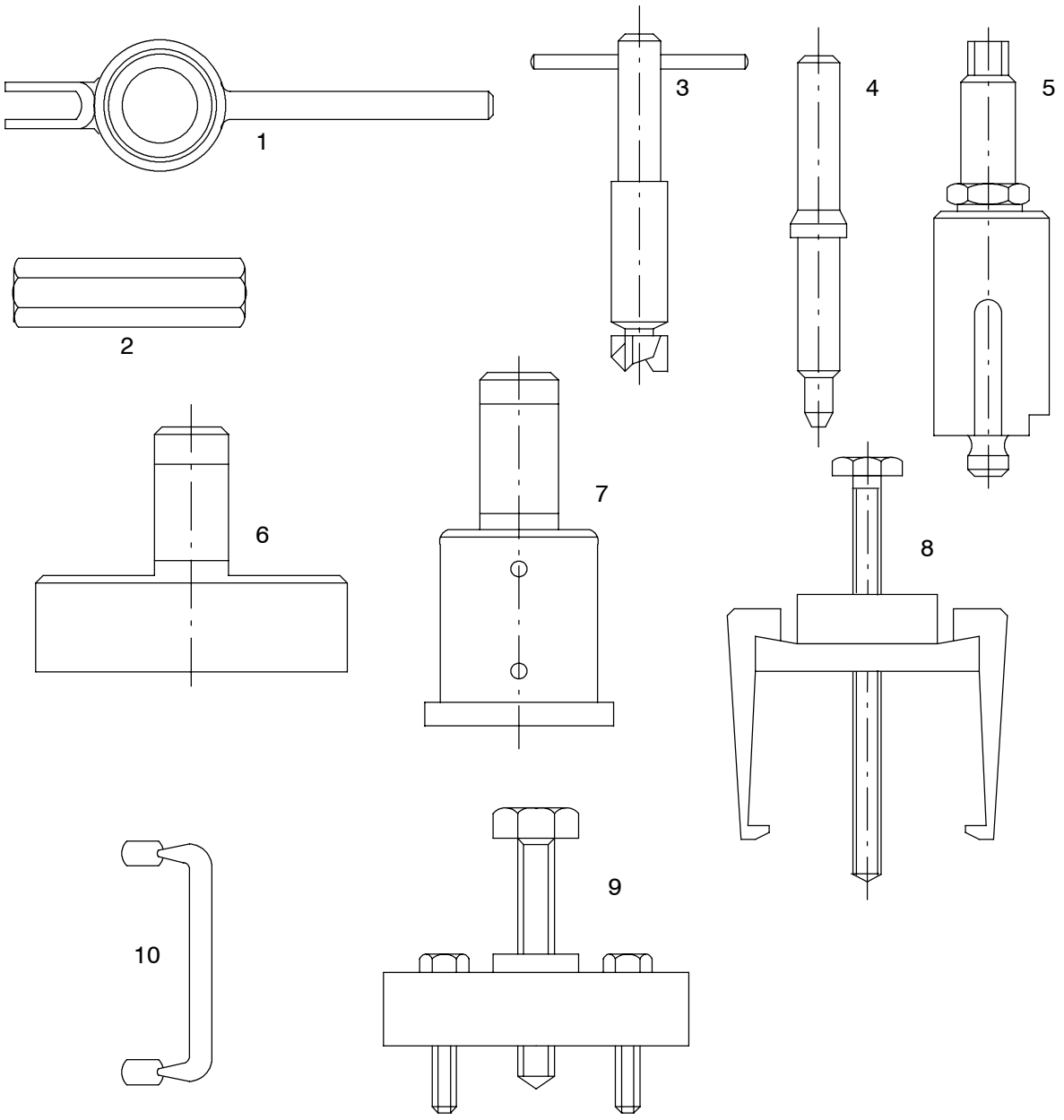
21. Engine B

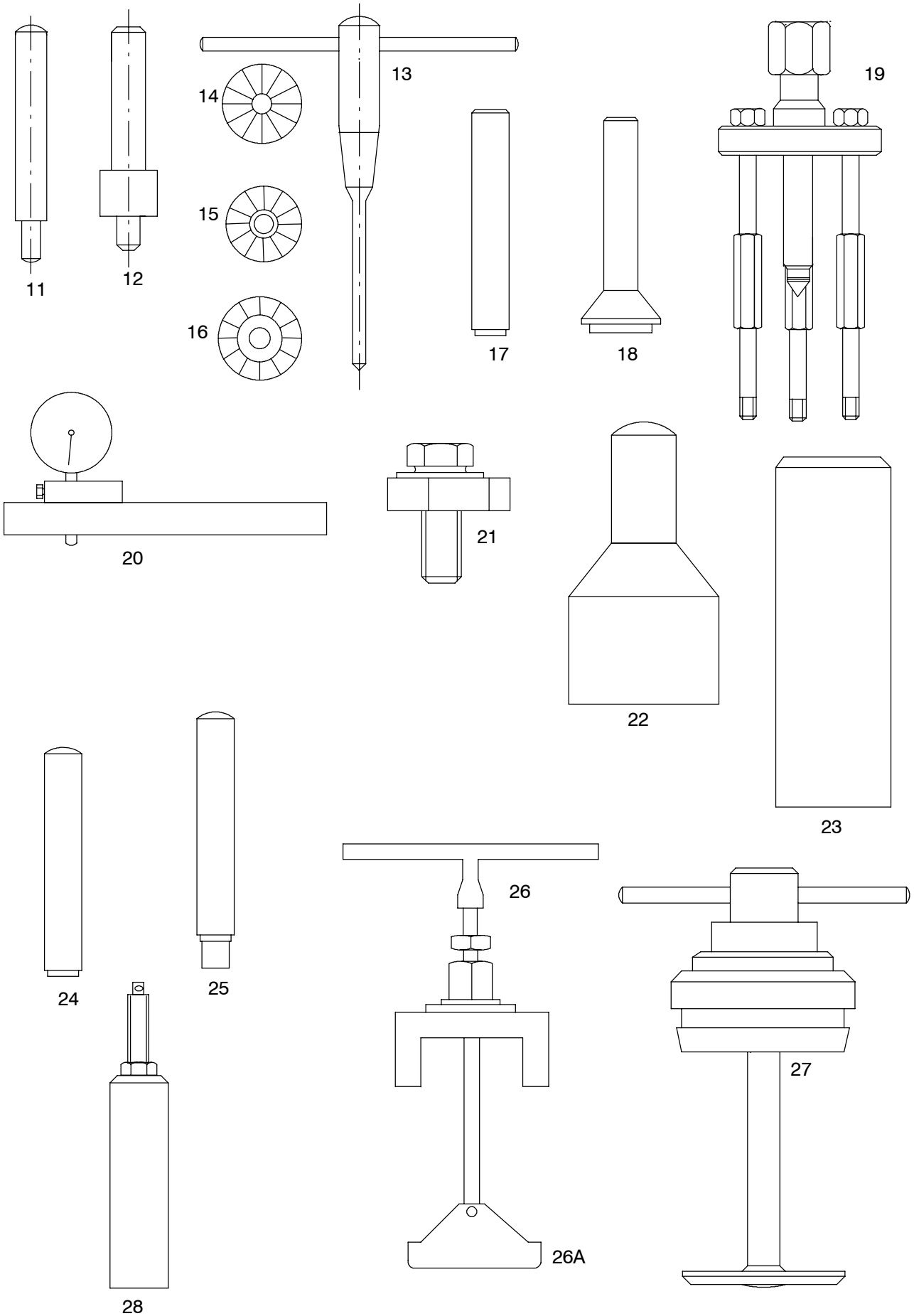
Part number	Description
11. 8360 97337	Drift for removing valve guide (505–905)
12. 8360 97457	Drift for fitting valve guide (505–905)
13. 8360 97434	T–handle for valve seat milling cutter (505–905)

14. 8360 97435 Milling cutter for facing exhaust and inlet valve seat(505–905)
15. 8360 97436 Milling cutter for exhaust and inlet valve seat (505–905)
16. 8360 97437 Inner milling cutter for exhaust and inlet valve seat (505–905)
17. 8361 97468 Drift for fitting 16 mm cap plug (505–905)
18. 7314 03506 Drift for fitting 36 mm cap plug (505–905)
19. 8360 97327 Puller for crankshaft gear (505–905)
20. 9025 79200 Holder for dial gauge (505–905)
21. 9025 78100 Press tool for cylinder liner (505–905)
22. 9025 98900 Drift for fitting dust cover, crankshaft front seal (505–905)
23. 9051 40200 Drift for fitting coolant pump seal (505–905)
24. 9025 98800 Drift for fitting tubular pin in timing gear casing (505–905)
25. 9025 98700 Drift for fitting tubular pin in timing gear casing (505–905)
26. 9051 73100* Puller for cylinder liner
26A. 8365 39293 Puller flange, **205, 305, 405**
26B. 8353 39292 Puller flange, **355, 455, 555**
27. 9051 72900* Milling cutter for fitting cylinder liner, **205, 305, 405**
27A. 9051 72800 Milling cutter for fitting cylinder liner, **355, 455, 555**
28. 9051 71300* Puller for injector

Locally prepared tools

29. 9051 64900 Drift for fitting coolant pump shaft (505–905)
30. ET(893 760) Support between front end and front axle to prevent oscillation

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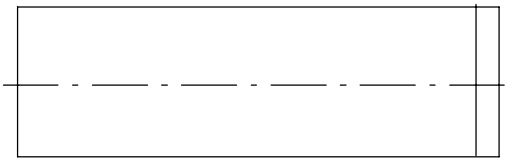

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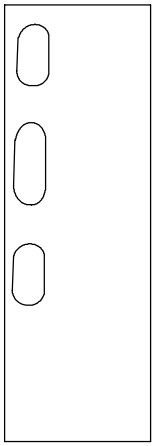

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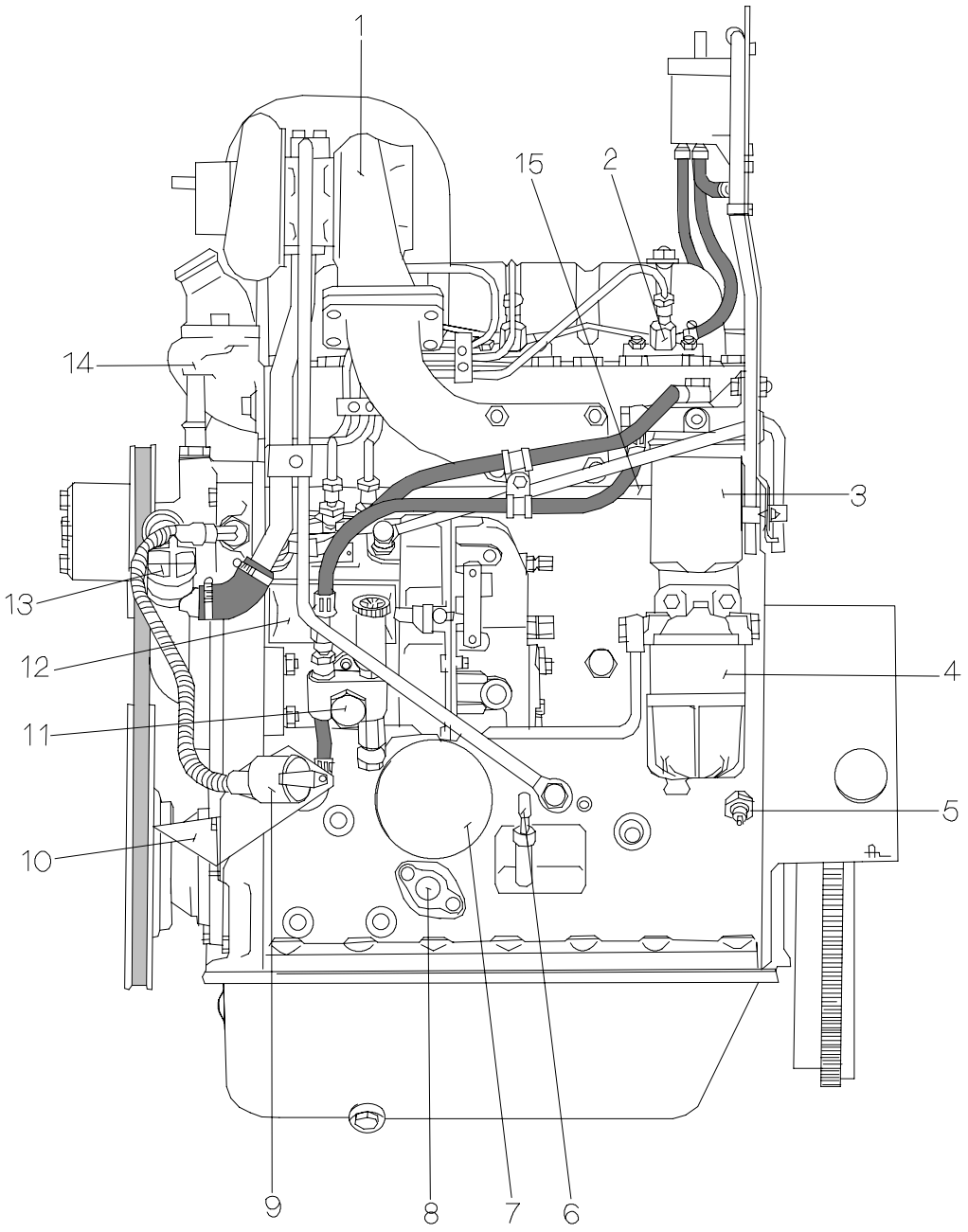
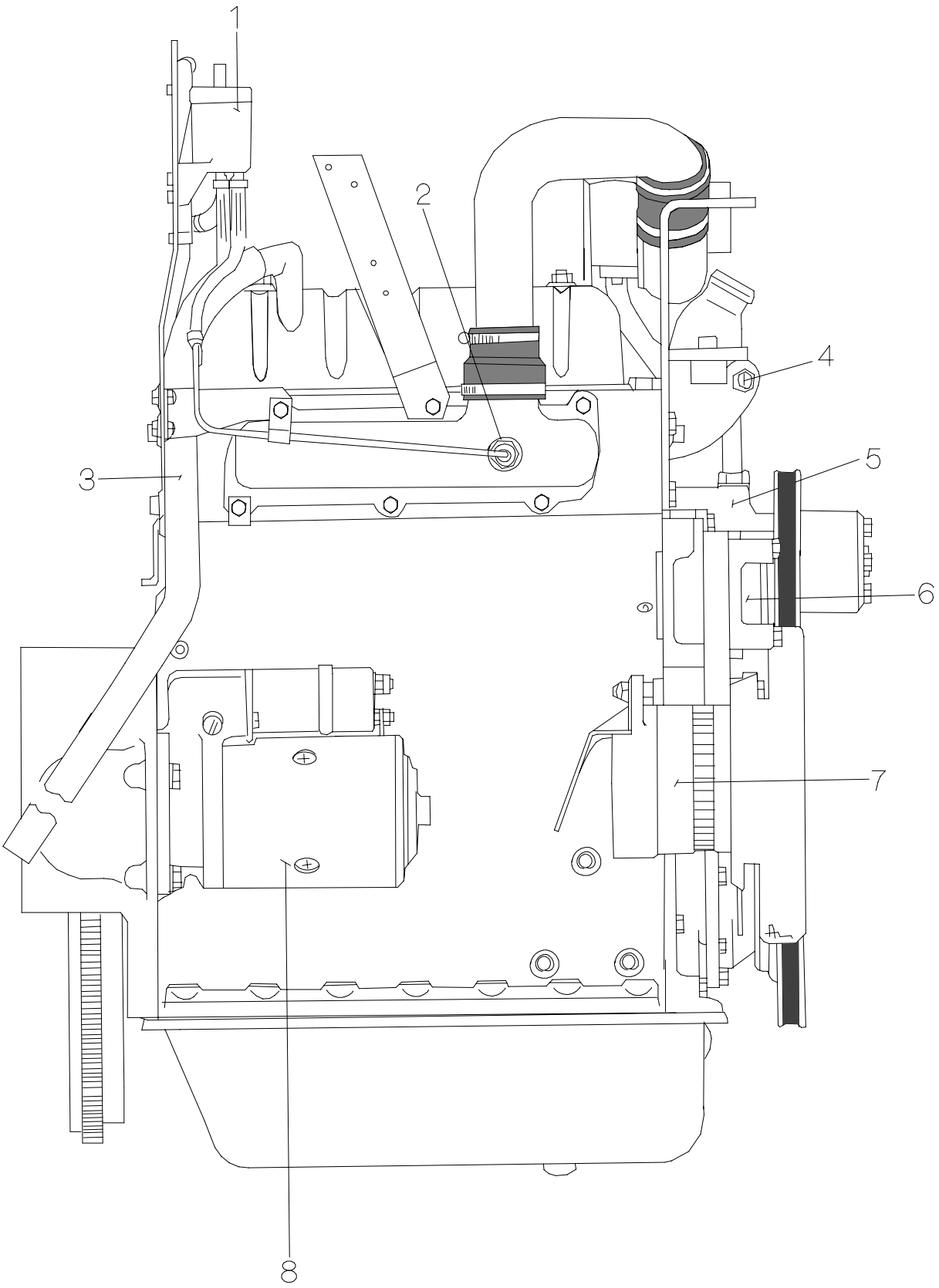
Engine, description

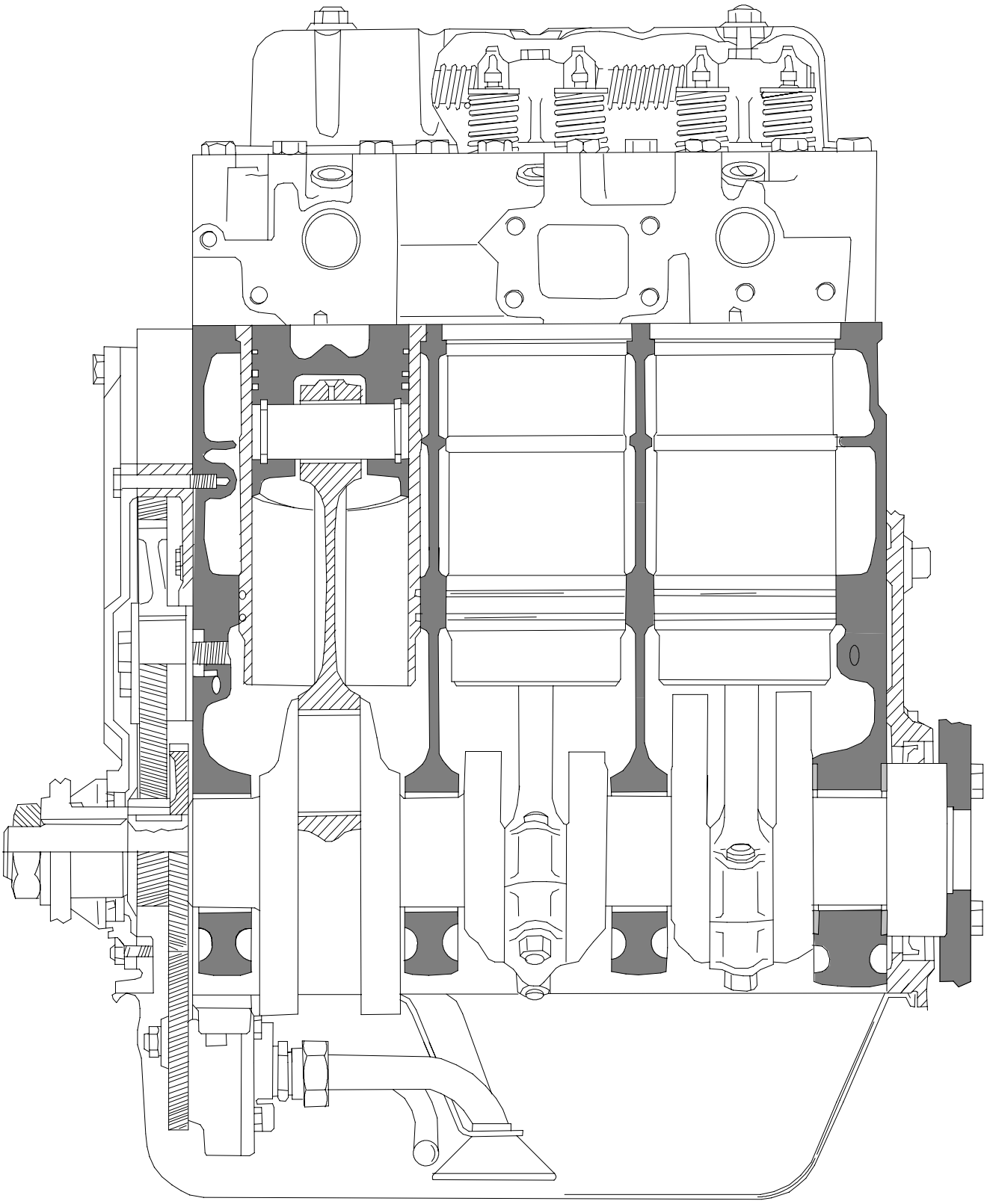
The engine on tractors 305–555 is a liquid–cooled, four–stroke, turbocharged, direct–injection diesel engine. The peripherals of the engine are shown in Figs. 210 1 and 210–2.



309 left side
1. Turbocharger
2. Injector
3. Fuel filter
4. Water trap
5. Oil pressure gauge sender
6. Oil dipstick
7. Oil filter
8. Oil pressure relief valve
9. Engine heater
10. Timing indicator
11. Fuel feed pump
12. Fuel injection pump
13. Oil filler
14. Thermostat housing
15. Serial number



309 right side
1. Thermostart device fuel reservoir
2. Thermostart glow plug
3. Breather hose
4. Temperature gauge sender unit
5. Coolant pump
6. Timing gear casing cover
7. Alternator
8. Starter motor

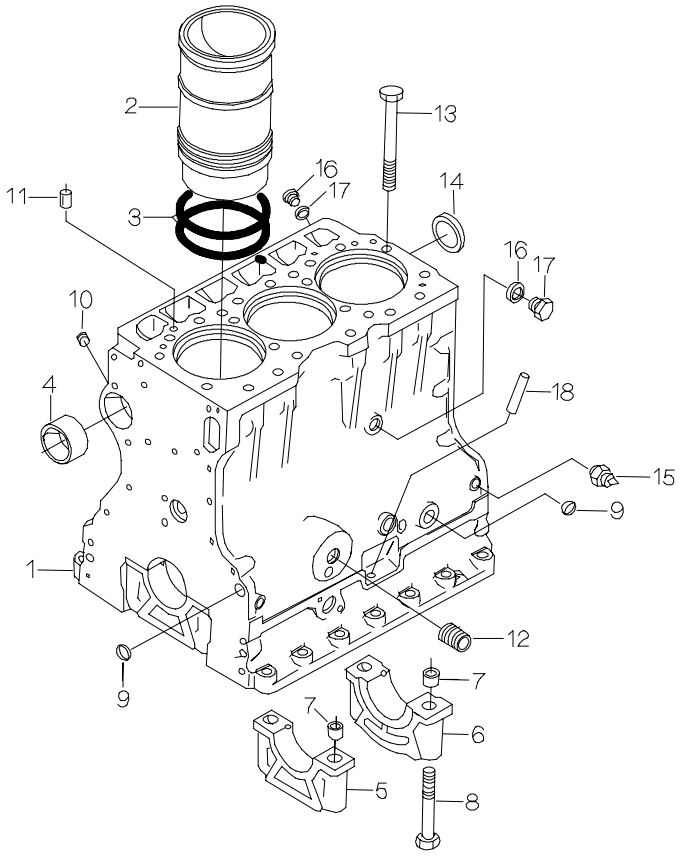


Longitudinal section of engine 309

Cylinder block

Figure 210 4

1. Cylinder block
2. Cylinder liner
3. O–ring
4. Bearing sleeve
5. Bearing cap
6. Bearing cap with thrust bearing
7. Guide sleeve
8. Bolt
9. Plug
10. Threaded plug
11. Guide pin
12. Threaded connection
13. Cylinder head bolt
14. Plug (camshaft end)
15. Pressure sender unit
16. Sealing ring
17. Plug
18. Pipe for oil dipstick



The cylinder block is the main body of the engine, to which other engine parts are attached. The cylinder liners are so called wet liners, which means that the coolant is in direct contact with the outer surface of the liners. The seal between the cylinder liner lower part and the cylinder block is achieved by two O–rings (3), which are fitted in grooves in the liner. The upper part is sealed by the cylinder head gasket. The distance between the cylinder liner flange and the face of the cylinder block plays a major role in sealing the upper part. Bear this in mind when fitting the cylinder liner.

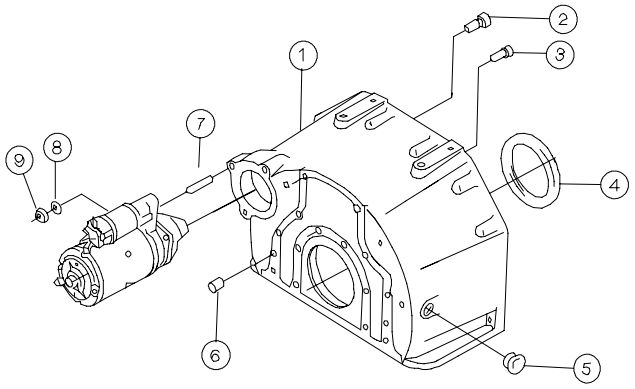
The camshaft is located in the cylinder block. The camshaft front bearing location is provided with a separate bearing sleeve (4). The remaining bearing locations are machined directly in the cylinder block. The drilling for the camshaft rear end is covered with a plug.

There is space on both sides of the rear main bearing for guide bearing shims (the camshaft thrust bearing).

Flywheel housing

Figure 210 5

1. Flywheel housing
2. Bolt M12x35
3. Socket head bolt M10x30
4. Crankshaft oil seal
5. Rubber plug
6. Tubular pin
7. Screw stud 10x25
8. Washer
9. Nut M10



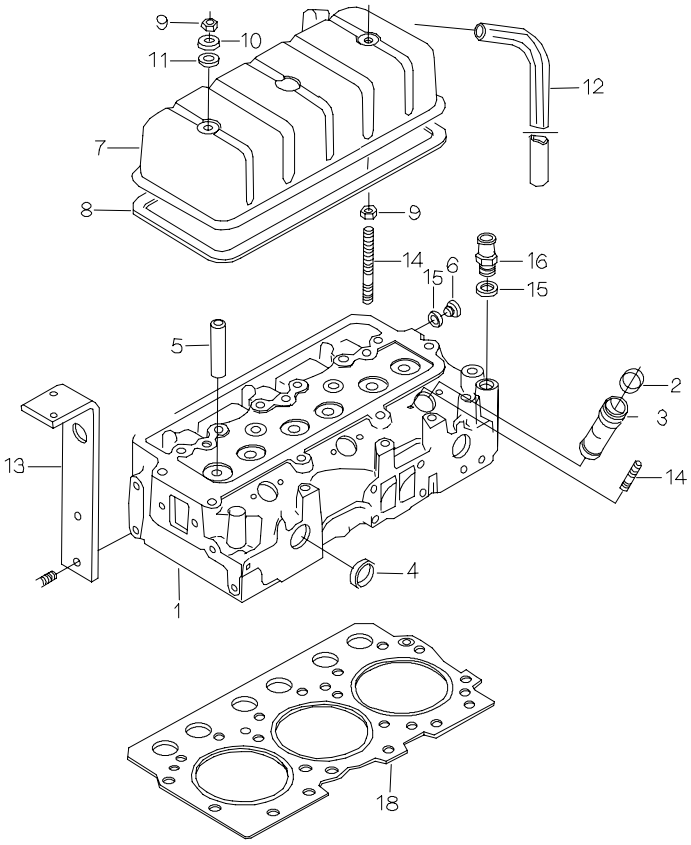
The flywheel housing is fitted to the rear end of the cylinder block. The starter motor and the crankshaft rear oil seal are also fitted in the flywheel housing. There is also a hole in the flywheel housing for inserting a tool in order to crank the engine. The return oil flow from the engine lubricating system is channelled through the flywheel housing.

The lower face of the flywheel housing fits up against the oil sump and its front face against the cylinder block. This has to be taken into account when fitting the flywheel housing, which is guided partly by the guide pin (6).

Cylinder head

Figure 210 6

1. Cylinder head
2. O–ring
3. Sleeve for injector
4. Plug
5. Valve guide
6. Plug
7. Valve cover
8. Gasket
9. Nut
10. Washer
11. Rubber seal
12. Breather hose
13. Lifting bracket
14. Screw stud
15. Sealing ring
16. Hose coupling
17. Bolt
18. Cylinder head gasket

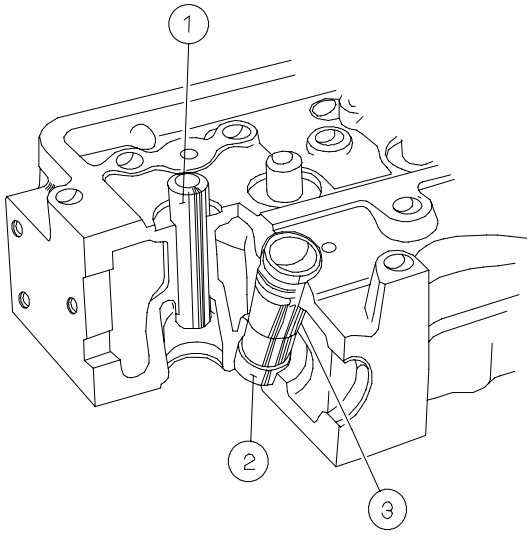


The cylinder head is made of cast iron, and each cylinder has its own inlet port and common exhaust port. The stiffness and even spread of attaching bolts give a good seal for the cylinder head gasket. The directed flow of the coolant ensures that the valve seats are effectively.

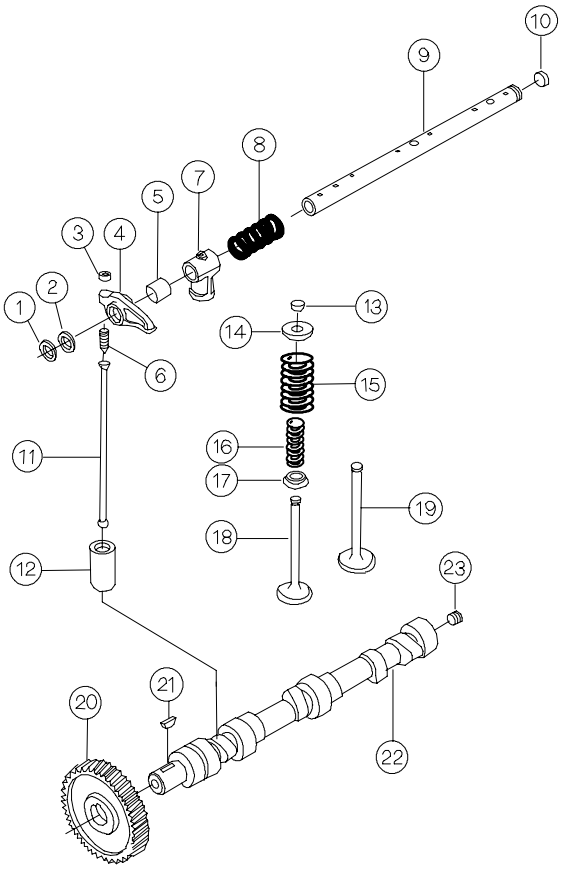
The inlet and exhaust valve guides (1) are identical and can be interchanged. The injectors are surrounded by replaceable copper sleeves (2) which are in contact with the coolant, thus the injectors are effectively cooled.

Cross–section of cylinder head

1. Valve guide
2. Injector sleeve
3. O–ring seals



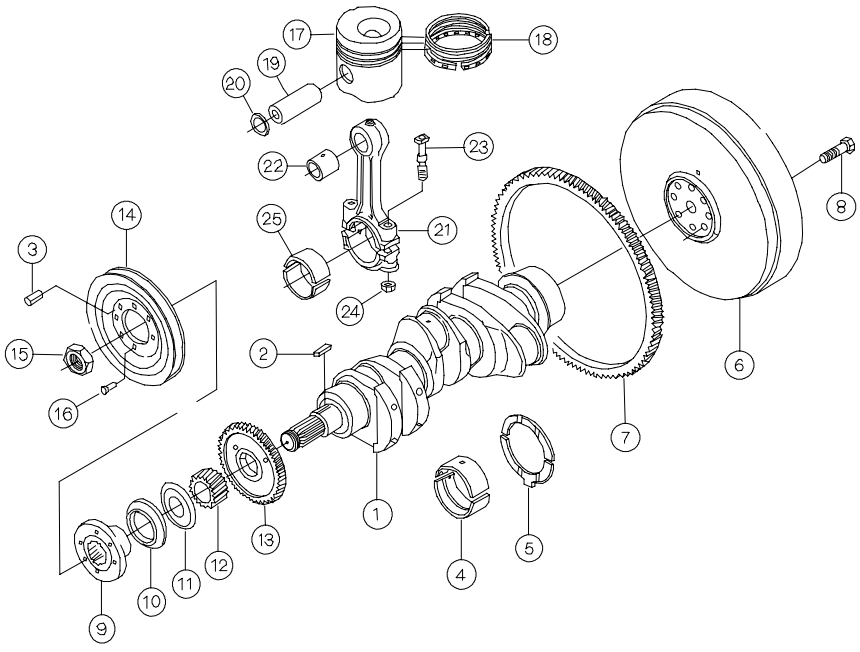
Valve mechanism



1. Circlip
2. Shim
3. Nut
4. Rocker arm
5. Bearing sleeve
6. Adjusting screw
7. Holder
8. Spring
9. Shaft
10. Plug
11. Pushrod
12. Tappet
13. Valve keepers
14. Spring guide
15. Valve spring
16. Valve spring
17. Spring guide
18. Exhaust valve
19. Inlet valve
20. Gear wheel
21. Key
22. Camshaft
23. Threaded plug

The valve mechanism is operated by the camshaft (22) which is located in the cylinder block. The drive is transferred with the help of tappets (12) and pushrods (11). The camshaft gear wheel (20) is fitted with a press fit and fixed with a key (21). Each bearings is lubricated by the force feed lubrication system through drilled oilways in the camshaft.

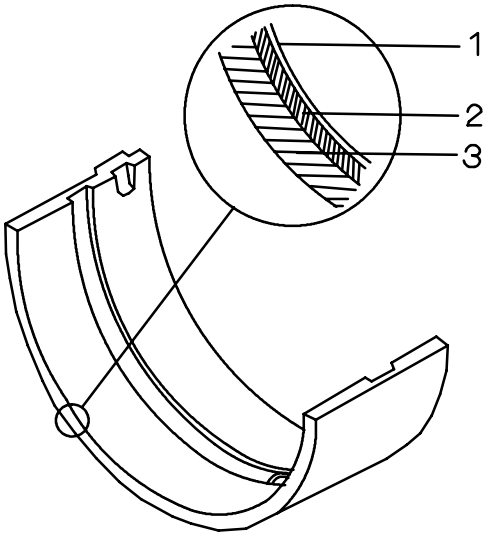
Crank mechanism



1. Crankshaft
2. Key
3. Cylindrical pin
4. Main bearing
5. Thrust bearing
6. Flywheel
7. Ring gear
8. Bolt
9. Hub
10. Shaft seal boot
11. Deflector ring
12. Gear wheel
13. Gear wheel
14. V–belt pulley
15. Nut
16. Socket head bolt M8x16
17. Piston
18. Piston rings
19. Piston pin
20. Retaining ring
21. Connecting rod
22. Bearing bushing
23 Bolt
24. Nut
25. Crankshaft bearing

The crankshaft (1) is forged from chrome alloy special steel and is induction hardened at the bearing and sealing surfaces. Gear wheels (12 and 13) are located at the front end of the crankshaft. They are fitted with a press fit, and drive the idler wheel and oil pump. In addition, the front end of the crank–shaft has splines for the hub (9) of the V–belt pulley (14). An oil deflector ring (11) is fitted between the hub and the gear wheel, and a dust shield (10) is fitted to the hub in order to seal the shaft.

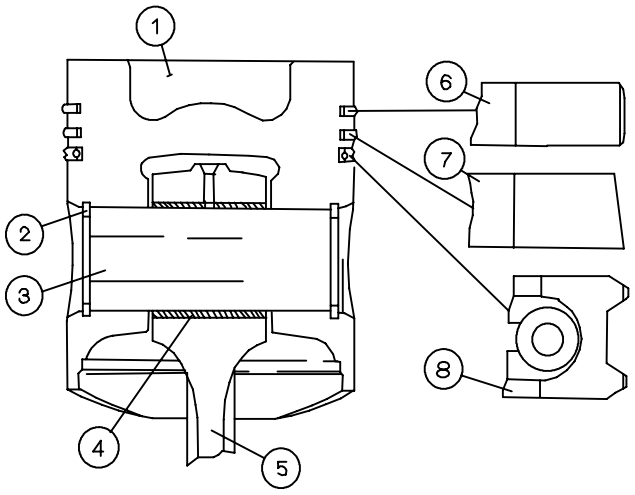
The flywheel (6) is fitted to the rear end of the crankshaft. The ring gear (7) is fitted to the flywheel with a press fit. The forged connecting rod has an I–shaped cross–section. The bearing location at the bottom end of the connecting rod is split, and the bearing cap is secured by two special bolts (23) and nuts (24). The upper end of the rod has a fixed bearing location, in which the piston pin bearing bushing (22) is fitted with a press fit.



Bearing shell

1. Indium–lead alloy
2. Lead–bronze
3. Steel shell

The crankshaft has four main bearings, one on either side of each cylinder. The thrust bearing is located on either side of the rear main bearing journal. The main and big–end bearings are three–layer bearings, which have a tough lead bronze alloy, with good heat dissipating properties, inside the steel shell. The actual sliding surface is covered by a layer of indium–lead, which makes the running–in period easier.



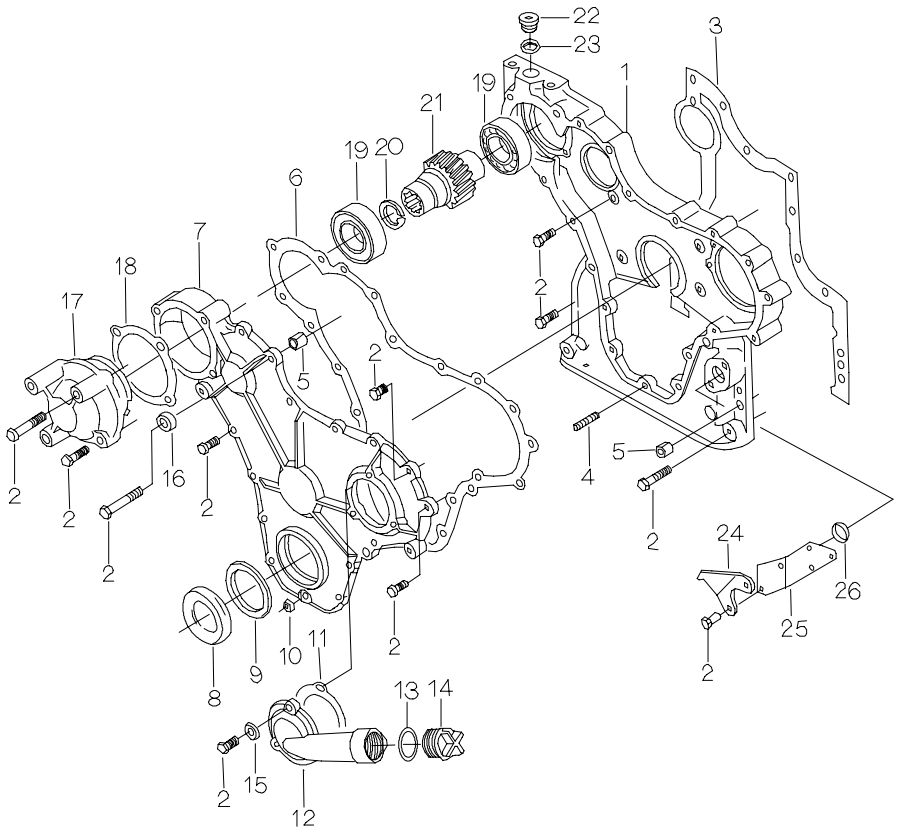
Piston

1. Combustion chamber
2. Circlip
3. Piston pin
4. Bearing bushing
5. Connecting rod
6. Chromed compression ring
7. Compression ring
8. Spring loaded oil control ring chromed slide surfaces

The piston is made of an eutectic aluminium alloy. In the upper part of the piston there is a combustion chamber (1). The shape of the chamber is intended to maximise the mixture of air and fuel. The number of piston rings is three, of which the upper (6) has a barrel face, chromed slide surface. The second compression ring (7) is tapered at an angle of 1,5°, and the third ring is a spring loaded oil control ring (8). The piston pin (3) has a close tolerance in the piston and a floating fit in the connecting rod.

Timing gear casing

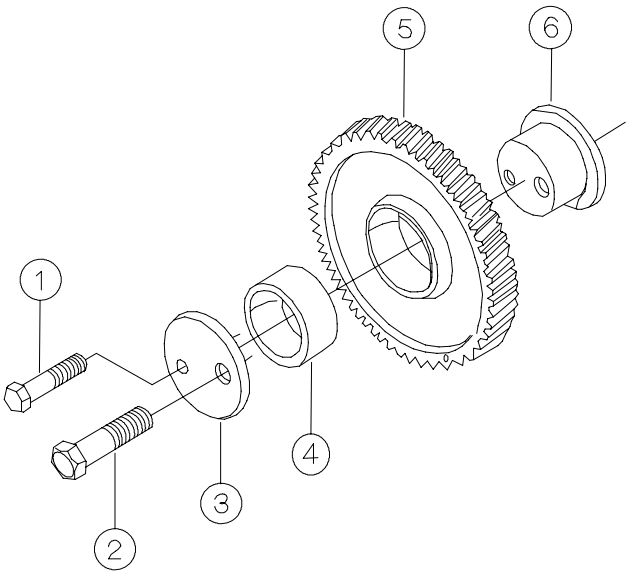
1. Timing gear casing
2. Bolt
3. Gasket
4. Screw stud
5. Tubular pin
6. Gasket
7. Front cover
8. Sealing ring
9. Protective ring
10. Nut
11. Gasket
12. Filler pipe
13. O–ring
14. Cap
15. Washer
16. Spacer ring
17. Bearing housing
18. Gasket
19. Bearing
20. Circlip
21. Shaft
22. Plug
23. Sealing washer
24. Timing indicator
25. Attaching plate
26. Rubber plug



The timing gear train consists of hardened, helically cut gear wheels. The gears are encased by the timing gear casing (1) which is fitted to the front of the engine. The fuel injection pump, alternator and hydraulic pump with its drive are fitted to the timing gear casing. The front cover (7) is fitted to the timing gear casing. Sealing ring (8) is fitted to the front end of the crankshaft and the protective ring (9) is positioned inside the location in the front cover. The timing gears drive the camshaft, fuel injection pump and oil pump.

Idler gear with securing parts

1. Bolt M10x55
2. Bolt M14x65
3. Locking flange
4. Bearing bushing
5. Gear wheel
6. Shaft stud



The bearing for the idler gear (5) is a sliding bearing (4) and is located on the axle (6). It is fitted to the cylinder block with two bolts (1 and 2). The crankshaft and camshaft gears are fitted to the shafts with a press fit and key. The fuel injection pump gear is fitted on the pump shaft, which is tapered, with a nut and key. In order to ensure the correct timing of the gears, there are punch marks on each gear.