



10 General

VALTRA

95

105

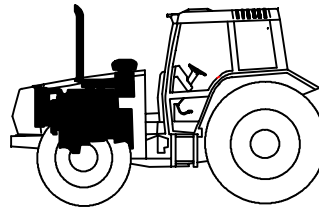
115

X100

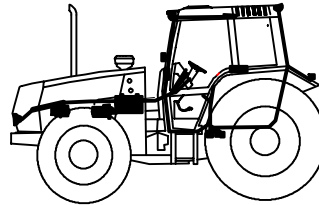
X110

X120

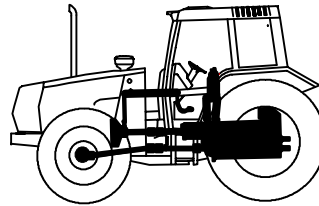
Service Manual



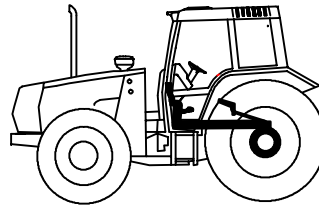
20 Engine



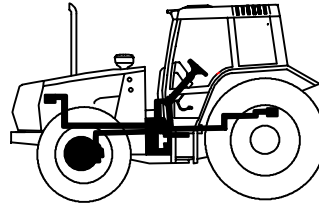
30 Electrical system



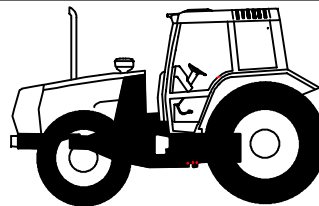
40 Power transmission



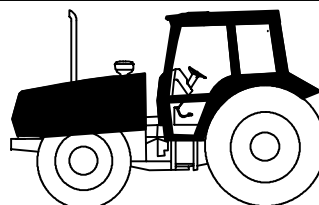
50 Brake system



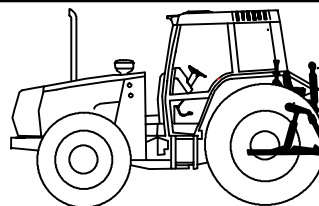
60 Steering system and Front axle



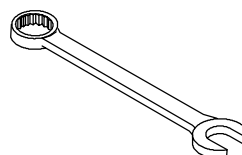
70 Frame and Wheels



80 Cab and Shields



90 Hydraulics



100 Tools

Order no 39 214 211
ENGLISH

10. General

11. Layout

12. Repairs

13. Maintenance

To the reader

The Service Manual for the ValtraValmet 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.

Valmet Tractors Inc.
Tractor Service

IMPORTANT!

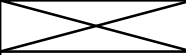
ValtraValmet **95**, **105** and **115** tractors are based on ValtraValmet agricultural tractors as follows:

- 95 is based on 6400DW tractor
- 105 is based on 6600 tractor
- 115 is based on 6800 tractor

ValtraValmet **X100**, **110H** and **X120** tractors are based on ValtraValmet agricultural tractors as follows:

- X100 is based on 6550Hi tractor
- X110 is based on 6650Hi tractor
- X120 is based on 6850Hi tractor

95– X120 tractors have frame steering (in 95–X120 tractors there is a new middle frame in place of the fuel tank which is fitted on the corresponding agricultural tractors) and 95–X120 can have special auxiliary hydraulics (e.g. special, fixed front loader and its control), which are not fitted on corresponding agricultural tractors. However, other vehicle components are the same as in corresponding agricultural tractors.

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	24. 5. 2004	X100—X120	110	0

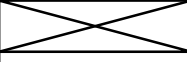
The following supplements have been published for the Valtra X100—X120 Service Manual:

Ordering number	Date	Notes
39 261 211	24.5.2004	

Supplement no. 39 261 211 (24. 5. 2004)

Includes:

— Agroline—instrument

11. Layout		Model 95, 105, 115 X100–X120	Code 110	Page 1
	1. 11. 2000			

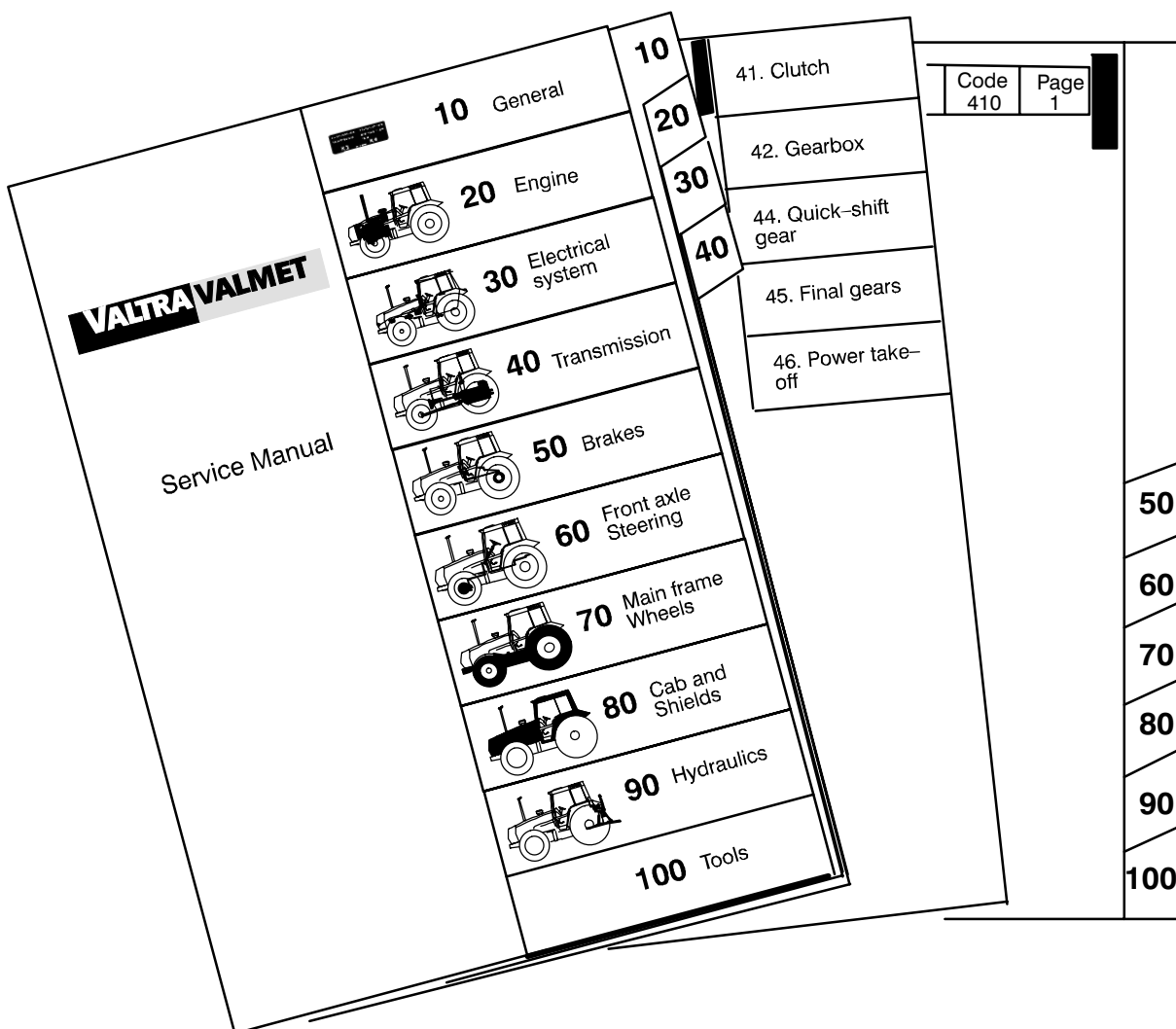
Layout of Service Manual

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. Quick—shift gear
45. Final drives etc.

11. Layout~~1. 9. 2000~~
1. 11. 2000Model
**95, 105, 115
X100—X120**Code
110Page
2**3. Code designation**

Three—digit code designations are used to distinguish 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 both 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)

4. 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.

VALTRA VALMET

41. Clutch

~~1. 9. 2000~~

1. 11. 2000

Model
95, 105, 115Code
410Page
1**5. Date**

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

6. Model

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

7. Additions and amendments of the service manual

New and up—dated pages will be continually 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) indicated 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 the page with the later date in the date box (and the old date in the crossed—over box) is valid (or the current page).

N.B. Fitting instructions for extra equipment are inserted into the service manual at the end of group concerned (E.g. code 39 is inserted at the end of group 30).

11. Layout		Model	Code	Page
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Code designation in the Service Manual

10. General

- 110 Layout
- 120 Repairs
- 130 Maintenance

20 Engine

21. Engine

- 210 Technical data, tools, description
- 211 Cylinder block and flywheel housing
- 212 Cylinder head and valve mechanism
- 213 Crank mechanism
- 214 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, tools, description
- 222 Fuel feed pump and fuel filters
- 223 Injection pump and injectors

23. Cooling system

- 230 Technical data, tools, description
- 231 Thermostat and coolant pump

30. Electrical system

- 310 Fuses, specifications, wiring diagrams
- 314 Autocontrol 2.2/2.3
- 321 ACB power lift
- 330 Agrodats on board computer
- 331 AD—instrument
- 370 Autocontrol 5 / 5.2 (HiTech)
- 371 Autocontrol 5.2

40. Power transmission

41. Clutch, fluid coupling

- 410 Technical data, tools, description
- 411 Clutch assembly and pedal rods
- 412 Hydraulic coupling

42. Gearbox

- 420 Technical data, tools, description
- 421 Selector forks
- 422 Gear shift levers
- 423 Shafts and gear wheels
- 424 Differential

44. DPS, reverse shuttle, 4WD clutch

- 440 DPS, technical data, tools, description
- 440 Reverse shuttle, technical data, tools, description
- 440 4WD clutch, technical data, tools, description
- 442 Reverse shuttle, repair instructions
- 443 4WD clutch, repair instructions
- 444 DPS, repair instructions

45. Final drives

- 450 Technical data, tools, description
- 451 Final drives, repair instructions

46 Power take—off

- 460 Technical data, tools, description
- 461 Power take—off, repair instructions

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50. Brakes

- 510 Technical data, description
- 511. Service brakes
- 520 Parking brake

60. Steering system and front axle

61. Steering system

- 610 Technical data, tools, description
- 611 Steering valve
- 612 Priority valve
- 613 Frame steering cylinders
- 614 Adjustments

64. Industrial powered front axle Dana (Sige)

- 640 Technical data, tools, description
- 641 Front axle housing
- 643 Hubs
- 644 Differential
- 645 Adjustments

65. Industrial powered front axle Carraro

- 640 Technical data, tools, description
- 641 Front axle housing
- 643 Hubs
- 644 Differential
- 645 Adjustments

70 Frame and wheels

- 710 Tractor frame
- 720 Tyres and wheel discs

80 Cab and shields

- 810 Cab
- 820 Shields
- 830 Air conditioner

90. Working hydraulics

91 Tractor working hydraulics

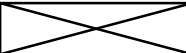
- 910 Technical data, tools, description
- 911 Pump and pipes, pressures
- 912 Power lift hydraulics
- 913 Three—point linkage, towing hook

92. Auxiliary working hydraulic, e.g. front loader

100. Special tools

- 101 Special tools (ETV)
- 102 Locally prepared tools

Note! Separate fitting instructions for the optional equipments are inserted into the Service Manual. These instructions are positioned to the end of each main group. E.g. code 39 are placed to the end of group 30.

12. Repairs		Model	Code	Page
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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:

- Determine the problem
- List possible causes
- Differentiate the causes
- Conduct checks in logical order to determine the exact cause
- Consider approximate remaining service life against cost of parts and labour..
- Make any necessary repairs.
- Recheck the parts and functions for correct operation

12. Repairs

1. 11. 2000

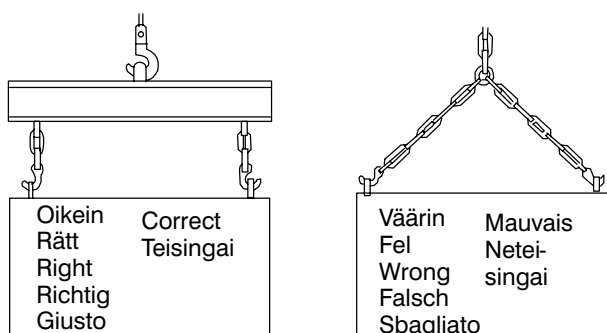
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**95, 105, 115
 X100–X120**

 Code
120

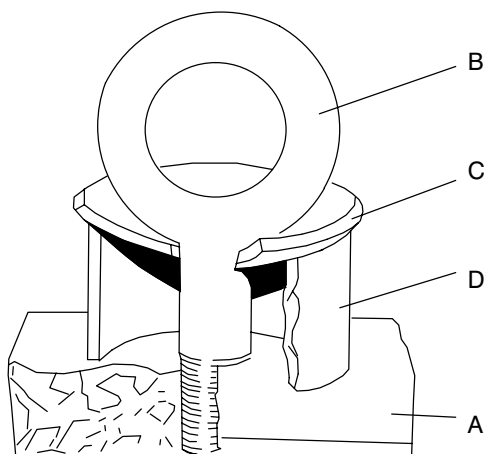
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2

Handling of heavy components

Unless otherwise specified, all removals should be accomplished using adjustable lifting equipment. All supporting slings must be parallel to each other and as near vertical as possible in relation to the object being lifted. However, where slings are of a far greater capacity than the weight of the load to be fitted, a triangular lifting arrangement may be used.



When removing a component at an angle, remember that the capacity of an eyebolt is reduced when the angle between the supporting members and the object becomes less than 90°.



Forged eyebolt support

- A. Load
- B. Lifting shackle
- C. Shackle retaining plate (3 mm thick)
- D. Sleeve

When necessary the forged eyebolt can be supported in the way shown in figure above. Sleeve D may or may not be welded to plate.

Warning! If a part resists removal, check that all nuts and bolts have been removed and that there is no interference from adjacent parts.

Cleanliness

To ensure long life of a machine, it is important to keep dirt and foreign material out of its vital working components. Precautions must be taken to safeguard against this. Enclosed compartments, seals and filters have been provided to keep the supply of air, fuel and lubricant clean. These protective devices must not be removed.

Whenever hydraulic, fuel, lubricating oil or lines are disconnected, clean the point of disconnection and the surrounding area. As soon as a line has been disconnected, cap, plug or tape the line or opening to prevent the ingress of foreign material.

The same cleaning and covering precautions should be taken when access covers or inspection plates are removed.

Clean and inspect all parts. Make sure that all passages and holes are clear. Cover all parts to keep them clean. Make sure parts are clean when they are reassembled. Leave new parts in their wrapping until they are actually needed for reassembly.

Assembly

When reassembling a machine, complete each step in sequence. never partially assemble one part then start to assemble another. Make all recommended adjustments. Always check the job on completion to ensure that nothing has been overlooked. Recheck the various adjustments before putting the machine back into service.

Note! Before fitting new parts, remove rust preventative compound from all machined surfaces (usually "peel-off substances").

Lubrication

Where applicable, fill the compartments of repaired or renewed components with the quantity, type and grade of clean lubricant recommended in the routine maintenance section of the Operator's Manual.

Shims

When shims are removed, tie them together and identify their location. Keep shims clean and take care not to bend them before refitting them.

Gaskets

Make sure that the holes in gaskets line up with lubricating oil passages in the mating parts. If gaskets have to be made, use material of the correct type and thickness. Make sure that holes are punched in the right places. Incorrectly punched gaskets can cause serious damage.

Lip type rubber seals

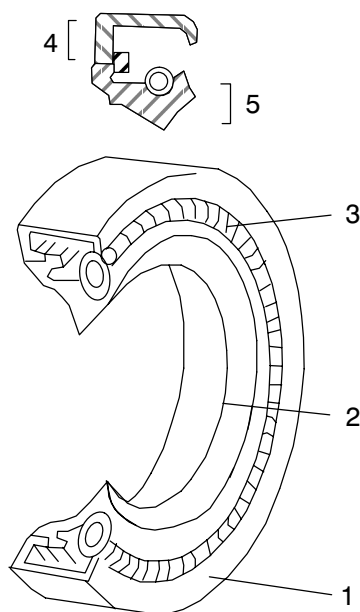
Lubricate the lips of lip-type rubber seals with oil before fitment. Do not use grease on seals, except for grease seals.

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The main parts of lip—type seal:

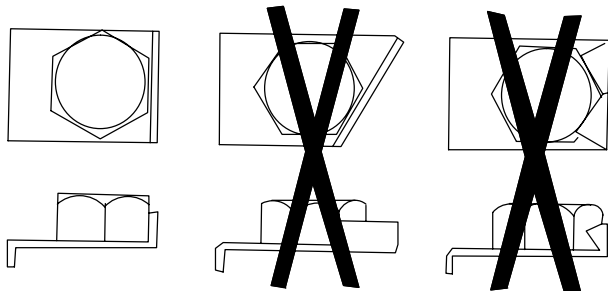
1. Case
2. Sealing element
3. Ring spring

The figure above shows the construction of a simple lip—type seal. The cross section shows the heel (4) and the toe (5), used to identify the sides of a single element seal. With a few exceptions, the toe of a single—lip is located on the lubricant side. Some seals have a second auxiliary lip which has no spring.

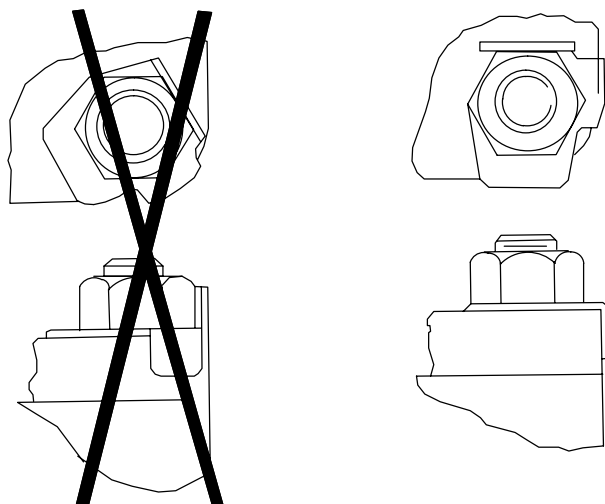
Cables and wires

When removing or disconnecting a group of cables or wires, label each one to ensure correct refitment.

Locking devices



Correct and incorrect use of retainers



Correct and incorrect method of fitting and bending locking tabs.

Slackening of nuts and bolts is prevented by mechanical means such as lockwashers, tab washers and cotter pins, or by Loctite—type locking agents.

Flat retainers must be installed properly to be effective. Bend one end of the retainer against the edge of the part. Bend the other end against one of the nut or bolt head. Always fit new retainers in compartments which house moving parts. When fitting lockwashers on aluminium housings, place a flat washer between the lockwasher and the housing.

Note!

1) Never fit a lockwasher (Grower, fan, spring, etc.) under a nut or bolt to which a specified torque has to be applied.

2) Always thoroughly degrease components before applying Loctite type locking agents.

Bushes and press fits

Do not fit bushes with a hammer alone. Use a suitable fitting tool and a hammer or, better still, a press if possible..

When using a press, ensure that pressure is applied directly in line with the bore. If the ring has an oil hole, take care to align it with the oil hole in the mating part. When press fitting a part into another part, lubricate the mating surfaces. Tapered parts should be assembled dry. Before assembly, check that the tapers are dry and free from burrs.

Fitting bolts in blind holes

Use bolts of the correct length. A bolt which is too long may "bottom" before the head comes into contact with the part it is to hold: this will cause damage to the threads. If a bolt is too short, there may not be enough threads engaged to hold the part securely.

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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

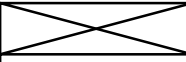
If the bolts differs from the standard range the values in the table must not be used.

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 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

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Maintenance ValtraValmet 95, 105 and 115 X100, X110 and X120

N.B. Detailed maintenance instructions, see Operator's Manual.

General

Correct maintenance at the right time is a basic condition for reliable operation of the tractor. Maintenance costs are small compared with any repair costs resulting from lack of maintenance. The most important measures are those which you carry out yourself and which include lubrication and various checks and adjustments.

The service intervals shown apply for normal operating conditions but in more severe conditions servicing should be carried out more frequently.

General instructions concerning oil checks and oil filling

- Always stop the engine before starting work
- Apply the parking brake to ensure the tractor cannot move. If the ground is uneven the wheels should be scotched
- Wash down the tractor first so that the work can be done more easily and quickly.
- 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.

Greasing lubricating points fitted with grease nipples

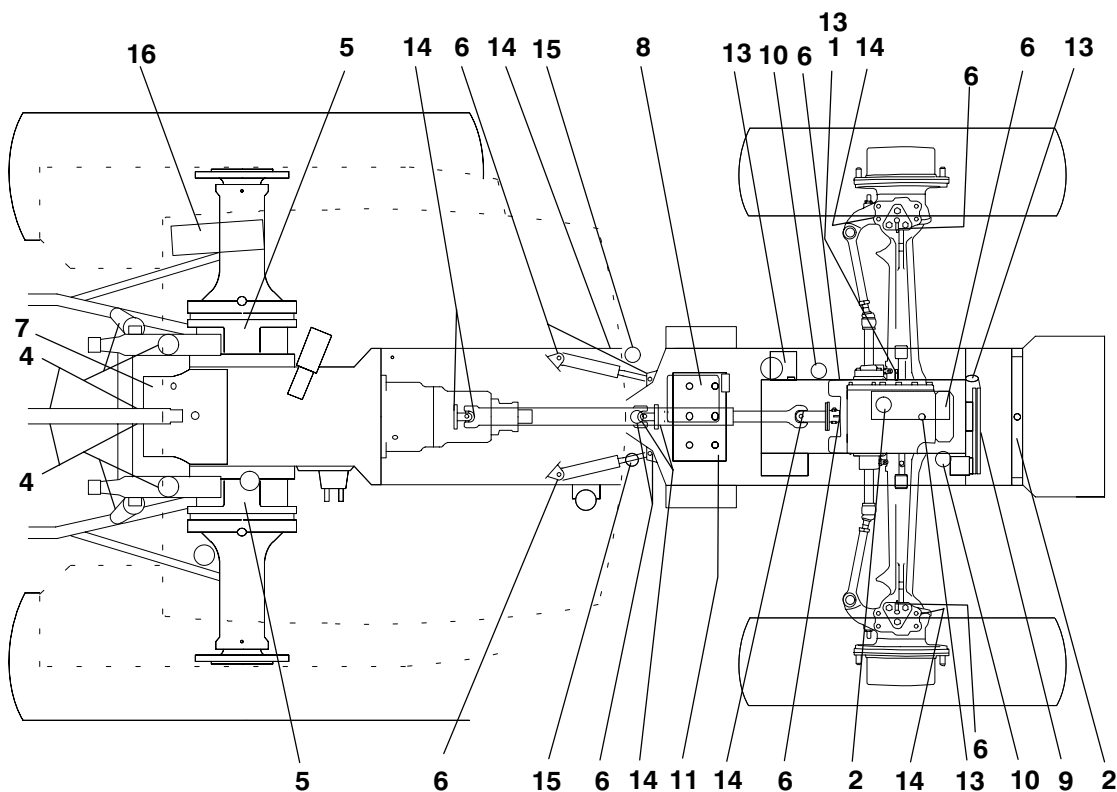
- Always clean the grease nipples before applying the grease gun.
- Apply grease through the nipples until clean grease oozes out (unless otherwise instructed).
- Wipe away superfluous grease which has been pressed out at the lubricating point.
- Preferably carry out lubrication with bearing points and joints unloaded and with the bearings in different positions.

Lubrication and maintenance schedule

All intervals are counted from zero hours on the hour recorder. For example, 1000 hours service is carried out every 1000 (yearly), 2000 hours (every other year) etc. even if the guarantee service has been carried out.

Example: The 1000 hour service contains all items mentioned under 10 h/Daily, 50 h/once a week, 250 h, 500 h and 1000 h.

Maintenance schedule



60A—10,5

Daily/every 10 hours

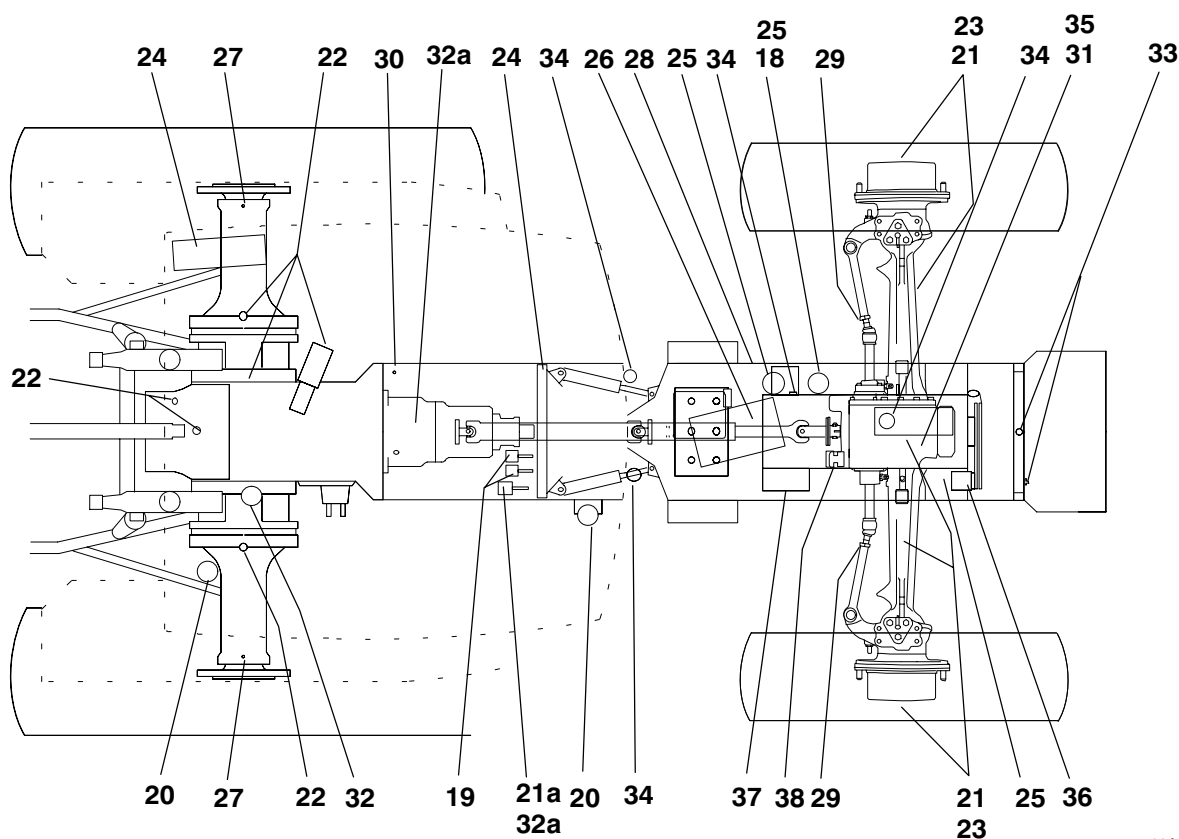
1. Check engine oil level
2. Check coolant level and radiator fins
3. Check for leakage

Weekly/every 50 hours

4. Grease three—point linkage and trailer hitch, option
5. Grease brake mechanism (high pressure grease)
6. Grease the following points:
 - bearings of front axle mounting (2 nipples)
 - front axle king pins (4 nipples), Carraro axle only
 - frame steering bearings (2 nipples)
 - steering cylinders bearings (4 nipples)
7. Check oil level in transmission and hydraulics
8. Clean the prefilter of the engine air intake
9. Check belt/belts tightness
10. Check fuel system pre—filter (X100—X120) /check/ empty water trap (95—115)
11. Check electrolyte level in battery

Every 250 hours

12. Grease door and window hinges and locks
13. Change engine oil and filter
14. Grease the following parts:
 - joints of powered front axle (2 nipples)
 - power transmission shaft of the front axle (4 nipples)
 - shaft between transmission and motor (4 nipples)
15. Check brake fluid level and clutch fluid level (95, 105 and 115)
16. Clean cab ventilation air filter
17. Check wheel nuts and bolts and tyre pressures



60A—11,4

Every 500 hours

- 18. Clean water trap of fuel system, 95—115
- 19. Check brake pedal free travel
- 20. Change pressure filters of transmission and hydraulics and hydraulics return oil filter or if filter warning light comes on
- 21. Check oil level in front axle differential and hubs
- 21a. Calibrate gas pedal, X100—X120

Every 1000 hours/yearly

- 22. Change oil in transmission/hydraulics and clean suction strainer
- 23. Change oil in front axle differential and hubs
- 24. Change cab ventilation air filter and recirculation filter
- 25. Change fuel filter and change pre-filter (X100—X120)
- 26. Change air filter and safety filter
- 27. Grease rear drive axle bearings, 95—115
- 28. Grease flywheel ring gear
- 29. Check/adjust front wheel toe-in
- 30. Clean fuel tank
- 31. Adjust valves
- 32. Change transmission housing breather
- 32a. Calibrate gas pedal and check function of HiTech shuttle (X100—X120)
- 32b. Tighten frame bolts and nuts

Every 2000 hours/every other year

- 33. Change engine coolant
- 34. Change brake fluid and clutch fluid (95—115)
- 35. Check and clean injectors (when using biodiesel after every 1000 hours)
- 36. Check alternator
- 37. Check starter motor

Every 4000 hours

- 38. Check turbocharger (authorised workshop)

13. Maintenance

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Recommended fuel and lubricants (all capacities are incl. of filters)

Part of machine	Valtra grade	SAE grade	API grade	Volume, when changing (litre)
Engine, 4—cylinders: — 95, 105, 115, X100, X110, X120	Valtra Engine	10W/30: −20°C...+30°C 15W−40: −10°C...+40°C	CE CF/CF−4	13
Tractor's hydraulic system and transmission	Valtra Transmission	HT 60: −30°C...+30°C HT 100: −10°C...+40°C	GL−4 (G2−98)	min 34, max 43 (105, 115, J02316—:max 45), extra max 50 (105, 115, J02316—: extra max 53). 95−X120 *): min 45, max 55, extra max 65.
Industrial powered front axle: — differential, 95—115 (Dana)	Valtra Axle	80W−90	GL−5 (LS)	8
— differential, X100—X120 (Carraro)				6
— hub reduction gears				2x1,5
Fuel tank	Diesel fuel			135
Engine cooling system — 95, 105 normal/with openable grill	water + anti−freeze agent (standard ASTM D3306−86a or BS 6580:1985)			15,5/19,5
— 115				20,5
— X100				17
— X110, X120				22
Brake fluid reservoir	Brake fluid SAE J1703			0,3
Clutch fluid reservoir (not HiTech)				0,2
Windscreen washer	Washer fluid			3
Auxiliary hydraulics oil tank	Oil DIN 51524 (HVLP 32)			100

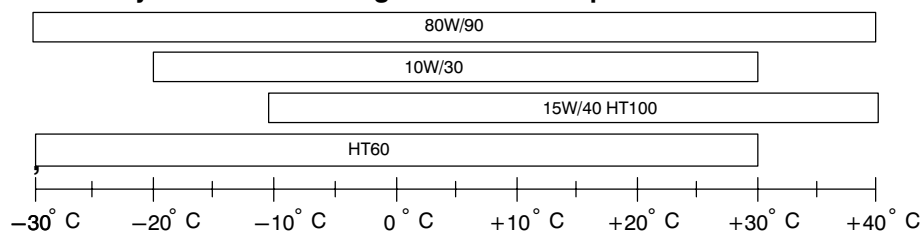
*) Chassis numbers, see page 450/6.

For HiTech transmission/hydraulics is not available suitable bio oil.

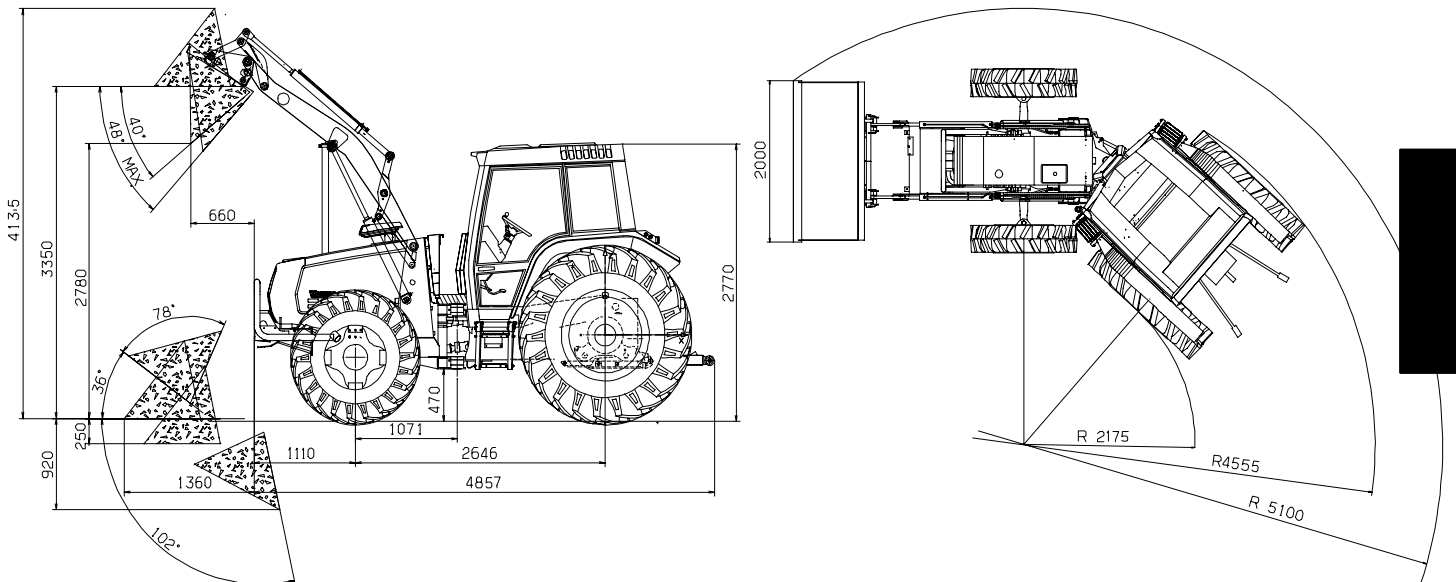
Biodiesel fuel

- In the Valmet engines it is accepted to use esterified rape oil as biodiesel fuel — or RME (rape oil esterified with methanol) without technical modifications on the engine. The requirement for the acceptance is that the biodiesel that is used is very pure and that it fills the Austria "Ö1190" biodiesel norm demands of pureness. Practically it means that the amount of pure carbon, hydrogen and oxygen content together in the biodiesel is more than 99 %.
- In the service instructions there is one change: checking cleaning of nozzles every 1000 hours.

Viscosity classes according to ambient temperature



Maintenance of optional fixed front loader



Maintenance weekly (at least every 50 hours)

1. Grease loader bar pivots (24 nipples).
2. Grease nipples of the front axle locking cylinders in the lower parts of the cylinders (2 nipples).
3. Check hydraulic oil level

Note! In service inspection after 100 running hours, the front loader oil filter must be changed.

Note! Regularly check the tightening of the bolts and nuts for the front axle locking cylinder attachments. Check now and then that the breathers are open. They can be loosen by unsrewing.

Maintenance at every 250 hours

4. Grease the drive shaft of the loader's variable displacement pump (3 nipples)

Maintenance at every 1000 hours (or yearly)

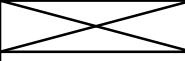
5. Change hydraulic oil and filter

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22. Fuel system

23. Cooling system

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E. Fitting crankshaft	2

2. Connecting rods and pistons:

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3****Specifications** (see also page 210/17)

Tractor	95	95 (41/00–)	105	115
Designation	420 DW	420DW	420 DS	420 DWI
Turbocharger	yes	yes	yes	yes (+interc.)
No of cylinders	4	4	4	4
Displacement (litres)	4,4	4,4	4,4	4,4
Cyl. bore (mm)	108	108	108	108
Stroke (mm)	1120	1120	120	120
Compr. ratio	16,5:1	16,5:1	16,5:1	16,5:1
Output (kW/r/min DIN)	70/2225	73,5/2200	77/2225	85/2225
Torque (Nm/r/min DIN)	390/1550	415/1400	405/1550	440/1550
Moment rise %	31	30	22	21
Low idling (r/min)	750	750	850	850
Compr. press. ¹⁾ (bar)	24	24	24	24
Max. no-load revs (r/min)	2425	2400	2425	2425

Tractor	X100	X110	X120
Designation	420DWRE	420DWRE	420 DWRIE
Turbocharger	yes	yes	yes, interc.
Number of cylinders	4	4	4
Displacement (litres)	4,4	4,4	4,4
Cyl. bore (mm)	108	108	108
Stroke (mm)	120	120	120
Compr. ratio	16,5:1	16,5:1	16,5:1
Output (kW/r/min DIN)	73,5/2200	81/2200	88/2200
Torque (Nm/r/min DIN)	430/1400	460/1400	490/1400
Moment rise %	35	31	28
Low idling (r/min)	850	850	850
Compr. press. ¹⁾ (bar)	24	24	24
Max. no load revs (r/min)	2400	2400	2400

¹⁾ Minimum value at operating temperature and starting revs. Max permitted difference between cylinders 3,0 bar.

Valves, rockers and tappets

With a valve clearance of 1,0 mm:

– inlet valve opens	0° ± 2° B.T.D.C
– inlet valve closes	16° ± 2° A.B.D.C
– exhaust valve opens	39° ± 2° B.B.D.C
– exhaust valve closes	1° ± 2° A.T.D.C

Valve clearance cold and hot:

– inlet valve	0,35 mm
– exhaust valve	0,35 mm

Angle of valve seat in cylinder head:

– inlet valve	35° ± 20'
– exhaust valve	45° ± 20'

Width of valve seat in cylinder head:

– inlet valve	2,9...3,7 mm
– exhaust valve	1,3...2,3 mm

Angle of valve face:

– inlet valve	35° – 20'
– exhaust valve	45° – 20'

Outside diameter of valve head:

– inlet valve	48 mm
– exhaust valve	41 mm

Max valve movement:

– inlet valve	10,9 mm
– exhaust valve	12,1 mm

Inlet valve stem diameter 8,960...8,975 mm

Exhaust valve stem diameter 8,925...8,940 mm

Inlet valve stem clearance 0,025...0,055 mm

– Reject limit 0,30 mm

Exhaust valve stem clearance 0,060...0,090 mm

– Reject limit 0,35 mm

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Inside diameter of valve guide before fitting	9,000...9,015 mm
Outside diameter of valve guide	16,028...16,039 mm
Diameter of valve guide bore in cylinder head	16,000...16,018 mm
Protrusion of valve guide top above cylinder head surface	21 mm
Depth of valve face below cylinder head surface:	
– inlet valve	0,7±0,05 mm
– exhaust valve	0,6±0,05 mm
Valve spring free length	69,8 mm
Spring pressure when spring compressed to a length of:	
– 48,6 mm	327±17 N
– 37,4 mm	500±23 N
Rocker arm shaft diameter	19,959...19,980
Inside diameter of rocker arm bearing bush:	
– (when fitted in position)	19,990...20,010 mm
Outside diameter of rocker arm bearing bush	23,035...23,075 mm
Diameter of rocker arm bore	23,000...23,021 mm
Max. permissible push rod deflection (when free)	0,4 mm
Free length of rocker arm spring	80 mm
Spring pressure when spring compressed to a length 58 mm	80...100 N
Outside diameter of tappet	29,939...29,960 mm
Diameter of tappet bore in cylinder block	30,000...30,043 mm
Engines from week 34 1996:	
Rocker arm shaft diameter	22,970...22,990 mm
Diameter of rocker arm bore	23,000...23,021 mm

Camshaft

Diameter of camshaft bearing journal no 1	49,925...49,950 mm
Diameter of camshaft bearing journals (others than no 1)	49,885...49,910 mm
Diameter of camshaft bearing journals nos 2, 3 and 4 (620/634–engines)	49,865...49,890 mm
Inside diameter of camshaft bearing bushes (when fitted in position)	50,010...50,070 mm
Diameter of camshaft bearing bores (others than no 1)	50,000...50,025 mm
Camshaft clearance in bearing bush no 1	0,060...0,145 mm
Camshaft clearance in bearing bushes (others than no 1)	0,090...0,140 mm
Camshaft clearance in bearing bushes nos 2, 3 and 4 (620/634–engines)	0,110...0,160 mm
Bearing bush tolerance in block (press fit)	0,025...0,080 mm
Diameter of bearing bush bore in block	55,620...55,650 mm
Camshaft end play with 0,5 mm gasket between cylinder block and timing gear housing and between timing gear housing and front cover	0,5...1,0 mm
Cam height (distance between back of cam and tip of cam):	
– inlet valve	41,180...41,430 mm
– exhaust valve	40,080...40,330 mm
Cam lift:	
– inlet valve	7,38 mm
– exhaust valve	8,28 mm
Camshaft max permissible deflection (total indicator reading)	0,03 mm

Cylinder liners

Protrusion of cylinder liner above cylinder block top face	0,030...0,080 mm
Max. permissible height difference between liners (under same head)	0,02 mm
Outer diameter of cylinder liner guide:	
– at upper end of liner	124,475...124,500 mm
– at lower end of liner	122,961...122,986 mm
Liner bore	108,000...108,022 mm
Height of cylinder liner flange	9,03...9,05 mm
Height of cylinder liner flange, 1st oversize, part no 8366 47933	9,08...9,10 mm
Height of cylinder liner flange, 2nd oversize, part no 8366 47934	9,13...9,15 mm
Height of cylinder liner flange, 3rd oversize, part no 8366 47935	9,23...9,25 mm
Outer diameter of cylinder liner flange	131,700...131,800 mm

Piston, rings and gudgeon pin

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:	
– 17 mm from lower edge	107,873...107,887 mm

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Pin bore in piston	40,003...40,009 mm
Piston pin diameter	39,991...40,000 mm
Width of ring grooves:	
– 1st groove tapered groove	
– 2nd groove	2,520...2,540 mm
– 3rd groove	4,040...4,060 mm
Side clearance of piston rings in their grooves:	
– 1st ring, tapered	
– 2nd ring	0,03...0,062 mm
– 3rd ring	0,05...0,082 mm
– reject limit	0,15 mm
Piston ring height (in direction of cylinder):	
– 1st ring tapered	
– 2nd ring	2,478...2,490 mm
– 3rd ring	3,975...3,990 mm
Piston ring gap (with piston fitted in cylinder)	
– 1st ring	0,40...0,55 mm
– 2nd ring	0,60...0,80 mm
– 3rd ring	0,30...0,60
– reject limit	1,0 mm
Max. permissible weight difference between pistons in same engine	25 g
Piston to be heated up to 100°C before fitting gudgeon pin.	
Piston position in cylinder: combustion chamber of piston to face towards injector.	

Connecting rod

Inside diameter of piston pin bush (with bush pressed into connecting rod)	40,025...40,040 mm
Outside diameter of piston pin bush	44,082...44,120 mm
Interference fit: connecting rod small end bushing–connecting rod	0,057...0,120 mm
Connecting rod small end bore	44,000...44,025
Connecting rod big end bore	71,730...71,749 mm
Big end bearing shell thickness:	
– standard	1,835...1,842 mm
– 1st undersize 0,25 mm	1,960...1,967 mm
– 2nd undersize 0,50 mm	2,085...2,092 mm
– 3rd undersize 1,00 mm	2,335...2,342 mm
– 4th undersize 1,50 mm	2,585...2,592 mm
Big–end bearing clearance	0,046...0,098 mm
End float (side clearance) at big–end on crankshaft	0,200...0,410 mm
Piston pin bushing location perpendicular to longitudinal axis of connecting rod to be within	0,15:100
Piston pin bushing location and big–end bearing location to be parallel to within	0,05:100
Weight marking (letter) at lower end.	
Max. permissible weight difference between connecting rods in the same engine	20 g
Position of connecting rod; order no at valve mechanism side (away from the combustion chamber in the piston)	

Crankshaft

Crankpin diameter:	
– standard	67,981...68,000 mm
– 1. undersize 0,25 mm	67,731...67,750 mm
– 2. undersize 0,50 mm	67,481...67,500 mm

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– 3. undersize 1,00 mm	66,981...67,000 mm
– 4. undersize 1,50 mm	66,481...66,500 mm
Crankpin length	40,000...40,160 mm

Main bearing journal diameter:

– standard	84,985...85,020 mm
– 1st undersize 0,25 mm	84,735...84,770 mm
– 2nd undersize 0,50mm	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 diameter (in cylinder block) 91,000...91,025 mm

Main bearing shell thickness:

– standard	2,955...2,965 mm
– 1st undersize 0,25 mm	3,080...3,090 mm
– 2nd undersize 0,50 mm	3,205...3,215 mm
– 3rd undersize 1,00 mm	3,455...3,465 mm
– 4th undersize 1,50 mm	3,705...3,715 mm

Main bearing clearance 0,050...0,127 mm

Length of thrust bearing journal (journal nearest to flywheel):

– standard (2 standard thrust plates)	45,000...45,080 mm
– 1st oversize (one std and one 0,1 mm overthick thrust plate)	45,100...45,180 mm
– 2nd oversize (one std and one 0,2 mm overthick thrust plate)	45,200...45,280 mm
– 3rd oversize (one 0,1 mm and one 0,2 mm overthick thrust plate)	45,300...45,380 mm
– 4th oversize (two 0,2 mm overthick thrust plates)	45,400...45,480 mm

Other crankshaft journals may not be ground longer.

Crankshaft end float 0,100...0,380 mm

Max. permissible ovality and other deformity of crankpins or journals 0,03 mm

Crankshaft unbalance 1,0 Ncm Max.

Balancing unit ring gear location, diameter (420 engines) 150,220...150,260 mm

Balancing unit ring gear I.D. (420 engines) 150,000...150,040 mm

Flywheel

Flywheel ring gear no. of teeth 133 pcs

Interference fit between ring gear–flywheel 0,425...0,600 mm

Before fitting the ring gear, heat up to a temperature of 150...200 °C

Flywheel unbalance 1,0 Ncm Max

Max permissible axial wobble of flywheel clutch face, measured at inner edge

of clutch face on diameter 200 0,06:ø200

Timing gears

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

Max. permissible side wobble of gears 0,05 mm

Idler gear shaft, diameter 54,951...54,970 mm

Inner diameter of idler gear bushing (fitted) 55,000...55,030 mm

Inner diameter of Idler gear hole 60,000...60,030 mm

Camshaft gear hole diameter 32,000...32,025 mm

Camshaft end diameter 32,043...32,059 mm

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7**Timing marks:**

Timing marks on gears are in alignment when the 1st cylinder piston is at its top dead centre between compression and power strokes.

On crankshaft gear 2 dots on tooth

On idler gear:

– against crankshaft gear mark 0 on tooth

– against camshaft gear mark 1 dot on tooth

– against fuel injection pump gear mark 1 dot on notch

On camshaft gear 1 dot on notch

On injection pump gear 1 dot on tooth

Cylinder block

Holes for guide pins 13,250...13,320 mm

Main bearing location diameter 91,000...91,025 mm

Main bearing location (with bearings 8361 40950) 92,000...92,025 mm

Cylinder liner location, diameter:

– upper end 124,514...124,554 mm

– lower end 123,000...123,040 mm

Inner diameter of camshaft bushing (fitted) 50,010...50,070 mm

Cylinder block height 428,170...428,430 mm

Distance between piston and top dead centre at different crank shaft angles

Grad	420 engines mm	Grad	420 engines mm
6°	0,423	21°	5,100
10°	1,173	22°	5,587
11°	1,418	23°	6,095
12°	1,686	24°	6,624
13°	1,976	25°	7,173
14°	2,289	26°	7,742
15°	2,625	27°	8,331
16°	2,983	28°	8,939
17°	3,363	29°	9,567
18°	3,765	30°	10,213
19°	4,188		
20°	4,633		

Cylinder head

Height of cylinder head 104,800...105,000 mm

Height (min.) of cylinder head after repair grinding 104,000 mm

Cylinder head straightness:

– in lateral direction 0,05 mm

– in longitudinal direction 0,10 mm

Valve guide inner diameter (not fitted) 9,000–9,015 mm

Valve guide outer diameter 16,028...16,039 mm

Valve guide bore diameter in cylinder head 16,000...16,018 mm

Height of valve guide upper end from cylinder head surface 21 mm

Valve head depth from cylinder head surface:

– inlet valve 0,7±0,05 mm (max. 1,70 mm)

– exhaust valve 0,6±0,05 mm (max. 1,60 mm)

Valve sealing surface angles:

– inlet valve 35° +20'

– exhaust valve 45° +20'

Valve sealing surface width:

– inlet valve 2,9...3,7 mm

– exhaust valve 1,3...2,3 mm

Diameter of exhaust valve seat insert 44,070...44,132 mm

Diameter of exhaust valve seat insert location 44,000...44,025 mm

Diameter of exhaust valve seat insert (repair part 8366 52269) 44,270...44,332 mm

Diameter of exhaust valve seat insert location (repair part 8366 52269) 44,200...44,225 mm

Diameter of inlet valve seat insert (8366 47936) 48,570...48,632 mm

Diameter of inlet valve seat insert location 48,500...48,525 mm

Diameter of inlet valve seat insert (repair part 8368 55347) 48,770...48,832 mm

Diameter of inlet valve seat insert location (repair part 8368 55347) 48,700...48,725 mm

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Lubricating system

Oil pressure at normal running temperature:

– at idling speed (min.)	100 kPa (1,0 kp/cm ²)
– at running speed	250–400 kPa (2,5–4,0 kp/cm ²)
Free length of oil pressure valve spring	80 mm
Spring pressure when valve spring is compressed to a length of 52 mm	54+5 N (5,4+0,5 kp)
Diameter of oil pressure valve plunger	19,602...19,635 mm
Diameter of oil pressure valve cylinder	19,700...19,752 mm
Oil filter by-pass valve opens at a pressure difference of	2±0,5 kp/cm ²

Oil pump (420 engines)

Backlash between gears when crankshaft lies firmly against the lower side of main bearings:

– crankshaft gear–lubricating oil pump gear	0,05...0,25 mm
– between the pump gears	0,16...0,26 mm

Diameter of drive shafts:

– at bearings for body and cover	17,966...17,984 mm
– at gear wheel pressed on shaft	18,099...18,109 mm
Diameter of shaft holes on body and cover	18,000...18,018 mm
Diameter of gear wheel holes	18,060...18,078 mm
Drive shaft gear (press fit), distance between side gear (thread side) and first shoulder	14,80...15,20 mm
Fixed shaft, diameter	18,028...18,039 mm
Protrusion of fixed shaft end below pump body face	0,5...1,0 mm
Thickness of cover gasket	0,06...0,08 mm

Outside diameter of gear	43,486...43,525 mm
Housing diameter	43,650...43,750 mm
Thickness of gears	24,000...24,027 mm
End play of gears	0,03...0,11 mm
Depth of housing	24,000...24,043 mm
Number of teeth on drive gear (320 engines)	51 pcs
Number of teeth on drive gear (420 engines)	46 pcs

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Balancing unit (420 engines)

Tooth backlash:

– crankshaft ring gear–balancer weight gear wheel	0,1...0,3 mm
– between the balancer weights gear wheels	0,05...0,250 mm
Balancing weights end float	0,1...0,5 mm
Shaft diameter at bearing surfaces	36,000...36,016 mm
Bearing bushing inner diameter (fitted)	36,050...36,075 mm
Diameter of holes in body for shafts, rear end	36,058...36,083 mm
Diameter of holes in body for shafts, front end	35,958...35,983 mm
Shim thickness, cylinder block–balancer unit	0,2 mm

Schwitzer S1B (420 DS engines) and S1BG by–pass turbo (420 DW engines)

Shaft end float	max 0,14 mm
Shaft radial clearance ¹⁾	max 0,51 mm
Turbine housing attaching bolts	22 Nm
Nut at end of shaft	8,1 Nm
By–pass passage opening pressure (S1BG)	1,035 bar

¹⁾ Measured at nut on end of shaft.

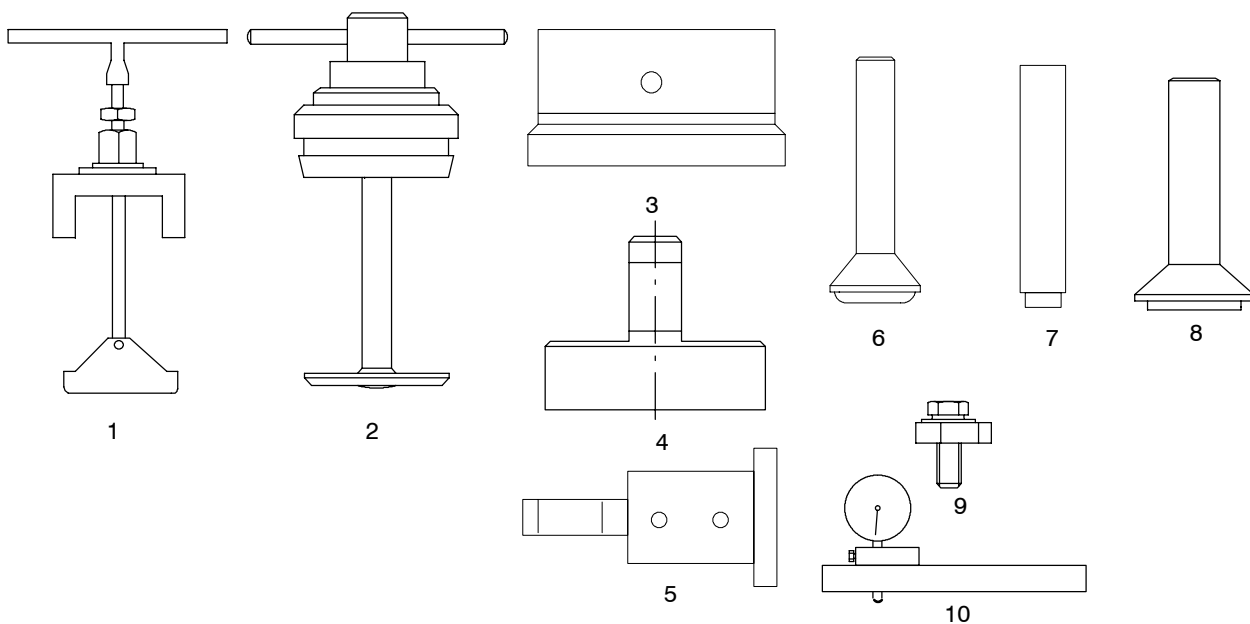
Tightening torques

Main bearing bolts	200 Nm
Cylinder head bolts	80 Nm+90°+90°+60°
Cylinder head studs to cylinder block	30 Nm
Main bearing bolts	200 Nm
Connecting rod bolts	40 Nm + 90°
Crankshaft nut:	
– 420 engines	600 Nm
Flywheel bolts:	
– 10.9	140 Nm
– 12.9	160 Nm
Flywheel housing bolts:	
– outer ring M12	110 Nm (8.8), 150 Nm (12.9)
– inner ring M10	60 Nm (8.8), 90 Nm (12.9)
Idler gear bolts:	
– M10	60 Nm
– M14	200 Nm
Compressor V–belt pulley, nut	80 Nm
Balancing weights, 420	60 Nm
Exhaust manifold bolts	50 Nm
Inlet manifold bolts	30 Nm
Injector attaching nuts (on studs)	15 Nm
Delivery valve retainer	40 Nm
Injector nozzle sleeve	60 Nm
Engine–oil sump:	
– 320/420 engines M12 bolts	110 Nm (8.8), 140 (12.9)
Nut for lubricating oil pump gear	60 Nm
Lubricating oil pump fixing bolts	60 Nm

Special tools

Order no	Description
1 9051 73100	Puller for cylinder liner
2 9101 65600 *)	Milling cutter for cylinder liner seat
3 9052 46400	Centring tool for flywheel housing
4 9052 46300	Drift for fitting rear crankshaft seal
5 9030 15200	Drift for fitting front crankshaft seal
6 9052 46620	Drift for 40 mm cap plug
7 9052 46650	Drift for 16 mm cap plug
8 9025 87400	Drift for fitting camshaft cup plug
9 9101 66300 *)	Press tool for cylinder liner
10 9025 79200	Holder for dial gauge
11 9101 66100 *)	T–handle for valve seat milling cutter
12 9101 71100 *)	Milling cutter for facing exhaust valve seat
13 9101 65502 *)	Milling cutter for exhaust valve seat
14 9101 65503 *)	Inner milling cutter for exhaust valve seat
15 9101 75800 *)	Milling cutter for facing inlet valve seat
16 9101 65505 *)	Milling cutter for inlet valve seat
17 9101 65506 *)	Inner milling cutter for inlet valve seat
18 9101 66200 *)	Lever for compressing valve spring
19 9052 47200	Counter nut for lever above
20 9101 66000 *)	Milling tool for injector seat
21 9052 46660	Drift for 36 mm cup plug
22 9101 65800 *)	Drift for removing valve guide
23 9101 65900 *)	Drift for fitting valve guide
25 9101 65700 *)	Spanner for crankshaft nut
26 9052 48800	Puller for crankshaft gears
27 9020 01100	Conical sleeve for fitting pistons
28 9025 98900	Drift for fitting dust cover, crankshaft front seal
29 9025 98800	Drift for fitting tension pin in timing gear casing
30 9025 98700	Drift for fitting tension pins in timing gear casing and flywheel housing
31 8366 62022	Electronical device (TimeTrac) for checking injection timing on E–engines

*) New tools for 20–series engines. Other tools are the same as for engines on 505–905 tractors.



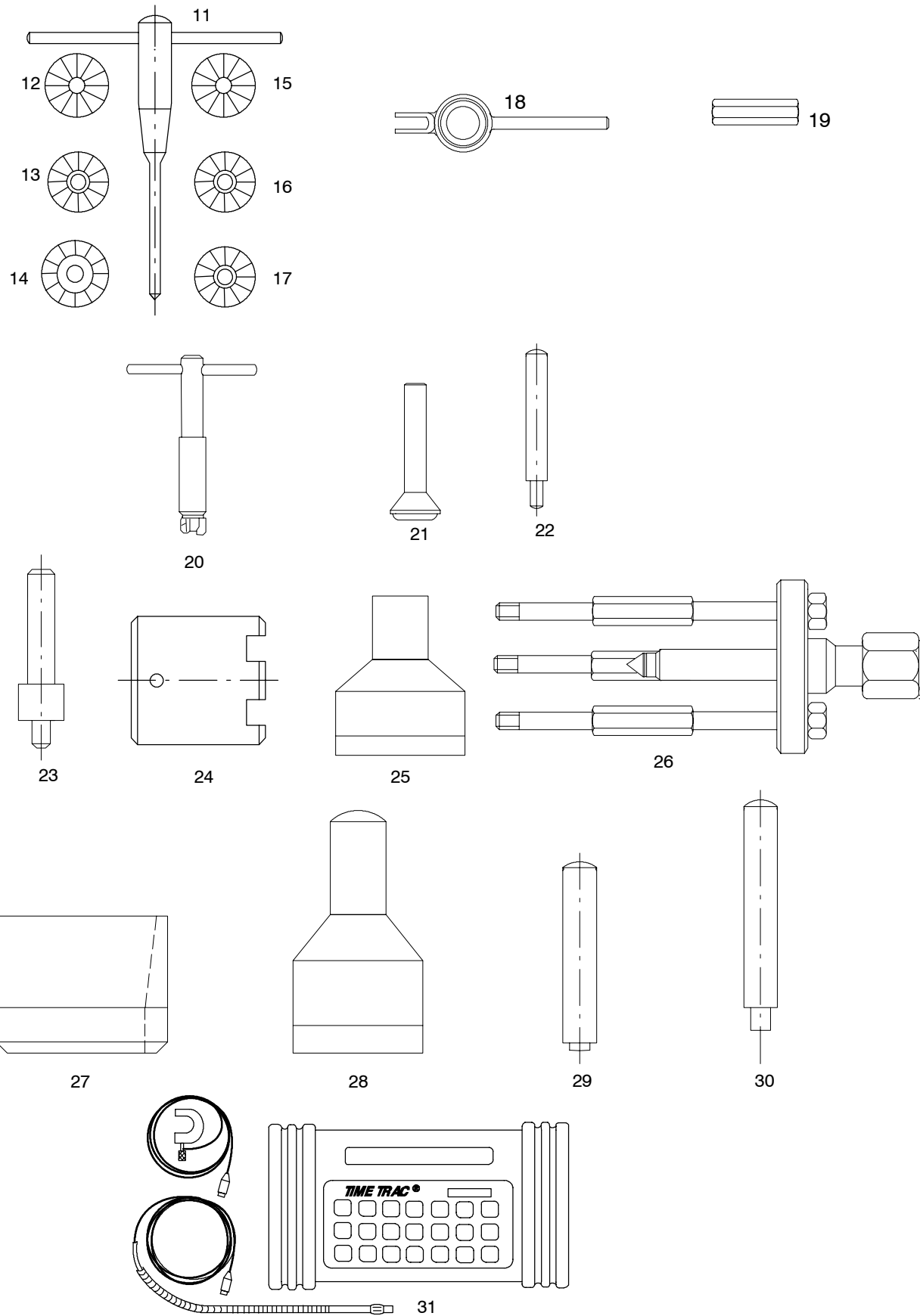
21. Engine

1. 11. 2000

Model
95-115
X100-X120

Code
210

Page
11



Engine, description

General

The Valmet 20-series engines (3-, 4-, or 6-cylinders) are water-cooled, four stroke, turbocharged, direct-injection in-line diesel engines. Technical values, see page 210/3.

The engines have a rigid and ribbed cylinder block. The crank mechanism is designed for supercharging. The cylinder liners are wet and supported at the middle, the cylinder head bolts are high tensile bolts.

Cylinder block

The cylinder block is the main body of the engine, to which other engine parts are attached. Wet and replaceable cylinder liners are supported at the middle which reduces vibrations and directs coolant circulation mainly to the upper part of the liners.

The seal between the cylinder liner lower part and the cylinder block is achieved by three o-rings, which are fitted in grooves in the liner. The upper part is sealed by the cylinder head gasket.

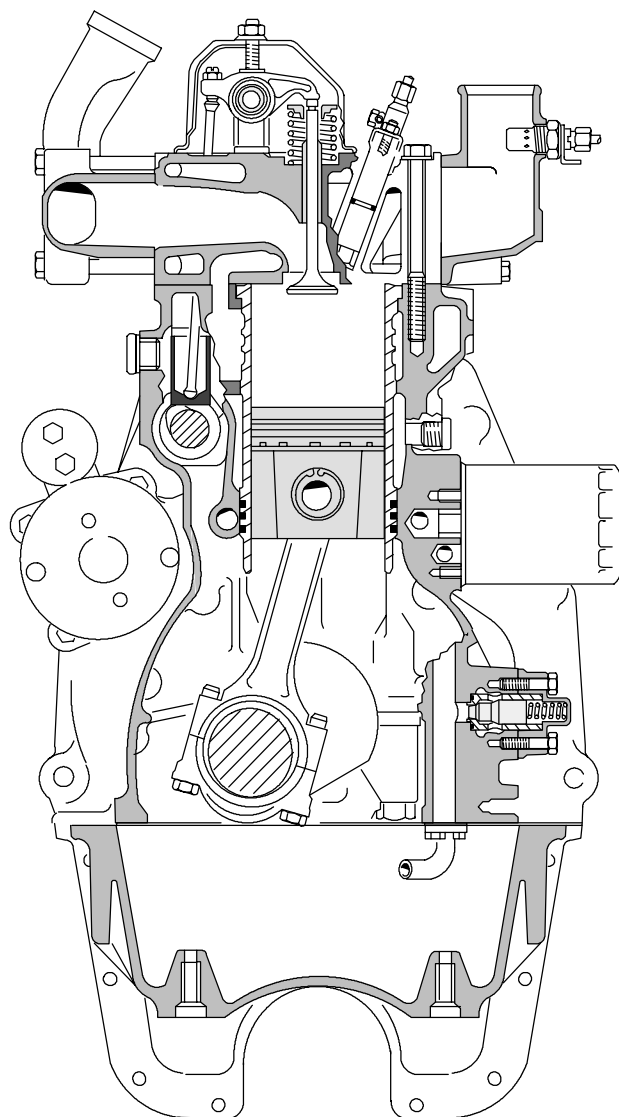
The camshaft is located in the cylinder block. The camshaft front bearing location is fitted with a separate bearing sleeve. The remaining bearing locations are machined directly in the cylinder block. The drilling for the camshaft rear end is covered with a plug.

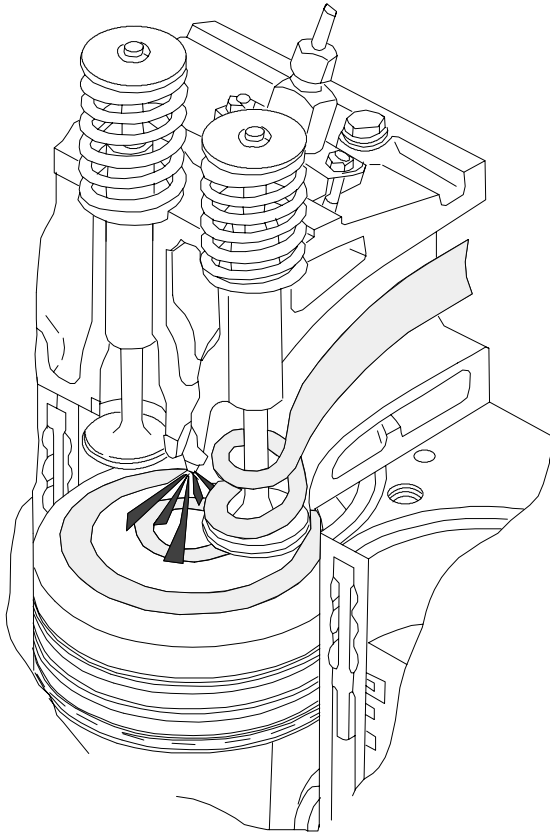
There are spaces on both sides of the rear main bearing for guide bearing shims (the crankshaft thrust bearings).

Flywheel housing

The flywheel housing is fitted at the rear end of the cylinder block. The seal for the crankshaft rear end is placed in a bore in the housing. The starter motor fixing point is fitted in the fly-wheel housing.

The lower face of the flywheel housing functions as a sealing surface for the oil sump gasket. This means that the lower face of the cylinder block must be level with the flywheel housing. When fitting the flywheel housing, its position is determined by tension pins.





Crank mechanism

The crankshaft is forged from chrome alloy special steel and is induction hardened at the bearing and sealing surfaces. This makes it possible to grind bearings four times without a new heat treatment. Gear wheels are located at the front end of the crankshaft. They are a press fit, and drive the idler wheel and oil pump. In addition, the front end of the crankshaft has splines for the hub of the V-belt pulley. An oil deflector ring is fitted between the hub and gear wheel, and a dust shield is fitted on the hub in order to protect the seal.

The crankshaft is supported on the cylinder block by main bearings which are placed on both sides of each cylinder. Thus there is one main bearing more than cylinders. The crankshaft thrust washers are placed in both sides of the rear-most main bearing.

At the rear end of the crankshaft there is fitted a flywheel on which is a press-fit a starter ring gear. The forged crankshaft has an I-section cross-section. The bearing location at the bottom end of the connecting rod is split, and the bearing cup is secured by two special bolts and nuts. The upper part has a wedge-shaped bearing location, in which the piston pin bearing bushing is fitted with a press fit.

The piston is made of an eutectic aluminium alloy. In the upper face of the piston there is a combustion chamber. The shape of the chamber is intended to maximise the mixture of air and fuel. The piston has three rings. The upper molybdenum-coated ring has a wedge-shaped cross-section. On natural aspirated engines and on slight supercharged engines the upper ring is right-angled. The middle ring is tapered and it fits into its groove. The taper taking up the clearance. The oil control ring is spring loaded and it has a two-stage, chromed scraping edge.

On the turbocharged engines the upper ring location is formed in a cast iron ring which is cast in the piston. In addition, the piston on supercharged engines is graphite coated to ensure correct running-in.

Four-cylinder engines (420) are equipped with a balancer unit. The eccentric weights, which rotate at twice the engine speed, even out the vibration forces exerted by the movement of the pistons and the crank mechanism.

Cylinder head

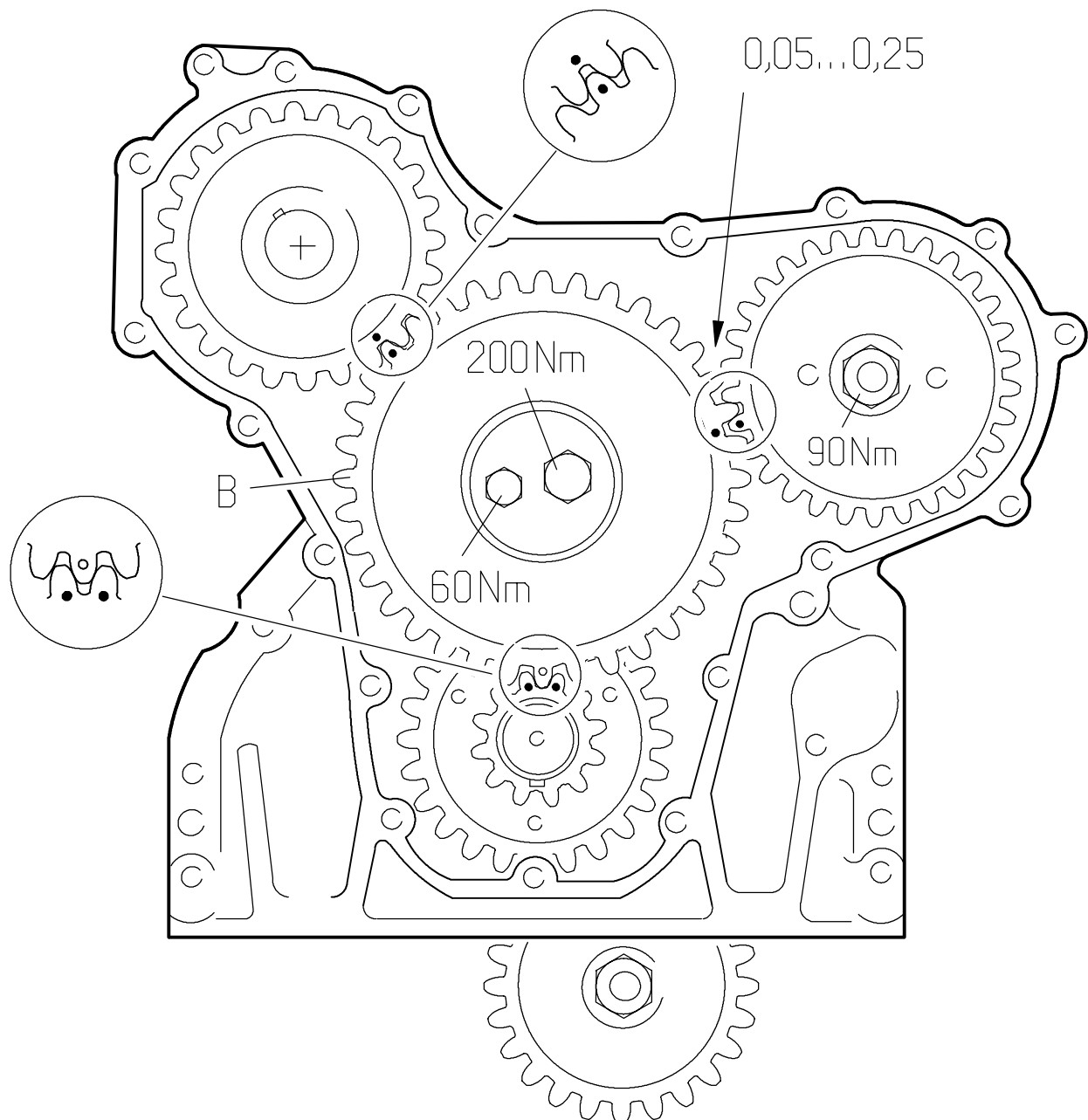
420-engine have one cylinder head. Each cylinder has its own inlet and exhaust ports located on either side of the head. Between hot exhaust valves a cool inlet valve is fitted to balance the thermal load.

Cylinder head bolts are high tensile bolts which are tightened up to yield limit using angle tightening principle. Due to the large stretch the tightening forces are kept constant during the whole lifetime and retightening is unnecessary.

The injector locations are machined directly into the cylinder head. The inlet and exhaust valve guides are identical and can be interchanged. In addition, the exhaust valves are equipped with replaceable valve seat inserts.

Valve mechanism

The valve mechanism is operated by the camshaft which is located in the cylinder block. The drive is transferred with the help of tappets and pushrods. The camshaft gear wheel is fitted with a press fit and fixed with a key. Each bearing is lubricated by the force feed lubrication system through drilled oilways in the motor block.



Timing gears

The timing gear train consists of hardened, helically cut gear wheels. The gears are encased by the timing gear casing which is fitted to the front of the engine. The timing gear drives the camshaft, fuel injection pump and oil pump.

The idler gear is supported with a bearing sleeve on the shaft on the front face of the cylinder block.

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