

Service Manual

Hydraulic Excavator

A 900 C - A 924 C Litronic EDC

1 Document identification

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2 Product identification



Type:	A 900 C - A 924 C Litronic EDC
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Introduction

This manual contains technical data, design and functional descriptions, as well as instructions as regards the operation and the adjustment of machine settings. The document includes a number of drawings, functional schematics, as well as detailed views of units and assemblies of **LIEBHERR hydraulic excavators**.

The documentation has been designed to support customer support services, but does of course not replace proper technical training and qualification of the user, and participation in LIEBHERR operator training courses.

General basic technical information is not included in the manual. For operating instructions and information on spare parts, please refer to the separate documentation.

During all work on the machine, strictly adhere to the relevant accident prevention and safety regulations.

1 Symbols used in this manual

Tasks and procedures that are associated with specific dangers are accompanied by safety instructions. The safety instructions are graded according to the severity of the risk and are identified with the terms **DANGER**, **CAUTION** and **NOTE** and the respective danger symbol:

These terms are used in combination with the following symbols:



Danger

Warning referring to a danger where there is a high probability of death or serious injury to operators, unless the prescribed safety measures are taken.



Caution

Warning relating to dangers that might lead to injury or damage to the machine, unless the prescribed safety measures are taken.



Note

This symbol accompanies instructions and tips regarding the operation, maintenance and repair of the equipment. If adhered to, the service life of the machine can be prolonged and/or procedures are made easier.

- This symbol precedes entries in a list.
 - This symbol precedes entries in a sub-list.
- ☐ This symbol identifies "Pre-condition MUST be fulfilled"
- ▶ This symbol indicates a single procedure in a sequence of procedures.
 - ↪ This symbol indicates a result of an action.

This manual has been exclusively compiled for internal use by the registered machine owner.

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This service manual shall be amended without prior notice to reflect new technical developments and machine series. LIEBHERR reserves the right to make minor technical amendments to the machines that might not be reflected in the accompanying documentation.

Symbols used in this manual

Depending on the series development, the service manual shall be revised in electronic format. Changes and amendments are listed in group 1.02.

This manual might be complemented by additional service information sheets issued by LIEBHERR.

Compiled by the Technical Documentation Department.

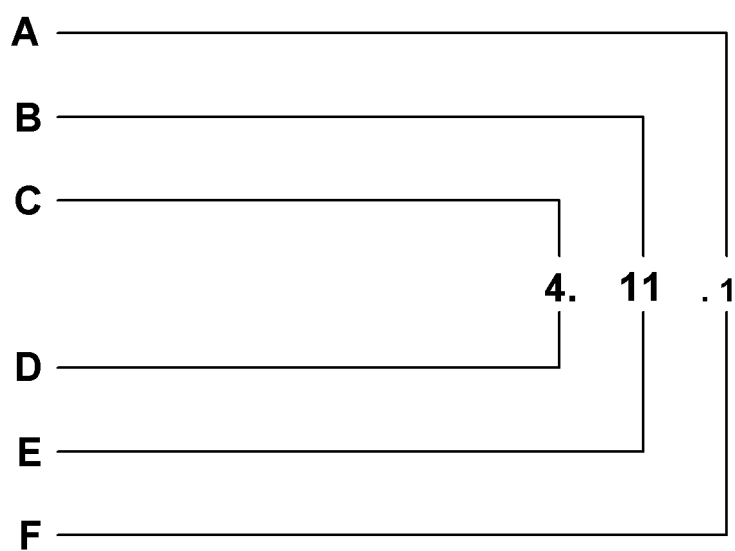
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of **LIEBHERR-HYDRAULIKBAGGER GMBH 88457 Kirchdorf / Iller, Germany.**

We hope that the information in this documentation aimed at improving the service of LIEBHERR excavators is of use to you.

1.1 Explanation

In order to make it easy for users to find specific information regarding revised or amended documents, each page is identified as follows:



A Page number

B Subgroup

C Main group

D Drive motor

E Diesel engine

F Page

The main groups are listed in the main group directory.

The subgroups are listed on the first page of each main group section. The subgroup list also includes the machines and serial numbers to which the subgroup is relevant.

In the event of minor changes, we will send you the amended page showing the current date.

If an existing subgroup is completely revised and re-edited, the new version will be assigned a new subgroup number.

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Assembly instruction for hydraulic cylinder WN 4121 C	1.22.1	A 900 C-LI EDC A 904 C-LI EDC A 914 C-LI A 924 C-LI
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Filling quantities	1.40.1	A 900 C-LI EDC A 904 C-LI EDC A 914 C-LI A 924 C-LI

Fuels, lubricants and process chemicals	1.51.1	A 900 C-LI EDC 24677- A 904 C-LI EDC 30580- A 914 C-LI 35112- A 924 C-LI 34519-
TE_ML05 lubricant list	1.55.1	A 914 C-LI A 924 C-LI
TE_ML07 lubricant list	1.56.1	A 914 C-LI A 924 C-LI

Changes and modifications to series

1 Last updated 09/2010

Change mark	Change to group	Type of modification	affected models
revised	5.10	Clutch installation revised	A 900 C - A 924 C
revised	7.60	Alarm temperatures amended	A 900 C - A 904 C
NEW	7.61	Cooling unit	A 914 C - A 924 C
NEW	8.75	Monitoring display from version 4.8/4.8.1	A 900 C - A 924 C
revised	8.100	Kit schematics added	A 900 C - A 924 C
revised	16.08	Overload warning system revised	A 900 C - A 924 C
NEW	16.14	Camera monitoring	A 900 C - A 924 C
NEW	16.24	Swivel rotator	A 900 C - A 924 C
revised	16.70	Reversible fan drive (manual)	A 900 C - A 904 C
NEW	16.71	Reversible fan drive (manual/automatic)	A 900 C - A 904 C EDC
NEW	16.72	Reversible fan drive (manual/automatic)	A 914 C - A 924 C EDC

2 Last updated 07/2010

Change mark	Change to group	Type of modification	affected models
revised	1.51	New axle oil: Liebherr Gear Plus 20W-40 replacing Liebherr Gear Basic 90 LS ZF list release amended	A 900 C - A 924 C
revised	4.27	Diesel particle filter revised	A 900 C - A 924 C
NEW	4.41	Data logger with new software	A 900 C - A 924 C
revised	7.51	LSC control valve block revised	A 900 C - A 904 C
revised	8.12/8.14	Plug connections of A700 added	A 900 C - A 924 C
revised	8.70	Excavator control plug connections added	A 900 C - A 924 C
revised	12.40/12.42/ 12.44	A 904 C type 1003 equipped with MS-E 3060/ MT-E3060 axles	A 900 C - A 904 C
revised	13.18	Joystick control: voltage test and error monitoring added	A 904 C - A 924 C
NEW	16.05	Pipe fracture safety valve for stick cylinder	A 914 C - A 924 C
revised	16.23	Pipe layer: settings added	A 904 C - A 924 C
NEW	16.76	Stroke and stick limitation with proximity switches	A 900 C - A 904 C
NEW	16.77	Stroke limitation with angle sensors	A 914 C - A 924 C
revised	17.50	Heating and air-conditioning system: REHE-AT mode extended from 10 to 60 minutes from 06/2010	A 900 C - A 924 C

Last updated 03/2010

3 Last updated 03/2010

Change mark	Change to group	Type of modification	affected models
revised	2.06	Special tools for electrical equipment	A 900 C - A 924 C
revised (d)	6.31	Brake piston modified (restricted connection A-B)	A 900 C
revised (d)	6.36	Brake piston modified (restricted connection A-B)	A 904 C
NEW (c+d)	6.41	Brake piston modified (restricted connection A-B) Hydraulic system (directional valve 540 extended for optional proportional control installation)	A 914 C - A 924 C
revised	7.27	DMVA regulating motor (travel drive)	A 900 C - A 924 C
NEW	7.28	DMVA regulating motor (travel drive) Brake piston modified (restricted connection A-B)	A 900 C - A 924 C
revised	7.40/7.41	Control oil unit (filter cartridge installation)	A 900 C - A 924 C
revised	8.100	Kit schematics added	A 900 C - A 924 C
revised	12.40	Steering axle (design modified)	A 900 C
revised	12.42	Rigid axle (design modified)	A 900 C
revised	12.44	Differential (design modified)	A 900 C
revised	12.50	Steering axle (design modified)	A 904 C - A 924 C
revised	12.52	Rigid axle (design modified)	A 904 C - A 924 C
revised	12.54	Differential (design modified)	A 904 C - A 924 C
NEW	13.15	Four-wheel steering	A 924 C
NEW	13.18	Joystick steering	A 904 C - A 924 C
revised	16.15	Hydraulic quick change adapter (emergency release)	A 900 C - A 924 C
NEW	16.19	Hydraulic-electric LIKUFIX coupling system	A 900 C - A 924 C
NEW	16.51	Changeover of control	A 900 C - A 924 C
NEW	16.72	Mower rake accessory kit	A 900 C - A 904 C
NEW	17.40	Inspection and repair instructions for heating and air-conditioning system	A 900 C - A 904 C
revised	17.50	Heating and air-conditioning system	A 900 C - A 924 C

4 Last updated 12/2009

Change mark	Change to group	Type of modification	affected models
revised	2.08	New tools added	A 900 C - A 924 C
revised	7.42	Pilot control unit control range changed	A 900 C - A 924 C
revised	8.80	Error codes added	A 900 C - A 924 C

Change mark	Change to group	Type of modification	affected models
NEW	8.130	Schematic for changeover bucket tilting AHS amended	A 900 C - A 924 C
NEW	16.52	AS1 proportional control	A 900 C - A 904 C
NEW	16.53	AS1 proportional control	A 914 C - A 924 C
NEW	16.54	AHS11 proportional control	A 900 C - A 904 C
NEW	16.55	AHS11 proportional control	A 914 C - A 924 C
NEW	16.56	AHS12 proportional control	A 900 C - A 904 C
NEW	16.57	AHS12 proportional control	A 914 C - A 924 C
NEW	16.58	Proportional control changeover AHS11/12	A 900 C - A 904 C
NEW	16.86	Electronic stick cylinder shut-down	A 924 C

5 Last updated 11/2009

Change mark	Change to group	Type of modification	affected models
NEW	1.25	Tightening torques for piston rod bearing	A 900 C - A 924 C
NEW	1.30	Angle-controlled screw tightening method	A 900 C - A 924 C
revised	1.51	Fuels, lubricants and process chemicals	A 900 C - A 924 C
revised	2.06	Tool no. 60 (new, replaces no. 61)	A 900 C - A 924 C
revised	3.43	Adjustment protocol V4.7	A 900 C 37762→
revised	3.44	Adjustment protocol V4.7	A 900 C 39762→
NEW	3.45	Adjustment protocol V4.8 (new: test secondary)	A 900 C 47104→
NEW	3.49	Adjustment protocol V4.8 (new: test secondary)	A 904 C 47104→
revised	3.51	Adjustment protocol V4.7	A 914 C 39037→
NEW	3.52	Adjustment protocol V4.8 (new: test secondary)	A 914 C 47116→
revised	3.56	Adjustment protocol V4.7	A 924 C 39037→
NEW	3.57	Adjustment protocol V4.8 (new: test secondary)	A 924 C 47116→
revised	3.62	Checking and adjusting tasks V4.7	A 900 C - A 904 C
NEW	3.63	Checking and adjusting tasks V4.8	A 900 C - A 904 C
revised	3.71	Checking and adjusting tasks V4.7	A 914 C - A 924 C
NEW	3.72	Checking and adjusting tasks V4.8	A 914 C - A 924 C
revised	7.22	Torque Control valve settings changed	A 914 C - A 924 C
revised	12.01	Tyres (tightening torques added)	A 900 C - A 924 C
NEW	12.03	Use of special tool	A 924 C
NEW	12.07	Steering drive axle LT 71	A 924 C
NEW	12.08	Rigid axle D 71	A 924 C
revised	16.10	Tool management amended	A 900 C - A 924 C

Last updated 04/2009

Change mark	Change to group	Type of modification	affected models
revised	16.60	Hydraulic operator's cab elevation system	A 904 C - A 924 C
NEW	16.61	Hydraulic operator's cab elevation system	A 904 C - A 924 C
NEW	16.80	Stick cylinder shut-down with proximity switch	A 900 C - A 904 C
NEW	16.81	Stick cylinder shut-down with proximity switch	A 904 C
NEW	16.82	Stick cylinder shut-down with proximity switch	A 924 C
NEW	16.85	Electronic stick cylinder shut-down	A 904 C
NEW	18.01	Fixture of operator's cab elevation system	A 904 C - A 924 C

6 Last updated 04/2009

Change mark	Change to group	Type of modification	affected models
revised	3.43	Sequence of slewing gear adjustments changed	A 900 C 37762→ A 900 C 39762→
revised	3.47	Sequence of slewing gear adjustments changed	A 904 C 37774→
revised	3.62	Sequence of slewing gear adjustments changed	A 900 C - A 904 C
NEW	3.71	Test and adjustment tasks version 4.7	A 914 C - A 924 C
revised	4.27	Control unit from software version 6	A 900 C - A 924 C
NEW	4.40	Data logger	A 900 C - A 924 C
(a)	6.40	Installation of 1.0 mm nozzle to stabilise LS signal to pump	A 914 C from 39216 A 924 C from 39216
revised	7.06/7.07	Item 92 bushing omitted from 04/2009	
revised	7.49	Pilot control unit adjusted for EDC series	A 900 C - A 924 C
NEW	7.60	Cooling unit	A 900 C - A 904 C
NEW	8.02	Notes regarding the electrical system	A 900 C - A 924 C
revised	9.10	Slewing gear mechanism extended	A 900 C - A 924 C
NEW	16.10	Tool management	A 900 C - A 924 C
NEW	16.35	Installation instruction for V-belt drive	A 900 C - A 924 C

7 Last updated 12/2008

Change mark	Change to group	Type of modification	affected models
revised	2.01	New tools added	A 900 C - A 924 C
revised	2.02	New tools added	A 900 C - A 924 C
NEW	2.09	Tools for Kessler axles	A 924 C
revised	3.00	Inspection and maintenance schedule updated	A 900 C - A 924 C
revised	7.01	Hydraulic pumps - dismantling, installation instructions updated	A 900 C - A 924 C

Change mark	Change to group	Type of modification	affected models
NEW	8.74	Additions made to version 4.7	A 900 C - A 924 C
revised	8.80	Error codes updated	A 900 C - A 924 C
NEW	9.21	Slewing gear brake	A 900 C - A 924 C
NEW	9.25	Positioning brake	A 900 C - A 924 C
revised	12.00	Axles updated	A 900 C - A 924 C
revised	14.10	Oscillating axle support updated	A 900 C - A 924 C
revised	16.03/04	Pipe fracture safety valves - sealing tasks modified	A 900 C - A 924 C

8 Last updated 07/2008

Change mark	Change to group	Type of modification	affected models
NEW	3.62	Checking and adjusting tasks V4.7	A 900 C - A 904 C
NEW	3.80	Adjustment protocol for kits	A 900 C - A 924 C
revised	6.34	Hydraulic system	A 900 C - A 904 C
revised	6.35	Hydraulic system	A 900 C - A 904 C
revised	7.05	DPVO variable-displacement pump	A 900 C
NEW	7.06	DPVO variable-displacement pump	A 900 C
revised	7.07	DPVP variable-displacement pump	A 900 C - A 924 C
revised	7.27	DMVA regulating motor (travel motor)	A 900 C - A 924 C
NEW	7.51	LSC control valve block	A 900 C - A 904 C
revised	8.38	Electrical system	A 904 C
revised	8.100	Electrical kits added	A 900 C - A 924 C
revised	10.10	Slewing ring	A 900 C - A 924 C
NEW	16.16	Hoist cylinder protection	A 900 C - A 924 C
NEW	16.23	Pipe layer	A 900 C - A 924 C
revised	16.40	Accessory kit AS1	A 900 C - A 904 C
NEW	16.41	Accessory kit AS1	A 914 C - A 924 C
revised	16.60	Hydraulic operator's cab elevation	A 904 C - A 924 C
NEW	16.65	Dozer blade	A 900 C - A 924 C

9 Last updated 05/2008

Change mark	Change to group	Type of modification	affected models
revised	2.01	Tools	A 900 C - A 924 C
revised	2.05	Tools	A 900 C - A 924 C
revised	3.43	Adjustment protocol	A 900 C - 37762
revised	3.47	Adjustment protocol	A 904 C - 37774
revised	3.50	Adjustment protocol	A 914 C - 35112

Last updated 03/2008

Change mark	Change to group	Type of modification	affected models
NEW	3.51	Adjustment protocol V4.7	A 914 C - 39037
NEW	3.56	Adjustment protocol V4.7	A 924 C - 39037
NEW	6.10	Grab Control	A 904 C (type 1004/1071)
NEW	6.35	Hydraulic system	A 904 C - 39333
NEW	7.55	LSC pilot plate	A 914 C - A 924 C
revised	8.34	Circuit diagram	A 900 C - A 904 C
NEW	8.99	Self-holding mechanism for quick change adapter locking	A 900 C - A 924 C
revised	8.100	List of electrical kits	A 914 C - A 924 C
revised	15.10	Hydraulic brake system	A 900 C - A 924 C
revised	15.20	Compact brake block	A 900 C - A 924 C

10 Last updated 03/2008

Change mark	Change to group	Type of modification	affected models
NEW	3.43	Adjustment protocol V4.7	A 900 C 37762
NEW	3.47	Adjustment protocol V4.7	A 904 C 37774
revised	3.50	Adjustment protocol V 4.6	A 914 C 35112
revised	3.55	Adjustment protocol V 4.6	A 924 C 34519
revised	6.40	Hydraulic system	A 914 C/A 924 C 34519
NEW	7.22	Hydraulic fixed displacement motor of slewing gear	A 914 C/A 924 C
NEW	7.32	Hydraulic double plunger cylinder	A 900 C - A 924 C
NEW	8.73	Monitoring display V4.6	A 900 C - A 924 C

11 4th addendum

Change mark	Change to group	Type of modification	affected models
	1.00	Factory standards revised	
	1.51	Lubricants and process chemicals list revised	
	3.06	Type overview	A 914 C 35112→ A 924 C 34519→
	3.16/3.17/ 3.18	Technical data	A 914 C 35112→ A 924 C 34519→
	3.27	Inspection and maintenance schedule	A 914 C 35112→ A 924 C 34519→
	3.30	Lubricating charts	A 914 C 35112→ A 924 C 34519→

Change mark	Change to group	Type of modification	affected models
	4.05	Bleeding of fuel system	
	4.12/4.13	Technical data of diesel engine	A 914 C 35112→ A 924 C 34519→
	6.17	Adjustment protocol	A 914 C 35112→
	6.18	Adjustment protocol	A 924 C 34519→
	6.22	Design of hydraulic system	A 914 C 35112→ A 924 C 34519→
(b)	6.31 6.34	Grapple switching modified	A 900 C 35328→ A 904 C 35343→
	6.28	Setting instructions	A 914 C 35112→ A 924 C 34519→
	6.40	Hydraulic system	A 914 C 35112→ A 924 C 34519→
	7.31	Extension and retraction times of hydraulic cylinders	
	8.01	Overview of electrical symbols	
	8.14	Arrangement of components	A 914 C 35112→ A 924 C 34519→
	8.40	Electrical system (construction model)	A 914 C 35112→ A 924 C 34519→
	8.42	Electrical system (industrial model)	A 914 C 35112→ A 924 C 34519→
	8.44	Operating symbols on operator's platform	
	8.73	Monitoring display	from BST version 4.4
	8.82	Slip ring rotary connection	
	8.100	Overview of electric kits	from new software version
	16.02	Pipe fracture safety valves revised	
	16.21	Pressure and flow reduction	A 914 C 35112→ A 924 C 34519→
	16.32	Generator drive accessory kit	
	16.34	Generator drive conversion kit	
S408	16.60	Changes to hydraulic operator's cab elevation	A 904 C 35102→
	16.69	LIEBHERR bypass filter	
	16.70	Reversible fan drive adjustment via display	from BST version 4.6
	18.53	Semi-automatic central lubrication system	
	18.54	Automatic central lubrication system	

12 3rd addendum

Change mark	Change to group	Type of modification	affected models
	1.51.	Lubricants and fuels adjusted to suit new EDC engines	A 900 C from 24677→ A 904 C from 30580→

Change mark	Change to group	Type of modification	affected models
	3.05.	Type overview of new A 904 C series	A 904 C from 30580→
	3.15.	Technical data of new A 904 C series	A 904 C from 30580→
	3.25.	Inspection and maintenance schedule	A 904 C from 30580→
	3.30.	New A 904 C series added to lubricating chart	A 904 C from 30580→
	5.20.	Pump distribution gear of the DPVP pump	A 904 C from 30580→
	6.15.	Adjustment protocol of new A 904 C series	A 904 C from 30580→
	6.34.	Hydraulic system of new A 904 C series	A 904 C from 30580→
	7.07.	DPVP double variable-displacement pump	A 904 C from 30580→
	8.38.	Electrical system of industrial model	A 904 C from 30580→
	12.50.	New MS-E 3070 steering axle	A 904 C from 30580→
	12.52	New MT-E 3070 rigid axle	A 904 C from 30580→
	12.54.	New MS/MT 3070 differential	A 904 C from 30580→
	13.33:	New steering cylinder	A 904 C from 30580→
	15.05.	Changes to operating pressure of the brake system	A 900 C from 32355→ A 904 C from 32365→

13 2nd addendum

Change mark	Change to group	Type of modification	affected models
	3.11.	Technical data	A 900 C from type 1002 24677→
	4.12.	Technical data of new diesel engine	A 900 C from type 1002 24677→ A 904 C from type 1003 30580→
	6.11.	Adjustment protocol of A 900 type 1002	A 900 C from type 1002 24677→
	6.21.	New components in hydraulic unit	A 900 C from type 1002 24677→ A 904 C from type 1003 30580→
	6.26.	Adjustment guidelines with menu interface	A 900 C from type 1002 24677→ A 904 C from type 1003 30580→
a)	6.30.	Additional line at control valve block P" to DRDA. The LS signal of the stroke limitation has been amplified in order to lower the slewing gear priority. As a result, the loading movement of the hoist cylinder has been improved.	A 900 C from type 987 17700→
	6.31.	Hydraulic system type 1002	A 900 C from type 1002 24677→
	7.27.	New DMVA regulating motor	A 900 C from type 1002 24677→ A 904 C from type 1003 30580→
	7.41.	New control and regulating unit	A 900 C from type 1002 24677→ A 904 C from type 1003 30580→
	8.12.	New electrical components	A 900 C from type 1002 24677→ A 904 C from type 1003 30580→
	8.34.	New electrical system	A 900 C from type 1002 24677→ A 904 C from type 1003 30580→

Change mark	Change to group	Type of modification	affected models
	11.12.	New 2HL290 transmission	A 900 C from type 1002 24677→ A 904 C from type 1003 30580→
	11.35.	New HBGV block	A 900 C from type 1002 24677→ A 904 C from type 1003 30580→
	12.40.	New MS-E 3060 steering axle	A 900 C from type 1002 24677→
	12.42.	New MT-E 3060 rigid axle	A 900 C from type 1002 24677→
	16.46.	AHS 11 with Tool Control – location of prop. solenoid valve Y414 changed	A 900 C 25000→ A 904 C 25000→
	16.49.	AHS 11 with Tool Control – location of prop. solenoid valve Y414 changed	A 900 C 25000→ A 904 C 25000→
	16.60.	Hydraulic operator's cab elevation Hydraulic unit modified / external emergency discharge device modified	A 904 C 26965→ A 904 C 22588→

Safety instructions

Working with the machine holds dangers to which you as the owner, machine operator or maintenance expert could be exposed. If you regularly read and observe the safety information, you can guard against dangers and accidents. This applies especially to persons, who are working on the machine only occasionally, such as for maintenance work. The following information comprises safety regulations which, if followed conscientiously, will guarantee your safety and that of other persons, as well as avoid damage to the machine.

Following these regulations does not release you from the responsibility to follow all safety regulations and guidelines valid for the jobsite, as required by law or issued by trade associations.

For EU countries, guideline 89/655/EEC contains the minimum safety information applicable to the operator.

1 Proper use

- The hydraulic excavator is a machine with attachments (such as backhoe, grapple, bucket) designed to loosen, take on, transport and dump soil, rocks and other materials, where the load is predominantly transported without moving the machine. Moving the machine when it is carrying a load must be carried out by observing the appropriate safety measures (see section "Notes for machine operating safety").
- Machines used for load-lifting work are subject to specific conditions and must be equipped with the stipulated safety devices (see section "Load-lifting work").
- Other or additional usage, such as for demolition or material handling work, requires special equipment and may also require special safety devices. These attachments (e.g. log grapple, demolition hammer, concrete cutter etc.) may only be attached and used with approval and in accordance with the basic machine manufacturer.
- Transporting persons is not deemed to be intended use. The manufacturer is not liable for damage resulting from this action. The risk must be assumed solely by the user.
- Observing the operating instructions and the inspection / maintenance instructions is also deemed to be appropriate and destined use in accordance with regulations.

2 General Safety instructions

- Please familiarize yourself with the operating instructions before starting the machine.
- Please verify that you have read and understood supplemental instructions (this may concern special options for the machine).
- Only explicitly authorized personnel may operate, maintain or repair the machine. The legal minimum age must be observed.
- Use only trained or instructed personnel. Clearly define who is responsible for the operation or set up, maintenance and repair. Reject unsafe instructions by third parties and/or allow your personnel to reject these. This also applies in regards to traffic regulations.
- Any person still in training should only operate or work on the machine under the constant supervision and guidance of an experienced person.
- Check and observe all persons working or operating the machine at least periodically to ensure that they observe safety instructions and guidelines given in the operating manual.
- Wear proper work clothing when operating or working on the machine. Avoid wearing rings, watches, ties, scarves, open jackets or loose clothing. There is a danger of injury, as these items could get caught or be pulled in.
Wear task-appropriate personal protective equipment at all times.
- Consult the supervisor for any special safety procedures applicable to your job site.
- Always raise the safety lever before leaving the operator's seat.

Crushing and burn prevention

- Keep steps, ladders and handholds (handles) in proper condition. Make especially sure that they are free of dirt, oil, ice and snow.
NOTE: To ensure that the doors open in all weather conditions, lubricate the weather strips at least every two months, or more often, if necessary, with talcum powder or silicon. Lubricate the door hinges and locks regularly.
- When entering or leaving the cab, do not use the steering column, the control panel or the joysticks as handholds.
- Never jump off the machine, always use the steps, ladders, rails and handles provided to climb off or on the machine.
- Always face towards the machine when climbing on and off it, and always use the three points of contact with the machine (all times either two hands and one foot, or two feet and one hand are in contact with the access system).
- Familiarize yourself with the emergency exit.
- Proceed as described in the operating manual, if no other instructions are available for maintenance and repairs:
 - Place the machine on a solid and level ground and lower the working attachment to the ground.
 - Depressurize the hydraulic system.
 - Move all control levers to the neutral position.
 - Move the safety levers up prior to leaving the machine.
 - Remove the ignition key.
- Before servicing the hydraulic system you must reduce the pressure in the hydraulic system and tank, as described in this operating manual.
- Secure all loose parts on the machine.
- Never start a machine before completing a thorough walkaround inspection. Insure that all required safety signs are in place and legible.
- Do not modify, alter or otherwise change any safety-related systems of components without the specific approval of LIEBHERR.

3 Crushing and burn prevention

- Never work underneath the attachment as long as it is not safely resting on the ground or properly supported.
- Insure that all load supporting systems are in good repair and rated for the required load.
- Always wear work gloves when handling wire ropes.
- When working on the attachment, never align bores with your fingers, always use a suitable alignment tool.
- Keep hands, tools and any other objects away from contact with the cooling fan. The cooling fan can cause severe injury, objects can be catapulted away or destroyed, and the fan can be damaged by the objects.
- At or near operating temperature, the engine cooling system is hot and under pressure. Avoid contact with any components containing coolant. Danger of severe burns.
- Check the coolant level only after the radiator cap on the expansion tank is cool enough to touch. Turn the cap carefully to relieve the pressure.
- At or near operating temperature, the engine and the hydraulic oil are hot. Do not allow your skin to come into contact with hot oil or components containing hot oil.
- Always wear safety glasses and protective gloves when handling batteries. Avoid sparks and naked flames.
- Do not let any assisting personnel hold the attachment, bucket or grapple to assist in any operation.
- When working on the engine area, make sure that the side doors are properly secured to remain open during the service operation.

4 Fire and explosion prevention

- Switch off the diesel engine prior to filling the tank.
- Have skilled personnel immediately repair all defects, such as loose connections, blown fuses and burned out light bulbs, burned or frayed cables.
- Do not smoke and avoid naked flames when filling the tank or loading the batteries.
- Always start the diesel engine according to the operating instructions.
- Never store flammable fluids on the machine except in appropriate storage tanks.
- Regularly inspect all lines, hoses and fittings for leaks and damage.
- Repair any leaks immediately and replace damaged components.
- Be certain that all clamps, guards and heat shields are properly installed to prevent vibration, rubbing and heat build up.
- Do not use cold start aids (ether) near heat sources or naked flames or in insufficiently ventilated areas.
- Do not use ether containing starting aids to start diesel engines with pre-heat system or flame glow systems.
- Familiarize yourself with the location and use of fire extinguishers on the machine as well as the local fire reporting procedures and fire fighting possibilities.

5 Transport

- Insure that the transporting vehicle or truck trailer is rated for the intended machine weight and size.
- Park the machine on a level surface and chock the track chains and/or wheels.
- During transport, remove parts of the attachment that create an over width or length condition, if necessary.
- Clean the undercarriage. The undercarriage must be swept clean, meaning, the chains / wheels must be free of snow, ice and sludge prior to driving onto the transporting vehicle.
- Align the machine precisely with the loading ramp.
- Attach the manual lever for sensitive driving (crawler excavator) to the driving pedals.
- Have another person guide and signal the operator.
- On wheel models equipped with an uppercarriage locking mechanism, the uppercarriage must be secured to the undercarriage with the locking pin after loading onto the trailer.
- Secure the machine and any loose components with tiedowns in accordance with any applicable national regulations.
- Release all pressure lines (as described in this operating manual), remove the ignition key and pull the safety lever up prior to leaving the machine.
- Close all cab and panel doors.
- Verify that no one remains on the machine during the transport.
- Investigate the travel route, specifically in reference to limits for width, height and weight prior to the transport.
- Pay special attention when driving under electrical lines and bridges and when passing through tunnels.
- Use the same care for unloading as for loading.

6 Bringing the machine into service

- Before starting the machine, perform a thorough walkaround inspection.
- Visually check the machine for loose bolts, cracks, wear, leaks and damage.
- Never start or operate a damaged machine.

Starting the machine

- Make sure to correct any problems immediately.
- Verify that all hoods, covers and doors are closed, however, the locks should remain unlocked.
- Verify that all safety signs are in place.
- Make sure that all windows, as well as the inside and outside mirrors are clean. Secure all doors and windows to prevent unintentional movement.
- Before operating the machine, adjust the operator's seat, the mirror, the armrests and the other items to ensure comfortable and safe working conditions.
- The noise protection devices on the machine must be in working order.
- Never operate the machine without the cab.

7 Starting the machine

- Before start up, check all indicator lights and instruments for proper function, bring all controls into neutral position and insure that the safety lever is in the raised position.
- Blow the horn briefly prior to starting the diesel engine, in order to warn persons located near the machine.
- Only start the machine from the driver's seat.
- Start the diesel engine according to the regulations in the operating instructions, if you have not received any other instructions.
- Lower the safety lever and check all indicators, gauges, warning devices and controls for their proper indication.
- Only operate the diesel engine in a well-ventilated area, if the area is enclosed. If necessary, open doors and windows in the building to provide ample fresh air.
- Bring the engine and hydraulic oil to operating temperature. Low oil temperatures cause a slow reaction of the controls.
- Check that all attachment functions are operating properly.
- Carefully take the machine to an open area and check all control functions.

8 Shutting down the machine

- Park the machine on level and stable ground whenever possible. Otherwise, chock or block wheels when parking on a slope.
- Lower the attachment so that it rests on the ground.
- Move all control elements into the neutral position. Set the parking and slewing gear brake.
- Switch off the diesel engine according to the operating instructions and move the safety lever up, prior to leaving the driver's seat.
- Lock the machine, as well as all hoods, covers and doors; remove all keys and secure the machine against any unauthorized use.

9 Towing the machine

- Always observe the correct procedure: See chapter "Towing the machine" in this operating manual.
- The machine may only be towed in exceptional circumstances, such as moving a disabled machine from a hazardous location.
- Before pulling or towing the machine, check all cables, hooks and couplers for safety and stability.
- Towing equipment must have sufficient tensile strength and must be attached to the undercarriage at the designated tiedown attachment points.
- Never allow anyone to remain in the area of the towing devices.
- During the towing procedure, keep within the required transport position, the permissible speed

and distance.

- Proceed as outlined in the operating manual when putting the machine back into service.

10 Working with the machine

- Before starting to work, familiarize yourself with the specific conditions of the job site and any local regulations. These include: the obstacles in the working or movement area, the load carrying capacity of the ground and required safeguards for the job site to protect machines and personnel from public highway traffic.
- Always keep an adequate safety distance to overhangs, edges, embankments and an unsecured substrate.
- Be particularly cautious in conditions of reduced visibility and changing ground conditions.
- Always locate any underground utilities before you dig. Observe the required clearance distances to any underground utilities.
- Familiarize yourself with the location of power lines and use caution when working near them. Observe the required clearance distances to any power lines.
- In the case of contact with a power line:
 - do not move the machine or its attachment,
 - do not leave the operator's platform,
 - warn people in the vicinity not to approach or touch the machine,
 - have the power turned off.
- Before moving the machine, always ensure that the attachments are safely secured.
- When traveling on public roads, observe all traffic regulations, insure that your equipment has all required lighting and marking, and observe any applicable load limitations.
- Always turn on the lights in conditions of poor visibility or darkness.
- Do not permit any passengers on the machine (except on two way excavators).
- Operate the machine only when seated and with the seat belt fastened.
- Report any problems or needed repairs and make sure that all required repairs are carried out immediately.
- Insure that the intended work area is clear of all personnel before beginning work.
- Before starting to work, always check the brake system as outlined in the operating manual.
- Never leave the operator's seat as long as the machine is still moving.
- Never leave the machine unattended while the diesel engine is running.
- Know the loads to be handled and be aware of any stability limitations these loads may create.
- The maximum approved passable incline / traverse slope of the machine depends on the attached equipment as well as the substrate.
- For travel, move the uppercarriage parallel to the undercarriage and hold the load as close as possible to the ground.
EXCEPTION: see WHEN LOADING AND UNLOADING
- Adjust the travel speed to suit local conditions.
- Avoid working movements which could cause the machine to tip over.
- If possible, always work downhill or uphill, never sideways on a slope.
- Travel downhill at the permitted speed or you could lose control over the machine.
- Travel down grades at the appropriate speed to maintain control of the machine. Shift to a lower gear to allow the engine to control the maximum speed of the machine.
- When loading a truck, make sure that the truck driver leaves the cab, even if a rock protection is present.
- Always use the safety devices intended for their specific use for demolition work, clearings, hoisting operations, etc.
- For terrain which is difficult to gain an overview of and whenever necessary, ask for assistance of a guide. Have only one person signal you.
- Only permit experienced personnel to secure loads and signal the machine operator. The guide

Working with the machine

must position himself within view of the operator or be in voice contact with him.

- Depending on the attachment combination, there can be a danger of collision between the working tool and the operator's cab, the cab protection or the boom cylinders. To avoid damage, utmost attention is required when the bucket teeth enter this range.

10.1 Use in material handling applications, specifically when travelling with raised loads and attachments

- Material handling applications, especially using a grapple, may require travel with suspended loads. Doing this will shift the machine centre of gravity and reduce stability.
The following practices and precautions should be observed:
 - Match your travel behaviour to the changed machine characteristics and surrounding conditions.
 - Reduce the travel speed to avoid sudden braking or steering manoeuvres.
 - Avoid sudden speed changes, such as braking, acceleration, changes in travel direction.
 - Turn the uppercarriage only if the undercarriage is not travelling.
 - Turn the uppercarriage only after taking on the load.
 - Move the machine only after you have taken on the load, lifted it and turned the uppercarriage in travel position.
 - If so required to the job site conditions, ensure, that you have appropriate windscreen protection. The protective screen (FOPS) must be installed if there is a danger of falling objects from overhead.
 - Do not exceed the grapple rated load. Know the density and weight of materials being handled.
- The working sequences when working with machines with grapples require a properly instructed and trained operator.
- The work application is only permitted after the machine operator has received sufficient training and practical experience.

10.2 Application of machines with tower elevation

- Due to the tower elevation, the centre of gravity of the machine will shift upward in vertical direction. The travel and work behaviour of the machine will thereby be strongly influenced, for example reduction of dynamic stability.
- Due to the elevated centre of gravity, the machine must be aligned in horizontal direction before starting to work. In horizontal direction, the centre of gravity of the uppercarriage is above the centre of the undercarriage, which improves stability.
- The machine can rock despite levelling and tip over!
For that reason, the following rules must be strictly observed:

When driving the machine:

- Driving with loads is not permitted.
- Swing the uppercarriage parallel to the undercarriage (transport position).
- Pull the attachment as close as possible to the machine.
- Only then may the outriggers be retracted and the machine be driven.
- Check the roadway to ensure that the ground is solid and even! Potholes and uneven road surfaces endanger the stability of the machine.
- Match your travel behaviour to the changed machine characteristics (higher centre of gravity) and surrounding conditions.
- Reduce the travel speed to avoid sudden braking or steering manoeuvres.
- Avoid sudden speed changes, such as braking, acceleration, changes in travel direction.
- Travel up or down grades perpendicular (at right angles) to the slope.
- Special care must be taken when driving through narrow passages - drive slowly!

In material handling operation:

- Wheel model: Before moving (turning) the uppercarriage from transport position, the machine must be supported on outriggers and horizontally aligned.

- Make sure to check the placement surface of the outriggers (load carrying capacity of ground). Sinking of an outrigger below ground level would result in devastating consequences!
- Carry out all movements with increased caution.
- When swinging a load, first bring the attachment as low and close to the machine as practical. Note: be aware of the hazard of grapple swing when moving a load toward the operator cab.
- Avoid abrupt slow down or acceleration of the attachment or uppercarriage.
- Never lift a heavier load than stated in the load chart.

10.3 Additional notes for machines with fixed cab raiser

- To enter and exit the machine, park the machine on level ground. Position the uppercarriage to the undercarriage in such a way that the steps and ladders are aligned.
- When entering or leaving the machine, always face the machine and use the three points of contact with the machine.
- When you can reach the door handle with your free hand, open the door first before climbing higher. Note that factors such as wind, can make it more difficult to open the door. For that reason, always guide the door by hand when opening the door. Make sure that the door is properly latched open.
- Continue to climb up and immediately sit on the operator's seat in the cab. Then close the door and fasten the safety belt.
- Proceed with the same care when exiting and climbing down as when entering and climbing up the machine.
- Park the machine only on firm and level ground. Position the uppercarriage to the undercarriage in such a way that the steps and ladders are aligned.
- Release the safety belt. When exiting, face the machine and use the three-point support. Climb down until you can close the door safely. Always guide the door by hand when closing the door.
- Finally climb down to the ground.

10.4 Protection from vibrations

- The vibration impact on mobile construction machinery is usually the result of the manner of utilization. Especially the following parameters have a significant influence:
 - Terrain conditions: Unevenness and potholes;
 - Operating techniques: Speed, steering, braking, control of operating elements of the machine during travel as well as working.
- The machine operator determines the vibration impact to a great part, since he himself selects the speed, the gear ratio, the working manner and the travel route.
This results in a wide range of various vibration impacts for the same machine type.

The full body vibration impact for the machine operator can be reduced if the following recommendations are observed:

- Select the appropriate machine, equipment parts and auxiliary devices for the corresponding tasks.
- Keep the seat in good order and adjust it as follows:
 - The seat adjustment and the suspension should be made according to the weight and the size of the operator.
 - Check the suspension and the adjustment mechanism regularly and make sure that the characteristics of the seat remain as specified by the seat manufacturer.
- Check the maintenance condition of the machine, especially regarding: Tire pressure, brakes, steering, mechanical connections, etc.
- Do not steer, brake, accelerate and shift or move and load the attachment of the machine in a jerky manner.
- Match the machine speed to the travel route to avoid vibration impacts.
 - Decrease the speed when driving on pathless terrain;

Installation and removal of attachment parts

- Drive around obstacles and avoid very impassable terrain.
- Keep the quality of the terrain where the machine is working and travelling in good order:
 - Remove large rocks and obstacles;
 - Fill furrows and holes;
 - To establish and retain suitable terrain conditions, keep machines available and allow for sufficient time.
- Travel longer distances (i.e. on public roads) with suitable (medium) speed.
- For machines, which are frequently used for travel, consider use of auxiliary ride control systems, and also monitor speed to minimize buildup of "pitching" vehicle movement.

11 Installation and removal of attachment parts

- Equipment and attachment parts made by other manufacturers or those which do not have LIEBHERR's general approval for installation may not be installed on the machine without prior written approval by LIEBHERR.
LIEBHERR must be provided with the required technical documentation necessary for this purpose.
- Set the machine on a level and stable ground prior to any work with attachments.
- Lock the uppercarriage with the locking pin to the undercarriage.
- Do not position yourself under a raised attachment that has not been adequately and securely supported.
- Never place yourself under a machine while it is elevated.
- Remove hydraulic system pressure before working on any attachments (as described in this operating manual).
- Do not attempt to lift heavy parts. Use suitable lifting devices with sufficient load carrying capacity.
- Insure any lifting system or lifting device that is used is in good repair and adequately rated for the component or machine to be supported. Always wear work gloves when handling wire cables.
- When working on the equipment: Switch off the diesel engine, remove the key and turn the safety lever upward.
- During repairs: Make sure that the hydraulic lines are properly attached and that all fittings and connections are properly tightened.
- As soon as an attachment part is removed and supported, cover or cap the openings in the hydraulic circuit to prevent dirt infiltration. Permit only authorized persons near the machine or the lifting device.

11.1 Removal and installation of attachment pins

- Never use your fingers to align pin bores. If possible, always use a hydraulic pin pulling device to push out the pins on the attachment.
- If pins must be removed with a sledge hammer, use a punch and a guide tube held by another person.
- To drive out a pin, install the impact screw from the tool box in the threaded bore of the pin and hit the screw only.
- For the installation of a pin retained with castle nut and cotter pin, drive the pin in first to the stop, then install the castle nut by hand until contact and tighten it only to the point where the cotter pin can be installed.

12 Maintenance

12.1 General safety instructions

- Maintenance and repairs may only be carried out by trained expert technicians.
- Always note the frequency intervals for inspections as contained in this operating manual.
- Insure that an adequately equipped workshop is available to perform these tasks, and note the designated qualifications of the personnel responsible for each inspection.
- The maintenance and inspection schedule sets out precisely who should, or is allowed to carry out which jobs.
The machine operator (and his staff) are allowed to carry out certain jobs, but other jobs must be carried out only by qualified and trained staff.
- Spare parts must meet the technical requirements set forth by the manufacturer. This is always ensured with original spare parts.
- Wear task-appropriate personal protective equipment at all times. Example: In addition to a protective helmet and safety boots, for certain jobs protective goggles and gloves are also necessary.
- Keep unauthorized personnel away from the machine during maintenance.
- Secure a wide-ranging area for maintenance, as necessary.
- Inform the operator before starting to carry out special tasks and maintenance work. Make sure he knows the person who is in charge of the work.
- Perform all maintenance operations on the machine on a level and stable ground with the working equipment lowered and the diesel engine turned off, unless described otherwise in the operating manual.
- Hang a well visible warning label “do not switch on” onto the ignition during maintenance operations, especially when working under the machine. Remove the ignition key and set the main battery switch to position 0.
- Re-torque all bolts at the completion of the maintenance procedure to the required torque specification.
- If the dismantling of safety equipment is necessary, the safety equipment must be re-attached and inspected directly upon conclusion of the operations.

12.2 Checking for cracks

- Machines are subject to different loads, depending on application, job site, duration of use and conditions of use. The different load conditions result in different service lives for various machines components. This could lead to cracks and loose connections, particularly on load-bearing parts. This applies particularly to machines used in material handling or industrial applications or for machines with special equipment, such as demolition excavators. To ensure that operating safety is maintained, the machine must be checked regularly for cracks, loose connections or other visible damage.
- To check for cracks, it is necessary to keep the machine clean and to clean it regularly.
- The inspection must be carried out according to the inspection and maintenance schedule.
- It is advisable to carry out these inspections with the machine supported, on firm and level ground.
- Specific attention should be given to the following:
 - The steel structure undercarriage with axle and gear mounting, support, lower slewing ring seating with tower and slewing ring.
 - The steel structure uppercarriage with bearing block for boom and boom cylinder, upper slewing ring seating, cab bearing, mounting of slewing gear and counterweight.
 - Steel structure of working attachments, e. g. boom, stick, quick change adapter, digging tool and grapple.
 - Hydraulic cylinder, axles, steering, pins and pin connections, steps, ladders and mounting elements.
- Check for cracks visually. If a crack is suspected or is in areas which are not easily visible, such

as the slewing ring seating, then the dye penetration procedure should be used to check for cracks.

- Any damage found must be fixed immediately. Welding on load-bearing parts of earth moving machines, material handling and transport units may only be made by certified welders in accordance with acceptable welding practices. Contact LIEBHERR Service to discuss suitable measures.

12.3 Welding

- Welding, cutting and grinding should only be done with the specific approval of LIEBHERR. Prior to any welding, cutting or grinding, clean the machine and surrounding area to remove dust and flammable materials.
- Insure adequate ventilation.

12.4 Fuels, lubricants and process chemicals

- When handling oils, greases and other chemical substances, always observe the applicable safety regulations for the corresponding product.
- Ensure safe and environmentally friendly disposal of operating and service fluids as well as exchange parts.
- Handle hot operating and service fluids carefully (danger of burning and scalding).

12.5 Repair

- Do not attempt to lift heavy parts. Use lifting devices with sufficient load carrying capacity. When replacing parts or large sub-assemblies, use appropriate and functioning lifting devices and adequate load carrying capacity to insure safe movement during installation. Never stand or work under suspended loads.
- Always wear work gloves when handling wire ropes.
- Only permit experienced personnel to secure loads and signal the crane operator. The guide must position himself within view of the operator or be in voice contact with him.
- When working overhead, use appropriate safe access ladders and working platforms. Do not use parts of the machine as climbing devices, if they are not designed for this purpose. Wear a harness when working at great heights. Keep handles, steps, railings, platforms, and ladders free of dirt, ice and snow.
- When working on the attachment (for example when replacing teeth), make sure the machine is properly supported. Never use metal-on-metal support.
- Never stand underneath a machine that has been raised with the aid of work equipment unless it has been properly and securely supported.
- Always support the machine in such a way that any shifting weight will not endanger the stability of the machine and avoid metal to metal contact.
- Work on travel gears, brake and steering systems may only be carried out by specially trained expert personnel.
- If the machine must be repaired on an incline, block the track chains with chocks and secure the uppercarriage to the undercarriage with the locking pin.
- Only qualified, specially trained personnel may work on the hydraulic system.
- Do not check for hydraulic leaks with your hand. Use cardboard or similar material to detect leaks. Wear work gloves.
- Do not loosen any lines or bolts before lowering the equipment, turning off the diesel engine and relieving the hydraulic system. After the diesel engine has been turned off, you must move all pilot controls (right handed joystick and pedals) into all directions to reduce the control pressure and the dynamic pressure in the work cycles. Then release the pressure in the tank, as described in this operating manual.

12.6 Electrical system

- Check the electrical system regularly.
All defects, such as loose connections, burnt out fuses and bulbs, burnt or damaged wires or cables must be repaired immediately by an electrician or specially trained personnel.
- Only use original fuses with the correct amperage.
- Only qualified technicians should attempt troubleshooting or repairs on high voltage systems.
- DO NOT work on energized attachments.
- When working on mid and high voltage components, shut off the voltage and connect the supply cable to the ground to discharge any stored energy.
- Check all disconnected parts if they are truly free of current, ground them and short circuit them. Insulate adjacent, current carrying parts.
- Disconnect the battery before working on the electrical system or before carrying out any arc welding work on the machine.

12.7 Pressure accumulator

- Pressure accumulators contain stored energy and operate at high pressures. Only specially trained personnel may work on pressure accumulators.
- Do not operate damaged pressure accumulators.
- You must reduce the pressure in the hydraulic system as described in this operating manual prior to working on a hydraulic accumulator.
- Do not weld or solder on the pressure accumulator and do not carry out any mechanical work on them.
- Fill the pressure accumulator only with nitrogen.
- The accumulator housing can become hot during operation, there is a danger of burning.
- New pressure accumulators must be charged to the required pressure for the application before use.
- The operating data (minimum and maximum pressure) is marked permanently on the pressure accumulators. Make sure that the marking remains visible.

12.8 Hydraulic hoses and lines

- Hydraulic lines and hoses may never be repaired!
- All hoses, lines and fittings must be checked every two weeks for leaks and visible damage. Damaged parts must be replaced immediately. Remember that escaping high pressure oil can penetrate skin. Escaping oil can also cause fires.
- Even if hoses are properly stored and used, they undergo a natural aging process. For that reason, their service life is limited.
 - Improper storage, mechanical damage and impermissible use are the most frequent causes of failure.
 - Using hoses and lines close to the limit ranges of permitted use can shorten the service life (for example in high temperatures, frequent work cycles, extremely high impulse frequencies, multi shift operation).
- Hoses and lines must be replaced when the following conditions are found during inspection:
 - Damage to the outer layer as far as the intermediate layer (e.g. chafing, cuts and cracks);
 - Brittleness of the outer layer (hose material cracking);
 - Deformations, which differ from the natural shape of the hose or hose line, when under pressure or not under pressure, or in bends (e.g. separation of layers, blisters or bubbles);
 - Leaks;
 - Failure to follow installation instructions;
 - Damage or deformation of hose fittings, which reduce the strength of the fitting or the hose / fitting connection;
 - Hose slipping out of the fitting;

Maintenance

- Corrosion on the fittings, which reduces function and strength;
- When replacing hoses and lines, observe the following:
 - Use only original spare parts.
 - Route and install hoses and lines properly, observe correct connection points.
 - Always ensure that the hoses and lines are free of torsion when routing. On high pressure hoses, always attach the screws of half clamps or full flange on both ends of hose first and then tighten.
 - When using high pressure hoses and lines with a bent fitting, always tighten the end with the bent fitting first when tightening the flanges, then the end with the straight fitting.
 - Any existing mounting clamps in the centre of the hose may only be installed and tightened thereafter.
 - Check daily to ensure that all clamps, covers and protective devices are properly mounted. This prevents vibration and damage during operation.
 - Route the hoses and lines in such a way that chafing with other hoses or other structures is prevented.
 - A minimum distance of approximately $\frac{1}{2}$ of the outer hose diameter to the other parts is recommended. The distance should not be less than 10 to 15 mm (1/2 inch).
 - When replacing hoses and lines on movable parts (e.g. from boom to stick), check for hose interference and kinking over the complete range of motion.

12.9 Cab protection (FOPS)

For certain machine applications LIEBHERR offers optional cab protection systems of various designs. These systems consist of a full length FOPS (falling objects protective structure) or a top guard and front guard to protect the operator's cab and windscreen area from falling objects (for example rocks or debris).

The full length FOPS wraps around the operator's cab, is mounted to the uppercarriage and is a stand-alone system.

The top and front guards are either bolted individually or in combination to the cab structure. In that case the operator's cab is also part of the cab protection system and is subject to the following instructions.

- Never operate a machine if one of these protections is damaged in any way.
- Damages may occur due to:
 - structural modifications or repairs (for example welding, cutting or drilling)
 - deformation after an accident
 - falling objects
- Structural modifications or repairs of any kind are prohibited without the expressed, written approval of LIEBHERR.

PRELOADS AND TIGHTENING TORQUES FOR SCREWS WITH METRIC COARSE AND FINE THREADS ACCORDING TO DIN ISO 261

The preloads and torques included in the table are based on the VDI regulations 2230 of July 1986.
(The values of the edition from February 2003 have not been included in the table, as this would not be justified according to our experience.)

Assembly preloads F_M and tightening torques M_A at $v = 0.9$ for headless screws with metric coarse or fine threads according to DIN ISO 262 (and DIN ISO 965-2);

Head dimensions of hex head screws according to DIN EN ISO 4014 to 4018, screws with hexalobular external driving heads according to DIN 34800 or Allen head screws according to DIN EN ISO 4762 and "centre" bores according to DIN EN 20273

Metric coarse thread				Metric fine thread			
Surface finish: - black-chrome finish or phosphatised - electro-galvanised - flZn = zinc flake coating (LH standard 10021432, DAC)				Surface finish: - black-chrome finish or phosphatised - electro-galvanised - flZn = zinc flake coating (LH standard 10021432, DAC)			
oiled				oiled			
Thread	Class	Assembly preloads F_M in N	Tightening torques M_A in Nm	Thread	Class	Assembly preloads F_M in N	Tightening torques M_A in Nm
for mean friction factor $\mu_G = 0.12$				for mean friction factor $\mu_G = 0.12$			
M4	8.8	4 050	2,8				
	10.9	6 000	4,1				
	12.9	7 000	4,8				
M5	8.8	6 600	5,5				
	10.9	9 700	8,1				
	12.9	11 400	9,5				
M6	8.8	9 400	9,5				
	10.9	13 700	14,0				
	12.9	16 100	16,5				
M7	8.8	13 700	15,5				
	10.9	20 100	23,0				
	12.9	23 500	27				
M8	8.8	17 200	23	M8x1	8.8	18 800	24,5
	10.9	25 000	34		10.9	27 500	36
	12.9	29 500	40		12.9	32 500	43
				M9x1	8.8	24 800	36
					10.9	36 500	53
					12.9	42 500	62
M10	8.8	27 500	46	M10x1	8.8	31 500	52
	10.9	40 000	68		10.9	46 500	76
	12.9	47 000	79		12.9	54 000	89
				M10x1,25	8.8	29 500	49
					10.9	43 000	72
					12.9	51 000	84
M12	8.8	40 000	79	M12x1,25	8.8	45 000	87
	10.9	59 000	117		10.9	66 000	125
	12.9	69 000	135		12.9	77 000	150
				M12x1,5	8.8	42 500	83
					10.9	62 000	122
					12.9	73 000	145
M14	8.8	55 000	125	M14x1,5	8.8	61 000	135
	10.9	80 000	185		10.9	89 000	200
	12.9	94 000	215		12.9	104 000	235
M16	8.8	75 000	195	M16x1,5	8.8	82 000	205
	10.9	111 000	280		10.9	121 000	300
	12.9	130 000	330		12.9	141 000	360

Metric coarse thread				Metric fine thread			
Surface finish: - black-chrome finish or phosphatised - electro-galvanised - flZn = zinc flake coating (LH standard 10021432, DAC)				Surface finish: - black-chrome finish or phosphatised - electro-galvanised - flZn = zinc flake coating (LH standard 10021432, DAC)			
oiled				oiled			
Thread	Class	Assembly preloads F _M in N	Tightening torques M _A in Nm	Thread	Class	Assembly preloads F _M in N	Tightening torques M _A in Nm
for mean friction factor $\mu_G = 0.12$				for mean friction factor $\mu_G = 0.12$			
M18	8.8	94 000	280	M18x1,5	8.8	110 000	310
	10.9	135 000	390		10.9	157 000	440
	12.9	157 000	460		12.9	184 000	520
	8.8			M18x2	8.8	102 000	290
	10.9				10.9	146 000	420
	12.9				12.9	170 000	490
M20	8.8	121 000	390	M20x1,5	8.8	139 000	430
	10.9	173 000	560		10.9	199 000	620
	12.9	202 000	650		12.9	232 000	720
M22	8.8	152 000	530	M22x1,5	8.8	171 000	580
	10.9	216 000	750		10.9	245 000	820
	12.9	250 000	880		12.9	285 000	960
M24	8.8	175 000	670	M24x1,5	8.8	207 000	760
	10.9	249 000	960		10.9	295 000	1090
	12.9	290 000	1120		12.9	346 000	1270
	8.8			M24x2	8.8	196 000	730
	10.9				10.9	280 000	1040
	12.9				12.9	325 000	1220
M27	8.8	230 000	1000	M27x1,5	8.8	267 000	1110
	10.9	330 000	1400		10.9	381 000	1580
	12.9	385 000	1650		12.9	445 000	1850
	8.8			M27x2	8.8	255 000	1070
	10.9				10.9	365 000	1500
	12.9				12.9	425 000	1800
M30	8.8	280 000	1350	M30x1,5	8.8	335 000	1540
	10.9	400 000	1900		10.9	477 000	2190
	12.9	465 000	2250		12.9	558 000	2560
	8.8			M30x2	8.8	321 000	1490
	10.9				10.9	457 000	2120
	12.9				12.9	534 000	2480
M33	8.8	350 000	1850	M33x1,5	8.8	410 000	2050
	10.9	495 000	2600		10.9	584 000	2920
	12.9	580 000	3000		12.9	683 000	3420
	8.8			M33x2	8.8	395 000	2000
	10.9				10.9	560 000	2800
	12.9				12.9	660 000	3300
M36	8.8	410 000	2350	M36x1,5	8.8	492 000	2680
	10.9	580 000	3300		10.9	701 000	3820
	12.9	680 000	3900		12.9	820 000	4470
	8.8			M36x3	8.8	440 000	2500
	10.9				10.9	630 000	3500
	12.9				12.9	740 000	4100
M39	8.8	490 000	3000	M39x1,5	8.8	582 000	3430
	10.9	700 000	4300		10.9	830 000	4890
	12.9	820 000	5100		12.9	971 000	5720
	8.8			M39x3	8.8	530 000	3200
	10.9				10.9	750 000	4600
	12.9				12.9	880 000	5300

Notes:

- Torques indicated in drawings have precedence over those specified in the factory standards and must at all times be adhered to.
- For important screw connections, we recommend using a torque angle gauge. For such connections, the required tightening torques (assembly torque, angle of rotation) must be determined individually by the technical department.

LIEBHERR Standard

Product code **10409969**
Version **001**

- When tightening in aluminum, with or without Helicoil-Inserts, the values for category 8.8 must be used. However, tightening torques indicated on drawings are binding, to be treated with priority and must be adhered to.

Tightening torques

1 of screw-in studs (Ermeto)

1.1 mating material: steel (Grease well before inserting!)

Type with sealing edge			Type with EOLASTIC seal		
Type	Thread M or G	Tightening torques in Nm	Type	Thread M or G	Tightening torques in Nm
Light-duty series L			Light-duty series L		
GE 06 LM A 3 C	M 10x1	18	GE 06 LM ED A 3 C	M 10x1	18
GE 06 LR A 3 C	G 1/8 A	18	GE 06 LR ED A 3 C	G 1/8 A	18
GE 08 LM A 3 C	M 12x1.5	30	GE 08 LM ED A 3 C	M 12x1.5	25
GE 08 LR A 3 C	G 1/4 A	35	GE 08 LR ED A 3 C	G 1/4 A	35
GE 10 LM A 3 C	M 14x1.5	45	GE 10 LM ED A 3 C	M 14x1.5	45
GE 10 LR A 3 C	G 1/4 A	35	GE 10 LR ED A 3 C	G 1/4 A	35
GE 12 LM A 3 C	M 16x1.5	65	GE 12 LM ED A 3 C	M 16x1.5	55
GE 12 LR A 3 C	G 3/8 A	70	GE 12 LR ED A 3 C	G 3/8 A	70
GE 15 LM A 3 C	M 18x1.5	80	GE 15 LM ED A 3 C	M 18x1.5	70
GE 15 LR A 3 C	G 1/2 A	140	GE 15 LR ED A 3 C	G 1/2 A	90
GE 18 LM A 3 C	M 22x1.5	140	GE 18 LM ED A 3 C	M 22x1.5	125
GE 18 LR A 3 C	G 1/2 A	100	GE 18 LR ED A 3 C	G 1/2 A	90
GE 22 Lm A 3 C	M 22x1.5	140	GE 22 Lm Ed A 3 C	M 26x1.5	180
GE 22 Lr A 3 C	G 3/4	180	GE 22 Lr Ed A 3 C	G 3/4 A	180
GE 28 Lm A 3 C	M 33x2.0	340	GE 28 Lm Ed A 3 C	M 33x2.0	310
GE 28 Lr A 3 C	G 1 A	330	GE 28 Lr Ed A 3 C	G 1 A	310
GE 35 Lm A 3 C	M 42x2.0	500	GE 35 Lm Ed A 3 C	M 42x2.0	450
GE 35 Lr A 3 C	G 1 1/4 A	540	GE 35 Lr Ed A 3 C	G 1 1/4 A	450
GE 42 Lm A 3 C	M 48x2.0	630	GE 42 Lm Ed A 3 C	M 48x2.0	540
GE 42 Lr A 3 C	G 1 1/2 A	630	GE 42 Lr Ed A 3 C	G 1 1/2 A	540
Heavy-duty series S			Heavy-duty series S		
GE 06 SM A 3 C	M 12x1.5	35	GE 06 SM ED A 3 C	M 12x1.5	35
GE 06 SR A 3 C	G 1/4 A	55	GE 06 SR ED A 3 C	G 1/4 A	55
GE 08 SM A 3 C	M 14x1.5	55	GE 08 SM ED A 3 C	M 14x1.5	55
GE 08 SR A 3 C	G 1/4 A	55	GE 08 SR ED A 3 C	G 1/4 A	55
GE 10 SM A 3 C	M 16x1.5	70	GE 10 SM ED A 3 C	M 16x1.5	70
GE 10 SR A 3 C	G 3/8 A	90	GE 10 SR ED A 3 C	G 3/8 A	80
GE 12 SM A 3 C	M 18x1.5	110	GE 12 SM ED A 3 C	M 18x1.5	90
GE 12 SR A 3 C	G 3/8 A	90	GE 12 SR ED A 3 C	G 3/8 A	80
GE 14 SM A 3 C	M 20x1.5	150	GE 14 SM ED A 3 C	M 20x1.5	125
GE 14 SR A 3 C	G 1/2 A	150	GE 14 SR ED A 3 C	G 1/2 A	115

of swivelling connections (Ermeto)

Type with sealing edge			Type with EOLASTIC seal		
Type	Thread M or G	Tightening torques in Nm	Type	Thread M or G	Tightening torques in Nm
GE 16 SM A 3 C	M 22x1.5	170	GE 16 SM ED A 3 C	M 22x1.5	135
GE 16 SR A 3 C	G 1/2 A	130	GE 16 SR ED A 3 C	G 1/2 A	115
GE 20 SM A 3 C	M 27x2.0	270	GE 20 SM ED A 3 C	M 27x2.0	180
GE 20 SR A 3 C	G 3/4 A	270	GE 20 SR ED A 3 C	G 3/4 A	180
GE 25 SM A 3 C	M 33x2.0	410	GE 25 SM ED A 3 C	M 33x2.0	310
GE 25 SR A 3 C	G 1 A	340	GE 25 SR ED A 3 C	G 1 A	310
GE 30 SM A 3 C	M 42x2.0	540	GE 30 SM ED A 3 C	M 42x2.0	450
GE 30 SR A 3 C	G 1 1/4 A	540	GE 30 SR ED A 3 C	G 1 1/4 A	450
GE 38 SM A 3 C	M 48x2.0	700	GE 38 SM ED A 3 C	M 48x2.0	540
GE 38 SR A 3 C	G 1 1/2 A	700	GE 28 SR ED A 3 C	M 1 1/2 A	540

Tab. 1 Tightening torques of screw-in studs

GE = Straight screw-in connection (with metric thread M or pipe thread G)

2 of swivelling connections (Ermeto)

2.1 mating material: steel (Grease well before inserting!)

Type	Tightening torques		Type	Tightening torques	
	Thread	Nm		Thread	Nm
Light-duty series			Light-duty series		
WH / TH 06 LR KDS A 3 C	G 1/8 A	18	WH / TH 06 LM KDS A 3 C	M 10 X 1	18
WH / TH 08 LR KDS A 3 C	G 1/4 A	45	WH / TH 08 LM KDS A 3 C	M 12 X 1.5	45
WH / TH 10 LR KDS A 3 C	G 3/8 A	45	WH / TH 10 LM KDS A 3 C	M 14 X 1.5	55
WH / TH 12 LR KDS A 3 C	G 1/2 A	70	WH / TH 12 LM KDS A 3 C	M 16 X 1.5	80
WH / TH 15 LR KDS A 3 C	G 3/4 A	120	WH / TH 15 LM KDS A 3 C	M 18 X 1.5	100
WH / TH 18 LR KDS A 3 C	G 1 A	120	WH / TH 18 LM KDS A 3 C	M 22 X 1.5	140
WH / TH 22 LR KDS A 3 C	G 1 1/4 A	230	WH / TH 22 LM KDS A 3 C	M 27 X 2.0	320
WH / TH 28 LR KDS A 3 C	G 1 1/4 A	320	WH / TH 28 LM KDS A 3 C	M 33 X 2.0	360
WH / TH 35 LR KDS A 3 C	G 1 1/4 A	540	WH / TH 35 LM KDS A 3 C	M 42 X 2.0	540
WH / TH 42 LR KDS A 3 C	G 1 1/2 A	700	WH / TH 42 LM KDS A 3 C	M 48 X 2.0	700
Heavy-duty series			Heavy-duty series		
WH / TH 06 SR KDS A 3 C	G 1/4 A	45	WH / TH 06 SM KDS A 3 C	M 12 X 1.5	45
WH / TH 08 SR KDS A 3 C	G 1/4 A	45	WH / TH 08 SM KDS A 3 C	M 14 X 1.5	55
WH / TH 10 SR KDS A 3 C	G 3/8 A	70	WH / TH 10 SM KDS A 3 C	M 16 X 1.5	80
WH / TH 12 SR KDS A 3 C	G 3/8 A	70	WH / TH 12 SM KDS A 3 C	M 18 X 1.5	100
WH / TH 16 SR KDS A 3 C	G 1/2 A	120	WH / TH 14 SM KDS A 3 C	M 20 X 1.5	125
WH / TH 20 SR KDS A 3 C	G 3/4 A	230	WH / TH 16 SM KDS A 3 C	M 22 X 1.5	135
WH / TH 25 SR KDS A 3 C	G 1 A	320	WH / TH 20 SM KDS A 3 C	M 27 X 2.0	320

Type	Tightening torques		Type	Tightening torques	
	Thread	Nm		Thread	Nm
WH / TH 30 SR KDS A 3 C	G 1 1/4 A	540	WH / TH 25 SM KDS A 3 C	M 33 X 2.0	360
WH / TH 38 SR KDS A 3 C	G 1/4 A	700	WH / TH 30 SM KDS A 3 C	M 42 X 2.0	540
			WH / TH 38 SM KDS A 3 C	M 48 X 2.0	700

Tab. 2 Tightening torques of swivelling connections

3 of screw-in studs (Ermeto)

3.1 mating material: steel (Grease well before inserting!)

Type VSTI	Screw-in thread M	Tightening torques Nm	Type VSTI	Screw-in thread G	Tightening torques Nm
VSTI 10X1 ED A3C	M 10 X 1	12	VSTI 1/8 ED A3C	G 1/8 A	13
VSTI 12X1.5 ED A3C	M 12 X 1.5	25	VSTI 1/4 ED A3C	G 1/4 A	30
VSTI 14X1.5 ED A3C	M 14 X 1.5	35	VSTI 3/8 ED A3C	G 3/8 A	60
VSTI 16X1.5 ED A3C	M 16 X 1.5	55	VSTI 1/2 ED A3C	G 1/2 A	80
VSTI 18X1.5 ED A3C	M 18 X 1.5	65	VSTI 3/4 ED A3C	G 3/4 A	140
VSTI 20X1.5 ED A3C	M 20 X 1.5	80	VSTI 1 ED A3C	G 1 A	200
VSTI 22X1.5 ED A3C	M 22 X 1.5	90	VSTI 1 1/4 ED A3C	G 1 1/4 A	450
VSTI 26X1.5 ED A3C	M 26 X 1.5	120	VSTI 1 1/2 ED A3C	G 1 1/2 A	450
VSTI 27X2 ED A3C	M 27 X 2.0	135			
VSTI 33X2 ED A3C	M 33 X 2.0	225			
VSTI 42X2 ED A3C	M 42 X 2.0	360			
VSTI 48X2 ED A3C	M 48 X 2.0	360			

Tab. 3 Tightening torques of screw-in studs

VSTI = Hexagon socket plug

Installations for pistons and piston nuts by hydraulic cylinders

1. Application and purpose

This Liebherr standard applies only to hydraulic cylinders, and in particular to the mounting of pistons and piston nuts on piston rods from a thread diameter of M42 and greater.

This standard describes the tightening procedure with turning distance and angle.

For threads with diameters smaller than M42, the applicable tightening torque is indicated in the drawings. The values in the drawings are always binding.

2. Requirements / description of procedure

For the valid torque value number, refer to the drawing. The standard may **not** be adopted or transferred to apparently similar geometries.

Use this number to find the applicable turning distance and angle in the torque table (see item 4).

The torque values have been determined empirically and are subject to changes.

This standard differentiates between two tightening procedures, which are identified with 3-digit and 4-digit numbers respectively (see chapters 2.1 and 2.2).

2.1. Tightening with assembly wrench

This tightening procedure applies to **3-digit** tightening numbers.

Preparation:

Clean the contact surfaces (threads contact faces between piston rod, piston and piston nut) and apply a **thin layer** of Gleitmo high-performance lubricating grease (ID no. 8300 004, 40 g tube) **to both sides**.

Definitions:

Pretightening torque (Mv):

The piston (A) is secured with a torque wrench (B) applied to the square/hexagon head of the assembly wrench (C). The position of the torque wrench must be carefully noted (see figure 1).

Turning distance (4):

Radian measure [mm] travelled as a result of the tightening of the piston, or piston nut along the outer thread diameter, **after** application of the pretightening torque (see figure 2).

Turning angle (5):

Angle [°] travelled by the piston or piston nut respectively, **after** application of the pretightening torque (see figure 2).

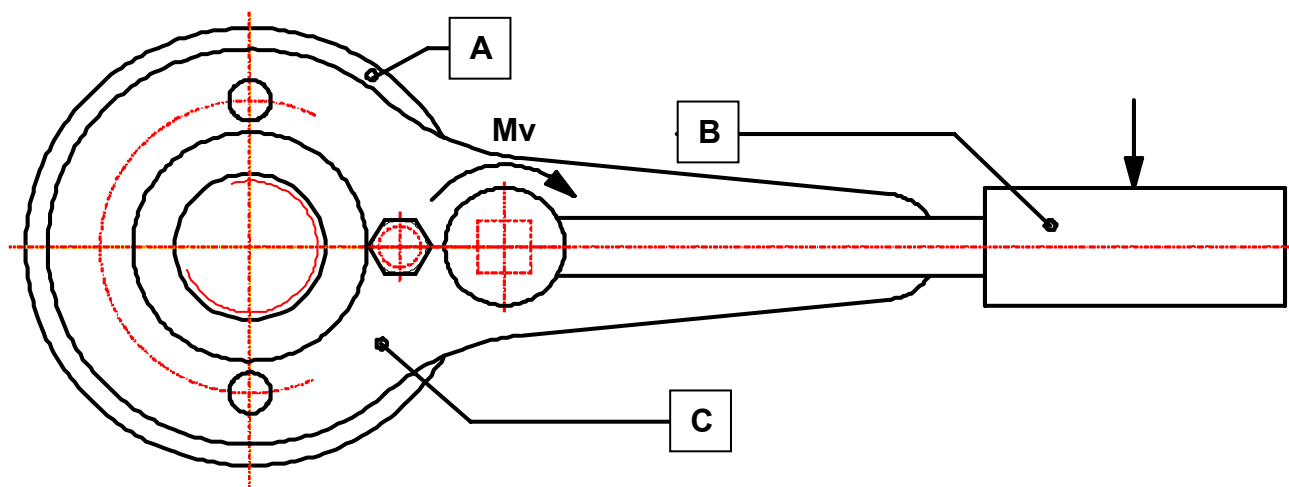


Figure 1

When applying the pretightening torque (Mv), the torque wrench (B) **must point in the same direction** as the assembly wrench (C). Proceed in the same way to tighten the piston nut, using a suitable assembly wrench.

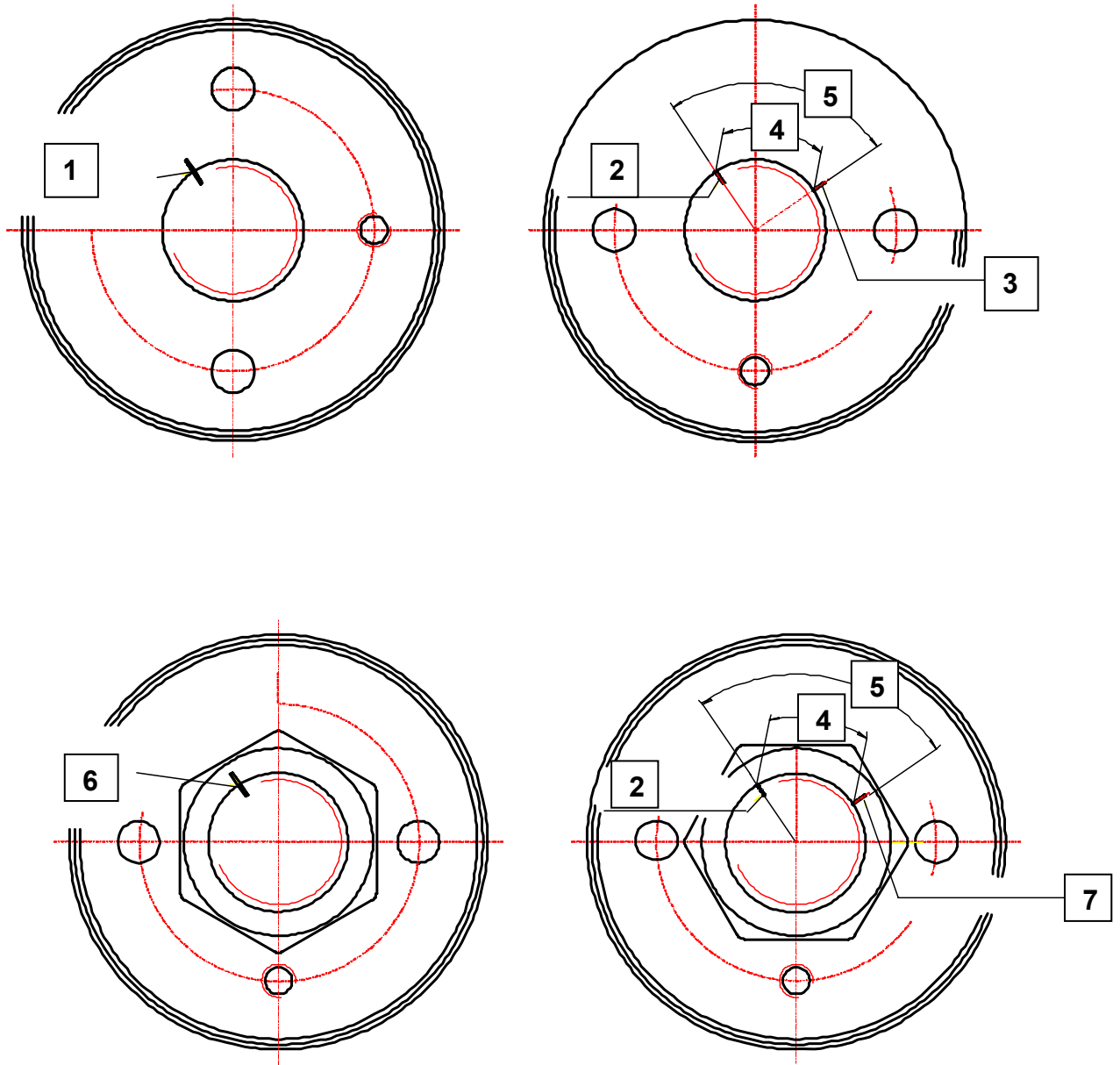


Figure 2

1: Markings on the piston and the piston rod thread **after** application of the pretightening torque

2: Markings on the piston rod thread

3: Markings on the piston **after** tightening

4: Turning distance

5: Turning angle

6: Markings on the piston nut and the piston rod thread **after** application of the pretightening torque

7: Markings on the piston nut **after** tightening

2.2. *Tightening with hydraulic assembly device*

This tightening procedure applies to **4-digit** tightening numbers.

Preparation:

Clean the contact surfaces (threads contact faces between piston rod, piston and piston nut) and apply **a thin layer** of Gleitmo high-performance lubricating grease (ID no. 8300 004, 40 g tube) **to both sides**.

Definitions:

Pretightening torque:

Torque applied on the piston or piston nut with the torque wrench (A) via the hexagon head (B) of the torque converter (C) (see figure 1).

Turning angle:

Angle [°] travelled by the piston or piston nut respectively, **after** application of the pretightening torque (see figure 3).

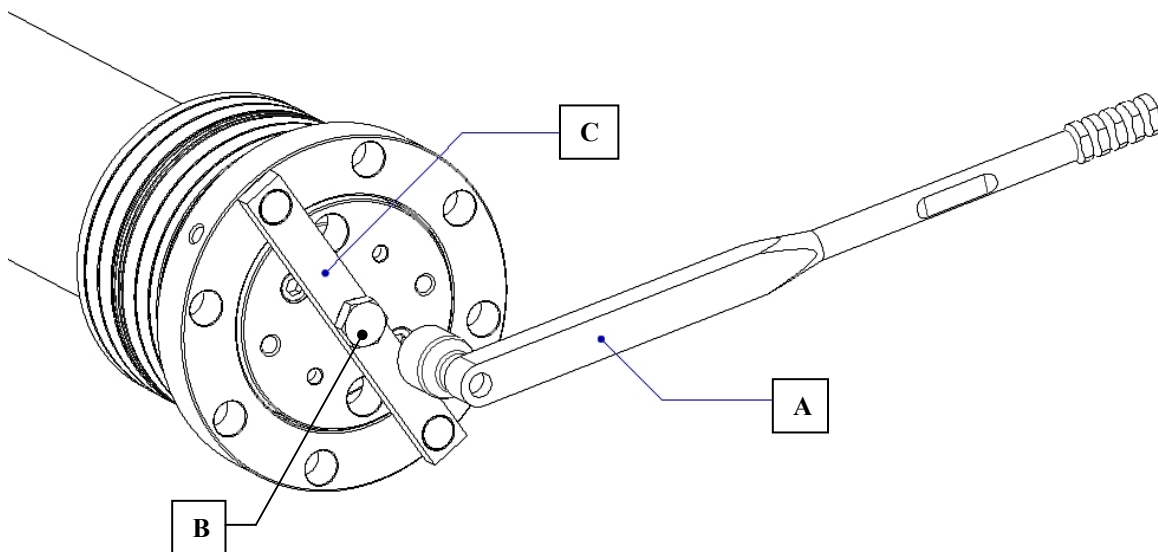


Figure 1

A: Torque wrench

B: Hexagon head

C : Torque converter

Operation of the assembly device:

See separate operating manual of the assembly device (H).

For suitable adapters for the piston rod, piston and piston nut, refer to the piston parts list (see figure 2).

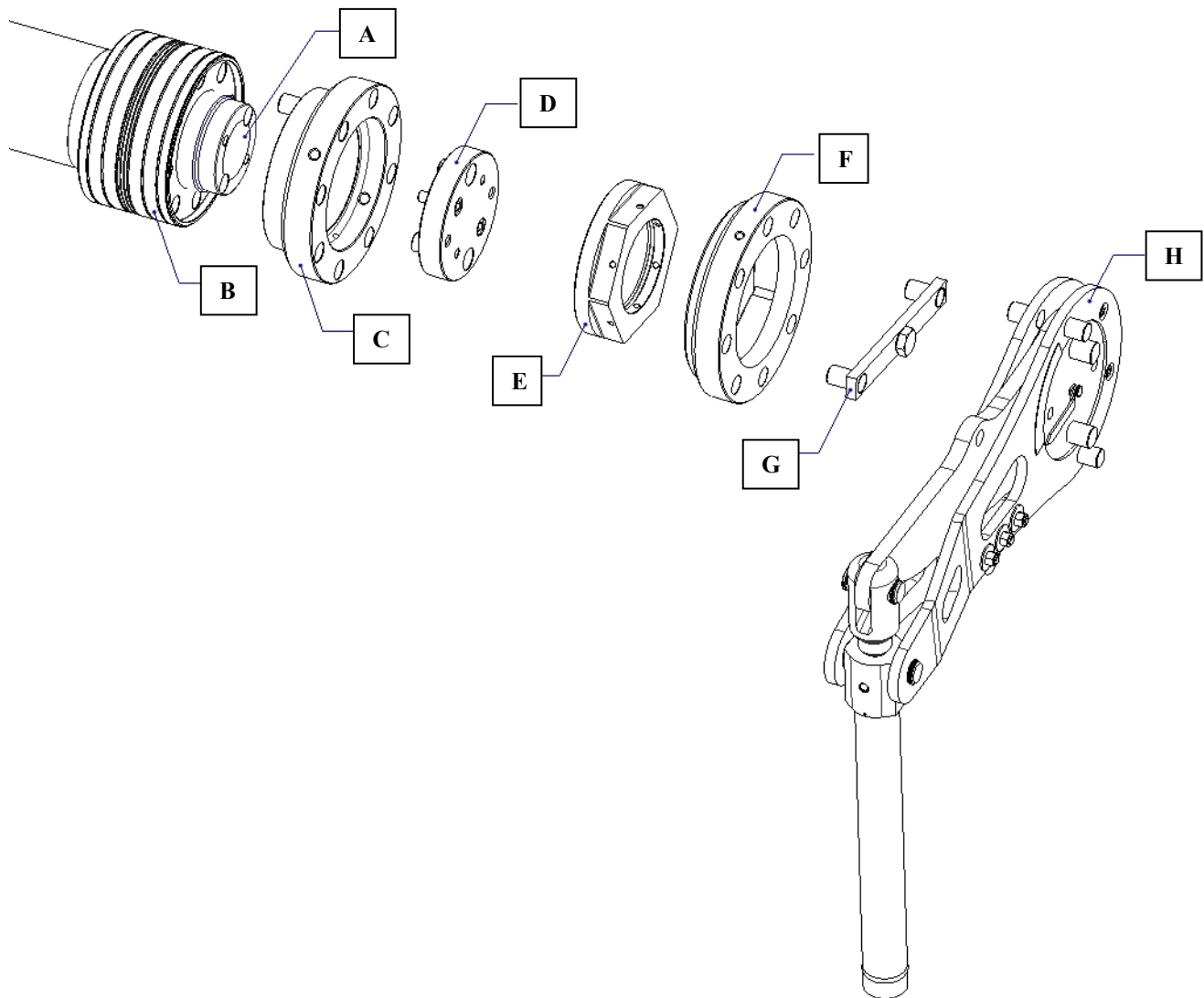


Figure 2

A: Piston rod

B: Piston

C : Adapter for piston

D: Adapter for piston rod

E: Piston nut

F: Adapter for piston nut

G: Torque converter

H: Assembly device

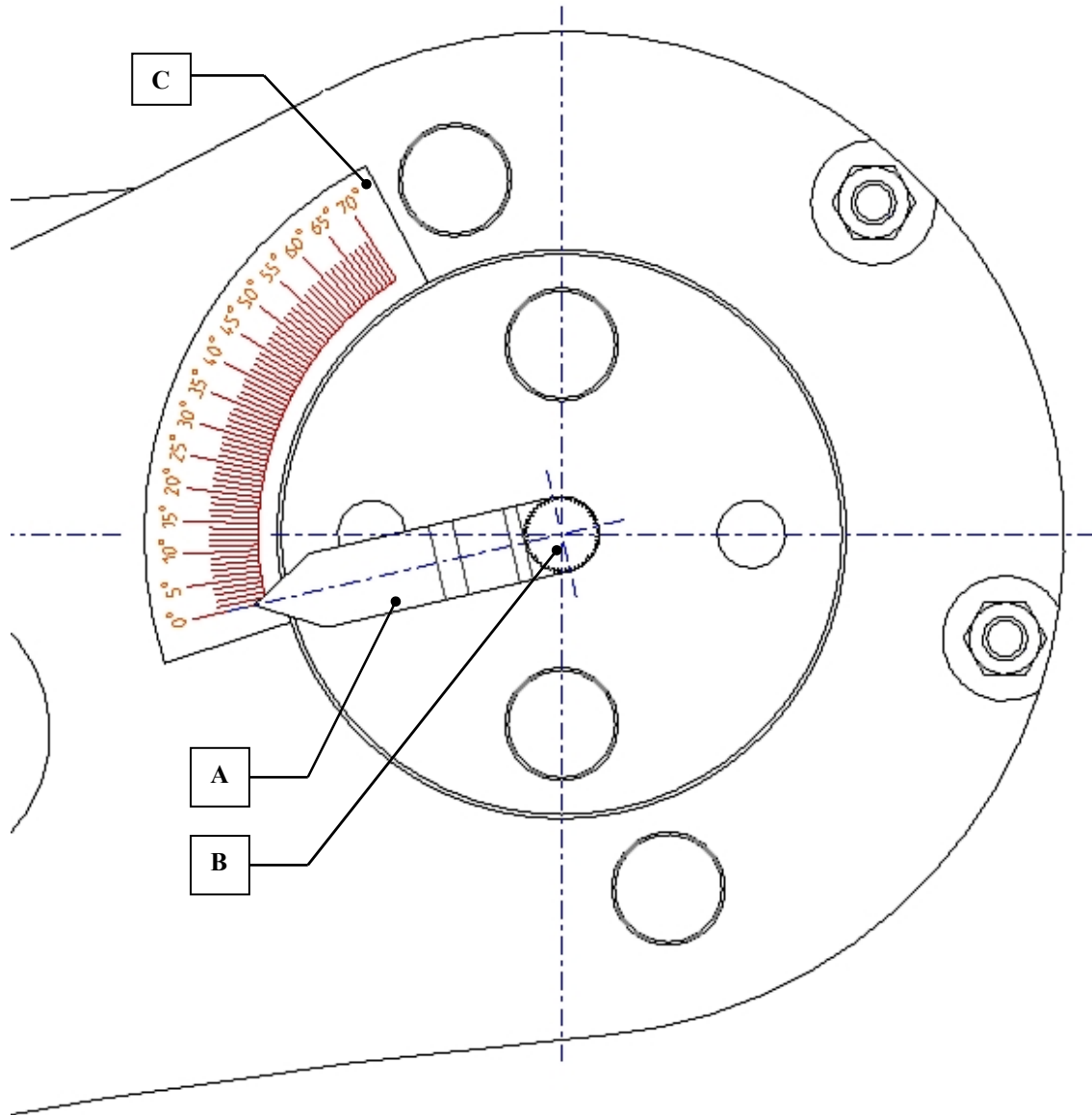


Figure 3

A: Dial

B: Adjusting screw

C : Angle scale

Before tightening, set the dial (A) with the adjusting screw (B) to position 0° on the angle scale (C).

The angle scale indicates the turning angle.

If the opening angle of the assembly device is not sufficient to achieve the prescribed turning angle, mount the device again for a second tightening process. Note the previously completed angle. Before continuing the tightening process, set the dial to the last achieved angle value. Repeat this process as often as necessary to achieve the prescribed turning angle.

3. Modifications

4. Other applicable documents

Torque table

Drawing with reference to this Liebherr Standard and the torque number.

4. Torque table

for LH standard 10334184

(Installation instructions for pistons and piston nuts)

The date indicates the latest status of the table.

This document is not subject to revision!

Tightening with assembly wrench (see 2.1)

No. 10334184 - ...	Pretightening torque [Nm]	Piston		Piston nut		Thread
		Turning distance [mm]	Turning angle ~ [°]	Turning distance [mm]	Turning angle ~ [°]	M [mm]
071	100	11 +1	30°	21 +1	57°	42x1.5
072	100	21 +1	57°	21 +1	57°	42x1.5
073	100	18 +1	49°	19 +1	52°	42x1.5
074	100	16 +1	44°	-	-	42x1.5
075	100	19 +1	52°	21 +1	57°	42x1.5
078	100	20 +1	55°	14 +1	38°	42x1.5
079	100	11 +1	30°	21 +1	57°	42x1.5
080	100	18 +1	49°	-	-	42x1.5
091	100	13 +1	30°	19 +1	44°	50x2
092	100	25 +1	57°	19 +1	44°	50x2
093	100	24 +1	55°	19 +1	44°	50x2
095	100	13 +1	30°	19 +1	44°	50x2
096	100	10 +1	23°	9 +1	21°	50x2/WS65
097	100	17 +1	39°	19 +1	44°	50x2
098	100	17 +1	39°	-	-	50x2
099	100	24 +1	55°	19 +1	44°	50x2
103	100	9 +1	21°	-	-	50x2
111	100	16 +1	33°	18 +1	37°	56x2
112	100	17 +1	35°	18 +1	37°	56x2
113	100	17 +1	35°	19 +1	39°	56x2
114	100	19 +1	39°	-	-	56x2
115	100	18 +1	37°	-	-	56x2
116	100	19 +1	39°	-	-	56x2
121	150	15 +1	29°	19 +1	36°	60x2
123	150	17 +1	32°	19 +1	36°	60x2
126	150	14 +1	27°	-	-	60x2
127	150	22 +1	42°	-	-	60x2
129	150	7 +1	13°	8 +1	15°	60x2
151	150	15 +1	27°	19 +1	34°	65x2
152	150	20 +1	35°	19 +1	34°	65x2
153	150	20 +1	35°	-	-	65x2
171	150	12 +2	20°	18 +1	30°	68x2
172	150	21 +2	35°	18 +1	30°	68x2
173	150	19 +2	32°	18 +1	30°	68x2
174	150	25 +2	42°	18 +1	30°	68x2
175	150	25 +2	42°	18 +1	30°	68x2
176	150	19 +2	32°	18 +1	30°	68x2
177	150	19 +2	32°	18 +1	30°	68x2
179	150	11 +2	19°	18 +1	30°	68x2
180	150	20 +2	34°	18 +1	30°	68x2
181	150	20 +2	34°	-	-	68x2
183	200	-	-	40 +2	67°	68x2
201	200	17 +2	26°	16 +1	24°	76x2
202	200	26 +2	39°	16 +1	24°	76x2
203	200	27 +2	41°	16 +1	24°	76x2
204	200	27 +2	41°	16 +1	24°	76x2
205	200	13 +2	20°	-	-	76x2
206	200	25 +2	38°	25 +1	38°	76x2
207	200	23 +2	35°	-	-	76x2
208	200	15 +2	22°	-	-	76x2
209	200	30 +2	45°	-	-	76x2
231	200	8 +2	11°	16 +1	22°	85x3
232	200	17 +2	23°	16 +1	22°	85x3
234	200	22 +2	30°	-	-	85x3
236	200	15 +2	20°	-	-	85x3

4. Torque table

for LH standard 10334184

(Installation instructions for pistons and piston nuts)

No.	Pretightening torque	Piston		Piston nut		Thread
10334184 - ...		Turning distance	Turning angle	Turning distance	Turning angle	M
	[Nm]	[mm]	~ [°]	[mm]	~ [°]	[mm]
261	250	20 +2	25°	10 +1	12°	95x3
265	250	24 +2	29°	10 +1	12°	95x3
267	250	24 +2	29°	-	-	95x3
268	250	20 +2	24°	-	-	95x3
281	250	20 +2	23°	13 +1	15°	100x3
282	250	25 +2	29°	-	-	100x3
283	250	25 +2	29°	21 +1	24°	100x3
284	250	9 +1	10°	-	-	100x3
285	250	18 +1	20°	-	-	100x3
301	300	21 +3	22°	20 +2	21°	110x3
302	300	18 +3	19°	20 +2	21°	110x3
303	300	20 +3	21°	20 +2	21°	110x3
304	300	23 +3	24°	20 +2	21°	110x3
305	300	9 +3	9°	-	-	110x3
306	300	24 +3	25°	-	-	110x3
307	300	27 +3	28°	-	-	110x3
331	400	23 +3	22°	20 +2	19°	120x3
332	400	11 +3	11°	-	-	120x3
333	400	27 +3	26°	-	-	120x3
334	400	20 +3	19°	20 +2	19°	120x3
335	400	30 +3	29°	-	-	120x3
336	400	29 +3	28°	-	-	120x3
501	200	21 +2	30°	-	-	80x2
531	500	34 +3	28°	-	-	140x3
561	100	10 +1	25°	-	-	45x1.5

Tightening with hydraulic assembly device (see 2.2)

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LIEBHERR	Bezeichnung Description / Dénomination	Blatt/Page/Feuille:	1
	Assembly instruction for piston rod bearings with external threads (hydraulic cylinders)	bestehend aus consisting of composé	4 Blatt Pages Feuille
		WN 4122 B	

Contents

1. **Scope of application**
2. **Description**
3. **Referenced documents (torque table)**

1. **Scope of application**

This factory standard applies exclusively to the assembly of hydraulic cylinders. For the valid factory standard number, refer to the drawing. The standard may **not** be adopted or transferred to apparently similar geometries.

The torques have been determined empirically and are subject to changes. The revision and release dates indicate the latest version of the factory standard.

2. Description

Preparation:

Clean the threads and apply a **thin layer** of Gleitmo high-performance lubricating grease (ID no. 8300 004, 40 g tube) **on both sides**.

Definitions:

Pretightening torque:

The piston rod bearing is secured with a torque wrench applied to the square of the assembly wrench. The position of the torque wrench must be carefully noted (see figure 1).

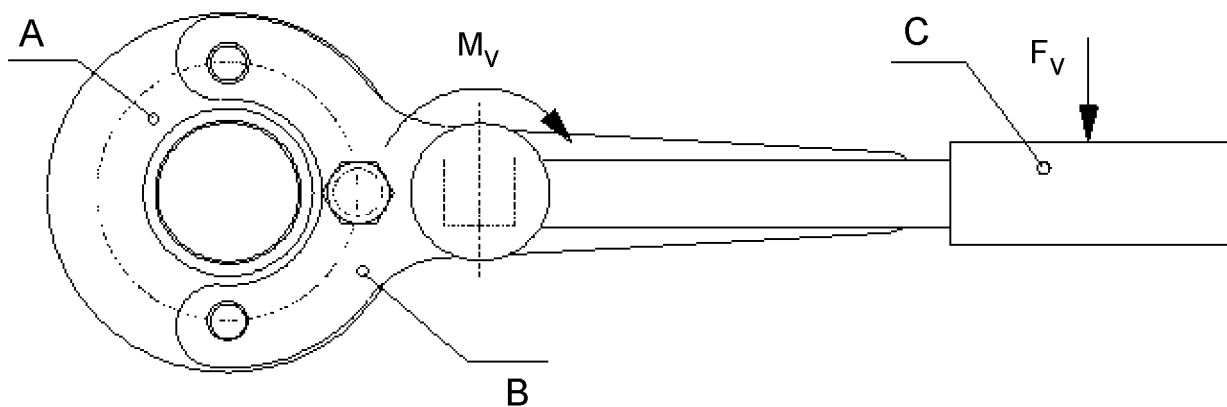


Figure 1

- A Bearing head
- B Assembly wrench
- C Torque wrench

When applying the pretightening torque, the torque wrench **must point in the same direction** as the assembly wrench.

Turning distance:

Radian measure [mm] between the bearing head outer diameter and the cylinder tube, travelled **after** application of the pretightening torque (see figure 2).

Turning angle:

Angle [°] travelled by the bearing head **after** application of the pretightening torque (see figure 2).

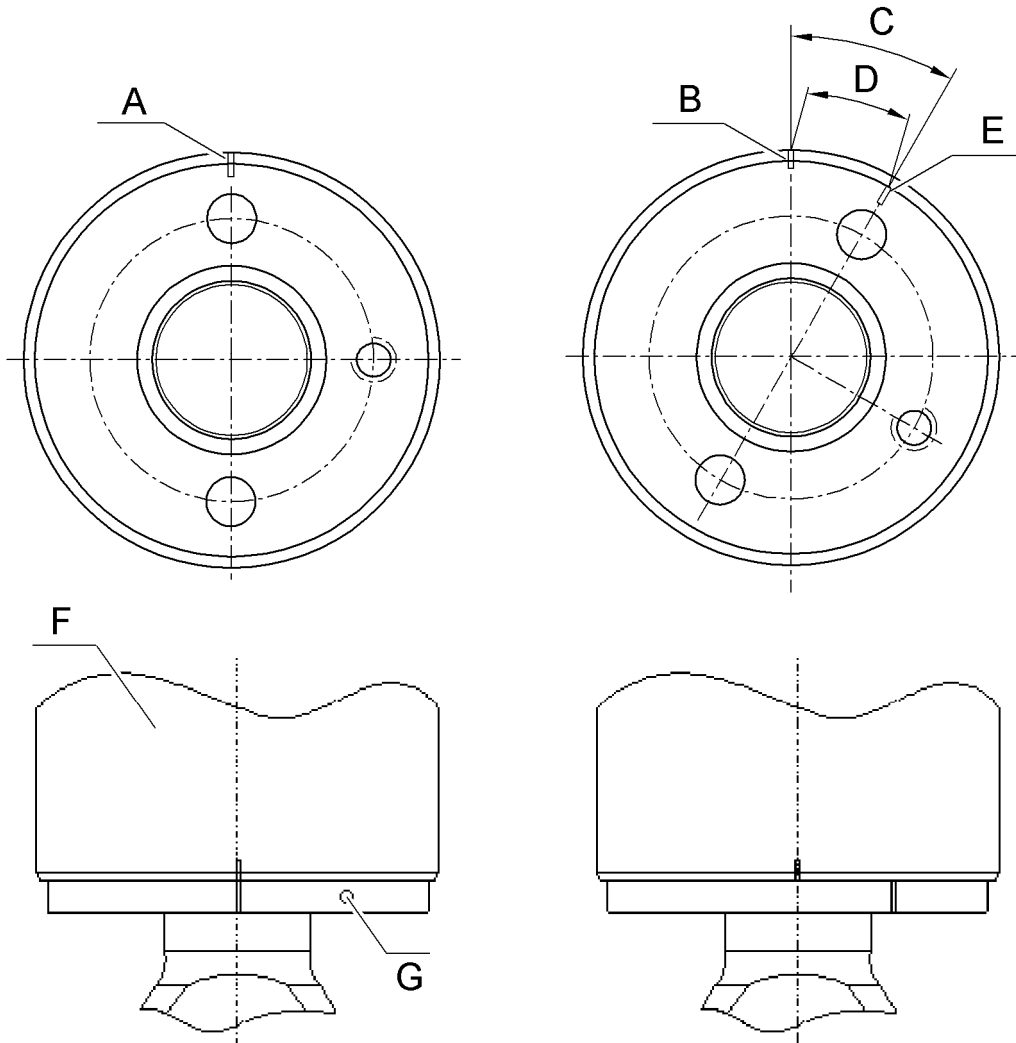


Figure 2

- A Marks on the cylinder tube and the outer diameter of the bearing head **after** application of the pretightening torque
- B Mark on the cylinder tube
- C Turning angle
- D Turning distance
- E Mark on the bearing head after tightening
- F Cylinder Tube
- G Bearing head

After the bearing head and the cylinder tube have been tightened, apply a notch mark at the rod side oil connection level, using a flat chisel.

3. **List of tightening torques for factory standard 4122**

(Assembly instructions for piston and piston nut)

The date indicates the latest version of this table.
This document is not covered by the revision service.

Edition: 14.09.2007

NU	Preload	Piston rod bearing	
		Turning distance [mm]	Turning angle ~ [°]
4122- ...	Torque Mv [Nm]		
001			
011	50	7 +1	10
016	100	10 +1	12
017	100	10 +1	12
026	100	9 +1	10
027	100	10 +1	11
031	100	8 +1	8
036	100	8 +1	9
037	100	10 +1	9
039			
041	150	9 +1	7
046	200	12 +1	10
047			
051			
052			
053	200	25 +1	18
061	200	10 +1	7
151	400	14 +1	6

Tightening torques for piston rod bearing screws with LH 320HV washers

1. Application and purpose

This Liebherr Standard applies exclusively to the mounting screws of the piston rod bearing of hydraulic cylinders.

2. Other applicable documents

Drawing with reference to this Liebherr Standard.
RIBE-Blauheft no. 30, 4. edition 2003.

3. Screw coating

Black screw → see table chapter 4.1

DACROMET screw (silver-colour zinc flake coating) → see table chapter 4.2

4. Table of tightening torques

4.1. Black screw + LH washer

The tightening torques apply to grease-free black screws used in conjunction with LH 320HV washers (FLZN anti-corrosion protection according to Liebherr Standard 10021432).

Tightening torques M_A determined according to RIBE-Blauheft.

Friction coefficients:

For thread friction torque M_G : $\mu_G = 0.14$

Head friction torque M_K : $\mu_K = 0.11$

Thread Wrench size	Strength class	M_G	M_K	M_A	LH washer 320HV	
		Nm	Nm	Nm	ID no.	d x D x h
M10 WS 16	8.8	28	21	50	99 18 225	10.5x18.0x3.0
	10.9	41	30	70		
	12.9	48	35	85		
M12 WS 18	8.8	49	35	85	99 18 226	12.5x21.0x3.5
	10.9	71	51	120		
	12.9	84	60	145		
M14 WS 21	8.8	78	56	135	95 86 491	14.5x25.0x3.5
	10.9	114	82	195		
	12.9	133	96	230		
M16 WS 24	8.8	119	87	205	99 18 228	16.5x28.0x4.0
	10.9	175	128	305		
	12.9	204	150	355		
M18 WS 27	8.8	166	121	285	95 86 492	18.5x31.0x5.0
	10.9	243	177	420		
	12.9	285	207	490		
M20 WS 30	8.8	232	172	405	99 18 229	20.5x34.0x5.0
	10.9	341	252	595		
	12.9	399	295	695		
M22 WS 34	8.8	314	237	550	92 82 976	22.5x38.0x5.0
	10.9	462	348	810		
	12.9	540	408	950		
M24 WS 36	8.8	401	293	695	99 18 230	24.5x40.0x5.0
	10.9	590	430	1020		
	12.9	690	504	1195		
M27 WS 41	8.8	583	438	1020	95 86 495	27.5x45.0x6.0
	10.9	857	644	1500		
	12.9	1003	753	1755		

M30 WS 46	8.8	794	594	1390	99 18 231	31.0x52.0x6.0
	10.9	1166	872	2040		
	12.9	1364	1021	2385		
M33 WS 50	8.8	1073	805	1880	95 86 496	34.0x56.0x7.0
	10.9	1576	1182	2760		
	12.9	1844	1383	3225		
M36 WS 55	8.8	1383	1031	2415	99 18 232	37.0x60.0x7.0
	10.9	2031	1515	3545		
	12.9	2377	1773	4150		
M39 WS 60	8.8	1779	1343	3120	96 02 352	40.0x66.0x8.0
	10.9	2613	1973	4585		
	12.9	3058	2309	5365		
M42 WS 65	8.8	2208	1654	3860	96 02 353	43.0x72.0x10.0
	10.9	3243	2429	5670		
	12.9	3795	2842	6635		
M42x3 WS 65	8.8	2315	1809	4125	96 02 353	43.0x72.0x10.0
	10.9	3401	2657	6060		
	12.9	3979	3109	7090		

4.2. DACROMET screw + LH washer

The tightening torques apply to grease-free DACROMET screws used in conjunction with LH 320HV washers (FLZN anti-corrosion protection according to Liebherr Standard 10021432).

Tightening torques M_A according to Liebherr Standard 10409969 (WN 4037).
(see internal memo from H. Wimbauer of the 19.10.01)

M10 WS 16	8.8	46	99 18 225	10.5x18.0x3.0
	10.9	68		
	12.9	79		
M12 WS 18	8.8	79	99 18 226	12.5x21.0x3.5
	10.9	117		
	12.9	135		
M14 WS 21	8.8	125	95 86 491	14.5x25.0x3.5
	10.9	185		
	12.9	215		
M16 WS 24	8.8	195	99 18 228	16.5x28.0x4.0
	10.9	280		
	12.9	330		
M18 WS 27	8.8	280	95 86 492	18.5x31.0x5.0
	10.9	390		
	12.9	460		
M20 WS 30	8.8	390	99 18 229	20.5x34.0x5.0
	10.9	560		
	12.9	650		
M22 WS 34	8.8	530	92 82 976	22.5x38.0x5.0
	10.9	750		
	12.9	880		
M24 WS 36	8.8	670	99 18 230	24.5x40.0x5.0
	10.9	960		
	12.9	1120		
M27 WS 41	8.8	1000	95 86 495	27.5x45.0x6.0
	10.9	1400		
	12.9	1650		
M30 WS 46	8.8	1350	99 18 231	31.0x52.0x6.0
	10.9	1900		

M30 WS 46	8.8	1350	99 18 231	31.0x52.0x6.0
	10.9	1900		
	12.9	2250		
M33 WS 50	8.8	1850	95 86 496	34.0x56.0x7.0
	10.9	2600		
	12.9	3000		
M36 WS 55	8.8	2350	99 18 232	37.0x60.0x7.0
	10.9	3300		
	12.9	3900		
M39 WS 60	8.8	3000	96 02 352	40.0x66.0x8.0
	10.9	4300		
	12.9	5100		

5. Revision log

Angle-controlled screw tightening method

1. Application and purpose

This Liebherr Standard has been devised to provide the production department at LHB with details of screw parameters for the angle-controlled tightening of screw connections.

This standard is only valid for screw connections that are specially marked in the drawing at LHB and to which one of the screwdriving conditions listed in the "Table of tightening torques" applies (see also section 2). The standard also contains information on two possible tightening methods.

2. Other applicable documents

- Table of tightening torques
- Drawing with reference to this Liebherr Standard and the screwdriving condition number

3. Requirements / description of procedure

With the torque-controlled tightening method, the prestressing force is applied exclusively by means of a specific torque. With the angle-controlled tightening method, the prestressing force is applied through a combination of torque and tightening angle.

The screw connection is thereby tightened in 2 steps:

1st step: Pre-torque M_{AF} [Nm]

In a first step, the screw is tightened with a preset torque, similar to the torque-controlled tightening method. This torque is known as the pre-torque M_{AF} and is considerably lower than the torque applied with the torque-controlled tightening method (approx. 15% to 30% of the tightening torque according to LH standard 10409969).

By pre-tightening with the pre-torque in this first step, the screw connection is properly defined and any dirt particles, burrs and other protrusions in the joints are eliminated.

2nd step: Additional angle of rotation $\Delta\Theta$ [°]

In the second step, the remaining prestressing force is applied by means of the additional angle of rotation $\Delta\Theta$. The additional angle of rotation results in an elongation of the screw and thus the desired prestress, depending on the pitch of the thread.

Advantages of the angle-controlled tightening method:

- With this method, the greater part of the prestressing force is applied to the screw connection through the angle of rotation, and friction factors (head contact friction and thread friction) play only a minor role. In contrast with the torque-controlled tightening method, this results in a significantly reduced dispersion of the prestressing forces.
- The angle-controlled tightening method is an overelastic tightening method. This means that, during tightening, the screw is stressed just beyond its breaking point. This results in significantly higher screw utilization and higher prestressing forces than are achievable with the torque-controlled tightening method.
-



Screws that have been tightened once with an angle-controlled method must not be used again!

4. Identification in drawing

The tightening values for the angle-controlled tightening method (pre-torque M_{AF} and additional angle of rotation $\Delta\Theta$) depend on the geometry of the individual screw (thread diameter, pitch, grip length, thread, length, etc.) It is thus not possible to provide generally applicable values.

In this standard, the respective screw connection geometries are assigned a screwdriving condition number. For the valid screwdriving condition number, you **must refer to the drawing**. The respective values may **not** be adopted for or transferred to apparently similar geometries!

For the applicable screw parameters, refer to the respective screwdriving condition number in the "Table of tightening torques" (see section 2).

Identification in the drawing:

**MOUNTING INSTRUCTION ACCORDING TO
LH STANDARD 1065 0522 - 0000**

Screwdriving condition
number

5. Tightening method

There are various ways in which a screw connection can be tightened according to the angle-controlled tightening method. In the sections below, tightening by hand with a torque wrench and tightening with a torque-controlled electric or hydraulic wrench are described.

The preferred method is tightening with a controlled electric or hydraulic wrench.

5.1. Preparation

All contact surfaces, and in particular the contact surfaces of the screw head and the nut must be cleaned. Ensure that the contact surfaces are free of tinder, burrs and weld splashes. If necessary, remove weld splashes with a scraper.

Remove excess grease along the thread length. This applies in particular to flat-bottom holes.

All surfaces of components that are to be placed against each other with the screw connection must be cleaned and degreased.

5.2. Tightening with torque wrench

1. Using a torque wrench, apply the pre-torque M_{AF} as specified in the "Table of tightening torques" for the respective screwdriving condition.
2. Apply a mark on the screw head that is aligned with a mark applied on the component (see figure 4).
3. Apply a third mark on the component, which indicates the additional angle of rotation $\Delta\Theta$ specified in the "Table of tightening torques" for the screwdriving condition marked in the drawing.
4. Using a suitable wrench (torque or standard wrench), turn the screw so that mark 1 and mark 3 are aligned (see figure 5).

Figure 4 Marks on screw and component after application of pre-torque

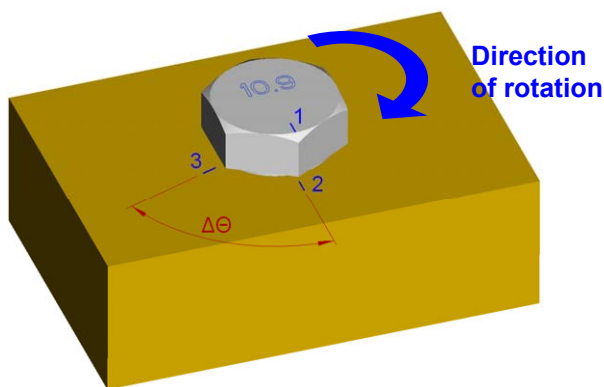
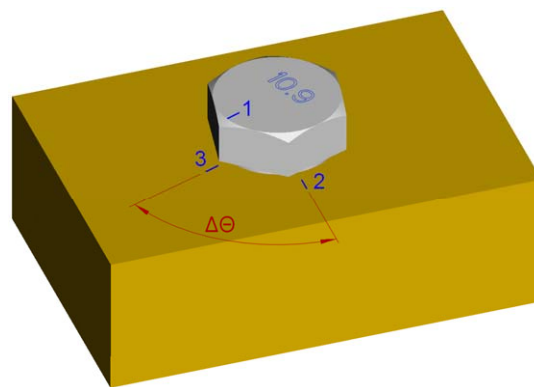


Figure 5 Marks on screw and component turning by additional angle of rotation



5.3. Tightening with electric or hydraulic wrench

1. In the control program of the electric or hydraulic wrench, enter the values for pre-torque M_{AF} , additional angle of rotation $\Delta\Theta$ and the tolerance window for the additional angle of rotation and the final tightening torque. The values are indicated for each screwdriving condition in the "Table of tightening torques".
2. Turn the screws by hand or with a pneumatic wrench. When using a pneumatic wrench, ensure that the screws are only turned, i.e. that the torque of the pneumatic wrench is smaller than the pre-torque!
3. Place the electric or hydraulic wrench on the screw head. Ensure that the reaction arm is suitably positioned.
4. Start the 2-step tightening procedure.
5. Check the achieved result (screw connection OK or NOK), indicated at the wrench tool.
6. Record the values of the achieved tightening torque and the additional angle of rotation.
7. After tightening of all screw connections, test a number of screws using the tightening torque according to LH standard 10409969. The number of screws to be tested depends on the total number of screw connections and is normally between 1 and 3 (see also section 6).

6. Checking during routine maintenance

Screw connections must normally be checked by service personnel at predefined intervals for proper fixture.

For screw connections established with the angle-controlled tightening method, observe the following:

The connections can only be checked as regards the correct tightening torque. To do this, use a torque wrench and apply the tightening torque specified in LH standard 10409969 to the screw connection.

7. Revision log

First issue

2. Table of tightening torques

for LH standard 10650522
(angle-controlled screw tightening)

Screwdriving condition no.	Strength class	Thread d [mm]	Pitch p [mm]	Rated length L [mm]	Thread length Lg [mm]	Grip length Lk [mm]	Head contact dw [mm]	Through-bore dh [mm]	Component edge DA [mm]	Pre-torque MAF [Nm]	Additional angle of rotation Δθ [°]	Torque window (for installation check)	
												Min. [Nm]	Max. [Nm]
0001	10.9	M16	2	55	49	34	24	17	45	113	50 +5	226	374
0002	10.9	M16	2	80	38	52	24	17,5	36	113	46 +5	227	376
0003	10.9	M20	2,5	70	66	47	30	21	45	191	61 +5	441	729
0004	10.9	M20	2,5	80	46	53	30	22	40	192	49 +5	445	736
0005	10.9	M20	2,5	70	66	45	30	21	45	191	58 +5	441	729
0006	10.9	M20	2,5	90	46	53	30	22	40	192	42 +5	445	736
0007	10.9	M20	2,5	90	46	63	30	22	40	192	54 +5	445	736
0008	10.9	M20	2,5	70	66	44	30	21	45	191	57 +5	441	729
0009	10.9	M20	2,5	105	46	77	30	22	60	192	54 +5	445	736
0010	10.9	M24	3	100	56	65	36	26	63	332	45 +5	766	1268
0011	10.9	M24	3	125	56	97	36	26	70	332	59 +5	766	1268
0012	10.9	M27	3	110	66	77	41	29	65	484	59 +5	1113	1864
0013	10.9	M27	3	150	66	116	41	30	70	487	72 +5	1120	1877
0014	10.9	M27	3	140	66	95	41	29	50	484	65 +5	1113	1864
0015	10.9	M27	3	150	66	134	41	30	65	487	91 +5	1120	1877
0016	10.9	M36	4	265	100	208	55	37,5	70	1142	94 +5	2627	4398
0017	10.9	M30	3,5	190	72	141,5	46	32	105	659	62 +5	1517	2530
0018	10.9	M30	3,5	200	72	136,5	46	32	125	659	52 +5	1517	2530
0019	10.9	M30	3,5	180	72	134	46	33	75	663	65 +5	1526	2546
0020	10.9	M36	4	200	84	157	55	38	80	1145	74 +5	2633	4410
0021	10.9	M42	4,5	300	109	265	65	45	110	1842	104 +5	4230	7111
0022	10.9	M24	3	96,5	96,5	50,2	36	26	36	332	68 +5	766	1268
0023	10.9	M24	3	96,5	96,5	53,2	36	26	36	332	72 +5	766	1268
0024	10.9	M30	3,5	119,4	119,4	57,6	46	33	46	663	68 +5	1526	2546
0025	12.9	M56	5,5	220	137	125	85	62	110	5186	67 +5	11878	20124
0026	10.9	M30	3,5	150	72	106	46	33	66	663	60 +5	1526	2546
0027	10.9	M30	3,5	150	72	101	46	32	55	659	60 +5	1517	2530
0028	12.9	M30	3,5	150	72	112	46	33	66	775	77 +5	1786	2979
0029	12.9	M30	3,5	150	72	101	46	32	55	771	71 +5	1776	2960
0030	10.9	M20	2,5	50	46	24	30	21	50	191	33 +5	441	729
0031	10.9	M20	2,5	60	55	29	30	22	46	192	39 +5	445	736
0032	12.9	M20	2,5	110	55	87	30	21	150	223	77 +5	516	853
0033	10.9	M16	2	50	45	19	24	17,5	90	113	30 +5	227	376
0034	10.9	M16	2	45	40	18	24	17,5	60	113	29 +5	227	376
0035	10.9	M16	2	70	65	39	24	17,5	130	113	56 +5	227	376
0036	12.9	M16	2	110	105	43,5	24	17,5	116	133	75 +5	266	440
0037	10.9	M30	3,5	100	95	68,2	46	33	85	663	63 +5	1526	2546
0038	10.9	M30	3,5	200	72	156	46	33	66	663	75 +5	1526	2546

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Filling quantities

1 General filling quantities


Note!

For correct fuels and lubricants, refer to group 1.51 "Fuels and lubricants".

For change intervals, refer to the inspection and maintenance schedule of the respective machine in group 3.

1.1 Hydraulic system

Machine	Type	System capacity (litre)	Tank capacity (litre)	Change volume (litre)
A 900 C EDC	1002	320	175	approx. 220
A 904 C EDC	1003	340	175	approx. 220
A 904 C-HD EDC	1004	340	175	approx. 220
A 904 C EDC	1005	340	175	approx. 220
A 904 C EDC	1071	340	175	approx. 220
A 914 C EDC	1044	470	250	approx. 330
A 914 C EDC	1045	470	250	approx. 330
A 924 C EDC	1047	500	250	approx. 330
A 924 C EDC	1048	500	250	approx. 330
A 924 C EDC	1049	500	250	approx. 330
A 924 C EDC	1050	500	250	approx. 330
A 924 C EDC	1051	500	250	approx. 330

Tab. 1 Hydraulic system

1.2 Diesel engine

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 900 C EDC	1002	28.5	-	approx. 28.0
A 904 C EDC	1003	28.5	-	approx. 28.0
A 904 C-HD EDC	1004	28.5	-	approx. 28.0
A 904 C EDC	1005	28.5	-	approx. 28.0
A 904 C EDC	1071	28.5	-	approx. 28.0
A 914 C EDC	1044	28.5	-	approx. 28.0

General filling quantities

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 914 C EDC	1045	28.5	-	approx. 28.0
A 924 C EDC	1047	28.5	-	approx. 28.0
A 924 C EDC	1048	28.5	-	approx. 28.0
A 924 C EDC	1049	28.5	-	approx. 28.0
A 924 C EDC	1050	28.5	-	approx. 28.0
A 924 C EDC	1051	28.5	-	approx. 28.0

Tab. 2 Diesel engine**1.3 Fuel tank**

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 900 C EDC	1002	290	-	-
A 904 C EDC	1003	350	-	-
A 904 C-HD EDC	1004	350	-	-
A 904 C EDC	1005	350	-	-
A 904 C EDC	1071	350	-	-
A 914 C EDC	1044	400	-	-
A 914 C EDC	1045	400	-	-
A 924 C EDC	1047	400	-	-
A 924 C EDC	1048	400	-	-
A 924 C EDC	1049	400	-	-
A 924 C EDC	1050	400	-	-
A 924 C EDC	1051	400	-	-

Tab. 3 Fuel tank**1.4 Coolant**

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 900 C EDC	1002	30	-	approx. 30
A 904 C EDC	1003	30	-	approx. 30
A 904 C-HD EDC	1004	30	-	approx. 30
A 904 C EDC	1005	30	-	approx. 30
A 904 C EDC	1071	30	-	approx. 30

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 914 C EDC	1044	35	-	approx. 35
A 914 C EDC	1045	35	-	approx. 35
A 924 C EDC	1047	35	-	approx. 35
A 924 C EDC	1048	35	-	approx. 35
A 924 C EDC	1049	35	-	approx. 35
A 924 C EDC	1050	35	-	approx. 35
A 924 C EDC	1051	35	-	approx. 35

Tab. 4 *Coolant*

1.5 Slewing gear mechanism

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 900 C EDC	1002	5.0	-	approx. 5.0
A 904 C EDC	1003	5.0	-	approx. 5.0
A 904 C-HD EDC	1004	5.0	-	approx. 5.0
A 904 C EDC	1005	5.0	-	approx. 5.0
A 904 C EDC	1071	5.0	-	approx. 5.0
A 914 C EDC	1044	6.0	-	approx. 6.0
A 914 C EDC	1045	6.0	-	approx. 6.0
A 924 C EDC	1047	6.0	-	approx. 6.0
A 924 C EDC	1048	6.0	-	approx. 6.0
A 924 C EDC	1049	6.0	-	approx. 6.0
A 924 C EDC	1050	6.0	-	approx. 6.0
A 924 C EDC	1051	6.0	-	approx. 6.0

Tab. 5 *Slewing gear mechanism*

1.6 Transmission

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 900 C EDC	1002	3.0	-	approx. 3.0
A 904 C EDC	1003	3.0	-	approx. 3.0
A 904 C-HD EDC	1004	3.0	-	approx. 3.0
A 904 C EDC	1005	3.0	-	approx. 3.0

General filling quantities

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 904 C EDC	1071	3.0	-	approx. 3.0
A 914 C EDC	1044	3.0	-	approx. 3.0
A 914 C EDC	1045	3.0	-	approx. 3.0
A 924 C EDC	1047	3.0	-	approx. 3.0
A 924 C EDC	1048	3.0	-	approx. 3.0
A 924 C EDC	1049	3.0	-	approx. 3.0
A 924 C EDC	1050	3.0	-	approx. 3.0
A 924 C EDC	1051	3.0	-	approx. 3.0

Tab. 6 Transmission**1.7 Rigid axle**

Machine	Type	System capacity (litre)	-	Change volume (litre)
Differential/*wide track				
A 900 C EDC	1002	12.6/13.6*	-	approx. 12.6/13.6*
A 904 C EDC	1003	13.1/14.5*	-	approx. 13.1/14.5*
A 904 C-HD EDC	1004	14.5	-	approx. 14.5
A 904 C EDC	1005	13.1/14.5*	-	approx. 13.1/14.5*
A 904 C EDC	1071	13.1/14.5*	-	approx. 13.1/14.5*
A 914 C EDC	1044	13.1/14.5*	-	approx. 13.1/14.5*
A 914 C EDC	1045	13.1/14.5*	-	approx. 13.1/14.5*
A 924 C EDC	1047	14.5	-	approx. 14.5
A 924 C EDC	1048	14.5	-	approx. 14.5
A 924 C EDC	1049	14.5	-	approx. 14.5
A 924 C EDC	1050	19.0	-	approx. 19.0
A 924 C EDC	1051	19.0	-	approx. 19.0
Wheel hubs				
A 900 C EDC	1002	2.5 each	-	approx. 2.5 each
A 904 C EDC	1003	2.5 each	-	approx. 2.5 each
A 904 C-HD EDC	1004	2.5 each	-	approx. 2.5 each
A 904 C EDC	1005	2.5 each	-	approx. 2.5 each
A 904 C EDC	1071	2.5 each	-	approx. 2.5 each
A 914 C EDC	1044	2.5 each	-	approx. 2.5 each
A 914 C EDC	1045	2.5 each	-	approx. 2.5 each

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 924 C EDC	1047	2.5 each	-	approx. 2.5 each
A 924 C EDC	1048	2.5 each	-	approx. 2.5 each
A 924 C EDC	1049	2.5 each	-	approx. 2.5 each
A 924 C EDC	1050	3.0 each	-	approx. 3.0 each
A 924 C EDC	1051	3.0 each	-	approx. 3.0 each

Tab. 7 Rigid axle

1.8 Steering axle

Machine	Type	System capacity (litre)	-	Change volume (litre)
Differential/*wide track				
A 900 C EDC	1002	9.5/10.6*	-	approx. 9.5/10.6*
A 904 C EDC	1003	9.6/11.0*	-	approx. 9.6/11.0*
A 904 C-HD EDC	1004	11.0	-	approx. 11.0
A 904 C EDC	1005	9.6/11.0*	-	approx. 9.6/11.0*
A 904 C EDC	1071	9.6/11.0*	-	approx. 9.6/11.0*
A 914 C EDC	1044	9.6/11.0*	-	approx. 9.6/11.0*
A 914 C EDC	1045	9.6/11.0*	-	approx. 9.6/11.0*
A 924 C EDC	1047	11.0	-	approx. 11.0
A 924 C EDC	1048	11.0	-	approx. 11.0
A 924 C EDC	1049	11.0	-	approx. 11.0
A 924 C EDC	1050	26.5	-	approx. 26.5
A 924 C EDC	1051	26.5	-	approx. 26.5
Wheel hubs				
A 900 C EDC	1002	2.5 each	-	approx. 2.5 each
A 904 C EDC	1003	2.5 each	-	approx. 2.5 each
A 904 C-HD EDC	1004	2.5 each	-	approx. 2.5 each
A 904 C EDC	1005	2.5 each	-	approx. 2.5 each
A 904 C EDC	1071	2.5 each	-	approx. 2.5 each
A 914 C EDC	1044	2.5 each	-	approx. 2.5 each
A 914 C EDC	1045	2.5 each	-	approx. 2.5 each
A 924 C EDC	1047	2.5 each	-	approx. 2.5 each
A 924 C EDC	1048	2.5 each	-	approx. 2.5 each
A 924 C EDC	1049	2.5 each	-	approx. 2.5 each

General filling quantities

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 924 C EDC	1050	3.0 each	-	approx. 3.0 each
A 924 C EDC	1051	3.0 each	-	approx. 3.0 each

Tab. 8 *Steering axle***1.9 Pump distributor gear**

Machine	Type	System capacity (litre)	-	Change volume (litre)
A 900 C EDC	1002	-	-	-
A 904 C EDC	1003	1.9	-	approx. 1.9
A 904 C-HD EDC	1004	1.9	-	approx. 1.9
A 904 C EDC	1005	1.9	-	approx. 1.9
A 904 C EDC	1071	1.9	-	approx. 1.9
A 914 C EDC	1044	1.9	-	approx. 1.9
A 914 C EDC	1045	1.9	-	approx. 1.9
A 924 C EDC	1047	1.9	-	approx. 1.9
A 924 C EDC	1048	1.9	-	approx. 1.9
A 924 C EDC	1049	1.9	-	approx. 1.9
A 924 C EDC	1050	1.9	-	approx. 1.9
A 924 C EDC	1051	1.9	-	approx. 1.9

Tab. 9 *Pump distribution gear***1.10 Windscreen washer system**

Machine	Type	System capacity (litre)	-	Refill volume (litre)
A 900 C EDC	1002	3.0	-	-
A 904 C EDC	1003	3.0	-	-
A 904 C-HD EDC	1004	3.0	-	-
A 904 C EDC	1005	3.0	-	-
A 904 C EDC	1071	3.0	-	-
A 914 C EDC	1044	5.0	-	-
A 914 C EDC	1045	5.0	-	-
A 924 C EDC	1047	5.0	-	-
A 924 C EDC	1048	5.0	-	-

Machine	Type	System capacity (litre)	-	Refill volume (litre)
A 924 C EDC	1049	5.0	-	-
A 924 C EDC	1050	5.0	-	-
A 924 C EDC	1051	5.0	-	-

Tab. 10 Windscreen washer system

1.11 Air-conditioning system

Machine	Type	System capacity	-	Change volume
Coolant (kg)				
A 900 C EDC	1002	approx. 1.4	-	approx. 1.4
A 904 C EDC	1003	approx. 1.4	-	approx. 1.4
A 904 C-HD EDC	1004	approx. 1.4/1.6*	-	approx. 1.4/1.6*
A 904 C EDC	1005	approx. 1.4/1.6*	-	approx. 1.4/1.6*
A 904 C EDC	1071	approx. 1.4/1.6*	-	approx. 1.4/1.6*
A 914 C EDC	1044	approx. 1.4	-	approx. 1.4
A 914 C EDC	1045	approx. 1.4	-	approx. 1.4
A 924 C EDC	1047	approx. 1.4/1.6*	-	approx. 1.4/1.6*
A 924 C EDC	1048	approx. 1.4/1.6*	-	approx. 1.4/1.6*
A 924 C EDC	1049	approx. 1.4/1.6*	-	approx. 1.4/1.6*
A 924 C EDC	1050	approx. 1.4/1.6*	-	approx. 1.4/1.6*
A 924 C EDC	1051	approx. 1.4/1.6*	-	approx. 1.4/1.6*
* with operator's cab elevation				
Coolant volume in cooling circuit (cm ³)				
A 900 C EDC	1002	200	-	approx. 200
A 904 C EDC	1003	200	-	approx. 200
A 904 C-HD EDC	1004	200	-	approx. 200
A 904 C EDC	1005	200	-	approx. 200
A 904 C EDC	1071	200	-	approx. 200
A 914 C EDC	1044	200	-	approx. 200
A 914 C EDC	1045	200	-	approx. 200
A 924 C EDC	1047	200	-	approx. 200
A 924 C EDC	1048	200	-	approx. 200
A 924 C EDC	1049	200	-	approx. 200
A 924 C EDC	1050	200	-	approx. 200

General filling quantities

Machine	Type	System capacity	-	Change volume
A 924 C EDC	1051	200	-	approx. 200

Tab. 11 *Air-conditioning system*

Fuels, lubricants and process chemicals

1 General information

Observe the instructions for lubricants and process chemicals. Lubricate the machine and change the oils at the prescribed intervals. For more information, see lubrication chart and inspection and maintenance schedule.

Keep workplaces for these activities clean. This enhances the service life and reliability of the machine.

- ▶ All work on the machine must be carried out while it is standing on firm and level ground.
- ▶ Shut down the diesel engine, remove the ignition key and set the battery main switch to position 0 (OFF).
- ▶ Clean lubricating nipples before adding grease.
- ▶ Clean all filling points and the area around them before opening the caps and screws.
- ▶ The oil should be changed while it is at operating temperature.
- ▶ After each oil change or refilling, check the fill level in the respective unit (the specified fill levels are guide values).
- ▶ Collect used oil and chemicals in suitable containers and dispose of them according to the applicable statutory regulations.

Recommended lubricants

2 Recommended lubricants

Designation	Recommended lubricant	Symbol
Diesel engine	Liebherr Motoroil 10W-40 Liebherr Motoroil 10W-40 low ash Liebherr Motoroil 5W-30	
Hydraulic system (system capacity / oil change volume / tank capacity)	Liebherr Hydraulic Basic 68 Liebherr Hydraulic Basic 100 Liebherr Hydraulic HVI Liebherr Hydraulic Plus Liebherr Hydraulic Plus Arctic	
Slewing gear mechanism	Liebherr Gear Basic 90 LS	
Transmission	Liebherr Motoroil 10W-40	
Rigid axle	Liebherr Gear Basic 90 LS	
Wheel hubs of the rigid axle	Liebherr Gear Basic 90 LS	
Steering axle	Liebherr Gear Basic 90 LS	
Wheel hubs of the steering axle	Liebherr Gear Basic 90 LS	
Tracks and gearing of the slewing ring, bearing of the equipment	Liebherr Universalfett 9900	
Hinges, joints, locks	Engine oil	-

3 Recommended fuels and chemicals

Designation	Recommended fuel	Symbol
Fuel tank	Conventional diesel fuel	
Coolant	Liebherr Antifreeze Mix Liebherr Antifreeze Concentrate	
Windscreen washer system	Conventional windscreen cleaning agent or denatured alcohol	-

4 Specifications for fuels, lubricants and process chemicals

4.1 Diesel fuels

4.1.1 Specification



The diesel fuels must meet the minimum requirements of the fuel specifications outlined below.

Approved specifications:

- DIN EN 590
- ASTM D 975 (89a) - 1D and 2D

The fuel supplier must submit a fuel certificate (fuel specification, sulphur content, lubricity, cetane number)

4.1.2 Sulphur content, lubricity

The following restrictions apply:

- Do not use fuels with a sulphur content of more than 1 % (10,000 mg/kg).
- When using engine oils conforming to specification E6 and standard oil change intervals (every 500 operating hours): Do not use fuels with a sulphur content of more than 0.005 % (50 mg/kg).
- When using exhaust gas purification units (particle filters): Do not use fuels with a sulphur content of more than 0.005 % (50 mg/kg).
- Diesel engines with external exhaust gas return system: We recommend using fuels with a sulphur content of less than 0.005 % (50 mg/kg).

Additional information: see oil change intervals for operation under adverse conditions.

According to DIN EN 590, diesel fuels must have a lubricity determined by HFRR test (corrected wear scar diameter [wsd 1.4] at 60 °C) of maximum 460 µm

The ASTM D 975 fuel standard does not specify that the fuels must undergo a fuel lubricity test. The required additives should be added by the supplier, who is responsible for the quality of the fuel.

4.1.3 Cetane number

ASTM D 975 fuels must have a cetane number of minimum 45. A cetane number of more than 50 is preferable, especially at temperatures below 0 °C (32 °F).

4.1.4 Low temperature operation

At low temperatures, paraffin crystals are formed in the diesel fuel. They increase the flow stress in the fuel filter so that the diesel engine might not be supplied with sufficient fuel.



Caution!

The use of an unsuitable fuel can cause damage to the diesel engine. Adding petroleum, normal car petrol or other substances damages the injection system.

- ▶ Never add petroleum, car petrol or other additives to the diesel fuel.
- ▶ At ambient temperatures of below -20 °C: use start-up aid (e.g. fuel filter heater).
- ▶ For operation of the machine under arctic conditions: use special diesel fuels that offer adequate viscosity.

4.2 Lubricating oil for the diesel engine

4.2.1 Quality



Modern diesel engines must be lubricated with high-performance oils. They consist of a basic oil with special additives.

The lubricating oil requirements for LIEBHERR diesel engines are based on the following standards and regulations:

Designation	Specification
ACEA classification (Association des Constructeurs Européens de l'Automobile)	E4, E6, E7 Caution: particle filter only permitted with E6
API classification (American Petroleum Institute)	CH-4, CI-4 Caution: observe shorter oil change intervals

Tab. 1 Lubricating oil specifications

If LIEBHERR oils are not available locally, use an oil that conforms to the specifications (before choosing an oil, contact our customer service department).

4.2.2 Viscosity

The choice of the lubricating oil viscosity is based on the SAE classification (Society of Automotive Engineers). The SAE classification does not provide any indication as regards the quality of a lubricating oil. The relevant factor for the correct choice of SAE class is the ambient temperature.

Excessively high viscosity might lead to start-up problems. If the viscosity is too low, the oil's lubrication might not be sufficiently efficient.

The temperature ranges shown in the diagram are approximate ranges that might temporarily be exceeded.

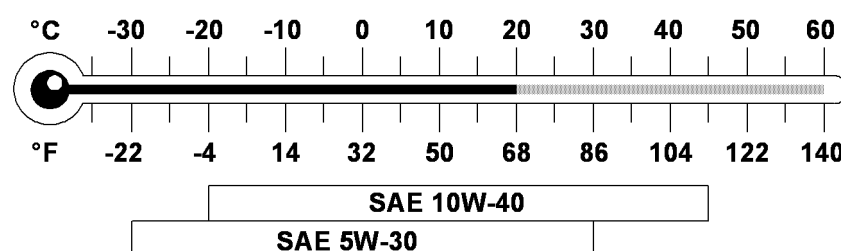


Fig. 1 Temperature-based selection of the SAE class

For ambient temperatures of -20 °C (-4 °F) to +45 °C (+113 °F), we recommend the following diesel engine oils:

Liebherr Motoroil 10W-40, specification ACEA E4

Liebherr Motoroil 10W-40 low ash, specification ACEA E6

For ambient temperatures of -30 °C (-22 °F) to +30 °C (+86 °F), we recommend the following diesel engine oils:

Liebherr Motoroil 10W-30, specification ACEA E4

4.2.3 Adverse operating conditions affecting the oil change intervals

Oil change intervals: see chapter "Inspection and maintenance schedule".

Subsequent oil changes depend on the climate, the sulphur content of the fuel and the oil grade. For details, see the table below.

If the specified operating hours (h) per year are not reached, the diesel engine oil and the filter must be changed at least once every year.

A number of **adverse factors** (unfavourable operating conditions) affect the length of the maintenance interval.

Possible adverse factors:

- Frequent cold starts
- Sulphur content of fuel
- Operating temperature

If such factors apply, the oil and filter must be changed according to the table below.

Adverse factor		Oil quality	
		CH-4, CI-4	E4 / E7*
Operating conditions	Sulphur content of fuel	Interval	
Normal climate, to -10 °C	to 0.5 %	250 h	500 h
	between 0.5 % and 1 %	125 h	250 h
below -10 °C	to 0.5 %	125 h	250 h
	between 0.5 % and 1 %	not permissible	125 h

Adverse factor		Oil quality
		E6
Operating conditions	Sulphur content of fuel	Interval
Normal climate, to -10 °C	to 0.005 %	500 h
	between 0.005 % and 0.05 %	250 h
	between 0.0501 % and 0.1 %	125 h
below -10 °C	to 0.005 %	250 h
	between 0.005 % and 0.05 %	125 h
	between 0.0501 % and 0.1 %	not permissible

h= operating hours

* TBN minimum 13 mg KOH/g

5 Coolant for the diesel engine

5.1 General recommendations



The radiator system works only properly when pressurised. It is therefore imperative that it is kept clean and sealed at all times, that the radiator sealing and operating valves work properly and that the required coolant level is maintained.

Corrosion inhibitors/antifreeze agents approved by LIEBHERR ensure proper protection against frost, corrosion and cavitation without causing damage to seals and hoses and without foaming.

Coolants that contain unsuitable corrosion inhibitors or antifreeze agents or that have been prepared incorrectly might cause failure of assemblies and component parts in the coolant circuit due to cavitation or corrosion. Heat-insulating deposits on components that conduct heat might result in overheating and consequently failure of the engine.

Coolant for the diesel engine

5.2 Water (fresh water)

Clear and clean water free of particles that meets the following chemical requirements is suitable for use as a coolant.

Do not use sea water, brackish water, brine or industrial wastewater.

Designation	Value / unit
Total alkaline earth metals (water hardness)	0.6 to 3.6 mmol/l (3 to 20 °dH)
pH at 20 °C	6.5 to 8.5
Chloride ion concentration	max. 80 mg/l
Sulphate ion concentration	max. 100 mg/l

Tab. 2 Fresh water quality

Designation	Value / unit
Total alkaline earth metals (water hardness)	0.6 to 2.7 mmol/l (3 to 15 °dH)
pH at 20 °C	6.5 to 8.0
Chloride ion concentration	max. 80 mg/l
Sulphate ion concentration	max. 80 mg/l

Tab. 3 Fresh water quality with use of DCA 4*

* = Diesel Coolant Additives

Water analysis results are available from the local authorities.

5.3 Mixing ratio for coolant

The coolant must contain min. 50% corrosion inhibitor and antifreeze agent at **all times of the year**.

Outdoor temperature to	Mixing ratio	
	Water %	Corrosion inhibitor/antifreeze agent %
-37 °C	50 %	50 %
-50 °C	40 %	60 %

Tab. 4 Permissible mixing ratio (for all seasons)

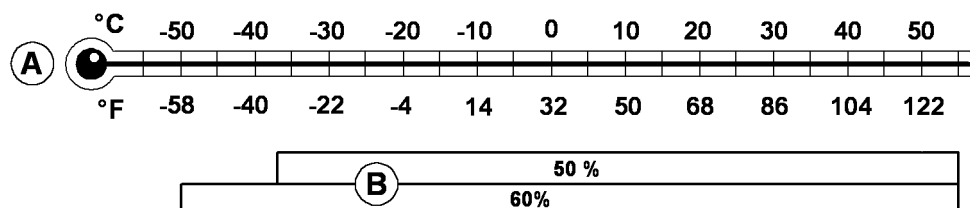


Fig. 2 Temperature-based mixing ratio of water + corrosion inhibitor / antifreeze agent

A Ambient temperature

B Corrosion inhibitor/antifreeze agent concentration in coolant

5.4 Permissible corrosion inhibitors/antifreeze agent



Note!

Improper mixing of different products might negatively affect the properties of the coolant and cause damage to the cooling system.

- ▶ Use only approved products. Do not mix different products.
- ▶ Never mix products containing silicone with silicone-free products.
- ▶ If the recommended LIEBHERR product is not available locally:
contact the LIEBHERR customer service department; choose a product conforming to the "Coolant specifications for LIEBHERR diesel engines".

Concentrate	
Product name	Manufacturer
Liebherr Antifreeze Concentrate	Liebherr

Ready-mixed corrosion inhibitor/antifreeze agent (premix)	
Product name	Manufacturer
Liebherr Antifreeze Mix	Liebherr

Premix = ready-mixed product (50 % water and 50 % corrosion inhibitor/antifreeze agent)

5.5 Approved corrosion inhibitors without antifreeze agent



Note!

Improper mixing of different products might negatively affect the properties of the coolant and cause damage to the cooling system.

- ▶ Use only approved products. Do not mix different products.
- ▶ Never mix products containing silicone with silicone-free products.
- ▶ If the recommended LIEBHERR product is not available locally:
contact the LIEBHERR customer service department; choose product conforming to the "Coolant specifications for LIEBHERR diesel engines".

In **exceptional circumstances** and at **ambient temperatures that are always above the freezing point**, e.g. during use in tropical regions where there are no corrosion inhibitors/antifreeze agents available, the following inhibitors must be added to the coolant:

- DCA 4 (Diesel Coolant Additives 4)
- Caltex / Chevron / Havoline / Total product

In this case, the coolant must be changed annually.

As part of routine maintenance work, check the concentration and correct it, if necessary.

Product name	Manufacturer
DCA 4 Diesel Coolant Additives	Fleetguard / Cummins Filtration
Caltex CL Corrosion Inhibitor Concentrate	Chevron Texaco
Chevron Heavy Duty Extended Life Corrosion Inhibitor Nitrite Free (ELC)	Chevron Texaco
Havoline Extended Life Corrosion Inhibitor (XLI)	Chevron Texaco
Total WT Supra	Total, Paris

6 Hydraulic oil



Hydraulic oils must meet the requirements outlined below.
Maximum water content of hydraulic oil: < 0.1 %

6.1 Hydraulic oil

LIEBHERR recommends using the following hydraulic oils in its machines (depending on temperature range):

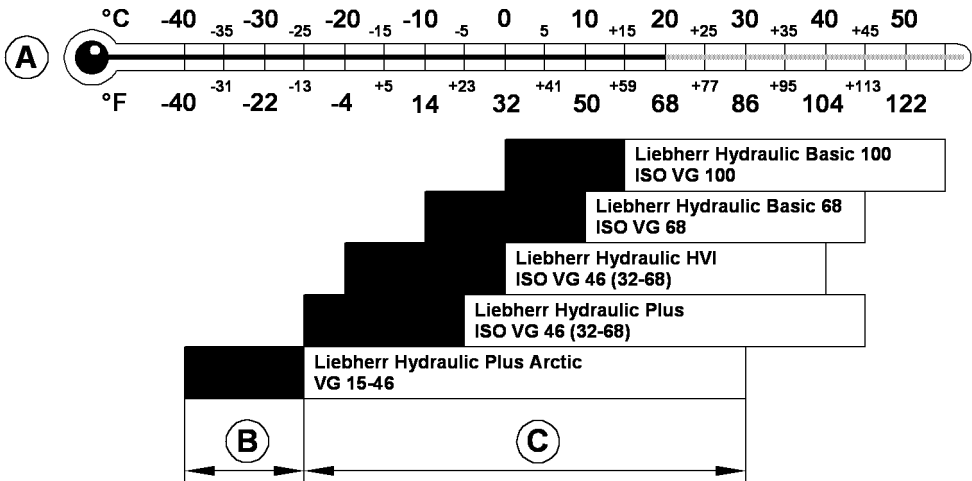


Fig. 3 Hydraulic oil for use as hydraulic fluid (ISO classes)*

- A Ambient temperature
- B Cold-start range with warm-up
- C Operating range

* temperature-based selection of the ISO class

Liebherr Hydraulic Plus and **Liebherr Hydraulic Plus Arctic** are suitable for both bio and long-term use.

If LIEBHERR oils are not available locally, use one of the engine oils listed in the section below (before choosing an oil, contact the respective customer service department).

Use only LIEBHERR hydraulic oils. The use of other oils is not permitted.

6.2 Engine oil used as hydraulic fluid

When using engine oil (third-party products) as hydraulic fluids, we advise customers to request a certificate from the oil manufacturer, confirming that the product meets the following specifications.

Engine oils that are to be used as hydraulic fluids must conform to the following specifications:

Single grade oils (1):	API - CD / ACEA - E1 (MB 226.0 and 227.0)
Multigrade oils (2):	API - CD, CE, CF / ACEA - E2, E3, E4 (MB 227.5, 228.1, 228.3 and 228.5)

Tab. 5 Engine oils for use as hydraulic fluids

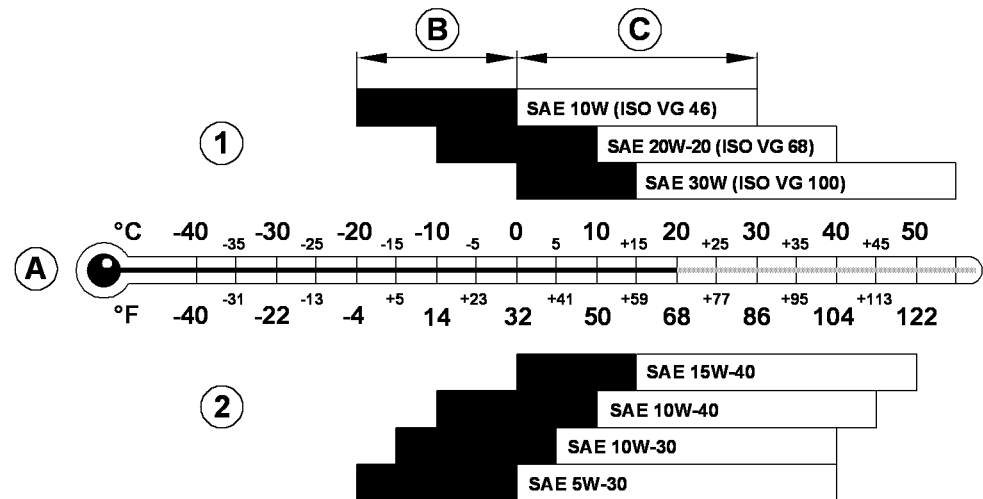


Fig. 4 Engine oil for use as hydraulic fluid (SAE classes)*

- | | | | |
|----------|-------------------------------|----------|-------------------|
| A | Ambient temperature | 1 | Single grade oils |
| B | Cold-start range with warm-up | 2 | Multigrade oils |
| C | Operating range | | |

* temperature-based selection of the SAE class; for deviating viscosity grade, consult LIEBHERR customer service.

6.3 Warm-up instruction

The black bar **B** indicates ambient temperatures that are up to 20 °C below the operating range **C**.

For cold starting at an ambient temperature below range **B**, the following warm-up instruction for hydraulic oil applies:

- **1.:** Start the diesel engine and run it at approx. 1 / 2 rated speed. Carefully activate the working hydraulics. Operate the hydraulic cylinders and move them to the stop. After approx. 5 minutes, start the travel hydraulics. Warm-up time: approx. 10 minutes.

For cold starting at even lower ambient temperatures, follow the warm-up instruction below:

- **2.:** Before starting the engine, warm up the hydraulic oil tank. Then proceed according to the warm-up instruction in **1**.

6.4 Biodegradable hydraulic oils



Caution!

Do not mix bio hydraulic oils with mineral oils!

When mixing ester-based biodegradable hydraulic oils with mineral oils, aggressive chemical reactions might occur, causing damage to the hydraulic equipment.

- Therefore never mix biodegradable hydraulic fluids from different producers, and never mix bio hydraulic oils with mineral oils!

LIEBHERR recommends using the following hydraulic oils in its machines (depending on the temperature range):

Liebherr Hydraulic Plus or **Liebherr Hydraulic Plus Arctic**

These products are polyalphaolefins (HEPR) conforming to CEC-L-33-A-93, and are biodegradable.

**Thank you very much
for your reading.**

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