

FAG



Hand pump PUMP1000-4L-CONTROL

User manual

SCHAEFFLER GROUP
INDUSTRIAL

Safety guidelines and symbols

High product safety Our products correspond to the current level of research and technology. If the bearing arrangement is designed correctly, the products are handled and fitted correctly and as agreed and if they are maintained as instructed, they do not give rise to any direct hazards.

Follow instructions This publication describes standard products. Since these are used in numerous applications, we cannot make a judgement as to whether any malfunctions will cause harm to persons or property.

It is always and fundamentally the responsibility of the designer and user to ensure that all specifications are observed and that all necessary safety information is communicated to the end user. This applies in particular to applications in which product failure and malfunction may constitute a hazard to human beings.

Definition of guidelines and symbols The warning and hazard symbols are defined along the lines of ANSI Z535.6–2006.

The meaning of the guidelines and symbols is as follows:

Warning 

If these safety guidelines are not observed, death or serious injury may occur.



If these safety guidelines are not observed, damage or malfunctions in the product or the adjacent construction will occur.

Note There follows additional or more detailed information that must be observed.

① Numbers within a circle are item numbers.

Hand pump

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Hand pump

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Hand pump

Features

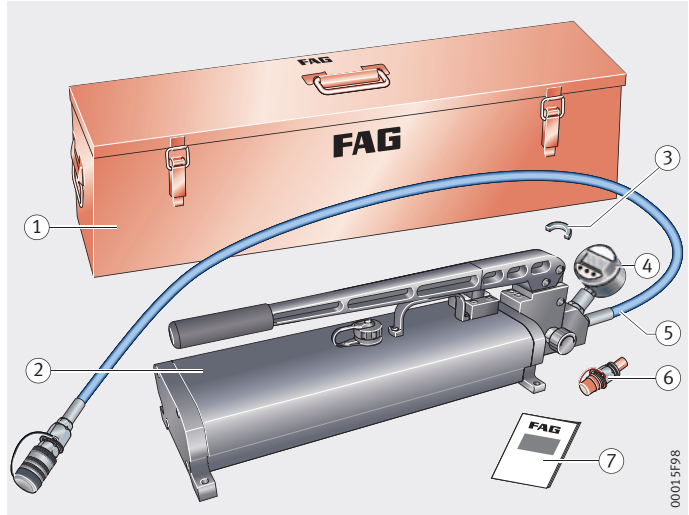
The hand pump and accessories are supplied in a sturdy metal case made from sheet steel. The metal case and parts should be checked immediately for any damage during transit. The carrier should be informed of any damage without delay.

Scope of delivery

The items included in delivery are shown in *Figure 1*.

- ① Metal case
- ② Hand pump
- ③ Spacer ring (half ring), HYDNUT50 to 150
- ④ Digital manometer
- ⑤ High pressure hose with coupling sleeve
- ⑥ Coupling nipple
- ⑦ User manual

Figure 1
Scope of delivery



Warning

If the hand pump or accessories are damaged, they must not be used. Do not attempt to carry out repairs. Any repair work required should be carried out by Schaeffler KG, Schweinfurt.

Hand pump

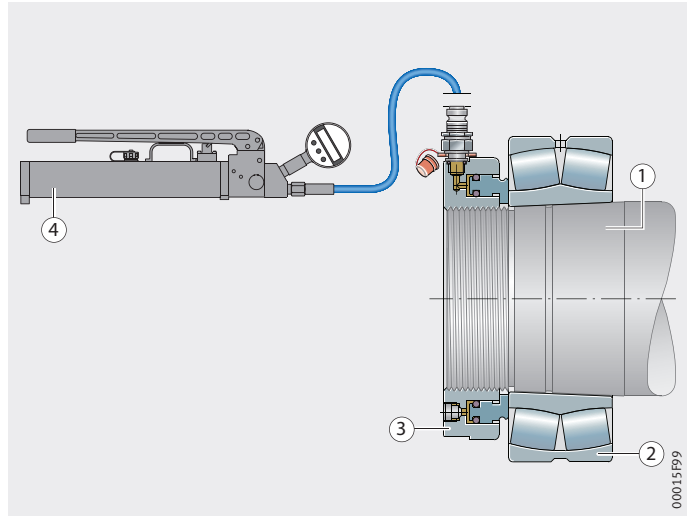
Design and safety guidelines

Intended purpose

The hand pump PUMP1000-4L-CONTROL is used to operate FAG hydraulic nuts. These are used to mount rolling bearings on a tapered seat, *Figure 2*.

- ① Tapered seat
- ② Rolling bearing
- ③ Hydraulic nut
- ④ Hand pump

Figure 2
Mounting



Note The hand pump can also be used for dismounting, see BA 007, FAG Hand Pump Sets.

Qualified personnel The hand pump must only be used by qualified personnel.

A person defined as qualified personnel:

- is authorised to use the hand pump
- has all the necessary knowledge
- is familiar with the safety guidelines
- has read and understood this manual.

Protective equipment Protective equipment is intended to protect personnel against health hazards.

When working with the hand pump, the following protective equipment must be used at all times:

- protective goggles
- gloves or oil-based cream.

Hydraulic oil

The only hydraulic oils that can be used are:

- any hydraulic oils with a viscosity of 32 mm²/s at +40 °C.



Only clean hydraulic oil should be used.

If the oil is not clean, this may lead to blockage of the filter fitted.

Warning



Hydraulic oil can cause irritation to skin and respiratory passages. Skin contact should therefore be avoided, vapours and fumes should not be inhaled. Eyes must be protected against hydraulic oil.

Maximum pressure

The hand pump delivers a pressure of up to 1000 bar. The maximum pressure that can be used with a hydraulic nut is 800 bar.

Warning



800 bar must never be exceeded.

The manometer must be monitored continuously during operation.

Ambient conditions

The hand pump should be used under the following ambient conditions:

- The surface underneath must be even and capable of supporting loads
- Temperature: 0 °C to +60 °C
- Humidity: max. 90%, no condensation.



Ensure that the ambient conditions are maintained throughout the operating period.

Hand pump

Initial operation

This manual describes the initial operation of the hand pump, for information on the initial operation of hydraulic nuts see BA 004, FAG Hydraulic Nuts.

Checking the hand pump

Before any use, check the hand pump and the accessories to be used, *Figure 3*.

- ① Hand pump
- ② Tank
- ③ Tank lid
- ④ Escape valve
- ⑤ Spacer ring (half ring), HYDNUT50 to 150
- ⑥ Digital manometer
- ⑦ High pressure hose

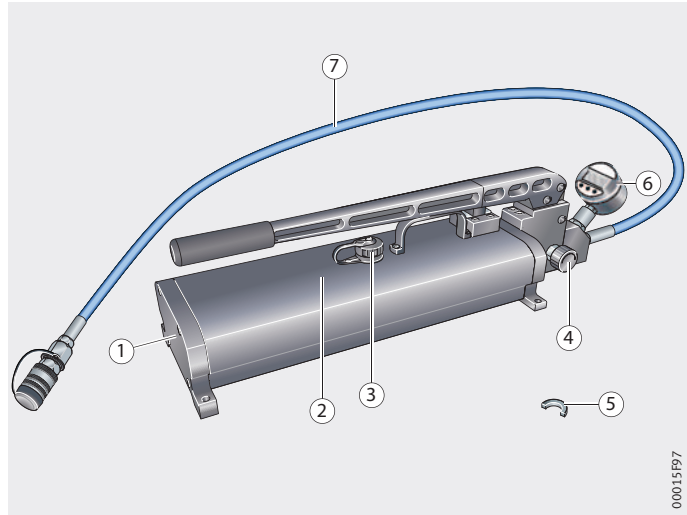


Figure 3

Checking for initial operation

The hand pump can only be put into operation if all the following questions can be answered with “yes”:

- Is the hand pump ① free from corrosion, cracks and damage?
- Is the tank ② completely filled with a suitable hydraulic oil, see page 7?
- Is the escape valve ④ easy to move and free from damage?
- Is the battery in digital manometer ⑥ in acceptable condition (if not, see the section Changing the battery, page 20)?
- Is the high pressure hose ⑦ free from damage and kinks?
- Is the high pressure hose suitable for at least 1000 bar?
- Is the required stroke volume set (see the section Setting the stroke volume, page 9)?



If the hand pump or accessories are damaged, they must not be used. Do not attempt to carry out repairs. Any repair work required should be carried out by Schaeffler KG, Schweinfurt.

Setting the stroke volume

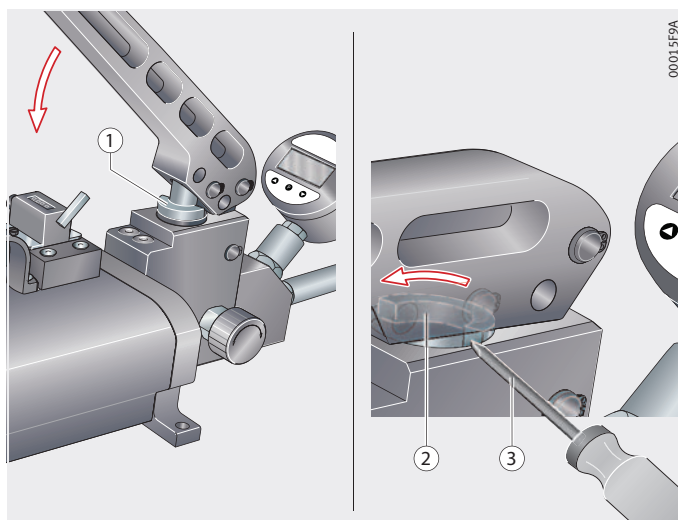
The stroke volume of the hand pump can be adjusted as a function of the hydraulic nut used.

Spacer ring

The spacer ring (half ring) restricts the stroke and thus reduces the stroke volume. The volume without a spacer ring (half ring) is 0,9 cm³ per stroke, when the spacer ring (half ring) is mounted, 0,2 cm³ of hydraulic oil is pressed into the hydraulic nut on a complete stroke.

- ① Spacer ring (half ring), position A
- ② Spacer ring (half ring), position B
- ③ Screwdriver

Figure 4
Spacer ring (half ring)



The spacer ring (half ring) should be mounted when using:
■ HYDNUT50 to HYDNUT150.

Mounting the spacer ring

A small flat blade screwdriver is recommended as a mounting tool, Figure 4:

- Insert the spacer ring (half ring) ① (position A, ②)
- Press the arm of the hand pump down almost to the stop
- Rotate the spacer ring (half ring) by 180° into position B, ③.

Dismounting the spacer ring

- Press the arm down almost to the stop
- Rotate the spacer ring (half ring) by 180° into position A, ②
- Move the arm upwards
- Remove the spacer ring (half ring).

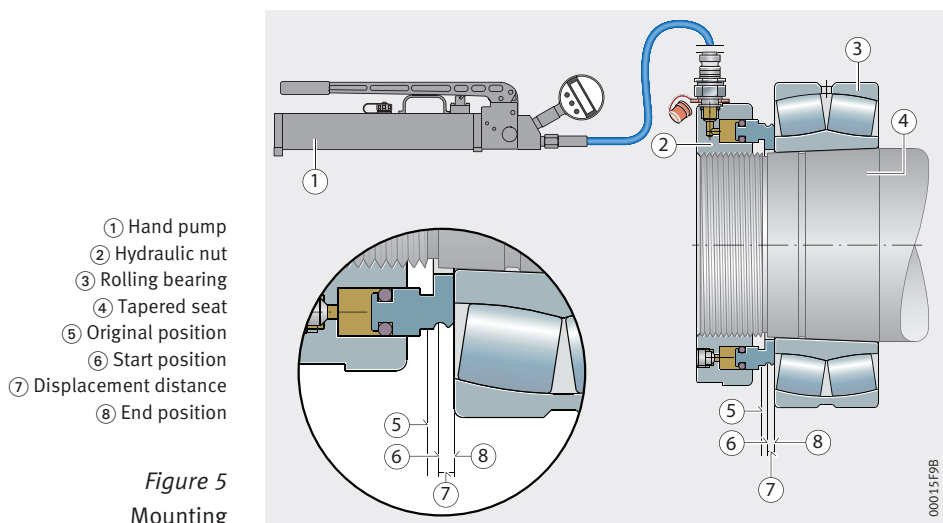


Do not replace the spacer ring (half ring) during operation of the pump. Any inaccuracies in the displacement distance can damage the bearing.

Hand pump

Operation The mounting operation begins with mounting of the rolling bearing on the tapered seat, *Figure 5*. Slide the rolling bearing gently onto the shaft or slide the mounting sleeve into the original position. A suitable hydraulic nut is then screwed onto the shaft and the hand pump is connected. The hand pump is then operated until the pressure to reach the start position is achieved. The hand pump is now operated (number of strokes in accordance with the table) until the rolling bearing has been driven up the required displacement distance and the end position is achieved. The pressure is then released and the hydraulic oil flows back into the pump, after which the pump can be removed.

Note In order to avoid delays during mounting, we recommend that the initial pressure and the number of strokes is determined before the start of mounting.



Mounting the rolling bearing

Slide the rolling bearing gently onto the shaft. In this way, it is possible to avoid sliding the rolling bearing on further than the start position.



If the rolling bearing is slid on further than the start position, the radial clearance is too small.

Mounting the hydraulic nut

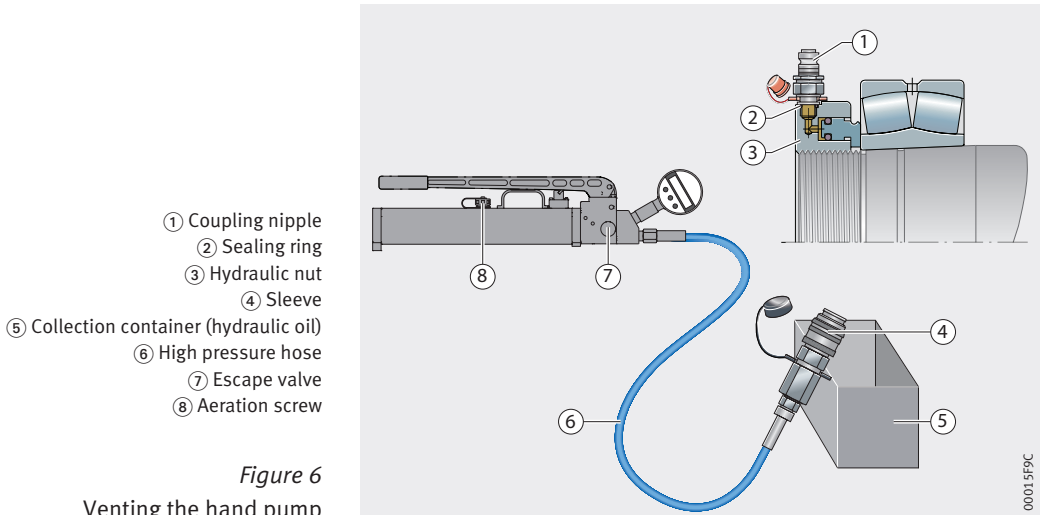
Locate the hydraulic nut on the tapered shaft or withdrawal sleeve. Screw a coupling nipple into the hydraulic nut.

Connecting the hand pump

Check whether the spacer ring (half ring) should be mounted, see the section Spacer ring, page 9. First mount or remove the spacer ring (half ring) as necessary and the hand pump should only be connected after this has been done.

Warning 

Only use the hand pump if the tank is completely filled with hydraulic oil. Otherwise, air may be sucked in and compressed.



Venting the hand pump

Before connecting the hand pump to the hydraulic nut, vent the hand pump, *Figure 6*:

- Provide a collection container ⑤ (not included in the delivery)
- Screw the coupling nipple ① and sealing ring ② into the hydraulic nut ③
- Place the hand pump on a rigid, horizontal surface, since it is only possible to prevent air being sucked in when the hand pump is horizontal
- Close the aeration screw ⑧ completely, then open it (one revolution)
- Close the escape valve ⑦
- Hold the high pressure hose ⑥ vertically upwards
- Operate the hand pump until oil emerges without air bubbles.

Connection

- Fit the sleeve ④ on the coupling nipple ①.

Warning 

The high pressure hose must be suitable for a pressure of at least 1000 bar. Do not extend the arm of the hand pump. Check whether the sleeve and coupling nipple are completely coupled. Observe a minimum bending radius for the high pressure hose of 70 mm.

Venting the hydraulic nut

Operate the hand pump until the hydraulic nut is completely vented, see BA 004, FAG Hydraulic Nuts.

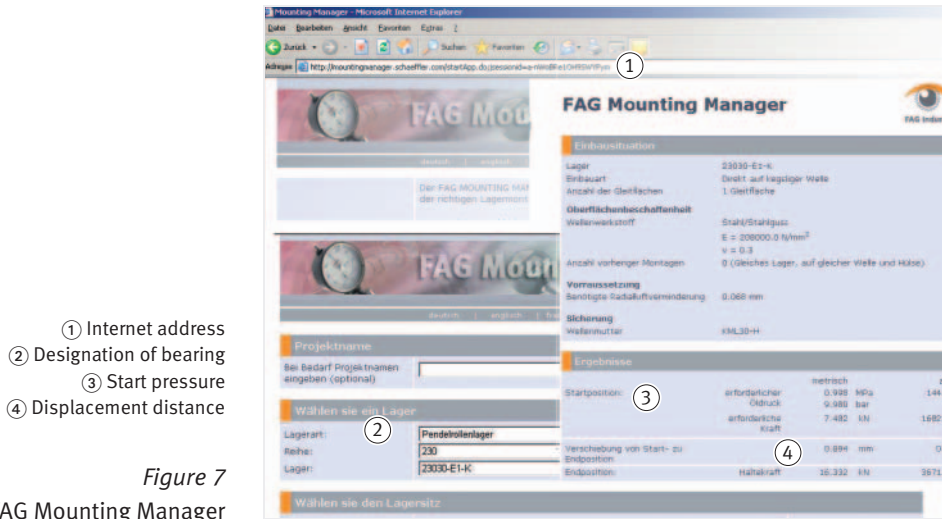
Hand pump

Setting the start position

The rolling bearing is displaced from the original position to the start position. The hand pump is of a twin stage design. At low pressure, a large quantity of oil is pressed into the hydraulic nut, while above 10 bar this quantity is significantly smaller, see the section Technical data, page 21.

Determining the start pressure

The start pressure can be determined, for example, using the Schaeffler software FAG Mounting Manager. A user manual for the software is available on the Internet.



After calling up FAG Mounting Manager, the necessary data are entered, *Figure 7*. The start pressure for reaching the start position is then displayed.



Do not loosen the connectors on the hand pump if the unit is still pressurised. Do not add any more oil.

Building up the start pressure

Once the start pressure has been built up, the rolling bearing is in the start position, *Figure 5*, page 10.

Keep the aeration screw open (one revolution):

- Close the escape valve, *Figure 3* ④, page 8
- Set the digital manometer to zero, then monitor continuously
- Operate the hand pump until the start pressure is reached.



Do not exceed the start pressure. If the start pressure is exceeded, the bearing must be dismounted and then remounted.

Setting the end position

The end position is reached when the rolling bearing has been moved the displacement distance. The displacement distance can be read off, for example, in FAG Mounting Manager.

Determining the number of strokes

The number of strokes can be read off on the basis of the displacement distance and the hydraulic nut used, *Figure 8*, and the value table, starting from page 24.

Example

The following hydraulic nut is used for mounting of bearings:

■ HYDNUT160.

When using HYDNUT160, any spacer ring present must be dismantled, see the section Spacer ring, page 9.

The software FAG Mounting Manager determines the displacement distance as follows:

■ 0,94 mm.

The next highest displacement distance is 1,01 mm and the number of strokes is as follows, see the value table:

■ 10 strokes for mounting with hydraulic support

■ 12 strokes for mounting without hydraulic support.

① Next highest displacement distance

② Number of strokes

Figure 8
Value table, excerpt

160	s mm	0,52	0,57	0,63	0,69	0,76	0,84	0,92	1,01	1
	x ₁ -	5	6	6	7	7	8	①	10	11
	x ₂ -	6	7	7	8	9	10	②	12	13
170	s mm	0,55	0,61	0,67	0,73	0,81	0,89	0,97	1,07	1
	x ₁ -	6	6	7	8	9	9	10	11	13
	x ₂ -	7	7	8	9	10	11	12	13	15
180	s mm	0,57	0,63	0,69	0,76	0,83	0,92	1,01	1,11	1
	x ₁ -	7	7	8	9	10	11	12	13	14
	x ₂ -	8	8	9	10	11	12	13	15	16
190	s mm	0,61	0,67	0,74	0,81	0,89	0,98	1,08	1,19	1
	x ₁ -	8	9	10	10	12	13	14	15	17
	x ₂ -	9	10	11	12	13	15	16	18	19
200	s mm	0,64	0,7	0,77	0,85	0,94	1,03	1,13	1,25	1
	x ₁ -	9	10	11	12	13	14	16	17	19
	x ₂ -	10	11	12	14	15	16	18	20	22
210	s mm	0,7	0,77	0,85	0,93	1,02	1,13	1,24	1,36	1
	x ₁ -	11	12	13	14	15	17	19	20	23
	x ₂ -	12	13	15	16	18	19	21	23	23
220	s mm	0,7	0,77	0,85	0,93	1,02	1,13	1,24	1,36	
	x ₁ -	11	12	14	15	16	18	20	22	00016064

Hand pump

Moving the rolling bearing to the end position

Warning 

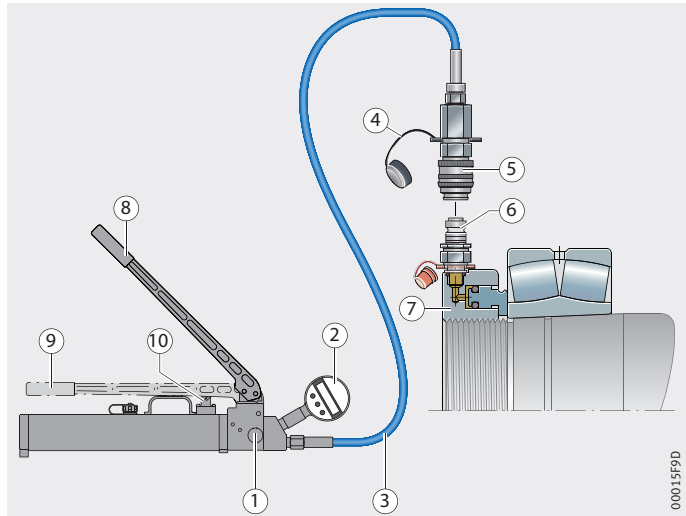
The hand pump is operated to bring the rolling bearing into the end position, *Figure 9*.

800 bar must not be exceeded. Do not loosen the connectors on the hand pump if the unit is still pressurised. Do not add any more oil.

- ① Escape valve
- ② Digital manometer
- ③ High pressure hose
- ④ End cap
- ⑤ Sleeve
- ⑥ Coupling nipple
- ⑦ Hydraulic nut
- ⑧ Upper stop
- ⑨ Lower stop
- ⑩ Stroke counter

Figure 9

End position, dismantling



Keep the aeration screw open (one revolution):

- Close the escape valve ①, set the stroke counter ⑩ to 0
- Monitor the digital manometer ②
- Move the hand pump from the upper stop ⑧ to the lower stop ⑨ until the stroke counter ⑩ shows the number of strokes.



Operate the escape valve by hand only. On each occasion, the arm must be moved up to the upper stop and then down. Do not exceed the number of strokes. If the number of strokes is exceeded, the bearing must be dismantled and then moved back to the start position.

Dismounting the hand pump

Releasing the pressure

Before the hand pump is removed, it must be unpressurised.

- Slowly open the escape valve ①
- Monitor the digital manometer ②.

Removing the hand pump

- Once the unit is unpressurised, remove the sleeve ⑤ from the coupling nipple ⑥
- Close the sleeve ⑤ using the end cap ④.

Maintenance The use of unsuitable replacement parts and oils can damage the hand pump and may lead to hazards occurring for the user.



Always use original replacement parts sets from Schaeffler KG. Only use oils recommended by us, see the section Hydraulic oil, page 7.

Changing the oil Check the hydraulic oil six months after the last oil change. Replace contaminated oil.

One year after the last oil change, replace the oil even if it is not contaminated:

- Empty the tank completely
- Check the tank and clean it if necessary
- Fill the tank completely with fresh oil, pump 50 times, then fill up with fresh oil.

Note Dispose of oil, contaminated cloths and similar materials in the correct manner.

Cleaning the tank Clean the tank if there are stubborn deposits on the walls of the tank:

- Empty the tank completely
- Fill the tank with petroleum ether
- Rock the filled tank
- Empty the tank completely
- Vent the tank.

Note Dispose of petroleum ether, contaminated cloths and similar materials in the correct manner.

Hand pump

Technical data Hand pump

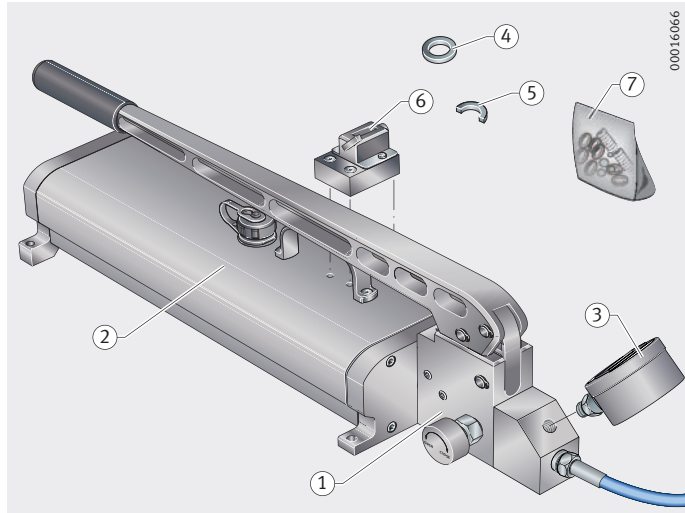
Component	Technical data
Threaded connector	G 1/4
Oil container capacity	4 l
Delivery volume <10 bar	4 cm ³ per stroke with spacer ring (half ring); 18 cm ³ per stroke without spacer ring (half ring)
Delivery volume >10 bar	0,2 cm ³ per stroke with spacer ring (half ring); 0,9 cm ³ per stroke without spacer ring (half ring)
Maximum oil pressure	1000 bar
Mass	≈ 24 kg (including metal case)

Ordering designations

Replacement parts, *Figure 10* and table Ordering designation PUMP1000-4L-CONTROL.

- ① Pump body
- ② Oil container
- ③ Digital manometer
- ④ Spacer ring (full ring)
- ⑤ Spacer ring (half ring)
- ⑥ Stroke counter
- ⑦ Wear parts (set)

Figure 10
Replacement parts



Ordering designation PUMP1000-4L-CONTROL

Component	Ordering designation
Complete hand pump	PUMP1000-4L-CONTROL (incl. digital manometer in metal case)
Pump body	PUMP1000-4L.BODY
Oil container	PUMP1000-4L.TANK
Digital manometer	PUMP1000.MANO-DIGI
Spacer ring (full ring)	PUMP1000-4L-CONTROL.RING-0,2ML
Spacer ring (half ring)	PUMP1000-4L-CONTROL.RING-0,9ML
Stroke counter	PUMP1000-4L-CONTROL.COUNTER
Wear parts	PUMP1000-4L.SPARE-KIT

Hand pump

EU Declaration of Conformity

Declaration of Conformity for hand pump PUMP1000-4L-CONTROL.

LUK **INA** **FAG**

EU Declaration of Conformity

In accordance with EG – EC machinery directive 98/37

We hereby declare that the products described below is in conformity with the applicable health and requirements of the EU Directive in terms of its design and type and in execution we have brought into circulation. This declaration shall cease to be valid if any modification is made to the product without our agreement.

Product designation: hydraulic hand pump
Product name: PUMP1000-4L-CONTROL

Applicable standards:

- EN 292-1:92
- EN 292-2:92
- EN 82:96

Signatures:

[Handwritten Signature]
Armin Kempkes
General Manager FIS

Schaeffler KG
F'IS - FAG Industrial Services
Georg-Schäfer-Str. 30
97421 Schweinfurt

[Handwritten Signature]
Paul Königer
Product Manager
Maintenance Tools

Date:
Schweinfurt, 03/09/09

This declaration certifies the agreement with the listed directives only. It contains no warranted qualities.

Schaeffler KG • Georg-Schäfer-Str. 30 • D-97421 Schweinfurt • Tel.: +4924679149-99

0001.64.5D

Figure 11
EU Declaration of Conformity

Hand pump

Digital manometer The digital manometer PUMP1000-4L-CONTROL.MANO is part of the hand pump and is already mounted when the hand pump is supplied.

Features A ceramic sensor records the pressure and shows the value on a four digit LED display. The accuracy is 0,5%. The manometer is powered by a 9 V battery and has a peak value memory.

Operation The device is operated using three membrane keys on the front, *Figure 12*.

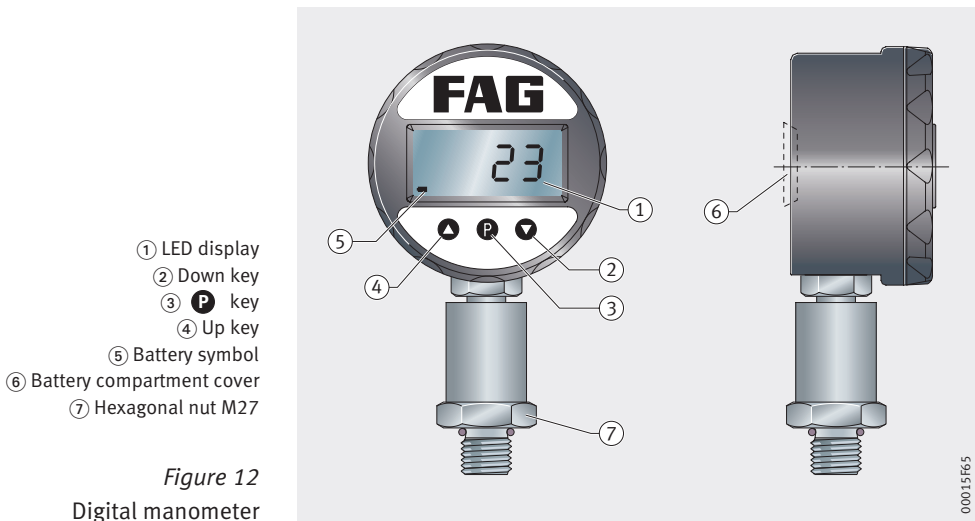


Figure 12
Digital manometer

Switching on, switching off

Key	Function
P	Device is switched on
2× P	Device is switched off

Control keys

The specific function of the key depends on whether the user changes between different menu items or is within a single menu item, see table.

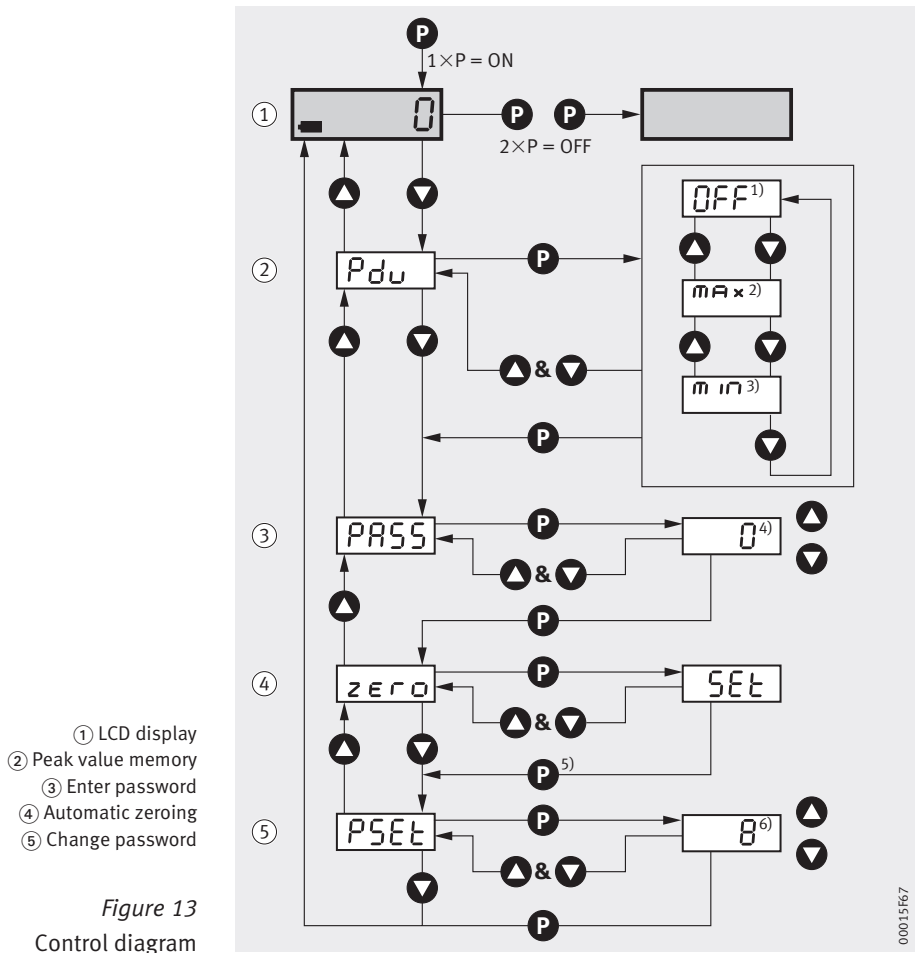
Function of control keys

Key	Select menu item	Set value
▼	Next menu item	Reduce value
▲	Previous menu item	Increase value
P	–	Confirm value ¹⁾
▲ & ▼	–	Cancel value
P & ▼	Jump to function	–

¹⁾ When the value is confirmed, the system moves to the next menu item.

Control diagram

The navigation and setting options are shown in the control diagram, *Figure 13*.



Footnotes for Figure 13

- 1) Peak value memory off.
- 2) Recording of maximum values.
- 3) Recording of minimum values.
- 4) Factory setting = 5.
- 5) Automatic zeroing.
- 6) New password, example.

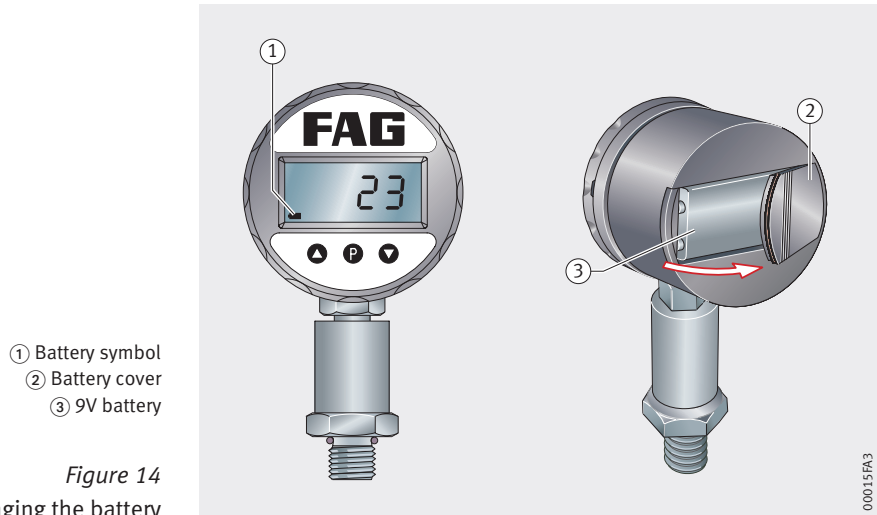
Hand pump

Maintenance

Contaminated hydraulic oil can make maintenance necessary at Schaeffler KG. If clean hydraulic oil is always used, maintenance is restricted to changing the battery.

Changing the battery

If the voltage of the battery falls below 7 Volt, the battery symbol is shown, *Figure 14*. Lift the battery cover outwards and change the battery.



- ① Battery symbol
- ② Battery cover
- ③ 9V battery

Figure 14
Changing the battery



Replace a used battery promptly by a fresh battery if the battery symbol is shown. Replace a damaged battery cover and seal promptly, since the ingress of hydraulic oil will destroy the device. Always mount and dismount the digital manometer using the hexagonal nut, never the housing, *Figure 12*, page 18!

Dismounting

To replace a digital manometer that is damaged or in need of maintenance:

- Ensure that the hand pump is unpressurised
- Unscrew the digital manometer (right hand thread) using a wrench (A/F27).

Mounting

To mount a new or repaired digital manometer:

- Use a new sealing ring, *Figure 12*, page 18
- Mount the digital manometer (right hand thread) using a wrench (A/F27).

Technical data
Digital manometer

Component	Technical data
Threaded connector	G ³ / ₄
Accuracy class	0,5%
Zero point correction	≅25%
Measurement range	0 bar to 1 000 bar
Overload range	1 500 bar
Power supply	9 V
Battery life	≈ 5 000 h (600 mAh)
Operating temperature	0 °C to +60 °C
Storage temperature	-30 °C to +80 °C
Max. relative humidity	90%, no condensation
Protection type	IP 65
Mass	≈ 0,35 kg

Ordering designations
Ordering designation
Digital manometer

Component	Ordering designation
Digital manometer	PUMP1000-4L-CONTROL.MANO
Sealing ring	Flat seal to DIN 16 258
Battery	9 V

Hand pump

Troubleshooting

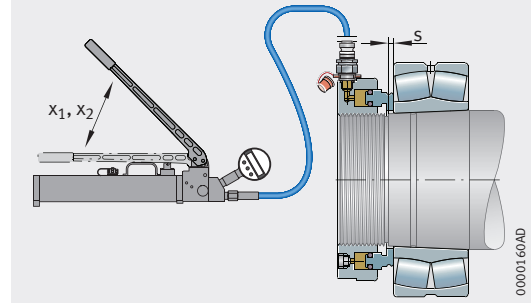
Malfunction, cause, remedies

A list of common malfunctions is shown in the following table.

Malfunction	Cause, remedy
Piston does not move out	<p>The hand pump was positioned with the head facing up:</p> <ul style="list-style-type: none"> ■ Position the hand pump with the feet facing down. <p>The escape valve of the hand pump is not closed or not completely closed:</p> <ul style="list-style-type: none"> ■ Close the escape valve. <p>Leak in the oil circuit:</p> <ul style="list-style-type: none"> ■ Replace leaking parts or send the hand pump to Schaeffler KG, Schweinfurt, for repair.
Cylinder moves out in a jolting motion or not completely	<p>Air in the oil circuit:</p> <ul style="list-style-type: none"> ■ Vent the pump, high pressure hose and hydraulic nut. <p>The piston of the hydraulic cylinder is bent or damaged and is being subjected to mechanical braking as a result:</p> <ul style="list-style-type: none"> ■ Send the hand pump to Schaeffler KG, Schweinfurt, for repair.
The piston sinks back under load	<p>Escape valve leaking:</p> <ul style="list-style-type: none"> ■ Replace leaking parts or send the hand pump to Schaeffler KG, Schweinfurt, for repair. <p>Cylinder seals leaking:</p> <ul style="list-style-type: none"> ■ Replace the seals. <p>Leakage at couplings or hose fittings:</p> <ul style="list-style-type: none"> ■ Replace parts with original replacement parts.
Cylinder does not move back completely or only very slowly	<p>Oil is not flowing freely back into the tank:</p> <ul style="list-style-type: none"> ■ Check whether the escape valve is completely open and the nipples and sleeves are correctly coupled.
Continuous oil loss	<p>Leakage at the pump piston:</p> <ul style="list-style-type: none"> ■ Replace the seals.
Stroke counter is not counting	Replace stroke counter.
Manometer not functioning	Replace the battery.

Displacement

Number of strokes



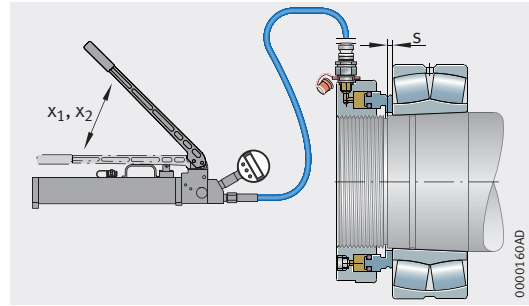
Value table

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method													
50¹⁾	s mm	0,2	0,22	0,24	0,27	0,29	0,32	0,35	0,39	0,43	0,47	0,52	0,57	
	x ₁ -	3	3	4	4	5	5	5	6	7	7	8	9	
	x ₂ -	5	5	5	6	7	7	8	9	10	11	12	13	
55¹⁾	s mm	0,21	0,23	0,25	0,28	0,31	0,34	0,37	0,41	0,45	0,5	0,54	0,6	
	x ₁ -	3	4	4	4	5	5	6	7	7	8	9	10	
	x ₂ -	5	5	6	7	7	8	9	10	11	12	13	14	
60¹⁾	s mm	0,23	0,25	0,28	0,31	0,34	0,37	0,41	0,45	0,49	0,54	0,6	0,66	
	x ₁ -	4	4	4	5	5	6	6	7	8	9	10	10	
	x ₂ -	5	6	6	7	8	9	9	10	11	12	14	15	
65¹⁾	s mm	0,24	0,26	0,29	0,32	0,35	0,39	0,43	0,47	0,51	0,57	0,62	0,68	
	x ₁ -	4	5	5	6	6	7	8	9	9	10	11	13	
	x ₂ -	6	7	8	8	9	10	11	12	14	15	16	18	
70¹⁾	s mm	0,25	0,28	0,3	0,33	0,37	0,4	0,44	0,49	0,54	0,59	0,65	0,71	
	x ₁ -	5	6	6	7	8	9	9	10	11	12	14	15	
	x ₂ -	7	8	9	10	11	12	13	15	16	18	19	21	
75¹⁾	s mm	0,27	0,3	0,33	0,36	0,4	0,43	0,48	0,53	0,58	0,64	0,7	0,77	
	x ₁ -	6	7	7	8	9	10	11	12	13	14	16	17	
	x ₂ -	8	9	10	11	12	14	15	17	18	20	22	24	
80¹⁾	s mm	0,28	0,31	0,34	0,37	0,41	0,45	0,5	0,55	0,6	0,66	0,73	0,8	
	x ₁ -	7	8	9	9	10	11	12	14	15	17	18	20	
	x ₂ -	10	11	12	13	14	16	17	19	21	23	25	28	
85¹⁾	s mm	0,3	0,33	0,36	0,4	0,44	0,48	0,53	0,58	0,64	0,71	0,78	0,86	
	x ₁ -	7	8	9	10	11	12	13	14	16	17	19	21	
	x ₂ -	10	11	12	13	15	16	18	20	22	24	26	29	
90¹⁾	s mm	0,31	0,34	0,38	0,41	0,45	0,5	0,55	0,6	0,66	0,73	0,8	0,88	
	x ₁ -	8	9	9	10	11	13	14	15	17	19	20	22	
	x ₂ -	11	12	13	14	16	17	19	21	23	25	27	30	
95¹⁾	s mm	0,32	0,35	0,39	0,43	0,47	0,52	0,57	0,62	0,69	0,75	0,83	0,91	
	x ₁ -	9	9	10	11	12	14	15	17	18	20	22	24	
	x ₂ -	11	13	14	15	17	18	20	22	24	27	30	32	
100¹⁾	s mm	0,34	0,37	0,41	0,45	0,5	0,55	0,6	0,66	0,73	0,8	0,88	0,97	
	x ₁ -	9	10	11	12	14	15	17	18	20	22	24	27	
	x ₂ -	12	14	15	16	18	20	22	24	27	29	32	35	

¹⁾ Spacer ring (half ring) must be mounted.

Displacement

Number of strokes



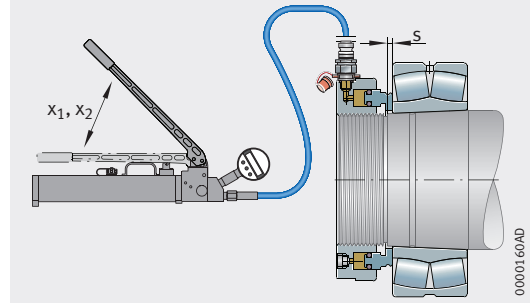
Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method												
105¹⁾	s mm	0,38	0,42	0,46	0,51	0,56	0,61	0,67	0,74	0,81	0,9	0,99	1,08
	x ₁ -	11	12	13	15	16	18	19	21	24	26	28	31
	x ₂ -	14	16	17	19	21	23	25	28	31	34	37	41
110¹⁾	s mm	0,37	0,41	0,45	0,49	0,54	0,6	0,66	0,72	0,79	0,87	0,96	1,06
	x ₁ -	11	12	13	15	16	18	19	21	24	26	29	31
	x ₂ -	14	15	17	19	20	23	25	27	30	33	36	40
115¹⁾	s mm	0,46	0,51	0,56	0,61	0,67	0,74	0,81	0,9	0,99	1,08	1,19	1,31
	x ₁ -	14	16	17	19	21	23	25	27	30	33	37	40
	x ₂ -	18	19	21	23	26	28	31	34	38	42	46	50
120¹⁾	s mm	0,4	0,44	0,48	0,53	0,59	0,64	0,71	0,78	0,86	0,94	1,04	1,14
	x ₁ -	13	14	15	17	19	20	23	25	27	30	33	36
	x ₂ -	16	17	19	21	23	25	28	30	33	37	40	44
125¹⁾	s mm	0,48	0,53	0,58	0,64	0,7	0,77	0,85	0,94	1,03	1,13	1,24	1,37
	x ₁ -	16	17	19	21	23	26	28	31	34	37	41	45
	x ₂ -	19	21	23	25	28	31	34	37	41	45	49	54
130¹⁾	s mm	0,42	0,46	0,51	0,56	0,61	0,68	0,74	0,82	0,9	0,99	1,09	1,2
	x ₁ -	14	15	17	19	20	22	25	27	30	33	36	40
	x ₂ -	17	18	20	22	24	27	30	32	36	39	43	48
135¹⁾	s mm	0,51	0,56	0,62	0,68	0,75	0,82	0,9	0,99	1,09	1,2	1,32	1,46
	x ₁ -	17	19	21	23	25	28	31	34	37	41	45	49
	x ₂ -	21	23	25	27	30	33	36	40	44	48	53	59
140¹⁾	s mm	0,45	0,5	0,54	0,6	0,66	0,72	0,8	0,88	0,96	1,06	1,17	1,28
	x ₁ -	14	15	16	18	20	22	24	26	29	32	35	39
	x ₂ -	16	18	19	21	23	26	28	31	34	38	42	46
145¹⁾	s mm	0,55	0,61	0,67	0,73	0,81	0,89	0,97	1,07	1,18	1,3	1,43	1,57
	x ₁ -	20	22	24	26	29	32	35	38	42	46	51	56
	x ₂ -	23	25	28	31	34	37	41	45	49	54	60	66
150¹⁾	s mm	0,49	0,54	0,59	0,65	0,72	0,79	0,87	0,95	1,05	1,16	1,27	1,4
	x ₁ -	19	21	23	25	27	30	33	36	40	44	48	53
	x ₂ -	22	24	26	29	32	35	39	42	47	51	57	62
155	s mm	0,51	0,56	0,62	0,68	0,75	0,82	0,91	1	1,1	1,21	1,33	1,46
	x ₁ -	5	5	6	6	7	8	8	9	10	11	12	13
	x ₂ -	5	6	7	7	8	9	10	11	12	13	14	16

¹⁾ Spacer ring (half ring) must be mounted.

Displacement

Number of strokes

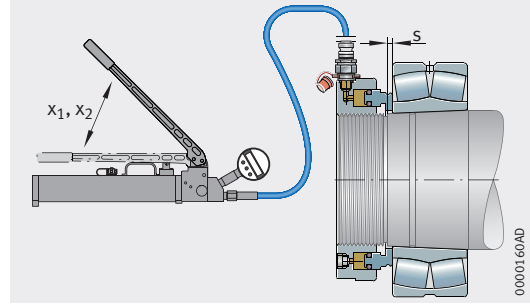


Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method												
160	s mm	0,52	0,57	0,63	0,69	0,76	0,84	0,92	1,01	1,11	1,23	1,35	1,48
	x ₁ -	5	6	6	7	7	8	9	10	11	12	13	15
	x ₂ -	6	7	7	8	9	10	10	12	13	14	15	17
170	s mm	0,55	0,61	0,67	0,73	0,81	0,89	0,97	1,07	1,18	1,3	1,43	1,57
	x ₁ -	6	6	7	8	9	9	10	11	13	14	15	17
	x ₂ -	7	7	8	9	10	11	12	13	15	16	18	19
180	s mm	0,57	0,63	0,69	0,76	0,83	0,92	1,01	1,11	1,22	1,34	1,48	1,63
	x ₁ -	7	7	8	9	10	11	12	13	14	16	17	19
	x ₂ -	8	8	9	10	11	12	13	15	16	18	20	22
190	s mm	0,61	0,67	0,74	0,81	0,89	0,98	1,08	1,19	1,31	1,44	1,58	1,74
	x ₁ -	8	9	10	10	12	13	14	15	17	19	20	22
	x ₂ -	9	10	11	12	13	15	16	18	19	21	23	26
200	s mm	0,64	0,7	0,77	0,85	0,94	1,03	1,13	1,25	1,37	1,51	1,66	1,83
	x ₁ -	9	10	11	12	13	14	16	17	19	21	23	25
	x ₂ -	10	11	12	14	15	16	18	20	22	24	26	29
210	s mm	0,7	0,77	0,85	0,93	1,02	1,13	1,24	1,36	1,5	1,65	1,82	2
	x ₁ -	11	12	13	14	15	17	19	20	23	25	27	30
	x ₂ -	12	13	15	16	18	19	21	23	26	28	31	34
220	s mm	0,7	0,77	0,85	0,93	1,02	1,13	1,24	1,36	1,5	1,65	1,82	2
	x ₁ -	11	12	14	15	16	18	20	22	24	27	29	32
	x ₂ -	13	14	16	17	19	21	23	25	27	30	33	37
230	s mm	0,76	0,84	0,92	1,01	1,11	1,22	1,35	1,48	1,63	1,79	1,97	2,17
	x ₁ -	14	15	16	18	20	22	24	26	29	32	35	39
	x ₂ -	15	17	19	20	23	25	27	30	33	36	40	44
240	s mm	0,76	0,84	0,92	1,01	1,11	1,22	1,35	1,48	1,63	1,79	1,97	2,17
	x ₁ -	14	15	17	19	21	23	25	27	30	33	36	40
	x ₂ -	16	17	19	21	23	26	28	31	34	37	41	45
250	s mm	1,37	1,51	1,66	1,82	2,01	2,21	2,43	2,67	2,94	3,23	3,55	3,91
	x ₁ -	28	31	34	37	41	45	49	54	60	65	72	79
	x ₂ -	31	35	38	42	46	51	56	61	67	74	81	90
260	s mm	0,82	0,9	0,99	1,09	1,2	1,32	1,45	1,6	1,76	1,93	2,13	2,34
	x ₁ -	17	19	21	23	25	28	30	34	37	41	45	49
	x ₂ -	19	21	23	26	28	31	34	38	42	46	50	55

Displacement

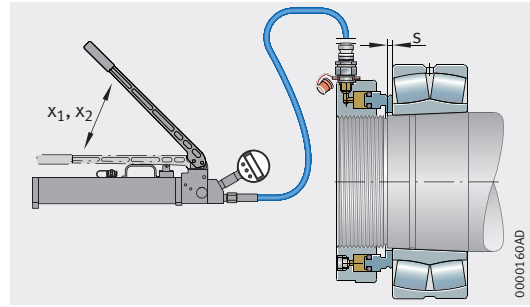
Number of strokes



Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method												
275	s mm	1,47	1,62	1,78	1,96	2,15	2,37	2,6	2,86	3,15	3,47	3,81	4,19
	x ₁ -	33	37	40	44	49	54	59	65	72	79	87	95
	x ₂ -	38	41	45	50	55	60	66	73	80	88	97	107
280	s mm	0,87	0,96	1,05	1,16	1,27	1,4	1,54	1,7	1,86	2,05	2,26	2,48
	x ₁ -	20	23	25	27	30	33	36	40	44	48	53	58
	x ₂ -	23	25	28	31	34	37	41	45	49	54	60	65
290	s mm	1,37	1,51	1,66	1,83	2,01	2,21	2,44	2,68	2,95	3,24	3,57	3,92
	x ₁ -	33	37	40	44	49	54	59	65	72	79	87	95
	x ₂ -	37	41	45	50	55	60	66	73	80	88	97	107
295	s mm	1,55	1,71	1,88	2,06	2,27	2,5	2,75	3,02	3,32	3,65	4,02	4,42
	x ₁ -	40	44	48	53	58	64	70	77	85	94	103	113
	x ₂ -	44	49	54	59	65	71	79	87	95	105	115	127
300	s mm	0,93	1,02	1,13	1,24	1,36	1,5	1,65	1,81	1,99	2,19	2,41	2,65
	x ₁ -	25	27	30	33	36	39	43	48	53	58	64	70
	x ₂ -	27	30	33	36	40	44	48	53	59	64	71	78
310	s mm	1,43	1,57	1,73	1,9	2,09	2,3	2,53	2,78	3,06	3,37	3,7	4,07
	x ₁ -	40	43	48	53	58	64	70	77	85	93	102	113
	x ₂ -	44	48	53	59	64	71	78	86	94	104	114	126
315	s mm	1,67	1,84	2,02	2,22	2,45	2,69	2,96	3,25	3,58	3,94	4,33	4,76
	x ₁ -	47	52	57	62	69	76	83	91	101	111	122	134
	x ₂ -	52	57	63	69	76	84	92	102	112	123	135	149
320	s mm	1,32	1,45	1,6	1,76	1,93	2,13	2,34	2,57	2,83	3,11	3,42	3,77
	x ₁ -	39	43	47	52	57	62	69	75	83	91	100	110
	x ₂ -	43	47	52	57	63	69	76	84	92	101	112	123
335	s mm	1,76	1,94	2,13	2,34	2,58	2,83	3,12	3,43	3,77	4,15	4,56	5,02
	x ₁ -	54	59	65	72	79	87	95	105	115	127	139	153
	x ₂ -	60	66	72	79	87	96	106	116	128	141	155	170
340	s mm	1,4	1,54	1,69	1,86	2,05	2,25	2,48	2,73	3	3,3	3,63	3,99
	x ₁ -	44	49	54	59	65	71	79	86	95	105	115	126
	x ₂ -	49	54	59	65	72	79	87	96	105	116	127	140
355	s mm	1,85	2,04	2,24	2,46	2,71	2,98	3,28	3,61	3,97	4,36	4,8	5,28
	x ₁ -	63	69	76	83	92	101	111	122	134	148	162	178
	x ₂ -	69	76	84	92	101	111	122	135	148	163	179	197
360	s mm	1,48	1,63	1,79	1,97	2,17	2,38	2,62	2,88	3,17	3,49	3,84	4,22
	x ₁ -	52	57	62	69	76	83	91	101	111	122	134	147
	x ₂ -	57	63	69	76	83	92	101	111	122	134	148	162

Displacement Number of strokes

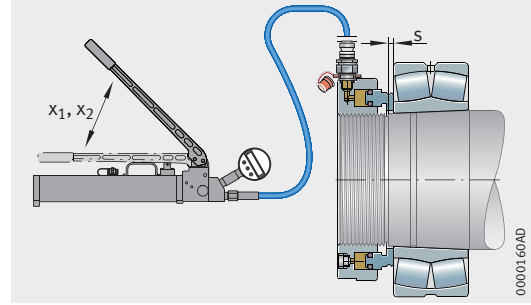


Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method													
375	s mm	1,94	2,13	2,35	2,58	2,84	3,12	3,44	3,78	4,16	4,57	5,03	5,54	
	x ₁ -	72	79	87	96	106	116	128	141	155	170	187	206	
	x ₂ -	79	87	96	106	116	128	141	155	170	187	206	227	
380	s mm	1,54	1,69	1,86	2,05	2,25	2,48	2,73	3	3,3	3,63	3,99	4,39	
	x ₁ -	58	63	70	77	84	93	102	112	124	136	150	165	
	x ₂ -	63	70	77	84	93	102	112	124	136	150	164	181	
395	s mm	2,07	2,28	2,5	2,76	3,03	3,33	3,67	4,03	4,44	4,88	5,37	5,91	
	x ₁ -	82	90	99	109	120	132	145	160	176	194	213	234	
	x ₂ -	90	99	109	120	132	145	160	176	193	213	234	257	
400	s mm	1,64	1,8	1,98	2,18	2,4	2,64	2,91	3,2	3,52	3,87	4,25	4,68	
	x ₁ -	67	74	81	89	98	108	119	131	144	158	174	191	
	x ₂ -	74	81	89	98	108	118	130	143	158	173	191	210	
415	s mm	2,17	2,39	2,63	2,89	3,18	3,49	3,84	4,23	4,65	5,12	5,63	6,19	
	x ₁ -	93	102	113	124	136	150	165	181	200	219	241	266	
	x ₂ -	102	112	123	136	149	164	181	199	219	240	264	291	
420	s mm	1,69	1,86	2,04	2,25	2,47	2,72	2,99	3,29	3,62	3,98	4,38	4,82	
	x ₁ -	73	81	89	98	107	118	130	143	157	173	190	209	
	x ₂ -	80	88	97	107	118	129	142	157	172	189	208	229	
435	s mm	2,26	2,49	2,73	3,01	3,31	3,64	4	4,4	4,84	5,33	5,86	6,45	
	x ₁ -	101	111	122	135	148	163	179	197	217	239	262	289	
	x ₂ -	111	122	134	147	162	178	196	216	237	261	287	316	
440	s mm	1,79	1,97	2,17	2,38	2,62	2,88	3,17	3,49	3,84	4,22	4,64	5,11	
	x ₁ -	85	93	102	113	124	136	150	165	181	200	220	242	
	x ₂ -	92	102	112	123	135	149	164	180	198	218	240	264	
460	s mm	1,85	2,04	2,24	2,46	2,71	2,98	3,28	3,61	3,97	4,36	4,8	5,28	
	x ₁ -	93	102	112	124	136	150	164	181	199	219	241	265	
	x ₂ -	101	111	123	135	148	163	179	197	217	239	263	289	
480	s mm	1,92	2,11	2,32	2,56	2,81	3,09	3,4	3,74	4,12	4,53	4,98	5,48	
	x ₁ -	99	108	119	131	144	159	175	192	211	232	256	281	
	x ₂ -	107	118	130	143	157	173	190	209	230	253	279	307	
500	s mm	2,01	2,21	2,43	2,68	2,94	3,24	3,56	3,92	4,31	4,74	5,21	5,73	
	x ₁ -	117	129	142	156	171	189	207	228	251	276	304	334	
	x ₂ -	127	140	154	170	187	205	226	248	273	301	331	364	
520	s mm	2,67	2,94	3,23	3,55	3,91	4,3	4,73	5,2	5,72	6,3	6,93	7,62	
	x ₁ -	161	177	195	215	236	260	286	314	346	380	418	460	
	x ₂ -	175	193	212	233	257	282	311	342	376	414	455	500	

Displacement

Number of strokes



Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T										
530	s mm	2,67	2,94	3,23	3,55	3,91	4,3	4,73	5,2	5,72
	x ₁ -	161	177	195	215	236	260	286	314	346
	x ₂ -	175	193	212	233	257	282	311	342	376
550	s mm	2,15	2,37	2,6	2,86	3,15	3,46	3,81	4,19	4,61
	x ₁ -	135	148	163	179	197	217	239	262	289
	x ₂ -	146	161	177	195	214	236	259	285	313
560	s mm	2,81	3,09	3,4	3,74	4,11	4,53	4,98	5,48	6,02
	x ₁ -	185	204	224	247	271	299	328	361	397
	x ₂ -	201	221	243	268	295	324	356	392	431
570	s mm	3,16	3,48	3,82	4,21	4,63	5,09	5,6	6,16	6,77
	x ₁ -	222	244	269	296	325	358	393	433	476
	x ₂ -	240	264	291	320	352	387	426	468	515
580	s mm	2,96	3,26	3,58	3,94	4,33	4,77	5,24	5,77	6,35
	x ₁ -	211	232	255	281	309	340	374	411	452
	x ₂ -	228	251	276	304	334	367	404	445	489

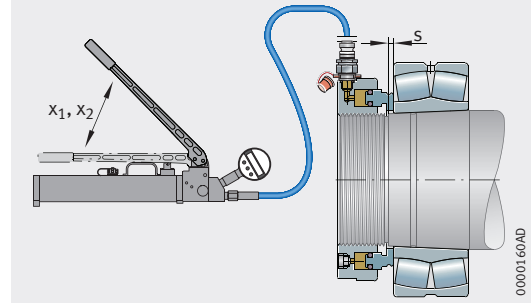
Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T										
530	s mm	10,87	11,95	13,15	14,46	15,91	17,5	19,25	21,18	23,29
	x ₁ -	680	749	823	906	996	1 096	1 206	1 326	1 459
	x ₂ -	739	813	894	984	1 082	1 191	1 310	1 441	1 585
550	s mm	14,2	15,62	17,19	18,9	20,79	22,87	25,16	27,68	30,45
	x ₁ -	937	1 031	1 134	1 247	1 372	1 509	1 660	1 826	2 009
	x ₂ -	1 017	1 119	1 230	1 353	1 489	1 638	1 802	1 982	2 180
560	s mm	11,27	12,4	13,64	15	16,5	18,15	19,97	21,96	24,16
	x ₁ -	767	844	929	1 022	1 124	1 236	1 360	1 496	1 645
	x ₂ -	832	915	1 006	1 107	1 218	1 340	1 474	1 621	1 783
570	s mm	15,97	17,57	19,33	21,26	23,38	25,72	28,3	31,13	34,24
	x ₁ -	1 122	1 235	1 358	1 494	1 643	1 807	1 988	2 187	2 406
	x ₂ -	1 215	1 336	1 470	1 617	1 779	1 957	2 152	2 367	2 604
580	s mm	14,96	16,46	18,1	19,91	21,9	24,1	26,5	29,16	32,07
	x ₁ -	1 066	1 173	1 290	1 419	1 561	1 717	1 889	2 078	2 286
	x ₂ -	1 153	1 268	1 395	1 535	1 688	1 857	2 042	2 247	2 471

5,07	5,58	6,13	6,75	7,42	8,16	8,98	9,88
317	349	384	423	465	511	562	619
345	379	417	459	505	555	611	672
6,63	7,29	8,02	8,82	9,7	10,67	11,74	12,91
437	481	529	582	640	704	775	852
474	522	574	631	695	764	840	924
5,26	5,78	6,36	7	7,7	8,47	9,32	10,25
358	394	433	477	524	577	634	698
388	427	470	516	568	625	687	756
7,45	8,2	9,02	9,92	10,91	12	13,2	14,52
524	576	634	697	767	843	928	1 020
567	623	686	754	830	913	1 004	1 104
6,98	7,68	8,45	9,29	10,22	11,24	12,36	13,6
497	547	602	662	728	801	881	969
538	592	651	716	787	866	953	1 048

Displacement

Number of strokes



Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T										
600	s mm	2,41	2,65	2,92	3,21	3,53	3,88	4,27	4,7	5,17
	x ₁ -	182	200	220	242	266	293	322	354	390
	x ₂ -	196	216	237	261	287	316	348	382	421
625	s mm	3,16	3,48	3,82	4,21	4,63	5,09	5,6	6,16	6,77
	x ₁ -	247	272	299	329	362	398	438	481	530
	x ₂ -	267	293	323	355	390	429	472	520	572
630	s mm	2,54	2,79	3,07	3,38	3,72	4,09	4,5	4,95	5,44
	x ₁ -	205	226	249	273	301	331	364	400	440
	x ₂ -	222	244	268	295	324	357	393	432	475
655	s mm	3,34	3,67	4,04	4,45	4,89	5,38	5,92	6,51	7,16
	x ₁ -	286	314	345	380	418	460	506	556	612
	x ₂ -	308	339	372	410	451	496	545	600	660
670	s mm	2,71	2,98	3,28	3,61	3,97	4,36	4,8	5,28	5,81
	x ₁ -	240	264	290	319	351	387	425	468	514
	x ₂ -	259	284	313	344	379	416	458	504	554

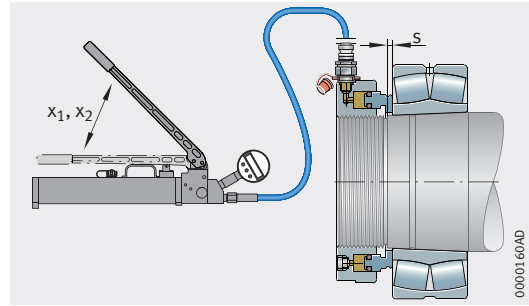
Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T										
600	s mm	12,18	13,4	14,74	16,21	17,83	19,62	21,58	23,74	26,11
	x ₁ -	919	1 010	1 111	1 223	1 345	1 479	1 627	1 790	1 969
	x ₂ -	992	1 091	1 200	1 320	1 452	1 598	1 758	1 933	2 127
625	s mm	15,97	17,57	19,33	21,26	23,38	25,72	28,3	31,13	34,24
	x ₁ -	1 249	1 373	1 511	1 662	1 828	2 011	2 212	2 433	2 676
	x ₂ -	1 348	1 482	1 631	1 794	1 973	2 170	2 387	2 626	2 889
630	s mm	12,84	14,12	15,53	17,09	18,8	20,68	22,74	25,02	27,52
	x ₁ -	1 038	1 142	1 257	1 382	1 520	1 672	1 840	2 024	2 226
	x ₂ -	1 120	1 232	1 355	1 491	1 640	1 804	1 984	2 183	2 401
655	s mm	16,88	18,57	20,43	22,47	24,72	27,19	29,91	32,9	36,19
	x ₁ -	1 443	1 587	1 746	1 921	2 113	2 324	2 557	2 812	3 094
	x ₂ -	1 556	1 711	1 882	2 071	2 278	2 506	2 756	3 032	3 335
670	s mm	13,7	15,07	16,57	18,23	20,05	22,06	24,27	26,69	29,36
	x ₁ -	1 213	1 334	1 468	1 615	1 776	1 954	2 149	2 364	2 600
	x ₂ -	1 307	1 438	1 581	1 739	1 913	2 105	2 315	2 547	2 801

5,68	6,25	6,88	7,56	8,32	9,15	10,07	11,07
429	471	519	570	627	690	759	835
463	509	560	616	678	745	820	902
7,45	8,2	9,02	9,92	10,91	12	13,2	14,52
582	641	705	775	853	938	1 032	1 135
629	692	761	837	920	1 012	1 114	1 225
5,99	6,59	7,25	7,97	8,77	9,65	10,61	11,67
484	533	586	645	709	780	858	944
523	575	632	696	765	842	926	1 018
7,88	8,66	9,53	10,48	11,53	12,68	13,95	15,35
673	741	815	896	986	1 084	1 193	1 312
726	798	878	966	1 063	1 169	1 286	1 414
6,39	7,03	7,73	8,51	9,36	10,29	11,32	12,45
566	623	685	753	829	911	1 003	1 103
610	671	738	811	893	982	1 080	1 188

Displacement

Number of strokes



Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T										
680	s mm	3,71	4,11	4,53	4,98	5,48	6,02	6,63	7,29	8,02
	x ₁ -	340	274	412	453	498	548	603	663	730
	x ₂ -	367	403	444	488	537	590	649	714	786
695	s mm	3,53	3,88	4,27	4,7	5,17	5,69	6,25	6,88	7,57
	x ₁ -	339	373	410	451	496	546	600	661	727
	x ₂ -	365	401	441	485	534	587	646	711	782
710	s mm	2,86	3,15	3,46	3,81	4,19	4,61	5,07	5,57	6,13
	x ₁ -	279	307	337	371	408	449	494	543	597
	x ₂ -	300	330	363	399	439	483	531	584	642
720	s mm	3,94	4,33	4,77	5,24	5,77	6,35	6,98	7,68	8,45
	x ₁ -	407	448	493	542	596	656	721	793	873
	x ₂ -	438	481	529	582	641	705	775	853	938
740	s mm	3,74	4,11	4,53	4,98	5,48	6,02	6,63	7,29	8,02
	x ₁ -	412	453	498	548	603	663	730	803	883
	x ₂ -	442	487	535	589	648	713	784	862	948

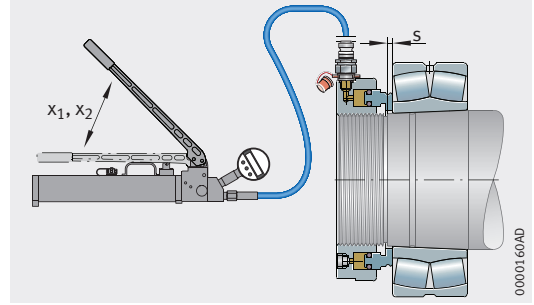
Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T										
680	s mm	18,9	20,79	22,87	25,16	27,68	30,44	33,49	36,84	40,52
	x ₁ -	1 721	1 893	2 082	2 290	2 519	2 771	3 048	3 353	3 688
	x ₂ -	1 853	2 038	2 242	2 466	2 713	2 984	3 282	3 610	3 971
695	s mm	17,84	19,63	21,59	23,75	26,12	28,74	31,61	34,77	38,25
	x ₁ -	1 713	1 885	2 073	2 280	2 508	2 759	3 035	3 339	3 673
	x ₂ -	1 843	2 028	2 231	2 454	2 699	2 969	3 266	3 592	3 952
710	s mm	14,46	15,9	17,49	19,24	21,16	23,28	25,61	28,17	30,99
	x ₁ -	1 409	1 549	1 704	1 875	2 062	2 269	2 495	2 745	3 020
	x ₂ -	1 515	1 666	1 833	2 016	2 218	2 439	2 683	2 952	3 247
720	s mm	19,91	21,91	24,1	26,51	29,16	32,07	35,28	38,81	42,69
	x ₁ -	2 058	2 264	2 490	2 739	3 013	3 315	3 646	4 011	4 412
	x ₂ -	2 212	2 433	2 676	2 944	3 238	3 562	3 918	4 310	4 741
740	s mm	18,9	20,79	22,87	25,16	27,68	30,44	33,49	36,84	40,52
	x ₁ -	2 082	2 290	2 519	2 771	3 048	3 353	3 689	4 057	4 463
	x ₂ -	2 236	2 460	2 706	2 976	3 274	3 601	3 961	4 358	4 793

8,82	9,7	10,67	11,74	12,91	14,2	15,62	17,19
803	883	971	1 068	1 175	1 293	1 422	1 564
864	951	1 046	1 150	1 265	1 392	1 531	1 684
8,32	9,16	10,07	11,08	12,19	13,41	14,75	16,22
799	879	967	1 064	1 170	1 287	1 416	1 558
860	946	1 041	1 145	1 259	1 385	1 524	1 676
6,74	7,42	8,16	8,98	9,87	10,86	11,95	13,14
657	723	795	875	962	1 058	1 164	1 281
707	777	855	941	1 035	1 138	1 252	1 377
9,29	10,22	11,24	12,37	13,6	14,96	16,46	18,1
960	1 056	1 162	1 278	1 406	1 546	1 701	1 871
1 032	1 135	1 248	1 373	1 511	1 662	1 828	2 011
8,82	9,7	10,67	11,74	12,91	14,2	15,62	17,19
971	1 068	1 175	1 293	1 422	1 564	1 721	1 893
1 043	1 147	1 262	1 388	1 527	1 680	1 848	2 033

Displacement

Number of strokes



Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T	s mm	3,82	4,2	4,62	5,08	5,59	6,15	6,77	7,44	8,19
750	x ₁ –	439	483	532	585	643	708	778	856	942
	x ₂ –	472	519	571	628	690	759	835	919	1 011
	s mm	4,19	4,61	5,07	5,58	6,13	6,75	7,42	8,17	8,98
760	x ₁ –	487	536	590	649	713	785	863	950	1 045
	x ₂ –	523	575	633	696	765	842	926	1.019	1 121
	s mm	3,94	4,33	4,77	5,24	5,77	6,35	6,98	7,68	8,45
780	x ₁ –	469	515	567	624	686	755	830	913	1 005
	x ₂ –	502	553	608	669	735	809	890	979	1 077
	s mm	4,01	4,41	4,85	5,34	5,87	6,46	7,1	7,81	8,6
800	x ₁ –	482	530	583	641	705	776	854	939	1 033
	x ₂ –	516	568	625	687	756	831	914	1 006	1 107
	s mm	4,19	4,61	5,07	5,58	6,13	6,75	7,42	8,17	8,98
830	x ₁ –	513	565	621	683	752	827	910	1 001	1 101
	x ₂ –	550	605	665	732	805	885	974	1 071	1 178

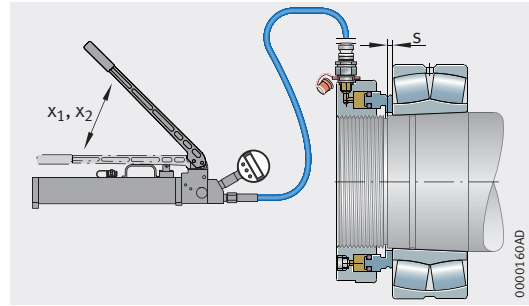
Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T	s mm	19,31	21,24	23,36	25,7	28,27	31,1	34,21	37,63	41,39
750	x ₁ –	2 221	2 443	2 687	2 956	3 251	3 577	3 934	4 328	4 760
	x ₂ –	2.384	2.622	2.884	3.173	3.490	3.839	4.223	4.645	5.109
	s mm	21,18	23,3	25,63	28,19	31,01	34,11	37,52	41,27	45,4
760	x ₁ –	2 463	2 709	2 980	3 278	3 606	3 967	4 364	4 800	5 280
	x ₂ –	2 642	2 906	3 197	3 517	3 868	4 255	4 681	5 149	5 664
	s mm	19,91	21,91	21,1	26,51	29,16	32,07	35,28	39,81	42,69
780	x ₁ –	2 369	2 605	2 866	3 153	3 468	3 815	4 196	4 616	5 077
	x ₂ –	2 539	2 793	3 072	3 380	3 718	4 089	4 498	4 948	5 443
	s mm	20,27	22,3	24,52	26,98	29,68	32,64	35,91	39,5	43,45
800	x ₁ –	2 435	2 679	2 947	3 242	3 566	3 922	4 314	4 746	5 221
	x ₂ –	2 609	2 870	3 157	3 473	3 820	4 202	4 622	5 084	5 593
	s mm	21,18	23,3	25,63	28,19	31,01	34,11	37,52	41,27	45,4
830	x ₁ –	2 595	2 855	3 140	3 454	3 800	4 179	4 597	5 057	5 563
	x ₂ –	2 778	3 056	3 362	3 698	4 068	4 475	4 922	5 414	5 956

9,01	9,91	10,9	11,99	13,19	14,51	15,96	17,55
1 036	1 140	1 254	1 379	1 517	1 669	1 835	2 019
1 112	1 223	1.345	1.480	1.628	1.791	1.970	2.167
9,88	10,87	11,95	13,15	14,47	18,91	17,5	19,25
1 149	1 264	1 390	1 529	1 682	1 851	2 036	2 239
1 233	1 356	1 491	1 641	1 805	1 985	2 184	2 402
9,29	10,22	11,24	12,37	13,6	14,96	16,46	18,1
1 105	1 215	1 337	1 471	1 618	1 780	1 958	2 153
1 185	1 303	1 433	1 577	1 734	1 908	2 098	2 308
9,46	10,4	11,44	12,59	13,84	15,23	16,75	18,43
1 136	1 250	1 375	1 512	1 663	1 830	2 013	2 214
1 217	1 339	1 473	1 620	1 782	1 960	2 156	2 372
9,88	10,87	11,95	13,15	14,47	15,91	17,5	19,25
1 211	1 332	1 465	1 611	1 773	1 950	2 145	2 359
1 296	1 426	1 568	1 725	1 898	2 087	2 296	2 526

Displacement

Number of strokes



Value table (continued)

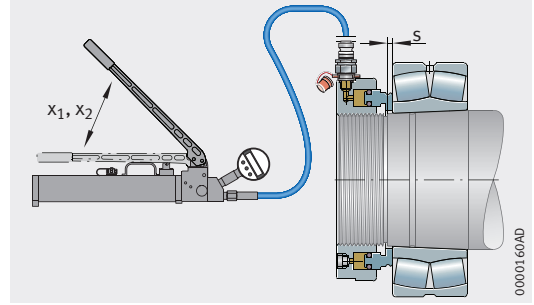
Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T										
850	s mm	4,29	4,72	5,19	5,71	6,28	6,91	7,6	8,36	9,2
	x ₁ -	551	606	667	733	807	887	976	1 074	1 181
	x ₂ -	590	648	714	785	863	950	1 045	1 149	1 264
880	s mm	4,42	4,86	5,35	5,88	6,47	7,12	7,83	8,61	9,47
	x ₁ -	565	621	683	752	827	909	1 000	1 100	1 210
	x ₂ -	604	664	730	803	884	972	1 069	1 176	1 294
900	s mm	4,62	5,08	5,59	6,15	6,76	7,44	8,18	9	9,9
	x ₁ -	643	707	778	856	941	1 036	1 139	1 253	1 378
	x ₂ -	687	755	831	914	1 005	1 106	1 216	1 338	1 472
930	s mm	4,69	5,16	5,67	6,24	6,87	7,55	8,31	9,14	10,05
	x ₁ -	673	741	815	896	986	1 084	1 193	1 312	1 443
	x ₂ -	718	790	869	956	1 051	1 157	1 272	1 399	1 539
950	s mm	4,89	5,38	5,92	6,51	7,16	7,88	8,66	9,53	10,48
	x ₁ -	743	817	898	988	1 087	1 196	1 315	1 447	1 592
	x ₂ -	792	870	957	1 053	1 159	1 274	1 402	1 542	1 696

Value table (continued)

Designation	s = Displacement x ₁ = Number of strokes with hydraulic method x ₂ = Number of strokes without hydraulic method									
HYDNU T										
850	s mm	21,68	23,85	26,24	28,86	31,75	34,92	38,41	42,26	46,48
	x ₁ -	2 785	3 064	3 370	3 707	4 078	4 486	4 934	5 427	5 970
	x ₂ -	2 980	3 278	3 606	3 967	4 363	4 799	5 279	5 807	6 388
880	s mm	22,34	24,57	27,03	29,74	32,71	35,98	39,58	43,54	47,89
	x ₁ -	2 854	3 140	3 454	3 799	4 179	4 597	5 056	5 562	6 118
	x ₂ -	3 051	3 356	3 692	4 061	4 467	4 913	5 405	5 945	6 540
900	s mm	23,35	25,69	28,26	31,08	34,19	37,61	41,37	45,51	50,06
	x ₁ -	3 250	3 575	3 933	4 326	4 758	5 234	5 758	6 334	6 967
	x ₂ -	3 470	3 817	4 199	4 619	5 081	5 589	6 148	6 763	7 439
930	s mm	23,71	26,08	28,68	31,55	34,71	38,18	42	46,2	50,81
	x ₁ -	3 403	3 743	4 117	4 529	4 982	5 480	6 028	6 631	7 294
	x ₂ -	3 630	3 993	4 392	4 831	5 314	5 846	6 430	7 074	7 781
950	s mm	24,72	27,19	29,91	32,9	36,19	39,81	43,79	48,17	52,98
	x ₁ -	3 753	4 129	4 541	4 996	5 495	6 045	6 649	7 314	8 045
	x ₂ -	3 999	4 399	4 839	5 323	5 856	6 441	7 085	7 794	8 573

10,12	11,13	12,24	13,46	14,81	16,29	17,92	19,71
1 299	1 429	1 572	1 729	1 902	2 093	2 302	2 532
1 390	1 529	1 682	1 850	2 035	2 239	2 463	2 709
10,42	11,46	12,61	13,87	15,26	16,78	18,46	20,31
1 332	1 465	1 611	1 772	1 949	2 144	2 359	2 595
1 423	1 566	1 722	1 894	2 084	2 292	2 521	2 774
10,89	11,98	13,18	14,5	15,95	17,54	19,3	21,23
1 516	1 668	1 835	2 018	2 220	2 442	2 686	2 955
1 619	1 781	1 959	2 155	2 370	2 607	2 868	3 155
11,06	12,16	13,38	14,72	16,19	17,81	19,59	21,55
1 587	1 746	1 921	2 113	2 324	2 557	2 812	3 094
1 693	1 863	2 049	2 254	2 479	2 727	3 000	3 300
11,53	12,68	13,95	15,35	16,88	18,57	20,43	22,47
1 751	1 926	2 119	2 330	2 564	2 820	3 102	3 412
1.866	2.052	2 258	2 483	2 732	3 005	3 305	3 636

Displacement Number of strokes



Value table (continued)

Designation	s = Displacement									
	x ₁ = Number of strokes with hydraulic method									
HYDNU T	x ₂ = Number of strokes without hydraulic method									
1000	s mm	5,07	5,58	6,13	6,75	7,42	8,17	8,98	9,88	10,87
	x ₁ -	841	925	1 017	1 119	1 231	1 354	1 489	1 638	1 802
	x ₂ -	895	984	1 083	1 191	1 310	1 441	1 585	1 744	1 918
1060	s mm	5,33	5,86	6,45	7,09	7,8	8,58	9,44	10,39	11,43
	x ₁ -	954	1 049	1 154	1 270	1 397	1 536	1 690	1 859	2 045
	x ₂ -	1 014	1 116	1 227	1 350	1 485	1 633	1 797	1 976	2 174
1080	s mm	5,81	6,39	7,03	7,73	8,51	9,36	10,29	11,32	12,45
	x ₁ -	1 085	1 193	1 313	1 444	1 588	1 747	1 922	2 114	2 326
	x ₂ -	1 152	1 268	1 394	1 534	1 687	1 856	2 042	2 246	2 470
1120	s mm	5,62	6,18	6,8	7,48	8,23	9,05	9,96	10,95	12,05
	x ₁ -	1 187	1 306	1 436	1 580	1 738	1 911	2 103	2 313	2 544
	x ₂ -	1 259	1 385	1 524	1 676	1 844	2 028	2 231	2 454	2 700
1180	s mm	5,91	6,5	7,15	7,87	8,65	9,52	10,47	11,52	12,67
	x ₁ -	1 379	1 517	1 669	1 835	2 019	2 221	2 443	2 687	2 956
	x ₂ -	1 462	1 608	1 769	1 946	2 140	2 354	2 590	2 849	3 133

Value table (continued)

Designation	s = Displacement									
	x ₁ = Number of strokes with hydraulic method									
HYDNU T	x ₂ = Number of strokes without hydraulic method									
1000	s mm	25,63	28,19	31,01	34,11	37,52	41,27	45,4	49,94	54,93
	x ₁ -	4 249	4 674	5 142	5 656	6 221	6 843	7 528	8 281	9 109
	x ₂ -	4 523	4 975	5 473	6 020	6 622	7 284	8 013	8 814	9 695
1060	s mm	26,94	29,63	32,6	35,86	39,44	43,39	47,73	52,5	57,75
	x ₁ -	4 821	5 303	5 834	6 417	7 059	7 764	8 541	9 395	10 335
	x ₂ -	5 126	5 639	6 203	6 823	7 505	8 256	9 082	9 990	10 989
1080	s mm	29,37	32,3	35,53	39,09	43	47,29	52,02	57,23	62,95
	x ₁ -	5 484	6 032	6 635	7 299	8 029	8 831	9 715	10 686	11 755
	x ₂ -	5 825	6 407	7 048	7 753	8 528	9 381	10 319	11 351	12 486
1120	s mm	28,41	31,25	34,37	37,81	41,59	45,75	50,32	55,36	60,89
	x ₁ -	5 999	6 599	7 259	7 985	8 783	9 661	10 628	11 690	12 859
	x ₂ -	6 366	7 002	7 702	8 473	9 320	10 252	11 277	12 405	13 645
1180	s mm	29,87	32,86	36,15	39,76	43,74	48,11	52,21	58,92	64,03
	x ₁ -	6 970	7 667	8 434	9 277	10 205	11 225	12 348	13 583	14 941
	x ₂ -	7 388	8 127	8 940	9 834	10 817	11 899	13 089	14 398	15 838

11,95	13,15	14,47	15,91	17,5	19,25	21,18	23,3
1 982	2 181	2 399	2 638	2 902	3 193	3 512	3 863
2 110	2 321	2 553	2 808	3 089	3 398	3 738	4 112
12,57	13,82	15,21	16,73	18,4	20,24	22,26	24,49
2 249	2 474	2 721	2 994	3 293	3 622	3 984	4 383
2 391	2 631	2 894	3 183	3 501	3 851	4 237	4 660
13,7	15,07	16,58	18,23	20,06	22,06	24,27	26,7
2 558	2 814	3 095	3 405	3 745	4 120	4 532	4 985
2 717	2 989	3 288	3 617	3 978	4 376	4 814	5 295
13,25	14,58	16,03	17,64	19,4	21,34	23,48	25,82
2 799	3 078	3 386	3 725	4 097	4 507	4 958	5 454
2 970	3 267	3 593	3 952	4 348	4 783	5 261	5 787
13,94	15,33	16,86	18,55	20,4	22,44	24,69	27,16
3 252	3 577	3 934	4 328	4 761	5 237	5 760	6 336
3 447	3 791	4 171	4 588	5 046	5 551	6 106	6 717

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