

OPERATING MANUAL

for Metering Pumps

This **Installation and Operating Manual** is supposed to be given to the person in charge of maintenance and operating.

Enduser:
Tesero Refining &
Marketing Co., USA

Project: SNCR



EPC: Worley Parsons

| | |
|------------|----------------------------------|
| Pump Type | ORLITA MfS 180/75 |
| Job No. | 2009601254 |
| Serial No. | 2009073514 2009073515 |
| Tag No. | GA-94 A/B |

INDEX

Operating Manual for Metering Pumps

| | | |
|-------------------|-------------------|--------------------------------|
| Kommission | Job No. | 2009601254 |
| Fabrik-Nr. | Serial No. | 2009073514 + 2009073515 |
| Pumpentyp | Pump Type | ORLITA MfS 180/75 |

| | | |
|----------|---|---|
| |  |  |
| 1 | Daten 'WIE GEBAUT' | 'AS BUILT' data |
| 1 | Maßblatt | General Arrangement Drawing |
| 2 | Datenblatt ORLITA & Leistungsdiagramm | Datasheet ORLITA & Performance Diagram |
| 3 | Zeichnung Typenschild | Nameplate Drawing |
| 4 | Testzertifikate | Test Certificates |
| 2 | Allgemeines | General Information |
| 1 | Einsatzrichtlinien | General Operating Instructions |
| 2 | Sicherheitsbestimmungen | Safety Instructions |
| 3 | Schmierstoffempfehlung | Lubrication Schedule |
| 4 | Inbetriebnahme | Startup |
| 5 | Ausserbetriebsetzung + Konservierung | Shutdown & Preservation |
| 6 | Inspektion- und Wartungsplan | Inspection & Maintenance Schedule |
| 7 | Anzugsmomente | Tightening Torques |
| 3 | Das Triebwerk | The Crank Gear |
| 1 | Typen S 80 / S 180 / S 600 / S 1400 | Types S 80 / S 180 / S 600 / S 1400 |
| 4 | Der Pumpenkopf | The Pump Head |
| 1 | Membrankopf MfS | Diaphragm Head MfS |
| 5 | Der Antrieb | The Drive Unit |
| 1 | Motor Betriebsanleitung (ohne) | Motor Manual (not included) |
| 2 | Getriebe Betriebsanleitung (SEW) | Reduction Gear Manual (SEW) |
| 6 | Angebautes Zubehör | Installed Accessories |
| 1 | Membranbruchüberwachung / Manometer | Diaphragm Rupture Indication / Pressure Gauge |
| 7 | Ersatzteil-Stücklisten | Pump Parts Lists |
| 1 | ORLITA MfS 180/75 | ORLITA MfS 180/75 |
| 8 | Zertifikate | Certification |
| 1 | CE Konformitätserklärung | CE Declaration of Conformity |
| 2 | Materialzeugnisse EN 10204 3.1 | Material Certificates EN 10204 3.1 |
| 3 | Sicherheitsdatenblatt Hydrauliköl (TTO-24) | Safety Data Sheet Hydraulic Oil (TTO-24) |
| 4 | Sicherheitsdatenblatt Kurbel-Getriebeöl (Mobilgear 600 XP 150) | Safety Data Sheet Crank Gear Oil (Mobilgear 600 XP 150) |
| 5 | Sicherheitsdatenblatt Reduzier-Getriebeöl (Mobil SHC 630) | Safety Data Sheet Reduction Gear Oil (Mobil SHC 630) |

BETRIEBSANLEITUNG

für Dosierpumpen

OPERATING MANUAL

for Metering Pumps

ProMinent Dosiertechnik GmbH

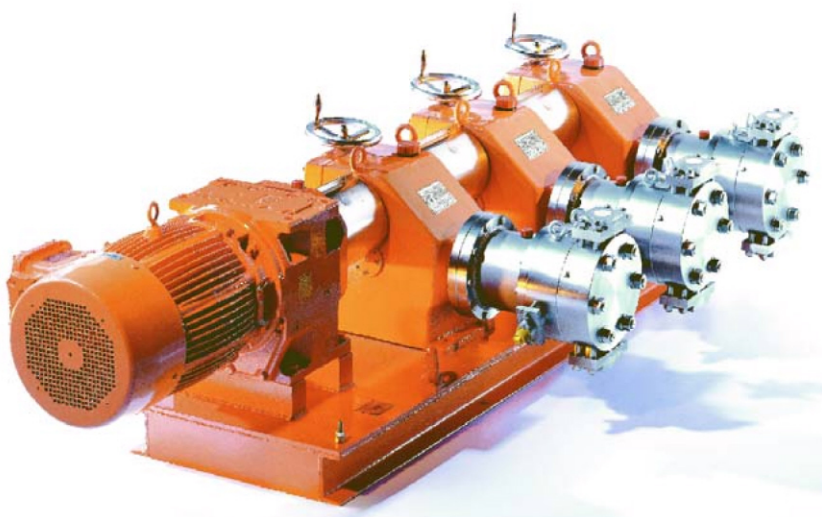
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ProMinent®



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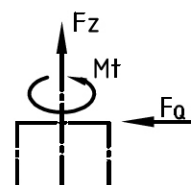
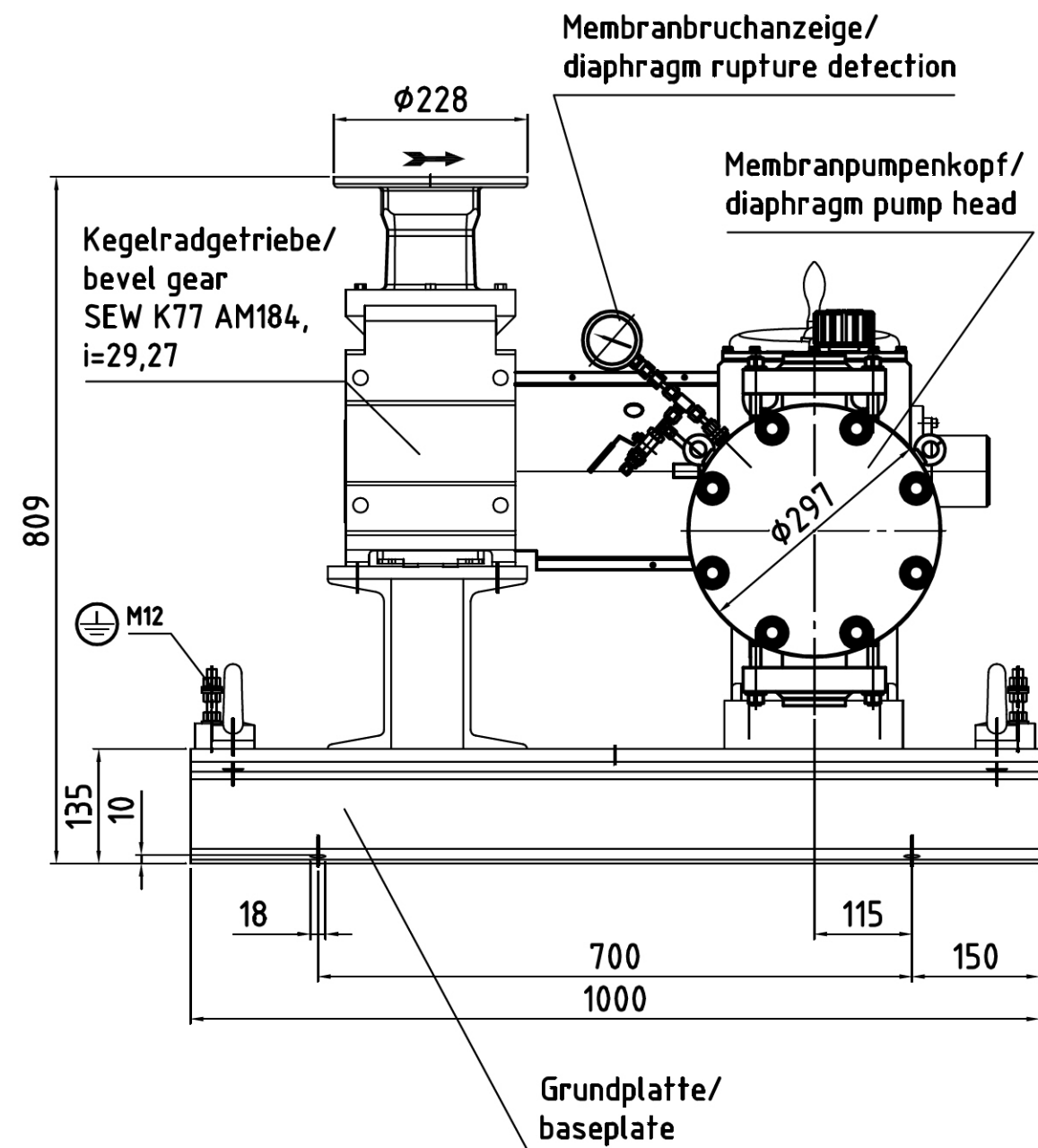
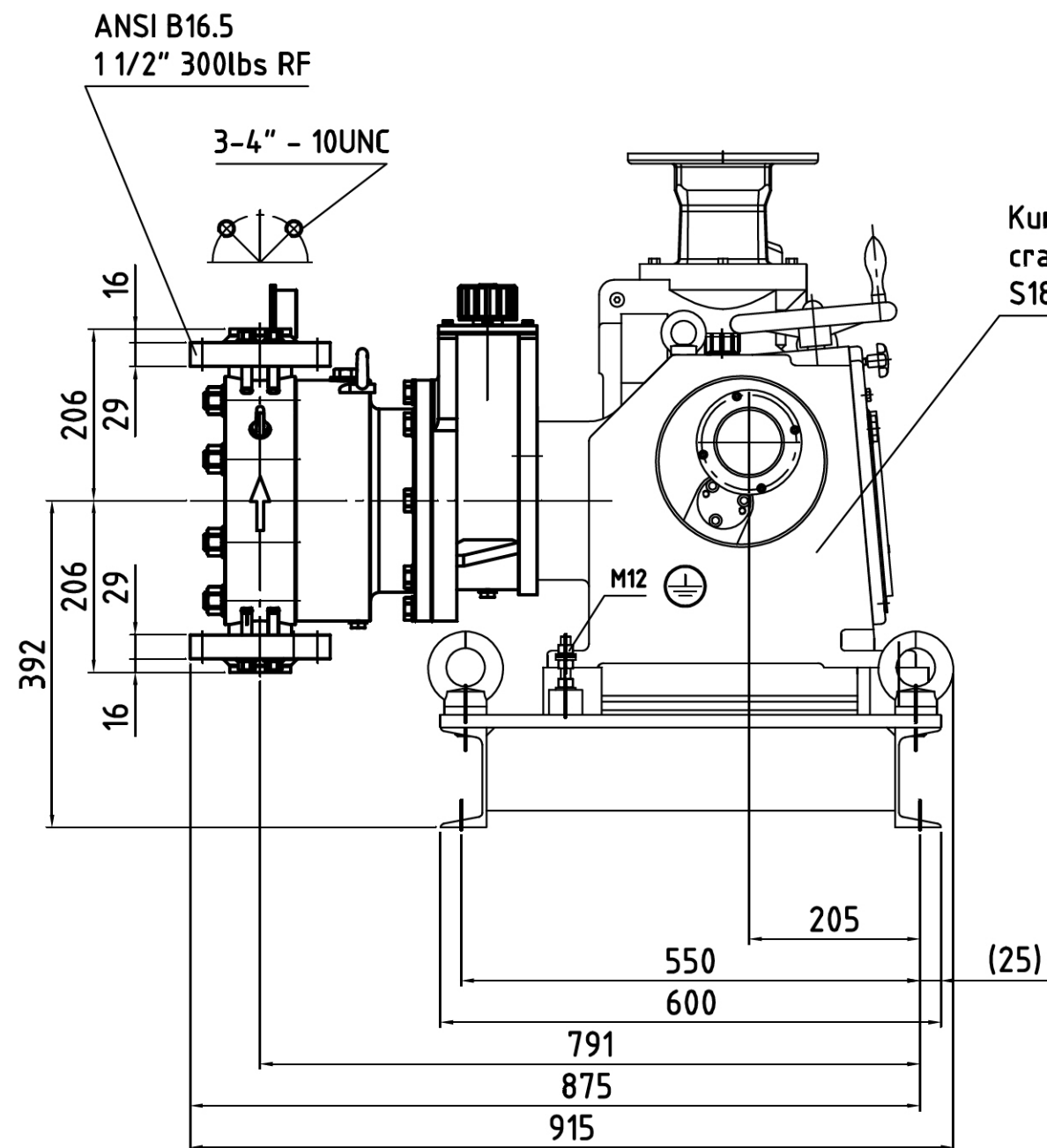
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Zulässige Belastung am Anschluß
max. torque & forces on nozzles

Fz= 240 N
Fq= 280 N
Mt= 80 Nm

| | | | | | | | | | |
|-----------|--------------|------|------|---|----------|----------|--|---|--|
| Project: | | | | | | Scale: % | | Weight: 490 kg | |
| GA-94 A/B | | | | NPL 904014 | | | | Status: AS BUILT | |
| | | | | | Date | Name | | Membranpumpe / diaphragm pump MfS 180/75 | |
| | | | | Drawn | 22.10.09 | Köhler | | | |
| | | | | Checked | 22.10.09 | Kania | | | |
| | | | | | | | | | |
| | | | | ProMinent® Im Schuhmachergewann 5-11 D-69123 Heidelberg | | | | 2009601254__10-03 | |
| | | | | | | | | | |
| Rev. | Modification | Date | Name | Origin | | | | Sheet 1 | |

| | | | | | | | | | | | |
|--|---|---|-----------------------|---|--------------------------------------|-------------------------------|---------------------|------------------------------|------------------------|------|-----|
| REM | ProMinent ProMinent Dosiertechnik GmbH Im Schuhmachergewann 5-11 69123 Heidelberg, Germany Tel.: + 49 (6221) 842-0 Fax: + 49 (6221) 842-419 E-Mail: info@prominent.com | | | EQUIPMENT DATASHEET POSITIVE DISPLACEMENT PUMP | | | JOB No. | | 2009601254 | | REM |
| | | | | | | | P.O. No. | | 200906683 | | |
| | | | | | | | QUOTE No. | | Q9080701 | | |
| | | | | | | | Previous Job | | N / A | | |
| Pump Type | | ORLITA MfS 180/75 | | | ATEX | | N / A | | | | |
| Serial Number | | 2009073514 + 2009073515 | | | No. Service / Spare | | 2 / 0 | | | | |
| OPERATING DATA | | | | | PERFORMANCE DATA | | | | | | |
| Liquid | | - | ammonia | | | Theoretic Capacity | | l/h | 646,73 | | |
| Solid Contents | | - | none | | | Effective Capacity | | l/h | 601,46 | | |
| Capacity (Min/Norm/Max) | | l/h | 113,6 - 455 | | | Stroke Speed | | min ⁻¹ | 61 | | |
| Suction Pressure | | barg | 1,24 - 18,47 | | | NPSH _R | | m | 2,4 | | |
| Rated Discharge Pressure | | barg | 18,3 | | | Efficiency mech. / hydr. | | | 0,83 | 0,93 | 2 |
| Process Temperature PT | | °C | -34 ... +43 | | | Abs. Power @ rtd. Pressure | | kW | 0,789 | | |
| Density @ PT | | kg/m ³ | 670,00 | | | Abs. Power @ RVS | | kW | 0,905 | | |
| Vapour Pressure @ PT | | bara | 7,4 | | | Stroke Volume | | cm ³ | 176,71 | | |
| Viscosity @ PT | | cP | 0,241 | | | Max Working Pressure | | barg | 30 | | |
| NPSH _A | | m | 1,5 | | | Temperature Range | | °C | -35 ... +80 | | |
| Ambient Temperature | | °C | N / A | | | Req. Suction Overpressure | | barg | 0 | | |
| NOZZLE DATA | | | | | SHOP TESTS & CERTIFICATES | | | | | | |
| | | Size | Rating | Facing | Orientation | Standard Test | y/n | Y | | | |
| | Suction | 1-1/2" | #300 RF | ANSI B16.5 | BOTTOM | Performance Test | y/n | Y | API 675 | | |
| | Discharge | 1-1/2" | #300 RF | ANSI B16.5 | TOP | Hydrostatic Test | y/n | Y | 45 bar | | |
| 1 | Diaph. Ctrl. | G 1/4 | PN40 | ISO 228 | side, 10 h | Hydrostatic Heating Jacket | y/n | N / A | | | |
| | Heating | --- | | | N / A | NPSH | y/n | N | | | |
| | Flushing | --- | | | N / A | Noise | y/n | N | | | |
| | | | | | | Material Certs. EN 10204 3.1B | y/n | Y | press. retaining parts | | |
| CONSTRUCTION | | | | | MOTOR | | NOT INCLUDED | | | | |
| Head Type / No. / Phased | | - | Mf4a075 | | 1 | N | Make | - | --- | | |
| Design | | - | double diaphragm hyd. | | | Rated Power | kW | ≥2,2 | | | |
| Characteristics | | - | | | | Speed | min ⁻¹ | 1800 | | | |
| Piston Diameter | | mm | 75 | | | Size / Mounting | - | NEMA 184 TC, vertical | | 3 | |
| Stroke Length | | mm | 40 | | | Enclosure | - | --- | | | |
| Stroke Adjustment | | - | manual | | | Voltage / Phase / Freq. | - | --- | | | |
| Signal | | - | N / A | | | Thermal Protection | - | --- | | | |
| Valve, Type & Size | | SS | cone DN 40 | | | Accessories | - | --- | | | |
| Valve, Type & Size | | DS | cone DN 40 | | | SPEED REDUCER | | | | | |
| Coupling Make | | | KTR Kupplungstechnik | | | Make / Design | - | SEW / bevel | | | |
| Coupling Type | | | ROTEX R-55 | | | Type | - | K77 AM 184 | | 3 | |
| Baseplate | | | ST-37 | | | Ratio | - | 29,27 | | | |
| MATERIALS | | | | | RELIEF VALVE | | | | | | |
| Pump Head | | 1.4404 | | | Set Pressure | | bar | 21 | | | |
| Diaphragm | | PTFE | | | Type | | - | INTERNAL | | | |
| Flange / Nozzle | | 1.4404 | | | Make / Model | | - | RV3-16 | | | |
| Valve Ball / Cone / Disc | | 3.7035 | | | LUBRICANTS | | Ltrs. | Type | included | | |
| Valve Seat | | 1.4404 | | | Hydraulic Liquid | | 4,5 | TTO-24 | Y | | |
| Valve Guide | | N / A | | | Crank Gear | | 10 | ISO VG 150 | Y | | |
| Valve Housing | | N / A | | | Speed Reducer | | 5,5 | CLP HC 68 | Y | | |
| Valve Seal | | 1.4571/1.4404 | | | WEIGHT & SIZE | | | | | | |
| Valve Spring | | N / A | | | Weight | | kg | 490 | | 4 | |
| Piston | | 1.7147 | | | Size | | mm | 915 x 1000 x 809 | | 4 | |
| Packing | | N / A | | | COATING | | | | | | |
| Hydraulic Seals | | LT-NBR | | | Top Coat Colour | | - | PASTELLORANGE RAL 2003 | | | |
| Hydraulic Chamber / Hydr. Block | | 1.4057 | | | Specification | | - | ProMinent Standard Structure | | | |
| NOTES | | | | | | | | | | | |
| 1 diaphragm rupture control: pressure gauge, dial size 100 mm, 0-40 bar, make WIKA, type 233.30 c/w venting connection | | | | | | | | | | | |
| 2 hydraulic efficiency: average of both pumps | | | | | | | | | | | |
| 3 speed reducer with adaptor flange NEMA 184 TC | | | | | | | | | | | |
| 4 weight and size without motor | | | | | | | | | | | |
| PLANT | | | | | | | | | | | |
| EPC | | Worley Parsons | | | | | | | | | |
| BUYER | | ProMinent Fluid Controls Inc., Pittsburgh / USA | | | | STATUS | | AS BUILT | | | |
| USER | | Teroso Refining & Marketing Co., USA | | | | EQUIPM. No. | | GA-94 A/B | | | |
| DATE / SIGN | | 06.11.2009 RW | | | | DWG No. | | 2009601254_10-03 | | | |

| | | | | | | | | | |
|--|--|---|-----------------------|---|----------------------------|--------------------------------------|-------------------------------------|------------------------------|------------------------|
| REM | ProMinent Dosiertechnik GmbH Im Schuhmachergewann 5-11 69123 Heidelberg, Germany Tel.: + 49 (6221) 842-0 Fax: + 49 (6221) 842-419 E-Mail: info@prominent.com | | | EQUIPMENT DATASHEET POSITIVE DISPLACEMENT PUMP | | | JOB No. 2009601254 | | REM |
| | P.O. No. 200906683 | | | | | | | | |
| | QUOTE No. Q9080701 | | | | | | | | |
| | Previous Job N / A | | | | | | | | |
| Pump Type ORLITA MfS 180/75 | | ATEX N / A | | | | | | | |
| Serial Number 2009073514 + 2009073515 | | No. Service / Spare 2 / 0 | | | | | | | |
| OPERATING DATA | | | | | | PERFORMANCE DATA | | | |
| Liquid | | - | ammonia | | Theoretic Capacity | gph | 170,85 | | |
| Solid Contents | | - | none | | Effective Capacity | gph | 158,89 | | |
| Capacity (Min/Norm/Max) | | gph | 120 | | Stroke Speed | min ⁻¹ | 61 | | |
| Suction Pressure | | psig | 18 - 268 | | NPSH _R | ft | 7,87 | | |
| Rated Discharge Pressure | | psig | 265 | | Efficiency mech. / hydr. | | 0,83 | 0,93 | 2 |
| Process Temperature PT | | °F | -34 ... +43 | | Abs. Power @ rtd. Pressure | hp | 1,056 | | |
| Density @ PT | | lb/ft ³ | 74,79 | | Abs. Power @ RVS | hp | 1,216 | | |
| Vapour Pressure @ PT | | psia | 107 | | Stroke Volume | in ³ | 10,7838 | | |
| Viscosity @ PT | | cP | 0,241 | | Max Working Pressure | psi | 435 | | |
| NPSH _A | | ft | 4,9 | | Temperature Range | °F | -31 ... +176 | | |
| Ambient Temperature | | °F | N / A | | Req. Suction Overpressure | psig | 0 | | |
| NOZZLE DATA | | | | | | SHOP TESTS & CERTIFICATES | | | |
| | Size | Rating | Facing | Orientation | Standard Test | y/n | Y | | |
| | Suction | 1-1/2" | #300 RF | ANSI B16.5 | Performance Test | y/n | Y | | |
| | Discharge | 1-1/2" | #300 RF | ANSI B16.5 | Hydrostatic Test | y/n | Y | 653 psi | |
| 1 | Diaph. Ctrl. | G 1/4 | PN40 | ISO 228 | side, 10 h | Hydrostatic Heating Jacket | y/n | N / A | |
| | Heating | --- | | | N / A | NPSH | y/n | N | |
| | Flushing | --- | | | N / A | Noise | y/n | N | |
| | | | | | | Material Certs. EN 10204 3.1B | y/n | Y | press. retaining parts |
| CONSTRUCTION | | | | | | MOTOR NOT INCLUDED | | | |
| Head Type / No. / Phased | | - | Mf4a075 | | 1 | N | Make | - | --- |
| Design | | - | double diaphragm hyd. | | | | Rated Power | hp | ≥3,0 |
| Characteristics | | - | 0 | | | | Speed | min ⁻¹ | 1800 |
| Piston Diameter | | mm | 75 | | | | Size / Mounting | - | NEMA 184 TC, vertical |
| Stroke Length | | mm | 40 | | | | Enclosure | - | --- |
| Stroke Adjustment | | - | manual | | | | Voltage / Phase / Freq. | - | --- |
| Signal | | - | N / A | | | | Thermal Protection | - | --- |
| Valve, Type & Size | | SS | cone DN 40 | | | | Accessories | - | --- |
| Valve, Type & Size | | DS | cone DN 40 | | | | SPEED REDUCER | | |
| Coupling Make | | | KTR Kupplungstechnik | | | | Make / Design | - | SEW / bevel |
| Coupling Type | | | ROTEX R-55 | | | | Type | - | K77 AM 184 |
| Baseplate | | | ST-37 | | | | Ratio | - | 29,27 |
| MATERIALS | | | | | | RELIEF VALVE | | | |
| Pump Head | | 1.4404 | | | | Set Pressure | psi | 305 | |
| Diaphragm | | PTFE | | | | Type | - | INTERNAL | |
| Flange / Nozzle | | 1.4404 | | | | Make / Model | - | RV3-16 | |
| Valve Ball / Cone / Disc | | 3.7035 | | | | LUBRICANTS | | gals | Type included |
| Valve Seat | | 1.4404 | | | | Hydraulic Liquid | 1,189 | TTO-24 | Y |
| Valve Guide | | N / A | | | | Crank Gear | 2,642 | ISO VG 150 | Y |
| Valve Housing | | N / A | | | | Speed Reducer | 1,453 | CLP HC 68 | Y |
| Valve Seal | | 1.4571/1.4404 | | | | WEIGHT & SIZE | | | |
| Valve Spring | | N / A | | | | Weight | lbs | 1080 | |
| Piston | | 1.7147 | | | | Size | inch | 36.0 x 39.4 x 31.9 | |
| Packing | | N / A | | | | COATING | | | |
| Hydraulic Seals | | LT-NBR | | | | Top Coat Colour | - | PASTELLORANGE RAL 2003 | |
| Hydraulic Chamber / Hydr. Block | | 1.4057 | | | | Specification | - | ProMinent Standard Structure | |
| NOTES | | | | | | | | | |
| FOR ANY NOTES PLEASE REFER TO SHEET 'SI_UNITS' | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| PLANT | | | | | | | | | |
| LOCATION | | Worley Parsons | | | | | | | |
| BUYER | | ProMinent Fluid Controls Inc., Pittsburgh / USA | | | | STATUS | | AS BUILT | |
| USER | | Teroso Refining & Marketing Co., USA | | | | EQUIPM. No. | | GA-94 A/B | |
| DATE / SIGN | | 06.11.2009 RW | | | | DWG No. | | 2009601254_10-03 | |

Pump Type

ORLITA MfS 180/75

Job No.

2009601254

Serial No.

2009073514 + 2009073515

TAG No.

GA-94 A/B

Speed

61 min-1

ProMinent Dosiertechnik GmbH

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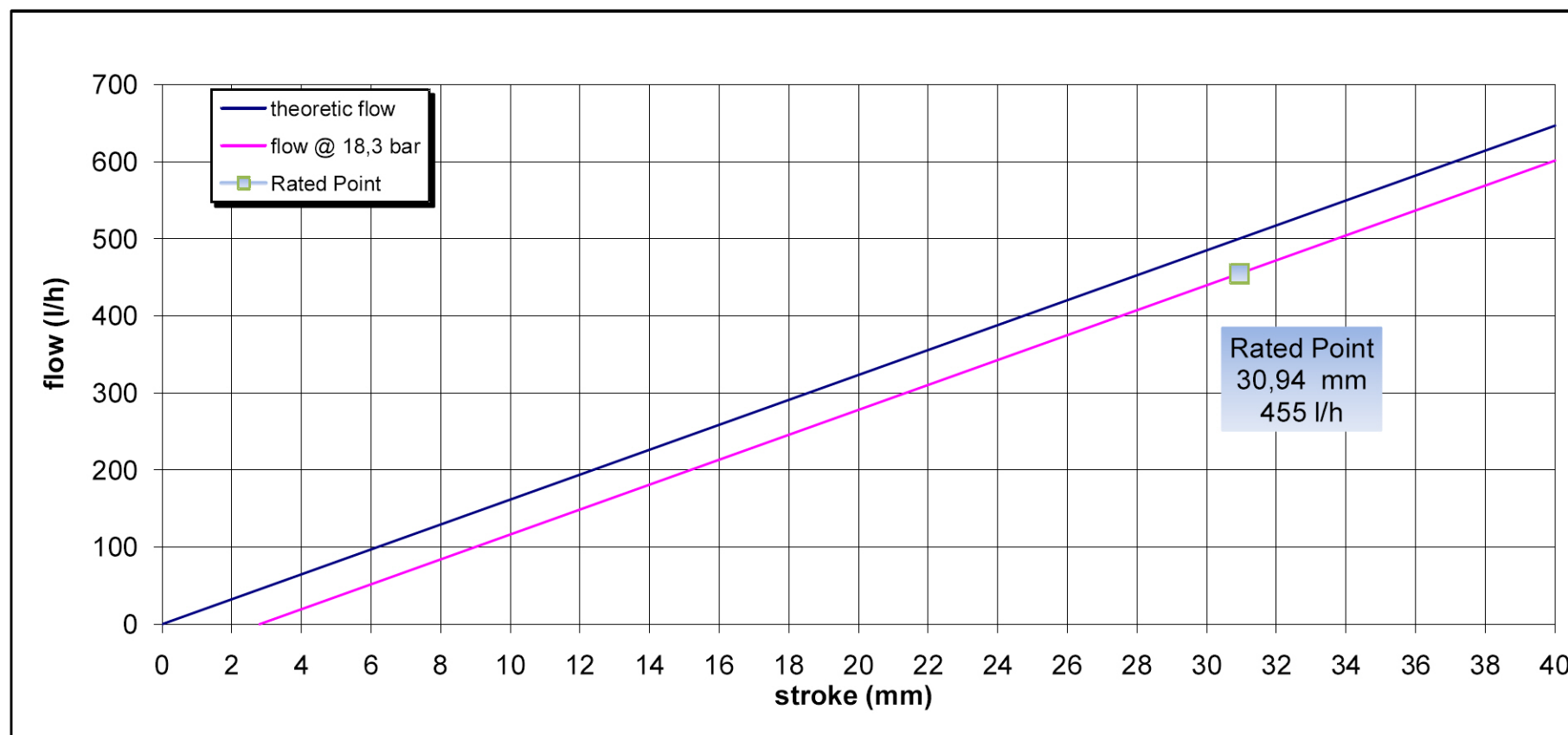
E-Mail: info@ProMinent.de

ProMinent®

PERFORMANCE DIAGRAM




| max Stroke/Stroke@zero flow | theoretic flow | flow @ 18,3 bar | efficiency |
|-----------------------------|----------------|-----------------|------------|
| 0 | 0 | | |
| 40 | 646,73 | | 1,000 |
| 2,8 | | 0 | |
| 40 | | 601,46 | 0,930 |



Rated Flow 455 l/h Rated Stroke 30,94 mm



SPEZIFIKATION / SPECIFICATION

| | | |
|-----------|-----------|---------------------------------|
| Werkstoff | Material | 1.4571 / 1.4401 (A316Ti / A316) |
| Dicke | Thickness | 0.5 mm |

| | Grösse / Size | Abmessung / Size [mm] | Material Nr |
|---|-------------------|-----------------------|-------------|
|  | 1 (klein / small) | 100 x 45 | 1029625 |
|  | 2 (Standard) | 90 x 64 | 1029626 |
|  | 3 (groß / large) | 210 x 148 | 1029627 |

| | | | |
|---|-------------|---|------------|
|  | |  | |
| Im Schuhmachergewann 5-11 69123 Heidelberg Deutschland | | | |
| Type | | ORLITA MfS 180/75 | |
| Ser.Nr. | 2009073514 | Baujahr | 2009 |
| p rtd (bar) | 18,3 | Q rtd (l/h) | 455 |
| p max (bar) | 30,0 | Q max (l/h) | 560 |
| p test (bar) | 45,0 | Q th (l/h) | 638 |
| RVS (bar) | 21,0 | n (1/min) | 60 / 60 Hz |
| Temp. (°C) | -35 ... +80 | Vol. (cm³) | 176,71 |
| GA-94 A | | | |

ANMERKUNGEN / NOTES

KAUF / JOB No. 2009601254

dergl. für / dto. for: 2009073515, GA-94 B


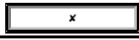
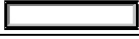
| | | |
|--------------|-------------|------------|
| Datum | Date | 30.10.2009 |
| Ausgefüllt | Prepared by | W. Foeth |
| Unterschrift | Signed | WF |



NAMEPLATE
for ORLITA® Metering Pumps

SI Einheiten / SI UNITS

SPEZIFIKATION / SPECIFICATION

| | | |
|-----------|-----------|---------------------------------|
| Werkstoff | Material | 1.4571 / 1.4401 (A316Ti / A316) |
| Dicke | Thickness | 0.5 mm |

| | Grösse / Size | Abmessung / Size [mm] | Material Nr |
|---|-------------------|-----------------------|-------------|
|  | 1 (klein / small) | 100 x 45 | 1029625 |
|  | 2 (Standard) | 90 x 64 | 1029626 |
|  | 3 (groß / large) | 210 x 148 | 1029627 |

| | | | |
|---|--------------|---|------------|
|  | |  | |
| Im Schuhmachergewann 5-11 69123 Heidelberg Germany | | | |
| Type | | ORLITA MfS 180/75 | |
| Ser.No. | 2009073514 | Built (year) | 2009 |
| p rtd (psi) | 265 | Q rtd (gph) | 120 |
| p max (psi) | 435 | Q max (gph) | 148 |
| p test (psi) | 653 | Q th (gph) | 168,5 |
| RVS (psi) | 305 | n (1/min) | 60 / 60 Hz |
| Temp. (F) | -31 ... +176 | Vol. (in ³) | 10.783 |
| GA-94 A | | | |

ANMERKUNGEN / NOTES

KAUF / JOB No. 2009601254

dergl. für / dto. for: 2009073515, GA-94 B

| | | |
|--------------|-------------|------------|
| Datum | Date | 30.10.2009 |
| Ausgefüllt | Prepared by | W. Foeth |
| Unterschrift | Signed | WF |

TESTZERTIFIKAT / TEST CERTIFICATE

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5-11
69123 Heidelberg, Germany

Tel.: + 49 (6221) 842-0
Fax: + 49 (6221) 842-419
eMail: info@prominent.com

ProMinent®

APZ 3.1 API - 001

Allgemeines/General

| | | | |
|----------------------------|--------------|--------------------|------------------------------|
| Auftrags-Nr./ job no. | : 2009601254 | Kunde/customer | : PM Fluid Controls Inc. USA |
| Pumpentyp/ pump type | : MfS 180/75 | Best.nr./order no. | : 200906683 |
| Seriennummer/ serial no. | : 2009073514 | Pumpennr./tag no. | : GA-94 A |
| Baujahr / Year | : 2009 | Bemerkungen/notes | : API 675 |
| Anzahl Köpfe/ no. of heads | : 1 | | |

Antriebsmotor/Drive motor

| | |
|---------------------------|----------------|
| Hersteller/Make | : not included |
| Typ/Type | : - |
| Leistung/Rating | : - kW |
| Spannung/Voltage | : - V |
| Frequenz/Frequency | : - Hz |
| Drehzahl/Speed | : - 1/min |
| Schutzart/Protect.class | : - |
| Ex-Zert.-Nr./Ex-cert. No. | : - |
| Fabriknr./Serial No. | : - |
| Motor Nr./ motor tag no. | : - |

Getriebe/Reduction gear

| | |
|----------------------|-------------------------|
| Hersteller/make | : SEW |
| Typ/Type | : K77 AM184 |
| Übersetzung/ratio | : 29,27 |
| Fabriknr./Serial no. | : 01.1307162601.0001.09 |

Medium /medium

| | |
|------------------------|------------------|
| Prüfmedium / Liquid | : Wasser / water |
| Temperatur/ temperatur | : 18 °C |

Verwendete Schmierstoffe/Used lubrications

Triebwerk/Crank gear

| | |
|----------------|--------------|
| Öltyp/Oil type | : ISO VG 150 |
|----------------|--------------|

Pumpenkopf/Pump head

| | |
|----------------|----------|
| Öltyp/Oil type | : TTO-24 |
|----------------|----------|

Allgemeine Messwerte / General test records

| | | | |
|-------------------|----------|--------------------|------------------------|
| ED ÜSV/RV setting | : 21 bar | Hubfrequenz/ speed | : 60,996 [1/min@60 Hz] |
| Gewicht/Weight | : 490 kg | | |

| Testart / Test designation | ausgef./ executed | Testwert/ Test value | siehe Blatt/ see sheet |
|--|----------------------|-------------------------|---------------------------|
| Druckprobe/ Hydrostatic Test | ✓ | 45 bar | APZ-3.1 API - 002 |
| Leistungstest / Capacity test | ✓ | 455 l/h @ 18,3 bar (*) | APZ-3.1 API - 003 |
| Protokoll Messwerte/ Test values | ✓ | 589,5 l/h @ 18,3 bar(*) | APZ-3.1 API - 004 |
| Nachweis Genauigkeit/ Proof of Accuracy | ✓ | < / = 1% (**) | APZ-3.1 API - 004 |
| Nachweis Reproduzierbarkeit/ Proof of Repeatability | ✓ | < / = 3% (**) | APZ-3.1 API - 005 |
| Nachweis Linearität / Proof of Linearity | ✓ | within +/- 3% (**) | APZ-3.1 API - 006 |

(*) base=speed @ 60 Hz

(**) base=rated flow

Heidelberg, den

20.10.2009

Kania

Unterschrift des Prüfers
Sign of testing personnel

-

Unterschrift des Kundenbeauftragten
Sign of the witness

TESTZERTIFIKAT / TEST CERTIFICATE

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5-11
69123 Heidelberg, Germany

Tel.: + 49 (6221) 842-0
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ProMinent®

Druckprobe / Hydrostatic Test

APZ-3.1 API - 002

| | | |
|-----------------------------|---|----------------------------|
| KundenauftragNr. / Job no. | : | 2009601254 |
| Kunde / customer | : | PM Fluid Controls Inc. USA |
| Pumpentyp / pump type | : | MfS 180/75 |
| Seriennr. / serial no. | : | 2009073514 |
| Pumpennr. / tag no. | : | GA-94 A |
| Material Nr. / material no. | : | |
| Anzahl Köpfe / no. of heads | : | 1 |

Testwerte / test values

| | | |
|--------------------------|---|-----------------------|
| Testdruck / pressure | : | <u>45</u> barg |
| Prüfzeit / time | : | <u>0,5</u> h |
| Testmedium / test liquid | : | <u>Wasser / water</u> |

☒ bestanden / existed

Druckprüfung / Hydrostatic Test

Die oben spezifizierte Dosierpumpe wurde in unserem Werk einem Prüfdruck unter obigen Bedingungen ausgesetzt und zeigte keinerlei Mängel.

The above specified dosing pump has been hydrostatically tested under the a.m. condition without showing any failure.

Bemerkungen:

Diese Bescheinigung wurde durch ein EDV-System erstellt und ist ohne Unterschrift gültig. Das Zertifikat entbindet den Käufer nicht von der Prüfung der erhaltenen Ware auf ihre Eignung und korrekte Qualität bezogen auf die spezifische Anwendung. Lager und Transportbedingungen können die Eigenschaften des Produktes beeinflussen. / This certificate is generated electronically, it is valid without a signature. The provision of this certificate and the data it contains does not remove from and of the correct quality for the application. The conditions of transport and storage may affect the properties of the material.

Heidelberg, den 20.10.2009

Dieser Test wurde überwacht von :
This test was witnessed by :

Kania

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Leistungstest / Performance Test

APZ 3.1 API - 003

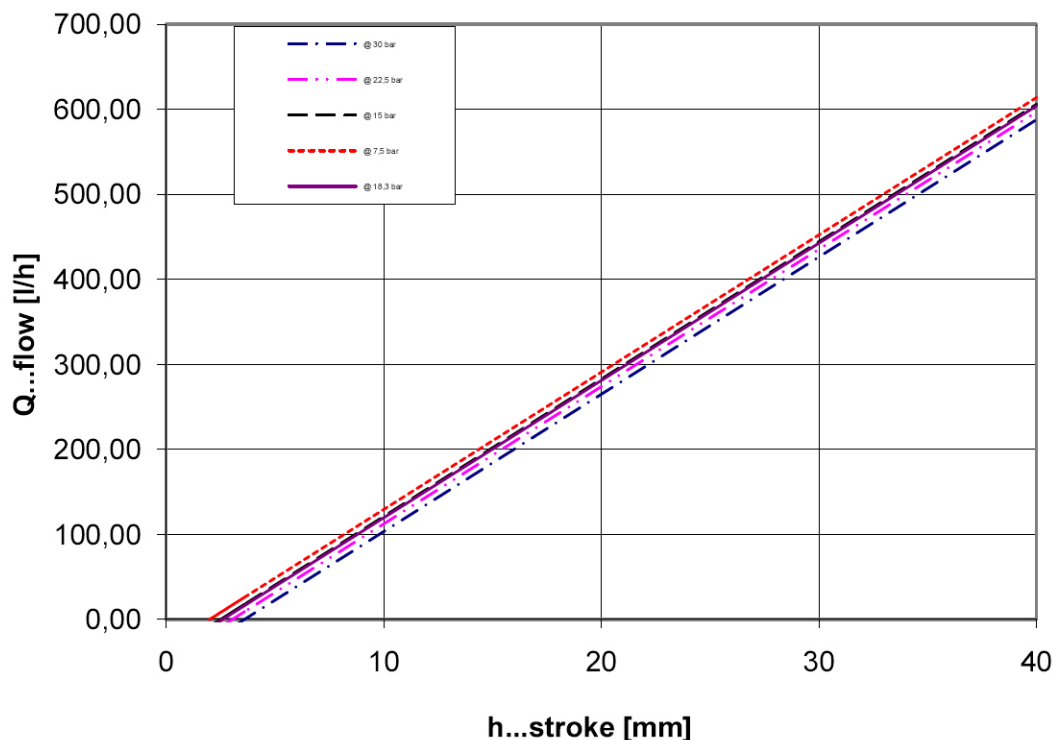
Kunde / customer : PM Fluid Controls Inc. USA
Pumpentyp / pump type : MfS 180/75
Serien-Nr. / serial no. : 2009073514
Pumpen-Nr. / tag no. : GA-94 A
Anzahl Köpfe / number of heads : 1
Prüfer / examiner : Kania
Datum / date : 20.10.2009

Statischer Leistungstest/Static performance test

| Druck/Pressure | [bar] | [mm] | [%] | [l/h] | [l/h] @ 60 Hz |
|-------------------|-------|------|-------|--------|---------------|
| 100% = | 30 | 3,60 | 91,00 | 490,02 | 588,02 |
| 75% = | 22,5 | 3,05 | 92,38 | 497,42 | 596,91 |
| 50% = | 15 | 2,50 | 93,75 | 504,83 | 605,79 |
| 25% = | 7,5 | 2,00 | 95,00 | 511,56 | 613,87 |
| Auslegung/Rated = | 18,3 | 2,60 | 93,50 | 503,48 | 604,18 |

Erläuterung/Comment: [mm]...Hubverlust/Stroke loss, [%]...Wirkungsgrad/Efficiency, [l/h]...Fördermenge/Max. flow

Hubfrequenz / Pump Speed = 60,996 [1/min@60 Hz]



TEST CERTIFICATE / PUMP TEST API 675

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Pumpentyp / pump type : MfS 180/75
SerienNr. / serial no. : 2009073514
Tag Nr. / tag no. : GA-94 A
Betriebsdruck / Rated pressure : 18,3 barg
Hubfrequenz / Pump speed [1/min] : 61,0 (@60Hz)
Nennförderleistung / Rated flow [l/h] : 455,0 (@60Hz)

APZ 3.1 API - 004

| (test @ 60Hz) | Stroke [mm] | Vol. [l] | Time (down) [s] | Flow (down) [l/h] | Flow[l/h] accuracy act / rtd | Time (up) [s] | Flow (up) [l/h] | Flow[l/h] accuracy act / rtd | repeat- ability act/rtd |
|--------------------|----------------|-------------|-----------------------|-------------------------|------------------------------------|---------------------|-----------------------|------------------------------------|-------------------------------|
| 100% pump capacity | 40 | 8,935 | 54,47 | 590,53 | 587,95 | | | 591,03 | |
| | | | 54,95 | 585,37 | | 54,15 | 594,02 | | |
| | | | | | 0,57% | 54,70 | 588,04 | 0,66% | 0,68% |
| | 32 | 8,935 | 67,94 | 473,45 | 472,68 | | | 471,30 | |
| | | | 68,16 | 471,92 | | 68,12 | 472,20 | | |
| | | | | | 0,17% | 68,38 | 470,40 | 0,20% | 0,30% |
| | 24 | 3,875 | 40,01 | 348,66 | 346,21 | | | 342,00 | |
| | | | 40,58 | 343,77 | | 40,79 | 342,00 | | |
| | | | | | 0,54% | 41,21 | 338,51 | 0,77% | 0,93% |
| | 16 | 3,875 | 65,38 | 213,37 | 213,38 | | | 214,45 | |
| | | | 65,37 | 213,40 | | 65,12 | 214,22 | | |
| | | | | | 0,00% | 64,98 | 214,68 | 0,05% | 0,23% |
| <= 10% rated | 6 | 0,526 | 41,62 | 45,50 | 45,21 | | | 45,05 | |
| | | | 42,16 | 44,91 | | 41,90 | 45,19 | | |
| | | | | | 0,06% | 42,16 | 44,91 | 0,03% | 0,03% |

Ergebnisse / Results

| | | | |
|------------|--------|-------------------------------------|---|
| Qth single | 646,18 | Förderleistung / max. flow | ✓ |
| Qth ges. | 646,18 | Genauigkeit / steady state accuracy | ✓ |
| eta | 0,91 | Genauigkeit / repeatability | ✓ |
| Q ges. | 589,49 | Regelverhältnis / turndown ratio | ✓ |

Heidelberg, den

20.10.2009

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TEST CERTIFICATE / PUMP TEST API 675

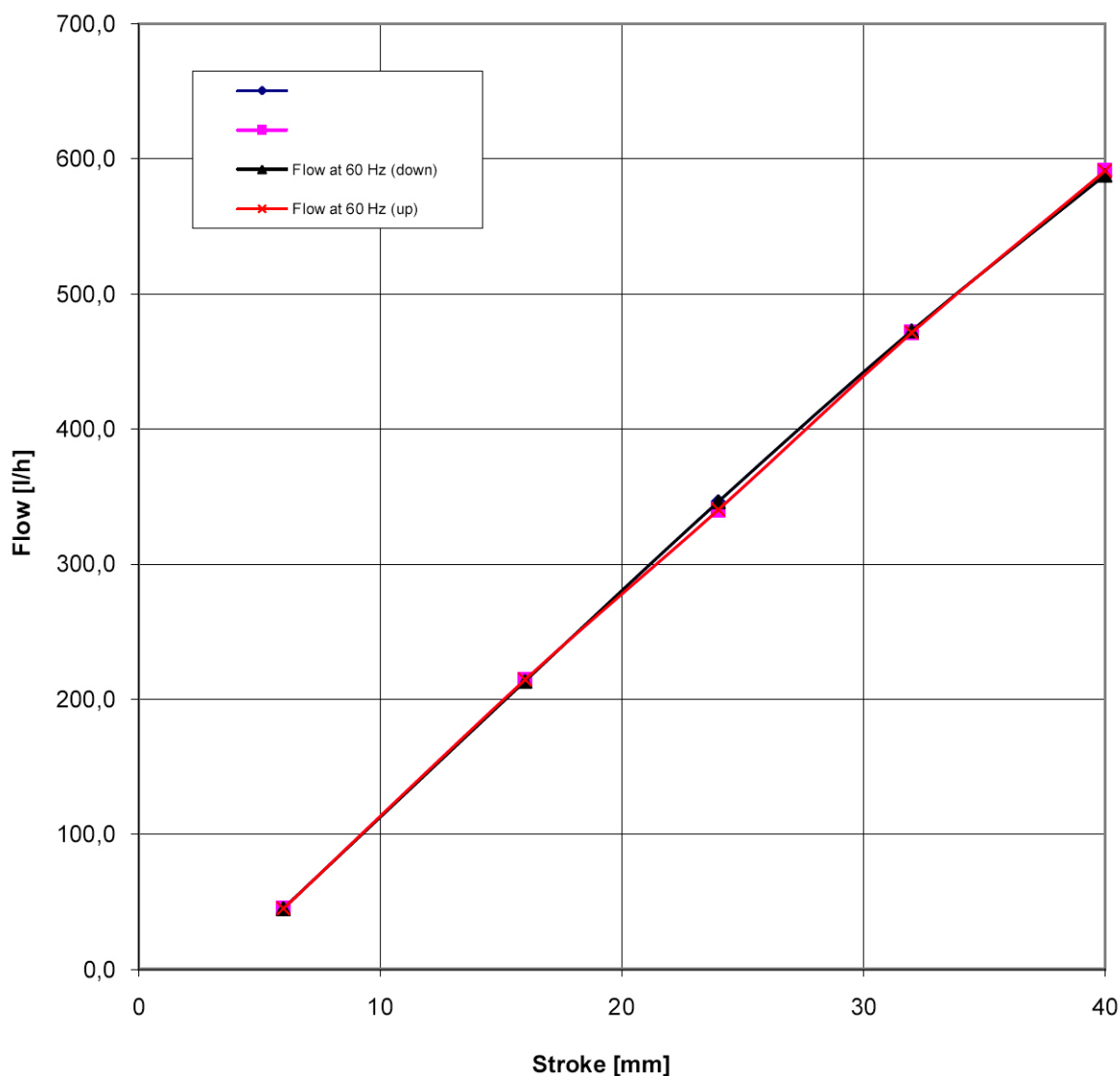
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Reproduzierbarkeit / Repeatability

APZ 3.1 API - 005

| | | | |
|------------------------|--------------|-------------------------|------------------|
| Pumpentyp / pump type | : MfS 180/75 | Förderleistung / | : 589,49 (@60Hz) |
| SerienNr. / serial no. | : 2009073514 | Capacity measured [l/h] | |
| Tag Nr. / tag no. | : GA-94 A | Hubfrequenz / | : 60,996 (@60Hz) |
| Betriebsdruck / | : 18,3 | Pump speed [1/min] | |
| Rated pressure [bar] | | | |



TEST CERTIFICATE / PUMP TEST API 675

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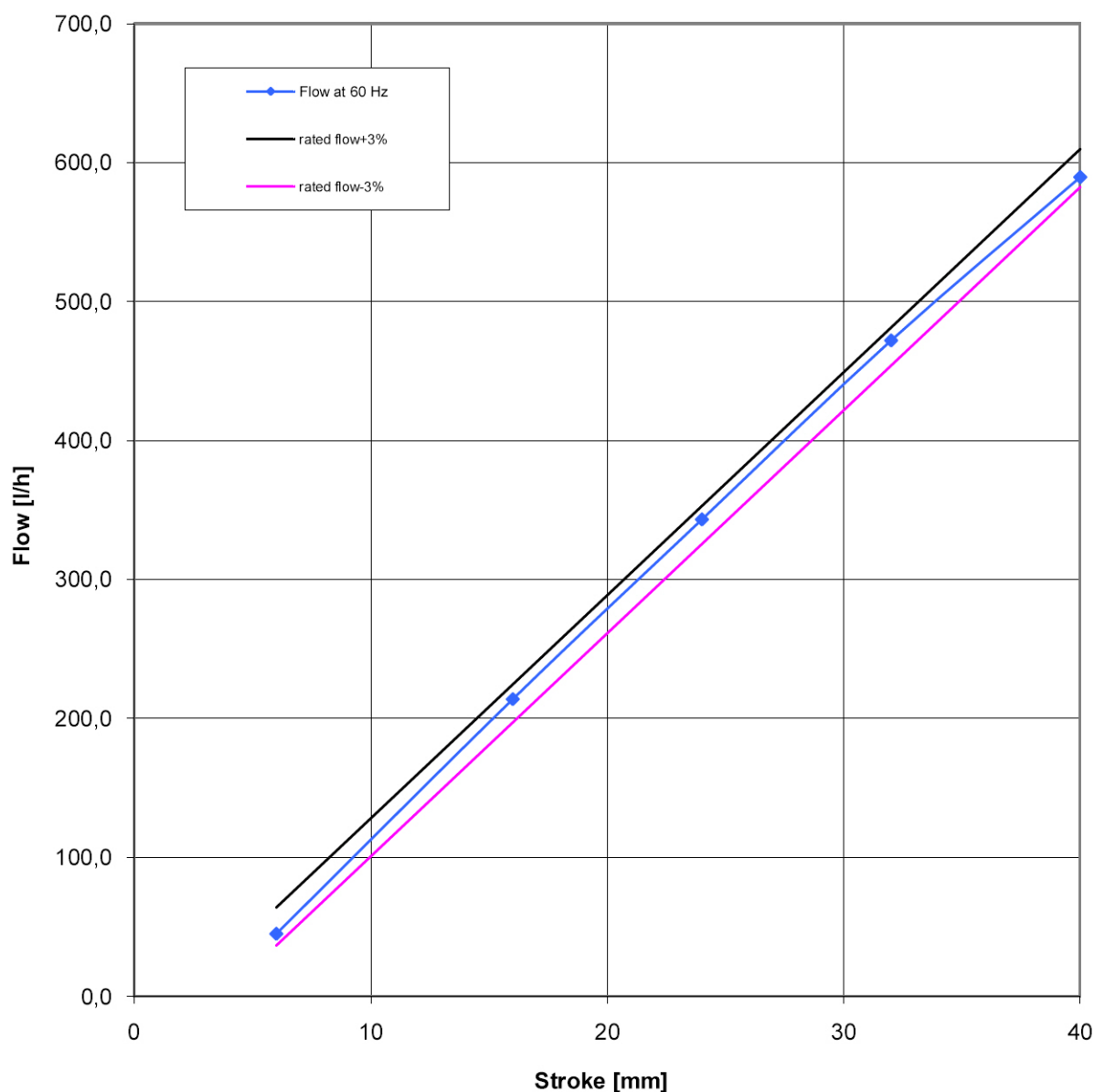
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eMail: info@prominent.com



Linearität / Linearity

APZ 3.1 API - 006

| | | | |
|------------------------|--------------|-------------------------|------------------|
| Pumpentyp / pump type | : MfS 180/75 | Förderleistung / | : 589,49 (@60Hz) |
| SerienNr. / serial no. | : 2009073514 | Capacity measured [l/h] | |
| Tag Nr. / tag no. | : GA-94 A | Hubfrequenz / | : 60,996 (@60Hz) |
| Betriebsdruck / | : 18,3 | Pump speed [1/min] | |
| Rated pressure [bar] | | | |



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APZ 3.1 API - 001

Allgemeines/General

| | | | |
|----------------------------|--------------|--------------------|------------------------------|
| Auftrags-Nr./ job no. | : 2009601254 | Kunde/customer | : PM Fluid Controls Inc. USA |
| Pumpentyp/ pump type | : MfS 180/75 | Best.nr./order no. | : 200906683 |
| Seriennummer/ serial no. | : 2009073515 | Pumpennr./tag no. | : GA-94 B |
| Baujahr / Year | : 2009 | Bemerkungen/notes | : API 675 |
| Anzahl Köpfe/ no. of heads | : 1 | | |

Antriebsmotor/Drive motor

| | |
|---------------------------|----------------|
| Hersteller/Make | : not included |
| Typ/Type | : - |
| Leistung/Rating | : - kW |
| Spannung/Voltage | : - V |
| Frequenz/Frequency | : - Hz |
| Drehzahl/Speed | : - 1/min |
| Schutzart/Protect.class | : - |
| Ex-Zert.-Nr./Ex-cert. No. | : - |
| Fabriknr./Serial No. | : - |
| Motor Nr./ motor tag no. | : - |

Getriebe/Reduction gear

| | |
|----------------------|-------------------------|
| Hersteller/make | : SEW |
| Typ/Type | : K77 AM184 |
| Übersetzung/ratio | : 29,27 |
| Fabriknr./Serial no. | : 01.1307162601.0002.09 |

Medium /medium

| | |
|------------------------|------------------|
| Prüfmedium / Liquid | : Wasser / water |
| Temperatur/ temperatur | : 18 °C |

Verwendete Schmierstoffe/Used lubrications

Triebwerk/Crank gear

| | |
|----------------|--------------|
| Öltyp/Oil type | : ISO VG 150 |
|----------------|--------------|

Pumpenkopf/Pump head

| | |
|----------------|----------|
| Öltyp/Oil type | : TTO-24 |
|----------------|----------|

Allgemeine Messwerte / General test records

| | | | |
|-------------------|----------|--------------------|------------------------|
| ED ÜSV/RV setting | : 21 bar | Hubfrequenz/ speed | : 60,996 [1/min@60 Hz] |
| Gewicht/Weight | : 490 kg | | |

| Testart / Test designation | ausgef./ executed | Testwert/ Test value | siehe Blatt/ see sheet |
|--|----------------------|-------------------------|---------------------------|
| Druckprobe/ Hydrostatic Test | ✓ | 45 bar | APZ-3.1 API - 002 |
| Leistungstest / Capacity test | ✓ | 455 l/h @ 18,3 bar (*) | APZ-3.1 API - 003 |
| Protokoll Messwerte/ Test values | ✓ | 608,6 l/h @ 18,3 bar(*) | APZ-3.1 API - 004 |
| Nachweis Genauigkeit/ Proof of Accuracy | ✓ | < / = 1% (**) | APZ-3.1 API - 004 |
| Nachweis Reproduzierbarkeit/ Proof of Repeatability | ✓ | < / = 3% (**) | APZ-3.1 API - 005 |
| Nachweis Linearität / Proof of Linearity | ✓ | within + / - 3% (**) | APZ-3.1 API - 006 |

(*) base=speed @ 60 Hz

(**) base=rated flow

Heidelberg, den

21.10.2009

Kania

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Druckprobe / Hydrostatic Test

APZ-3.1 API - 002

| | | |
|-----------------------------|---|----------------------------|
| KundenauftragNr./ Job no. | : | 2009601254 |
| Kunde / customer | : | PM Fluid Controls Inc. USA |
| Pumpentyp / pump type | : | MfS 180/75 |
| Seriennr./ serial no. | : | 2009073515 |
| Pumpennr. / tag no. | : | GA-94 B |
| Material Nr./ material no. | : | |
| Anzahl Köpfe / no. of heads | : | 1 |

Testwerte / test values

| | | | |
|--------------------------|---|-----------------------|------|
| Testdruck /pressure | : | <u>45</u> | barg |
| Prüfzeit/ time | : | <u>0,5</u> | h |
| Testmedium / test liquid | : | <u>Wasser / water</u> | |

☒ bestanden /existed

Druckprüfung / Hydrostatic Test

Die oben spezifizierte Dosierpumpe wurde in unserem Werk einem Prüfdruck unter obigen Bedingungen ausgesetzt und zeigte keinerlei Mängel.

The above specified dosing pump has been hydrostatically tested under the a.m. condition without showing any failure.

Bemerkungen:

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Heidelberg, den 21.10.2009

Dieser Test wurde überwacht von :
This test was witnessed by :

Kania

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Leistungstest / Performance Test

APZ 3.1 API - 003

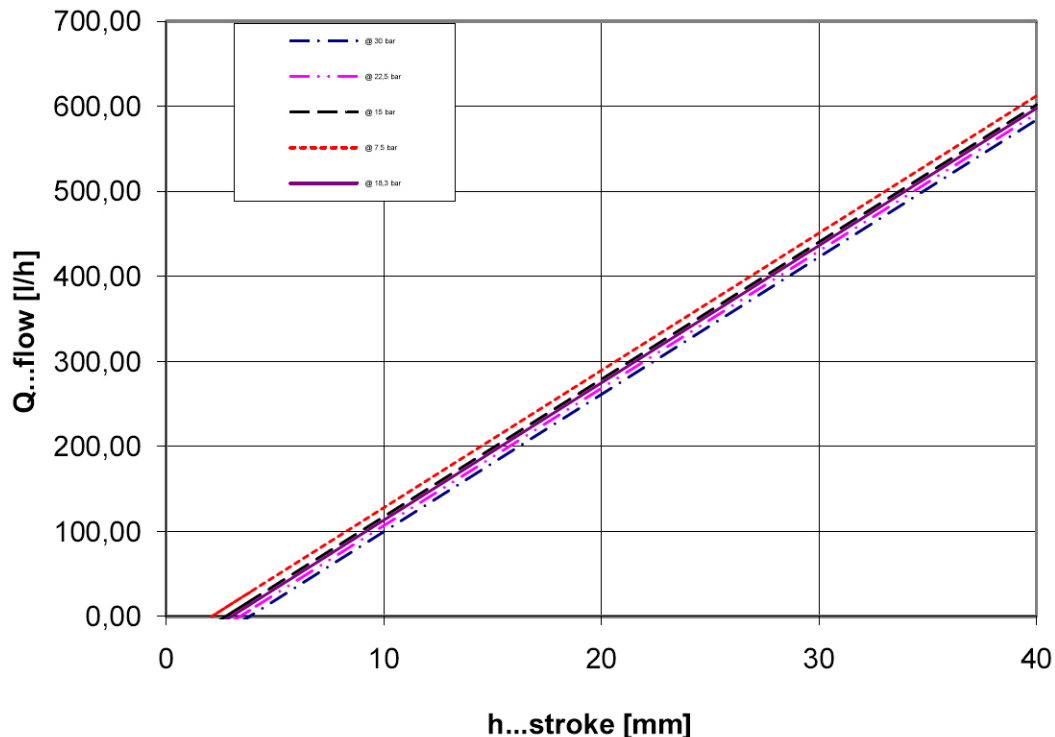
Kunde / customer : PM Fluid Controls Inc. USA
Pumpentyp / pump type : MfS 180/75
Serien-Nr. / serial no. : 2009073515
Pumpen-Nr. / tag no. : GA-94 B
Anzahl Köpfe / number of heads : 1
Prüfer / examiner : Kania
Datum / date : 21.10.2009

Statischer Leistungstest/Static performance test

| Druck/Pressure | [bar] | [mm] | [%] | [l/h] | [l/h] @ 60 Hz |
|-------------------|-------|------|-------|--------|---------------|
| 100% = | 30 | 3,85 | 90,38 | 486,66 | 583,99 |
| 75% = | 22,5 | 3,40 | 91,50 | 492,71 | 591,26 |
| 50% = | 15 | 2,75 | 93,13 | 501,46 | 601,76 |
| 25% = | 7,5 | 2,10 | 94,75 | 510,21 | 612,26 |
| Auslegung/Rated = | 18,3 | 3,00 | 92,50 | 498,10 | 597,72 |

Erläuterung/Comment: [mm]...Hubverlust/Stroke loss, [%]...Wirkungsgrad/Efficiency, [l/h]...Fördermenge/Max. flow

Hubfrequenz / Pump Speed = 60,996 [1/min@60 Hz]



TEST CERTIFICATE / PUMP TEST API 675

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Pumpentyp / pump type : MfS 180/75
SerienNr. / serial no. : 2009073515
Tag Nr. / tag no. : GA-94 B
Betriebsdruck / Rated pressure : 18,3 barg
Hubfrequenz / Pump speed [1/min] : 61,0 (@60Hz)
Nennförderleistung / Rated flow [l/h] : 455,0 (@60Hz)

APZ 3.1 API - 004

| (test @ 60Hz) | Stroke | Vol. | Time | Flow | Flow[l/h] | Time | Flow | Flow[l/h] | repeat- |
|--------------------|--------|-------|---------------|-----------------|-----------------------|-------------|---------------|-----------------------|--------------------|
| | [mm] | [l] | (down) [s] | (down) [l/h] | accuracy act / rtd | (up) [s] | (up) [l/h] | accuracy act / rtd | ability act/rtd |
| 100% pump capacity | 40 | 8,935 | 52,93 | 607,71 | 608,69 | | | 608,58 | |
| | | | 52,76 | 609,67 | | 53,04 | 606,45 | | |
| | 32 | 8,935 | | | 0,22% | 52,67 | 610,71 | 0,47% | 0,02% |
| | | | 67,73 | 474,92 | | | | | |
| | | | 67,54 | 476,25 | | 67,99 | 473,10 | | |
| | | | | | | 67,72 | 474,99 | | |
| | 24 | 3,875 | 40,14 | 347,53 | 347,79 | | | 347,53 | |
| | | | 40,08 | 348,05 | | 40,14 | 347,53 | | |
| | 16 | 3,875 | | | 0,06% | 40,35 | 345,72 | 0,40% | 0,06% |
| | | | 63,81 | 218,62 | | | | | |
| | | | 64,31 | 216,92 | | 64,56 | 216,08 | | |
| | | | | | | 64,69 | 215,64 | | |
| <= 10% rated | 5,5 | 0,526 | 45,72 | 41,42 | 41,16 | | | 41,54 | |
| | | | 46,29 | 40,91 | | 45,79 | 41,35 | | |
| | | | | | | 45,39 | 41,72 | | |

Ergebnisse / Results

| | | | |
|------------|--------|-------------------------------------|---|
| Qth single | 646,18 | Förderleistung / max. flow | ✓ |
| Qth ges. | 646,18 | Genauigkeit / steady state accuracy | ✓ |
| eta | 0,94 | Genauigkeit / repeatability | ✓ |
| Q ges. | 608,63 | Regelverhältnis / turndown ratio | ✓ |

Heidelberg, den 21.10.2009
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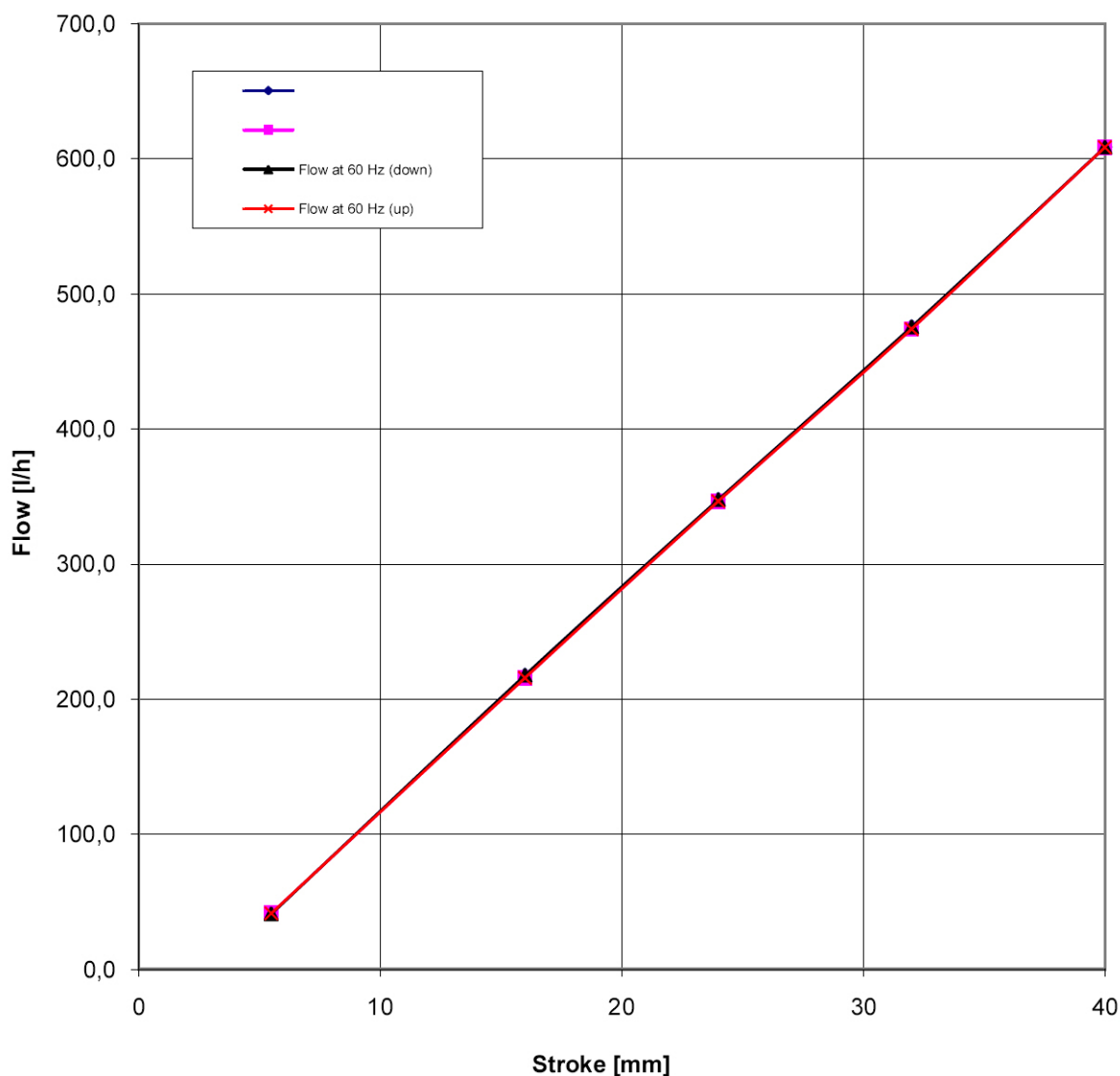
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Reproduzierbarkeit / Repeatability

APZ 3.1 API - 005

| | | | |
|------------------------|--------------|-------------------------|------------------|
| Pumpentyp / pump type | : MfS 180/75 | Förderleistung / | : 608,63 (@60Hz) |
| SerienNr. / serial no. | : 2009073515 | Capacity measured [l/h] | |
| Tag Nr. / tag no. | : GA-94 B | Hubfrequenz / | : 60,996 (@60Hz) |
| Betriebsdruck / | : 18,3 | Pump speed [1/min] | |
| Rated pressure [bar] | | | |



TEST CERTIFICATE / PUMP TEST API 675



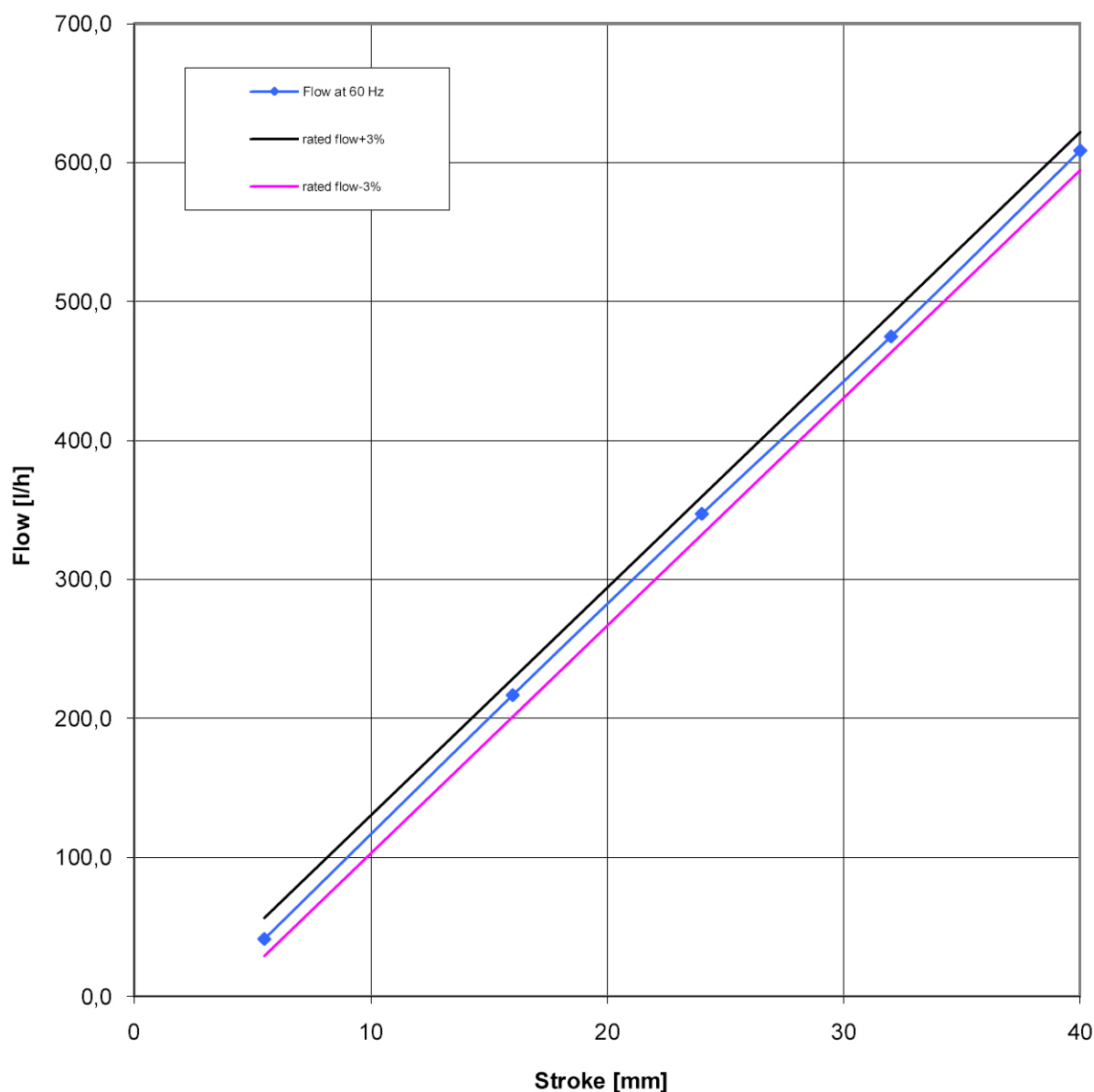
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Linearität / Linearity

APZ 3.1 API - 006

| | | | |
|--------------------------------------|--------------|--|------------------|
| Pumpentyp / pump type | : MfS 180/75 | Förderleistung / Capacity measured [l/h] | : 608,63 (@60Hz) |
| SerienNr. / serial no. | : 2009073515 | Hubfrequenz / Pump speed [1/min] | : 60,996 (@60Hz) |
| Tag Nr. / tag no. | : GA-94 B | | |
| Betriebsdruck / Rated pressure [bar] | : 18,3 | | |



BETRIEBSANLEITUNG

für Dosierpumpen

OPERATING MANUAL

for Metering Pumps

ProMinent Dosiertechnik GmbH

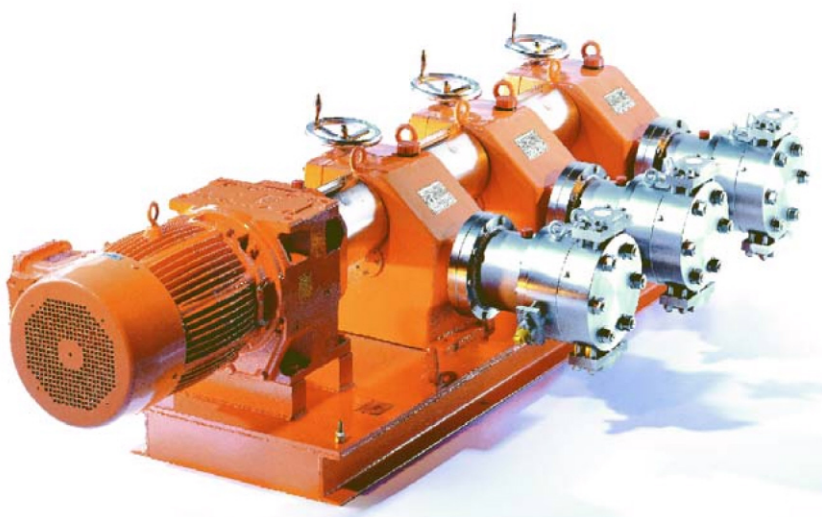
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1

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9

OPERATING INSTRUCTIONS

for Metering Pumps

Introduction

A detailed manual is prepared for metering pumps although no special knowledge is required for installation and start-up. Thus enables the non professionals to operate the machine successfully and trouble-free.

Even the finest machine is liable to break down if incorrectly assembled or badly maintained. Therefore it is very important that the operators carefully read these instructions before start-up of the pump.

Therefore the manual should neither be put to the files nor kept in the works manager's desk but should be in the hand of the machinist who works at this machine and who is responsible for it.

Any failure due to non-observance of this manual specially compiled for our customers' guidance is not covered by our guarantee.

In case of spare part orders we kindly ask our customers always to state the fabrication number of the pump as well as the article number or identification number of the spare part.

Pipes and Fittings

Connection of all pipes has to be effected stress-free. The position of the suction- and discharge pipe connections is mostly vertical. The exact position and the flow direction is to be taken from the G/A drawing. The pipes and fittings have to be cleaned inside very thoroughly and have to be assembled carefully to prevent any kind of impurities and foreign bodies (e.g. weld beads or scale) entering the pump in case of start-up.

For design and placement of pipes take care that no change in the concentration of the medium can occur either to the reflow or segregation of another medium otherwise an unexpected corrosion damage is possible for the medium contacted parts of the pump.

The size of suction and discharge piping shall at least meet the pump's nozzles size. It is always to be considered, that the pump is of the reciprocating type and has an oscillating flow characteristic both in suction and discharge flow. The difference between peak flow Q_{\max} and mean flow Q_{mean} is

approx.

- $Q_{\max} = 2.82 \cdot Q_{\text{mean}}$ for simplex pumps
- $Q_{\max} = 1.41 \cdot Q_{\text{mean}}$ for duplex pumps
- $Q_{\max} = 1.05 \cdot Q_{\text{mean}}$ for triplex pumps

If the number of heads exceeds three, the pulsation is negligible. The hydraulic efficiency of the pump is not considered for a.m. values.

The flow can be smoothened by one of the below mentioned matters.

Suction Pipe

The suction pipe should be placed in such a way that the medium is supplied to the metering pump under a constant pressure. The NPSH value for pump and suction pipe has to be considered. A filter has to be provided if contaminated media have to be dosed at a specified high degree of accuracy. Before using the pump with a solid containing liquid ORLITA shall be contacted. An exception is the rotary piston pump type DR, which can also convey impure and solids containing media. Furthermore the suction pipe should be short and unrestricted with an inside diameter at least equal to that of the diameter of the pump inlet. Piston pumps (PS), rotary piston pumps (DR) and hydro-mechanical diaphragm pumps (Mf) may work under suction conditions (see section 'suction height') within the range of physical limits. Diaphragm pumps (Mh) with hydraulically operated diaphragms only however always need a free inlet or even a suction pressure.

Suction Stabilizer

The installation of a suction stabilizer is necessary, if the suction pipe is long or when the viscosity and the quantity of the medium to be pumped is too high or too large to be accelerated during the suction stroke. Thus lead to loud knocking noises during operation.

If the existing operating conditions require the medium to be pumped at a temperature near its boiling point it is absolutely necessary to provide for a suction stabilizer. Already minor variations in suction pressure or temperature, due to the vacuum caused by the suction of the medium may lead to the gasing-off of the medium. Besides the unfavourable influence on the dosing accuracy it also lead to damage of the pump due to cavitation.

The suction stabilizer is a pressure tank in which a

OPERATING INSTRUCTIONS

for Metering Pumps

compressible gas phase (nitrogen) exists amongst the incompressible medium. Both phases are mostly separated by a diaphragm of a suitable material. During pressure stroke when the suction valve of the pump is closed the medium flows into the suction stabilizer which takes up the energy of the liquid column in motion and accumulates it by compression of the gas phase. Thus the velocity profile and the forces to acceleration of masses forms a mean value over the whole pump stroke and a smooth suction flow develops.

A guideline for sizing of pulsation dampeners is given under chapter 'pulsation dampener'.

Suction Filter

To protect the medium against contamination, especially when extreme dosing accuracy is required, a suction filter should be fitted into the suction pipe if necessary. Special care should be taken to select a filter size which leaves the medium enough space for a free flow in the event of the filter becoming clogged. Filter choking, especially in diaphragm pumps, may lead to serious operational break downs. However, a vacuum gauge fitted to the suction pipe in front of the pump inlet is a helpful means of control. Therefore a systematically cleaning is absolutely essential. The cleaning can be done without interrupting the operation of the pump, if two filters are provided in parallel for interchangeability. If so, ensure that the spare filter is brought into operation before the other filter is isolated.

Recommended filter mesh sizes depending on valve size (specified in mm)

10 µm
25 µm
50 µm
100 µm
150 µm
250 µm

Discharge Pipe

The discharge piping should have the same internal diameter as the pump discharge nozzle. Under operating conditions with no or high variation in differential pressure, the incorporation of a pressure holding valve is recommendable. If the differential pressure is below the suction pressure, as, for instance, in the case of delivery into a vacuum system, the incorporation of a pressure holding valve is absolutely indispensable.

Pulsation Damper

The installation of a pulsation damper is necessary if the pressure pipe is long or of small cross section. In this case pressure peaks may develop which can be several times as high as the operating pressure and which consequently could damage the pump or the pipe system. The installation of a pulsation damper is also necessary if the process does not allow the oscillating flow of a metering pump.

The pulsation damper is a pressure vessel in which a compressible gas phase (nitrogen) exists besides the incompressible flow medium. Mostly both phases are separated by a diaphragm of suitable material. The gas phase is subject to an overpressure that normally is 70...80 % of the minimum operating pressure. During operation the gas phase is then compressed to operating pressure and the nascent volume is replenished with flow medium. During suction stroke when the pump does not feed the pulsation damper gives off the medium again. A smooth flow now develops.

The piping between the pump's discharge nozzle and the dampener will always remain with a pulsating flow and has to be sized accordingly (same size as pump nozzles, refer to above mentioned). On dampener outlet the flow is smoothened and a smaller diameter might be chosen. The same refers to the suction side.

The sizing of a dampener is based on a degree of dampening expressed in X %. This means, that the mean pressure after the dampener carries a wave of $\pm X$ % of -pressure. Typical values for X are:

- ± 2.5 % für pumps according API 675
- ± 5 % for standard metering pumps

The required dampener volume V_{PD} is calculated with the equation:

Thereby means:

V_{PD} : required dampener volume in liter
 V_H : stroke volume of the pump in ml
 X: design dampening, \pm %
 f: factor for no. of pump heads
 f = 1 for simplex pump
 f = 4 for duplex pump
 f = 7.5 for triplex pump

OPERATING INSTRUCTIONS

for Metering Pumps

Pressure Holding Valve

If the pressure at the suction nozzle is higher than that at the pressure nozzle, the medium flows uncontrolled through the metering pump. Heavy fluctuating or very low operating pressures have a negative effect on the dosing accuracy.

Especially for the second case we recommend the installation of a pressure holding valve. As an external unit it is mostly the better alternative compared to the spring-loaded pressure valve in the pump.

It is recommendable to mount the pressure holding valve direct on the pressure socket of the pump. pressure holding valves are simply braced via connection flange of the pump and flange of the pipe or in case of smaller pumps are screwed direct on the pumps with threaded connections.

If the pressure holding valve is fitted on the end of a longer pressure pipe, provision should be made for a slight or automatic deaeration.

For installation take care of the flow direction. This can be recognized from outside by means of an arrow.

Safety Valve

Most product pipes also contain shut-off valves so that in principle a risk of delivery against a closed system exists. Metering pumps as positive displacement pumps displace the incompressible flow medium so long as the weakest part gives way. Metering pumps can be overloaded for a short time in consequence the weakest part is rarely the pump itself. Between the shut-off valves and the pump a safety valve of sufficient size has to be provided. This especially must be considered for plunger pumps (PS) and valveless rotary piston pumps (DR), which do not have an internal pressure relief device.

Hydraulically driven diaphragm pumps (Mf and Mh) have an internal pressure relief valve in the hydraulic chamber. It opens with unadmissible high pressure and thus limits the further pressure increase already within the pump. However this serves only for a protection of the pump itself and can replace the safety valve of the plant only exceptionally.

Operating Pressure

The operating pressure is either expressed in Pa, multiples of it (kPa, MPa, bar) or in metres of a liquid column (mLC). The criterion when choosing

the type of pump required is always the total discharge pressure (not the differential pressure). Pressure will always be applied directly on the pressure socket and is determined by the following factors:

1. Static system pressure
2. Height of the liquid column
3. Resistance of the piping to flow
4. Resistance of the apparatus
5. Opening pressure of spring-loaded pressure valves or similar valves
6. Pressure energy as a result of mass acceleration of the material to be conveyed
7. Additional pressure energy owing to increasing system resistance at higher viscosity of the medium due to an abnormal fall in temperature

The sum of all these values has to be considered by the owner of the plant. It results in the maximum operating pressure of which all parts of the metering pump have to be designed for. In case of disregarding all factors an overload of the metering pump is possible.

In view of the fact that metering pumps can be considerably overloaded for short periods, a permanent overload results in an overproportionate shortening of the service lifetime. The following example explains the limit of overloading:

If a bearing has been designed for a service life of 30.000 operating hours at the permissible load, this life is decreased to

- about 3,500 operating hours with a simple overload
- about 1,000 operating hours with twofold overload
- about 130 operating hours with a fivefold overload
- about 20 operating hours with a tenfold overload

Suction Height resp. Sucking Power

If the metering pump has to suck the liquid from a reservoir located at a lower level, the height between the pump centre and that level is the so-called suction height expressed in mLC (metres of a liquid column). To overcome the height, the pump has to build up a sufficiently large partial vacuum. Its limits are set by the nature of the pumped medium. It starts to gas off at a certain amount of partial vacuum (vapour pressure). Not only the amount of pumped liquid is thus reduced by the gased off volume but during continuous operation

OPERATING INSTRUCTIONS

for Metering Pumps

eration the pump will be damaged by cavitation.

The possible suction height in mLC is reduced by the pressure loss within the pump during the suction stroke. This depends on the pump specification and is called the NPSH_R-value (in mLC, Pa or multiples of it).

Commonly energy levels are specified instead of pressure values. The pressure loss then is expressed as a loss of discharge head.

In general the following is valid

The absolute suction head H_S must be bigger than the sum of all head losses in the pump (NPSH_R) and in the piping (ΔH_a and ΔH_R) plus the head of vapour pressure H_D .

Hereby means ΔH_a the head loss by liquid acceleration and ΔH_R the head loss by friction.

The absolute suction head H_S can be increased e.g. by pressurizing the suction vessel.

The calculation from pressure values to head values is given by the equation:

$$H_D = p_D / (\rho \cdot g)$$

with ρ as liquid density and g as gravity 9.81 m/s²

If the absolute suction head H_S is decreased by the head of vapour pressure H_D one gets the plants net discharge head H_1

$$H_1 = H_S - H_D$$

Deducting from H_1 the head losses by acceleration and by friction, one gets the plant characteristic value NPSH_A, the so-called 'Net Positive Suction Head available' with running reciprocating pump.

$$NPSH_A = H_1 - \Delta H_a - \Delta H_R$$

Also the pump itself causes a loss of suction head by internal flow resistance. This is called NPSH_R, the 'Net Positive Suction Head required'. Finally the net positive suction head summarizes:

$$NPSH = NPSH_A - NPSH_R$$

This values always must be bigger than zero to avoid cavitation.

Feed resp. Suction Pressure

As explained above, an inconvenient net positive suction head is to be improved by pressurizing the suction vessel.

Normally the suction pressure should always be lower than the operating pressure. If not, the operating pressure has to be artificially increased by using a pressure holding valve (see section pressure holding valve).

Flow Accuracy

Particular attention should be paid to those parts which influence the flow accuracy. These are:

- Pressure valve and suction valve
- Safety valve or overflow valve
- Sealings such as plunger packing, diaphragms or lipseals
- Refilling device (at diaphragm pumps)
- Venting valves in the hydraulic system of the pump

Of course, on occasion, flow variations can occur even in perfectly intact metering pumps owing to fluctuating operating conditions, especially in case of varying suction pressure and final pressure.

This influence on flow accuracy is conditioned by physical laws which must duly be taken into account where high demands are made on accuracy.

Discharge and Suction Valve

Depending on the nature of the medium to be pumped and the operating conditions different types of valves can be used:

- Single ball valve or double ball valve
- Disc valves
- Cone valves

Normally the valves of the metering pumps are self-actuating, e.g. they close and open by means of gravity or pressure. They can also be loaded by an additional spring if the self-closing forces are not sufficient (i.e. at viscous media).

Spring-loaded valves have to undergo a higher wear than self-actuated ones. Mostly the external pressure holding valve (see special section) is the better solution. Only the pressure valve has to be

OPERATING INSTRUCTIONS

for Metering Pumps

equipped with a spring but not the suction valve, as this will effect the sucking capability of the pump.

Ball Valves

Ball valves are not only suited for use with clear as well as contaminated liquids and suspensions. However, their performance is more or less influenced by the nature of the contamination.

Due to the large variety of precision balls available on the market the material can be suited widely to the requirements of the flow medium. Also very small valve sizes (DN 2mm) are available.

NOTE:

The higher the degree of contamination, the greater the velocity over the valve transverse sections should be.

Disc Valves

Disc valves are suitable for use with clean, low-boiling liquids and gases. However, they are very sensitive against contaminations. Their design permits their manufacturing from almost any material and combinations of material can be used where the corrosive action of the medium is very strong.

Cone Valves

For reasons of geometry cone valves, especially of bigger sizes, offer the lowest loss of pressure during suction ($NPSH_R$). They are suitable for use either with clear liquids as well as with contaminated ones and suspensions. Owing to the special marking of the guide surface a rotation is effected with each valve stroke. Thus leads to a self-cleaning effect of the valve together with low wear.

Cone valves can be produced of nearly all materials. The smallest size is limited to a nominal width of approx. 6 mm.

Due to its positive properties the cone valve is standard design for ORLITA metering pumps beginning at a nominal width of 6 mm.

Calibration and Test

Calibration and test can be carried out on the site under actual operating conditions by the following methods:

Measurement of the volume on suction side

Measurement of the volume on pressure side

Duration of tests: at least 1 minute or approx. 100

strokes

Note that these methods are less accurate than the metering pump in operation.

SAFETY INSTRUCTIONS

How to handle Metering Pumps

ENGLISH

Warnings and Symbols

The following signs and designations are used in the operating manual to designate instructions of particular importance.

Electricity



Attention: special information and/or orders and prohibitions directed towards preventing damages.



Danger: orders and prohibitions designed to prevent injury or extensive damage



Special hints for maintenance or overhaul



Basic Operation and Designated Use

The metering pump has been built in accordance with state-of-the-art standards and the recognized safety rules. Nevertheless, its use may constitute a risk to life and limb of the user or of third parties or cause damage to the machine and to other material property.

The metering pump must only be used in technically perfect condition in accordance with its designated use and the instructions set out in the manual, and only by safety-conscious persons who are fully aware of the risks involved in operating the machine. Any functional disorders, especially those affecting the safety of the machine, should therefore be rectified immediately.

The metering pumps is designed exclusively for dosing of liquids within the limits mentioned in the data sheet. Using the machine for purposes other than those mentioned is considered contrary to its designated use. ORLITA® cannot be held liable for any damage resulting from such use. The risk of such misuse lies entirely with the user. When operating the machine beyond the limits of its designated use consult ORLITA® for approval before carrying out any modifications.



SAFETY INSTRUCTIONS

How to handle Metering Pumps

ENGLISH

Operating the machine within the limits of its designated use the instructions set out in the operating manual must be also observed as well as the inspection and maintenance directives.



Organizational Measures

The operating instructions must always be at hand at the place of use of the pump. In addition to the operating instructions generally applicable legal and other mandatory regulations relevant to accident prevention and environmental protection shall be observed and instructed to the user.



These compulsory regulations may also deal with the handling of hazardous substances, issuing and/or wearing of personal protective equipment.

The operating instructions must be supplemented by instructions covering the duties involved in supervising and notifying special organizational features, such as job organization, working sequences or the personnel entrusted with the work. Especially the safety data sheets of the medium must be added.



Personnel entrusted with work on the pump must have read the operating instructions and in particular the chapter on safety before beginning work. This applies especially to persons working only occasionally on the pump, e.g. during setting or maintenance. It is to be checked - at least from time to time - whether the personnel is carrying out the work in compliance with the operating instructions and pays attention to risks and safety factors.



For reasons of safety, long hair must be tied back or otherwise secured, garments must be close-fitting and no jewellery such as rings may be worn. Injury may result from being caught up in the machinery. Protective equipment wherever required by the circumstances or by law must be used.



All safety instructions and warnings at the pump must be observed !



All safety instructions and warnings attached to the pump must be always complete and perfectly legible.



In the event of safety-relevant modifications or changes in the use, the pump must be stopped immediately and the malfunction is to be reported to the competent authority/person.

SAFETY INSTRUCTIONS

How to handle Metering Pumps

ENGLISH

It is not allowed to make any modifications, additions or conversions which might affect safety without manufacturer's approval. This also applies to the installation and adjustment of safety devices and -valves as well as to welding work on load-bearing parts.



Spare parts must comply with the technical requirements specified by the manufacturer. Spare parts from original manufacturer's equipment can be relied to do so. Prescribed intervals or those specified in the operating instructions for routine checks / inspections must be observed. For the execution of maintenance work, tools and workshop equipment adapted to the task are absolutely necessary.



The personnel must be familiar with the location and operation of fire extinguishers. All fire-warning and fire-fighting procedures are to be observed.



Selection and Qualification of Personnel

Any work on and with the pump must be carried out by reliable personnel only. Statutory minimum age limits must be observed. Only trained or instructed staff is to be employed and the individual responsibilities of the personnel for operation, commissioning, maintenance and repair is to be set out clearly. Only authorized personnel are allowed to work on or with the pump. Persons to be trained or instructed or persons taking part in a general training course are not allowed to work on or with the pump without permanently supervised by an experienced person.



Work on electrical system and equipment of the pump must be carried out only by a skilled electrician or by instructed persons under the supervision and guidance of a skilled electrician and in accordance with the electrical engineering rules and regulations.



Work on the hydraulic system must be carried out by specially trained personnel only.



SAFETY INSTRUCTIONS

How to handle Metering Pumps

ENGLISH

Safety Instructions Governing Specific Operational Phases

Standard operation

Any operational mode that might be prejudicial to safety is to be avoided. Necessary precautions to ensure that the machine is used only when in a safe and reliable state are to be taken. The pump must be operated only if all protective and safety-oriented devices, such as removable safety devices, emergency shut-off equipment, sound-proofing elements and exhausters are to be in place and fully functional.

The pump is to be checked at least once per working shift for obvious damage and defects. Report any changes (incl. changes in the machine's working behaviour) to the competent organization/person. If necessary stop the pump immediately and lock it.

In the event of malfunction, stop the pump immediately and lock it. Any defects have to be rectified immediately.

Before starting up or setting the pump in motion make sure that nobody is at risk.



Special work

Special works are activities in conjunction with utilization of the pump and repairs during operation; as well as disposal of parts and consumables.

The adjusting, maintenance and inspection activities and intervals set out in the operating instructions, incl. information on the replacement of wear parts must be observed. These activities may be carried out by skilled personnel only. Before beginning special operations and maintenance work the operating personnel is to be informed.

In any work concerning the operation, conversion or adjustment of the pump and its safety-oriented devices or any work related to maintenance, inspection and repair, the start-up and shut-down procedures set out in the operating instructions and the information on maintenance work must be observed.



SAFETY INSTRUCTIONS

How to handle Metering Pumps

ENGLISH

If the pump is completely turned off for maintenance and repair work, it must be secured against inadvertent starting.



To avoid the risk of accidents, individual parts and large assemblies being moved for replacement purposes should be carefully attached to the lifting tackle and secured. Only suitable and technically perfect lifting devices with adequate lifting capacity are to be used.



Never work or stand under suspended loads!

The pump especially its connections and threaded unions are to be cleaned of any traces of oil, fuel or preservations before carrying out maintenance/repair. Never use aggressive detergents ! Before cleaning the pump with water, steam jet (high-pressure cleaning) or detergents, cover or tape up all openings which - for safety and functional reasons - must be protected against water, steam or detergent penetration. Special care must be taken with crank gear, electric motors and control cabinets. After cleaning all covers and tapes applied for that purpose are to be removed. After cleaning, examine all lines for leaks, loose connections, chafe marks and damage; any defects found must be rectified without delay.



Always tighten any screwed connections that have been loosened during maintenance and repair!

Any safety devices removed for commissioning, maintenance or repair purposes must be refitted and checked immediately upon completion of the maintenance and repair work.



Ensure that all consumables and replaced parts are disposed of safely and with minimum environmental impact !



SAFETY INSTRUCTIONS

How to handle Metering Pumps

ENGLISH

Warning of Special Dangers

Electric energy

It is allowed only to use original fuses with the specified current rating. Switch off the pump immediately if troubles occurs in the electrical system.



Work on the electrical system or equipment may only be carried out by a skilled electrician himself or by specially instructed personnel under the control and supervision of such electrician and in accordance with the applicable electrical engineering rules.



If provided for in the regulations, the power supply to parts of pump, on which inspection, maintenance and repair work is to be carried out must be cut off. Before starting any work, check the de-energized parts for presence of power and ground or short-circuit them in addition to insulating adjacent live parts and elements !

The electrical equipment of the pump is to be inspected and checked at regular intervals. Defects such as loose connections or scorched cables must be rectified immediately !



Necessary work on live parts and elements must be carried out only in the presence of a second person who can cut off the power supply in case of danger by actuating the emergency shut-off or main power switch. Use insulated tools only!

It is mandatory to observe the safety instructions of the motor manufacturer!

Gas, dust, steam, smoke

Carry out welding, flame-cutting and grinding work on the pump only if this has been expressly authorized, as there may be a risk of explosion and fire!



Before carrying out welding, flame-cutting and grinding operations, clean the pump and its surroundings from dust and other inflammable substances and make sure that the premises are adequately ventilated (risk of explosion). Observe any existing national regulations if work is to be carried out in confined spaces !

Hydraulic and pneumatic equipment

Work on hydraulic equipment may be carried out only by persons having special knowledge and experience in hydraulic systems.



SAFETY INSTRUCTIONS

How to handle Metering Pumps

ENGLISH

Check all lines, hoses and screwed connections regularly for leaks and obvious damage.

Repair damage immediately !

The pump and its parts may be under compressive stress. Before carrying out any repair work depressurize all system sections and pressure pipes to be removed in accordance with the specific instructions for the unit concerned.

Hydraulic and compressed-air lines must be laid and fitted properly !

Ensure that no connections are interchanged !
The fittings, lengths and quality of the hoses must comply with the technical requirements.



Oil, grease and other chemical substances

When handling oil, grease and especially the medium, observe the product-related safety regulations.



Special hints for the use of positive displacement pumps

Before starting up the pump all shut-off devices on the suction and pressure side must be open. Otherwise there may be a risk that the pump and/or lines get damaged.

Positive displacement pumps that are not provided with safety devices in the pressure lines work until one functional part gets damaged.



Depending on the design of the pump leaks are unavoidable. Observe the medium-related safety regulations for disposal.

Clean the pumphead properly in accordance with the safety regulations for the medium before disassembling.



LUBRICATION SCHEDULE

for Metering Pumps

Lubricants for Crank Gears

ORLITA metering pumps in general are delivered including oil filling in the crank gears. Before start-up, oil level has to be checked. Type, quantity and oil change interval are shown in the table.

Lubricants and intervals of maintenance for reduction gears of other manufacturers are shown in their operating manuals attached to this documentation.

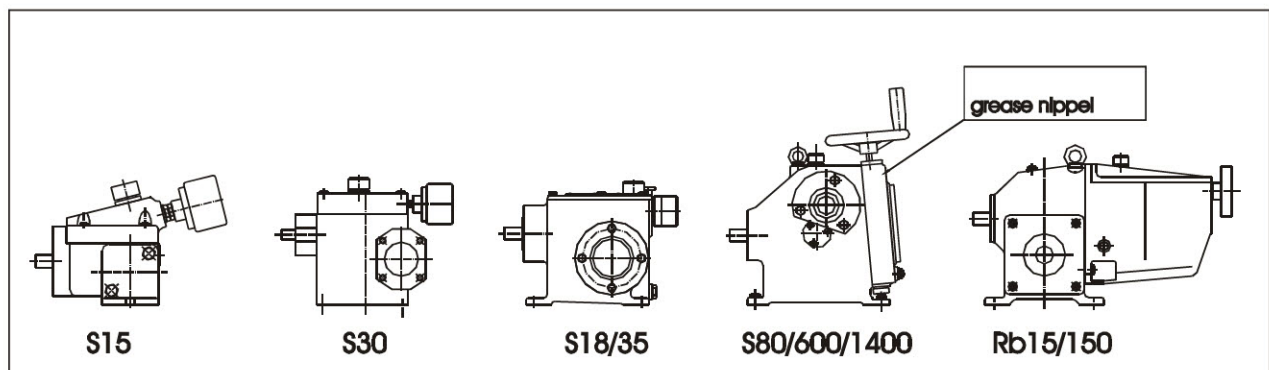


Table 1: Oil Capacity of Crank Gears

| Lubricants for normal ambient temperature | | | | |
|---|-------------|--|------------------|----------------------|
| -15°C ... + 40 °C | | | | |
| crank gear | filling [l] | lubricant specification | first oil change | scheduled oil change |
| AE 10.4 | 0,25 | ISO VG 150, DIN 51519 135...165 mm ² /s (40°C) | 500 h, max. 3 m | 8.000 h, max. 1 a |
| S 4 | 0,25 | | | |
| S 15 | 0,25 | | | |
| S 18 / S35 | 1,20 | | | |
| S 80 | 3,50 | | | |
| S 180 | 10,00 | | | |
| S 600 | 15,00 | | | |
| S 1400 | 45,00 | | | |
| | | | | |
| S 30 | 0.40 | synthetic gear oil ISO VG 220 | 500 h, max. 3 m | 4.000 h, max. 1 a |
| | | | | |
| Rb 15 | 0,90 | synthetic gear oil ISO VG 220 | 500 h, max. 3 m | 4.000 h, max. 1 a |
| Rb 150 | 4,00 | | | |
| | | | | |
| AE 80 | 0,35 | synthetic special grease | maintenance free | |

LUBRICATION SCHEDULE

for Metering Pumps

| crank gear | | | Relubrication Interval | |
|---|-------------|--|---------------------------------------|------------------------------------|
| Adjusting Spindle S 80, S 600, S 1400 | | grease on mineral oil base | 1 a with manual ad- justment | 1 m with remote ad- justment |
| Lubricants for high ambient temperature | | | | |
| 0°C ... + 55 °C | | | | |
| crank gear | filling [l] | lubricant specification | first oil change | scheduled oil change |
| S 18 / S 35 | 1,20 | ISO VG 220, DIN 51519 195...245 mm ² /s (40°C) | 500 h, max. 3 m | 8.000 h, max. 1 a |
| S 80 | 3,50 | | | |
| S 180 | 10,00 | | | |
| S 600 | 15,00 | | | |
| S 1400 | 45,00 | | | |
| Lubricants for low ambient temperature | | | | |
| -30°C ... + 45 °C | | | | |
| LT crank gear | filling [l] | lubricant specification | first oil change | scheduled oil change |
| S 18 / S 35 | 1,20 | Synthetic Gear Oil 150 cSt / 40 °C | 1.000 h, max. 6 m | 12.000 h, max. 3 a |
| S 80 | 3,50 | | | |
| S 180 | 10,00 | | | |
| S 600 | 15,00 | | | |
| S 1400 | 45,00 | | | |
| | | | Relubrication Interval | |
| Adjusting Spindle S 80, S 600, S 1400 | | synthetic special grease | 1 a with manual adjust- ment | 1 m with remote adjust- ment |
| Lubricants for arctic ambient temperature | | | | |
| -50°C ... + 45 °C | | | | |
| LT crank gear | filling [l] | lubricant specification | first oil change | scheduled oil change |
| S 18 / S 35 | 1,20 | Synthetic Gear Oil 68 cSt / 40 °C | 1.000 h, max. 6 m | 12.000 h, max. 3 a |
| S 80 | 3,50 | | | |
| S 180 | 10,00 | | | |
| S 600 | 15,00 | | | |
| S 1400 | 45,00 | | | |
| | | | Schmierfrist / Relubrication Interval | |
| Adjusting Spindle S 80, S 600, S 1400 | | synthetic special grease | 1 a with manual adjust- ment | 1 m with remote adjust- ment |

LUBRICATION SCHEDULE

for Metering Pumps

Table 2: Recommended Products

| Hersteller Make | Spezifikation General Specification | Bezeichnung Brand Name | Anmerkung Note |
|---|--|---------------------------|--|
|  | SYNTH ISO VG 220 | GLYCOLUBE 220 | ORLITA Standard bis/until 29.02.2008 |
| | ISO VG 150 | SPARTAN EP 150 | |
| | ISO VG 220 | SPARTAN EP 220 | |
| | grease on mineral oil base | BEACON 3 | |
|  | SYNTH ISO VG 220 | DEGOL GS 220 | |
| | ISO VG 150 | DEGOL BG 150 | |
| | ISO VG 220 | DEGOL BG 220 | |
| | grease on mineral oil base | | |
|  | SYNTH ISO VG 220 | TIVELA WB | |
| | ISO VG 150 | OMALA 150 | |
| | ISO VG 220 | OMALA 220 | |
| | grease on mineral oil base | ALVANIA T3 | |
|  | SYNTH ISO VG 220 | ENERSYN SG-XP 220 | |
| | ISO VG 150 | ENERGOL GR-XP 150 | |
| | ISO VG 220 | ENERGOL GR-XP 220 | |
| | grease on mineral oil base | | |
|  | SYNTH ISO VG 220 | GLYCOYLE HE 220 | ORLITA Standard ab/from 01.03.2008 |
| | ISO VG 150 | MOBILGEAR 600 XP 150 | |
| | ISO VG 220 | MOBILGEAR 600 XP 220 | |
| | grease on mineral oil base | | |
|  | SYNTH ISO VG 220 | RENOLIN UNISYN CLP 220 | ORLITA Standard |
| | synthetic gear oil ISO VG 150 | RENOLIN UNISYN CLP 150 | |
| | synthetic gear oil ISO VG 68 | RENOLIN UNISYN CLP 68 | |
| | | | |
|  | synthetic special grease | TURMOGREASE AL 2502/0 | with food service approval nur für / only for AE 80 |
| | synthetic special grease | TURMOGREASE SKL 18 | for low temperature service – 50 °C... + 50 °C |

LUBRICATION SCHEDULE

for Metering Pumps

Ölstand Triebwerk

Typen S 4, S 15, S 18, S 35, S 600, Rb 15, Rb 150, S 80 Serie bis 02/2000

Der Ölpegel soll bei stehendem Triebwerk kontrolliert werden und muß in etwa in Mitte des Ölstandsauges stehen.

Bei laufendem Triebwerk darf der dann schwankende Ölstand nicht soweit absinken, daß das Ölauge trocken ist. Tritt dieser Fall ein, so ist Öl aufzufüllen.

Triebwerk S 80, Serie ab 03/2000

Der Ölpegel soll bei stehendem Triebwerk kontrolliert werden. Dazu befindet sich auf der Skala der Hublänge eine entsprechende Markierung.

Triebwerk S 1400

Es gelten dieselben Vorschriften wie zuvor, allerdings ist nur das **obere** Ölstandsauge gültig.

Triebwerk S 30

Der Ölpegel muß die unterhalb des Zahnsegments sichtbare Scheibe bedecken. Die Kontrolle erfolgt durch die Einfüllöffnung und ist auch bei laufendem Triebwerk möglich.

Oil Level Crank Gear

Series S 4, S 15, S 18, S 35, S 600, Rb 15, Rb 150, S 80 Series until 02/2000

The oillevel is to be controlled when gear is standing still. It shall be in the middle of the oil level gauge glass.

When gear is running, the fluctuating level shall not drop so far, that gauge glass becomes dry. If so, oil has to be added.

Crank Gear S 80, Series from 03/2000

The oillevel is to be controlled when gear is standing still. The scale for the stroke length includes a marking for the oil level.

Crank Gear S 1400

Same regulation as before, but only the **upper** gauge glass is to be considered.

Crank Gear S 30

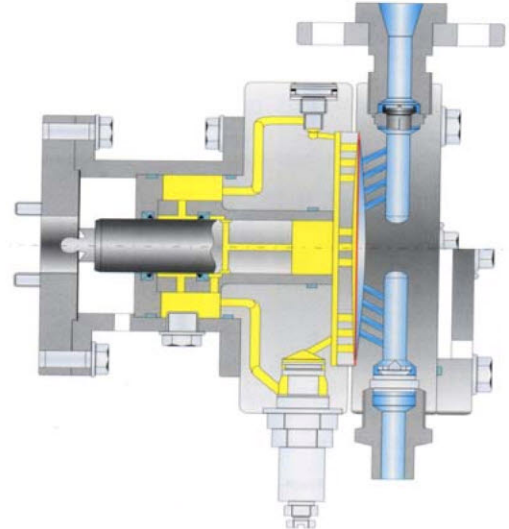
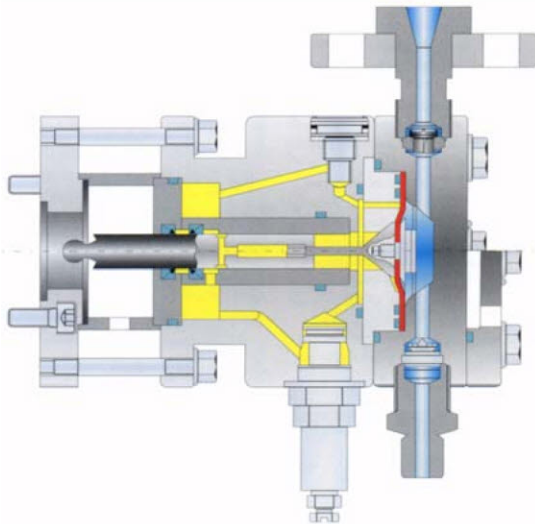
The oil level must cover the pulley to be seen under the toothed segment. Checking is to be done through the inlet opening and can be performed with running gear.

LUBRICATION SCHEDULE

for Metering Pumps

Druckmittel in Pumpenköpfen

Hydraulic Liquids for Pump Heads



Bei hydraulisch angetriebenen Membranpumpen (Baureihe Mf oder Mh) ist der Pumpenkopf bei Lieferung komplett mit Druckmittel befüllt. Das Druckmittel ist auf den jeweiligen Anwendungsfall abgestimmt. Im Wartungsfall ist nur Druckmittel lt. Stückliste oder Datenblatt zu verwenden.





Die Füllmenge ist von der Größe des Pumpenkopfes abhängig und ist in der Stückliste bzw. im Datenblatt angegeben.

In case of a hydraulically driven diaphragm pump (series Mf or Mh) the pump head upon delivery is completely filled with hydraulic liquid. The hydraulic liquid complies with the application. For maintenance only the hydraulic liquid according to parts list resp. datasheet is to be used.

The filling volume depends on the size of the pump head. It is stated on the spare parts list resp. on the data sheet.

Tabelle 3: Hydraulikflüssigkeiten

Table 3: Hydraulic Liquid





| Internal | Hydraulic Liquid | Brand | Designation | Temp. °C | p _{max} bar |
|-------------------|-----------------------------|---|-------------|-------------|-------------------------|
| NDT-2 1011067 | hydraulic oil ISO VG 22 |  | NUTO H-22 | -10...+80 | 2500 |
| HDT-9 1011073 | hydraulic oil ISO VG 32 |  | NUTO H-32 | -25...+100 | 4000 |
| HDT-10 1011072 | hydraulic oil ISO VG 46 |  | NUTO H-46 | -10...+100 | 4000 |
| HDT-11 1011071 | hydraulic oil ISO VG 68 |  | NUTO H-68 | +10...+120 | 4000 |
| NDNT-7 1011068 | antifreezing agent (glycol) | BASF | GLYSANTIN | -50...+25 | 160 |

LUBRICATION SCHEDULE

for Metering Pumps

Tabelle 3: Hydraulikflüssigkeiten

Table 3: Hydraulic Liquid

| Intern Internal | Hydraulikflüssigkeit Hydraulic Liquid | Marke Brand | Bezeichnung Designation | Temp. °C | p _{max} bar |
|--------------------|--|---|----------------------------|-------------|-------------------------|
| L-9 1014047 | Lebensmittel / Pharma Zulassung Food / Pharmaceuticals Approval |  | DTE FM 46 | 0...+120 | 400 |
| S-12 1012919 | Silikonöl silicone oil |  | AK 50 | -20...+160 | 1000 |
| S-13 1019746 | Silikonöl silicone oil |  | AK 150 | +25...+200 | 1000 |
| TTO-24 1011066 | Synthetisches Hydrauliköl synthetic hydraulic oil |  | TURMOFLUID TT0 24 | -50...+80 | 500 |

Ölstände Dosierkopf

Oil Level Dosing Head

Der Ölstand ist bei stehender Pumpe zu messen.

The oil level is to be checked when pump stands still.

Der Ölstand muß minimal die im folgenden Höhen am Peilstab haben:

The oil level shall have minimum height on the oil dip stick as follows.

- Bei Pumpen bis 30 mm Kolbendurchmesser 10 mm vom Peilstabende
- bei Pumpen mit mehr als 30 mm Kolbendurchmesser mindestens 15 mm von Peilstabende.

- For pumps with piston diameter up to 30 mm 10 mm from dip stick end.
- For pumps in excess of 30 mm piston diameter at least 15 mm from dip stick end.



ACHTUNG

ATTENTION

Es dürfen nur die Original Druckmittel verwendet werden.

Only the origin supplied hydraulic liquids may be used.

Verschiedene Druckmittel dürfen nicht vermischt werden. Bei Umstellung auf ein anderes Druckmittel muß das alte komplett aus dem Kopf entfernt werden. Ggf. muß der Kopf zerlegt und gereinigt werden.

Several hydraulic liquids must not be mixed. To change the type of liquid, the pump head completely must be drained. This might require a disassembly of the head and thoroughly cleaning.

LUBRICATION SCHEDULE

for Metering Pumps

Lubricants for Reduction Gears

This manual only is valid if the ORLITA pump is equipped with a reduction gear make



The gears are normally supplied incl. initial gear oil filling. The type of lubricant is stated below.

The implemented gear is stated both on the G.A. drawing and the (ORLITA) datasheet.

Tabelle 4: Getriebe Fabrikat ROSSI

Table 4: Gears Make ROSSI

| Bauart Design | Typ Type | BF Mtg | Anbau an Supplied for | Schmierstoff Lubricant | Vol [l] | Ölwechsel oil change |
|--------------------------------|-------------|-----------|--|--|---------|---|
| Stirnrad Helical | MR 2I 63 | B3 | Kurbeltrieb S 80 crank gear S 80 | Synthetiköl / synthetic oil 220 cSt / 40 °C Original Füllung / origin filling KLUEBER Syntheso D 220 EP | 1.6 | Dauer- schmierung lubricated for life |
| | MR 2I 64 | B3 | | | 1.6 | |
| | MR 2I 80 | B3 | | | 3.1 | |
| | MR 2I 81 | B3 | | | 3.1 | |
| | MR 2I 100 | B3 | Kurbeltrieb S 600 crank gear S 600 | Mineralöl / mineral oil 220 cSt / 40 °C Original Füllung / origin filling Esso Spartan EP220 Aral Degol BG220 | 5.6 | 8.000 h / 3 a |
| | MR 2I 101 | B3 | | | 5.6 | |
| | MR 2I 125 | B3 | | | 10.2 | |
| | MR 2I 126 | B3 | | | 10.2 | |
| | MR 2I 140 | B3 | Kurbeltrieb S1400 crank gear S1400 | | 11.6 | 8.000 h / 3 a |
| | MR 2I 160 | B3 | | | 19.6 | |
| | MR 2I 180 | B3 | | | 23.0 | |
| Schnecke Worm | MRV 40 | B6 | Kurbeltrieb S 18 | Original Füllung / origin filling KLUEBER Syntheso D 320 EP Synthetiköl / synthetic oil 320 cSt / 40 °C | 0.35 | Dauer- schmierung lubricated for life |
| | MRV 50 | B6 | crank gear S 35 | | 0.6 | |
| | MRV 80 | B6 | Kurbeltrieb S 80 | | 2.2 | |
| | MRV 81 | B6 | crank gear S 80 | | 2.2 | |
| | MRV 100 | B6 | Kurbeltrieb S 80 crank gear S 80 | | 5.4 | 18.000 h / 6 a |
| | MRV 126 | B6 | Kurbeltrieb S 600 crank gear S 600 | | 10.0 | |
| | MRV 160 | B6 | | | 18.0 | |
| | MRV 161 | B6 | | | 18.0 | |
| | MRV 200 | B3 | Kurbeltrieb S1400 crank gear S1400 | | 9.5 | 18.000 h / 6 a |
| | MRV 200 | B6 | | | 33.0 | |
| | MRV 250 | B3 | | | 17.0 | |
| | MRV 250 | B6 | | | 57.0 | |
| Kegelstirnrad Helical Bevel | MR CI 80 | B6 | Kurbeltrieb S 80 crank gear S 80 | Synthetiköl/synthetic oil 220 cSt/40°C Original Füllung / origin filling KLUEBER Syntheso D 220 EP | 1.3 | Dauer- schmierung lubricated for life |
| | MR CI100 | B6 | | | 2.9 | |
| | MR CI125 | B6 | Kurbeltrieb S 600 crank gear S 600 | Mineralöl / mineral oil 220 cSt / 40 °C Original Füllung / origin filling Esso Spartan EP220 / Aral Degol BG220 | 6.3 | 8.000 h / 3 a |
| | MR CI160 | B6 | Kurbeltrieb S1400 | | 11.8 | |
| | MR CI200 | B6 | crank gear 1400 | | 22.4 | |

LUBRICATION SCHEDULE

for Metering Pumps

The stated fillings are approximate values only and might – especially for big gears – vary depending on the actual gear ratio.

After the oil change the correct filling must be verified at the oil level sight glass.

The gears with **lifetime lubrication** do not require an oil change during their lifetime.

They do not have an oil level gauge glass or any other possibility to control the oil level.


Further information is to be found in the gear operating manual included in this documentation.

Low Ambient Temperature Service

The a.m. gears can be designed to operate at low ambient temperatures (special design) down to – 45 °C

Herby only the following gear oil must be used. Oil fillings are to be taken from Table 4.

(Tabelle 5 / Table 5)

| | | | |
|---|--|------------------------|--|
|  | synthetisches Getriebeöl synthetic gear oil ISO VG 150 | RENOLIN UNISYN CLP 150 | für Tieftemperatureinsatz for low temperature service – 50 °C... + 50 °C |
|---|--|------------------------|--|

Gears of other Make

Lubricants and intervals of maintenance for reduction gears of **OTHER MANUFACTURERS** are shown in their operating manuals attached to this documentation.

STARTUP

First Start-up & Re-Start-up

Transport and Installation

The pump must be transported to its final place by means of suitable appliances.

ATTENTION:

When moving the pump only use suitable lifting devices and transport means. Use only the marked lifting points at the baseplate of the pump. Only pumps without baseplate might be lifted at the drive motor, crank gear and pumphead. In certain circumstances there are references to lifting points at the pump.

ATTENTION:

Never use the stroke adjustment to lift the pump!

Do not lift the pump at handwheels, connection flanges, etc.!

Pay attention to the center of gravity position. Under no circumstance support the pump on its suction flange during transport or installation.

The pump must be installed on a suitable ground which is safe and free from vibrations.

Start-up

General Procedure

Check the pump for undamaged condition. Especially check for correct fit of coupling guards as well as undamaged terminal boxes of the electric motors. Take care of tight fit of all fastening bolts.

The safety regulations as well as the start-up instructions for the individual components such as motor, reduction gear, crank gear, pumphead and other accessories must always be followed.

1. **ATTENTION:** Upon delivery the crank gears typically are not filled with oil. Filling of oil has to be done according to the lubrication schedule. Operating the pump without lubricant will cause serious damages inside the crank gear !
2. Check the oil level in the crank gears as well as in the reduction gears and fill up if necessary. If more than one year has passed after delivery or in case the pump had to withstand extreme weather conditions all lubricants and hydraulic fluids should be replaced after a short test run of approx. 1 h.



STARTUP

First Start-up & Re-Start-up

3. Lube other lubricating points, e.g. grease nipples of the adjusting spindles at the crank gears.
4. Before start-up a hydraulic diaphragm pump head is to be filled up with hydraulic liquid as per lubrication schedule. If the filling has already been done at our works, check the level at the gauge glass / oillevel indicator and refill lost quantities. Always use original liquids mentioned in the lubrication schedule and parts lists.
5. Remove plugs, locking screws and the covers from suction and discharge nozzles.



6. **ATTENTION:** The tight locking screws at the crank gear and at the hydraulic pump heads must be substituted by a vented one. Operating the pump with tight locking screws might cause pump damage !

7. Check the painting for damages, repair if necessary.
8. Connect the remote stroke adjustment (optional accessory). Pay attention to the corresponding operating instructions! It is mandatory to check the proper function in order to avoid damage at the pump or plant. Crank gears may be adjusted during standstill in order to check rotation and also function of the limit switches at the stroke adjustment.

9. For pumps with gravity operated stroke indicator (crank drives S 15 and S 30) the base position must be checked according to the operating instructions.

10. Check for easy running as follows:
 - Adjust the pump to approx. 50 % of stroke
 - Disassemble the fan cover of the motor
 - Cautiously turn the pump at the fan wheel of the drive motor
 - Re-assemble the fan cover



11. The electric connections are to be made according to the operating instructions of the drive motor. It is mandatory to mind the correct sense of pump rotation.
ATTENTION: A wrong sense of rotation may cause serious damages in the crank drive!

12. Connect the piping on the suction and discharge side. Take care of the admissible forces & moments at nozzles. These values can be taken from the G/A drawing.

STARTUP

First Start-up & Re-Start-up

13. Inlet and outlet of the medium is to be provided. Especially take care that shut-off devices in the suction or pressure line are **not** closed.
 - Note: Piston pumps (series PS) and rotary piston pumps (series DR) are not suitable for dry run. Pump must always be operated with a liquid.
14. Now the pump can be started. Thereby observe
 - Sense of rotation
 - Tightness of discharge and suction connections
 - Tightness of hydraulics, crank gears and reduction gears
 - Unusual noise
15. When reaching the operating temperature after approx. 1 h test run the oil level in the crank gear, reduction gear and (hydraulic) pumphead has to be checked again and re-filled if necessary.
16. If the pump is provided with spring loaded valves and there is no suction pressure available, a first filling of the pump head with liquid at the medium side is necessary. The suction line largely should be free of gas, too. Preferably the filling should occur with low suction pressure ($p \geq 0.3$ barg). After having carried out these actions the increased suction pressure can be set to original operating condition.

Hydraulic Diaphragm Pumps (series Mf and Mh)

For a troublefree operation of hydraulic pumps (series Mf and Mh) the diaphragm pumphead must be totally vented. This is to be carried out when operating the pump at full stroke for several minutes (approx. 15 min). Thereby take care that the suction line is not pressurized. In case suction pressure is already available on the suction side, one has to expect a longer period for venting.

If the oil level in the storage chamber diminishes during venting, a refilling is necessary until the oil reaches the specified marking.

Piston Pumps (series PS)

The stuff box packing is pre-adjusted at our works. During longer storage the tension may decrease. Therefore check the tension before each start-up.

STARTUP

First Start-up & Re-Start-up

First the stuff box packing is to be slightly tightened by hand. A high leakage at the beginning is wanted. After a start-up phase of approx. 20 min slowly fasten the tightening screw until minimum leakage is reached. Thereby observe the temperature of the cylinder. A quick rise of temperature signifies a strong tightening of the packing during dry run and therefore damage of the packing.

Re-Startup

According to the different modes of shutdown the steps of the first start-up shall apply.

In addition to this pay attention to the operating instructions of the individual components such as motor, reduction gear, crank gear, pump head and other accessories which are mentioned in the manual.

Differing from the first start-up one has to take care for the re-start-up procedure that after a standstill of more than one year the lubricants and hydraulic fluids are to be replaced after a short test run (approx. 1 h). This shall apply without consideration of appearance of lubricants and greases.

If any cloudiness or discolour occur, **it is mandatory** to replace the lubricants.

SHUTDOWN

Preservation & Storage Post-Installation & Long-Time Stillstanding

Validity

This procedure refers to metering pumps of series Mf, Mh, PS, DR which are subject to

- long term standstill after installation without being put into service
- shutdown and standstill for a longer period

More than two months are considered as a longer period. For shorter periods no special procedures are necessary.

Depending on the used medium measures can be necessary already after a shorter period. This lies within the judgement of the pump user.

Type and quantity of the lubricants or the hydraulic fluid are shown in the operating manual.

Use the original fluids only !

A special preservation oil is not required.

Upon all works, especially the safety regulations must be followed.

In-Door Installation

This refers to metering pumps installed in frost-free rooms.

1. Flush and clean the pumphead **thoroughly**.
2. Check the oil level in the crank drive, reduction gear and pump head, refill if necessary.
3. At pumps already used for a longer period the gear oil in the crank drive should be exchanged.
4. Where appropriate close nozzles like flanges and threads.
5. Secure the pump against unintended start-up.

Further actions are not required.

Out-Door Installation

This refers to metering pumps installed outdoor without any protection or protected by a roof only and thereby must withstand wind and weather.

1. Flush and clean the pumphead **thoroughly**. In case of frost danger remove all water residues from the pumphead.

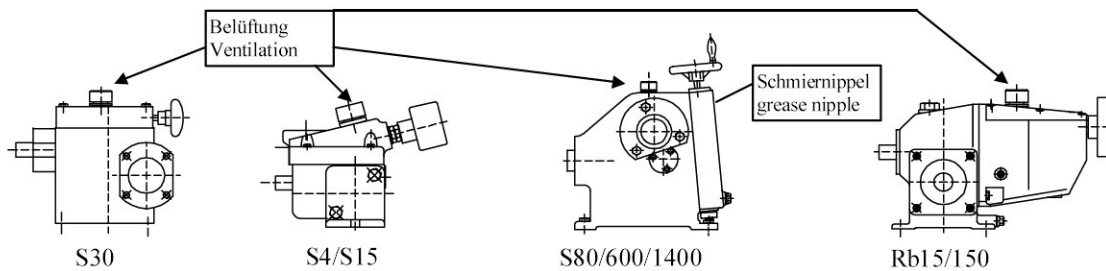
SHUTDOWN

Preservation & Storage

Post-Installation & Long-Time Stillstanding

2. Check the oil level in the crank drive, reduction gear and pumphead, refill if necessary.
3. At pumps already used for a longer period the gear oil in the crank drive should be exchanged.
4. Where appropriate close nozzles like flanges and threads.
5. Secure the pump against unintended start-up.
6. Check the painting for damages, repair if necessary.

The vented locking screw of the crank gear must be substituted by a tight one. Store vented type in a safe place !

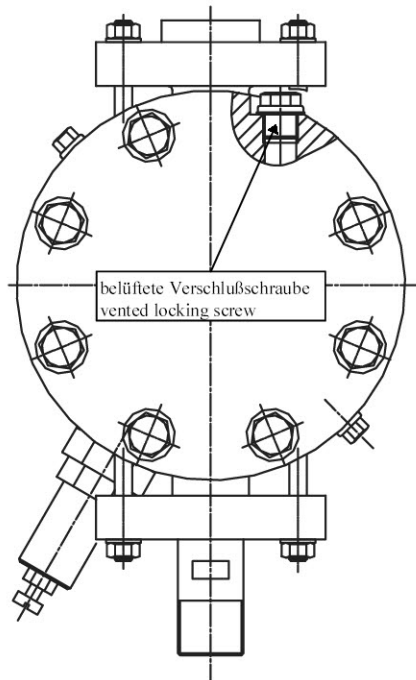


The vented locking screw of hydraulic pump heads must be substituted by a tight one. Store vented type in a safe place.

SHUTDOWN

Preservation & Storage

Post-Installation & Long-Time Stillstanding



Check each 3 months

Sight inspection for oil leakage, mechanical damage and begin of corrosion

Magazine Storage

This refers to metering pumps which are not installed after delivery or put into a dry and frost-free stock from their place of usage.

1. Flush the pumphead thoroughly, clean and dry. Cover the screw connections with suitable plastic screws. Shut the flange connections with metal covers and rubber seal with at least 4 screws.
2. Change the oil in the crank drive. At new pumps delivered with an oil filling it can remain in the drive gear.
3. Lube other lubrication points, e.g. grease nipples of adjusting spindles etc.
4. Check condition and filling quantity of the hydraulic fluid. In case of cloudiness or discolour exchange, otherwise remain in the pumphead.
5. Disassemble electrical connections, close the cable inlets thoroughly.
6. In case that the pumps cannot be stored or transported horizontally, the tight connections as described above must be installed before transport.
7. Check the painting for damages, repair if necessary. Especially consider baseplate fastening holes, earthing connections etc.

INSPECTION & MAINTENANCE

for Metering Pumps

CONTENTS

| | |
|--|---|
| Validity | 1 |
| Monthly Inspection | 2 |
| Annual Maintenance | 2 |
| Preventive Maintenance | 2 |
| Diaphragm Pumps Series Mf and Mh | 3 |
| Piston Pumps Series PS | 3 |
| Rotary Piston Pumps Series DR | 3 |
| Use in Hazardous Area | 3 |
| Additional weekly Inspection | 3 |
| Preventive Maintenance | 4 |
| Diaphragm Pumps Series Mf and Mh | 4 |
| Piston Pumps Series PS | 4 |
| Rotary Piston Pumps Series DR | 4 |
| Couplings | 4 |
| Reduction Gears | 4 |
| General Overhaul | 4 |
| Crank Gear | 4 |
| Pump Head | 5 |
| Pump Heads Series MfS | 5 |
| Pump Heads Series MhS | 6 |
| Pump Heads Series PS | 6 |
| Pump Heads Series DR | 6 |

Validity

The following information is valid for metering pumps of series MfS, PS, DR and MhS.

Data is based on a single shift operation with a maximum of 10 hours/day. More or longer shifts decrease the time schedule accordingly.

Also refer to lubricant recommendation as per chapter 'Lubrication Schedule'.

Oil levels for crank gears and hydraulic pumps heads are mentioned there.

User's standards shall supersede the below mentioned regulations only if service intervals are shortened, not prolonged.



This chapter also includes special instructions for inspection and maintenance for the use of the pump in hazardous area. These instructions are strictly to be followed.

Inspection and maintenance instructions for bought-out items like drive motor, speed reduction gear, coupling or stroke adjustment are to be taken from their manuals.

INSPECTION & MAINTENANCE **for Metering Pumps**

Monthly Inspection

Inspection is to be performed on running pump.
Unusual noise shall be watched.

Sight inspection of crank gear

- Lube oil level
- Lube oil leakage
- Mechanical damage
- Lube adjustment spindle on gears with remote stroke adjustment (only S 80, S 600, S 1400)

Sight inspection of speed reduction gear

- Lube oil level
- Lube oil leakage
- Mechanical damage

Sight inspection of drive motor

- Mechanical damage
- Pollution of cooling fan and fins

Sight inspection of pump head

- Liquid leakage
- Hydraulic liquid level and condition
- Hydraulic liquid leakage
- Mechanical damage
- Adjustment of packing on plunger heads series PS

Annual Maintenance

Maintenance is to be performed on stillstanding pump.
Works are to be done in addition to the usual monthly inspection.

General

- Check painting for damages or corrosion, repair if necessary
- Check all bolts for tight seat

Crank gear

- Lube oil change
- Lube adjustment spindle (only S 80, S 600, S 1400)

Coupling

- Check toothed segment for wear

Pump head (only Mf, Mh)

- Change hydraulic liquid
-

Preventive Maintenance

For pumps not being installed in hazardous area, in general it is not mandatory to replace wear parts of the pump in a fixed time schedule. Parts are to be changed only in case of damage.

With respect to an uninterrupted operation only with scheduled shutdowns, it might make sense to replace preventively wearing parts disregarding their actual condition.

INSPECTION & MAINTENANCE for Metering Pumps

Diaphragm Pumps Series Mf and Mh

10.000 h operation, longest after 3 years

- Diaphragm incl. intermediate shims and seals
- Venting valve
- Suction and discharge valve

A discharge pressure of 400 barg and above causes a quicker wear of diaphragm and seals for pumps series Mf. The lifetime will be much shorter, approx. 1000 h to 3000 h.

10.000 h operation, longest after 3 years

- Diaphragm
- Venting valve
- Suction and discharge valve

Piston Pumps Series PS

5.000 h operation, longest after 3 years

- Packing rings

10.000 h operation, longest after 3 years

- Guide rings
- Suction and discharge valve

Rotary Piston Pumps Series DR

5.000 h operation, longest after 2 years

- Lip rings and seals
- radial shaft seal of crank gear

Use in Hazardous Area

If the pump is used in hazardous area, the service intervals are of a shorter period as mentioned below.

Additional weekly inspection

Inspection is to be performed on running pump.

Sight inspection of crank gear

- Lube oil level
- Lube oil leakage

Sight inspection of speed reduction gear

- Lube oil level
- Lube oil leakage

Sight inspection of pump head

- Liquid leakage
- Hydraulic liquid level and condition
- Hydraulic liquid leakage

Acoustic control of the pump aggregate

- unusual noise level
- unusual noise frequency

INSPECTION & MAINTENANCE **for Metering Pumps**

Inspection of crank gear for unusual temperature rise

- under normal conditions hand warm

Preventive Maintenance

For safe operation normal wear parts must be replaced preventive.

To avoid with a maximum level of safety any defects caused by reaching the lifetime of wear parts, the following parts shall be replaced upon 90 % of their lifetime preventive.

Diaphragm Pumps Series Mf and Mh

9.000 h operation

- Diaphragm incl. intermediate shims and seals
- Venting valve
- Suction and discharge valve

A discharge pressure of 400 barg and above causes a quicker wear of diaphragm and seals for pumps series Mf. These parts shall be replaced after 2.700 h service time.

Piston Pumps Series PS

4.500 h operation

- Packing rings

9.000 h operation

- Guide rings
- Suction and discharge valve

Rotary Piston Pumps Series DR

4.500 h operation

- Lip rings and seals
- radial shaft seal of crank gear

Couplings

The inspection interval of the coupling (spider parts, sleeves, flexible elements) is to be taken from their manual, which forms part of the pump manual.

Reduction Gears

The inspection interval of the reduction gear (oil service, general overhaul) is to be taken from their manual, which forms part of the pump manual.

General Overhaul

Crank Gear

To provide a safe operation during the design lifetime of the pump aggregate, some parts need to be preventively replaced after 90 % of their lifetime. A general overhaul has to be scheduled for this.

INSPECTION & MAINTENANCE for Metering Pumps

| Crank Gear | Overhaul after |
|------------|----------------|
| S18 | 32 500 h |
| S35 | 32 500 h |
| S80 | 36 000 h |
| S180 | 36 000 h |
| S600 | 36 000 h |
| S1400 | 36 000 h |
| Rb15 | 21 500 h |
| Rb150 | 21 500 h |

The time period stated below assumes operation of pump at full load under consideration of the oil service intervals as given in the lubrication schedule.

Pump Head

The time period stated below assumes operation of pump at full load under consideration of the oil service intervals and the replacement of wear parts as mentioned above.

| Pump Head | Overhaul after |
|-----------|----------------|
| MfS | 27 000 h |
| MhS | 27 000 h |
| PS | 18 000 h |
| DR | 18 000 h |

Pump Heads Series MfS

In addition to the normal wear parts, replace

- hydraulic piston & guide bush (paired)
- diaphragm holding screw
- tension rod

INSPECTION & MAINTENANCE **for Metering Pumps**

Pump Heads Series MhS

In addition to the normal wear parts, replace

- hydraulic piston & guide bush (paired)

Pump Heads Series PS

In addition to the normal wear parts, replace

- plunger
- guide bush

Pump Heads Series DR

In addition to the normal wear parts, control/replace

- rotary piston
- cylinder

The necessity to replace these parts depends on wear and application.

To ensure a proper overhaul, ORLITA recommends to perform this in the factory or at an authorized service contractor.

TIGHTENING TORQUES

for bolts and nuts

Special Bolting

The reliable torques for screws and nuts especially for screw joints at the pump head and at the connection pieces are to be taken from the parts lists.

In the column 'Remarks' the reliable or required torque of the respective connection is shown:

Example: MA=15Nm

Screws in General

The following table is to be used only if the parts list shows no other data.

Reliable torques for shaft screws

Coefficient of Friction: 0,16

| | 8.8 | 10.9 | 12.9 | A2/A4-50 | A2/A4-70 | A2/A4-80 |
|-----|------|------|------|----------|----------|----------|
| M4 | 3,2 | 4,7 | 5,5 | 1 | 2,13 | 2,84 |
| M5 | 6,4 | 9,3 | 11 | 1,95 | 4,19 | 5,58 |
| M6 | 11 | 16 | 19 | 3,39 | 7,3 | 9,7 |
| M8 | 27 | 39 | 46 | 8,19 | 17,5 | 23,4 |
| M10 | 53 | 78 | 91 | 16,4 | 35,2 | 47 |
| M12 | 92 | 135 | 155 | 28,2 | 60,3 | 80,4 |
| M14 | 145 | 215 | 250 | 44,7 | 95,8 | 127,7 |
| M16 | 230 | 335 | 390 | 68,2 | 146,2 | 194,9 |
| M18 | 325 | 465 | 540 | 94,8 | 203,1 | 270,8 |
| M20 | 460 | 660 | 770 | 133,3 | 285,7 | 380,9 |
| M22 | 630 | 900 | 1050 | 178,4 | 212,4 | - |
| M24 | 790 | 1150 | 1300 | 230,1 | 273,9 | - |
| M27 | 1150 | 1650 | 1950 | 340,5 | 405,3 | - |
| M30 | 1600 | 2250 | 2650 | 431,1 | 549 | - |

Strength 8.8 to 12.9:

Values are given for 90% ... of the yield strength.

A2/A4-50 to A2/A4-80:

Values are given for 70 % ... of the yield strength.

The coefficient of friction of 0.16 applies as an average value for steels as well as for stainless steels (lubricated).

BETRIEBSANLEITUNG

für Dosierpumpen

OPERATING MANUAL

for Metering Pumps

ProMinent Dosiertechnik GmbH

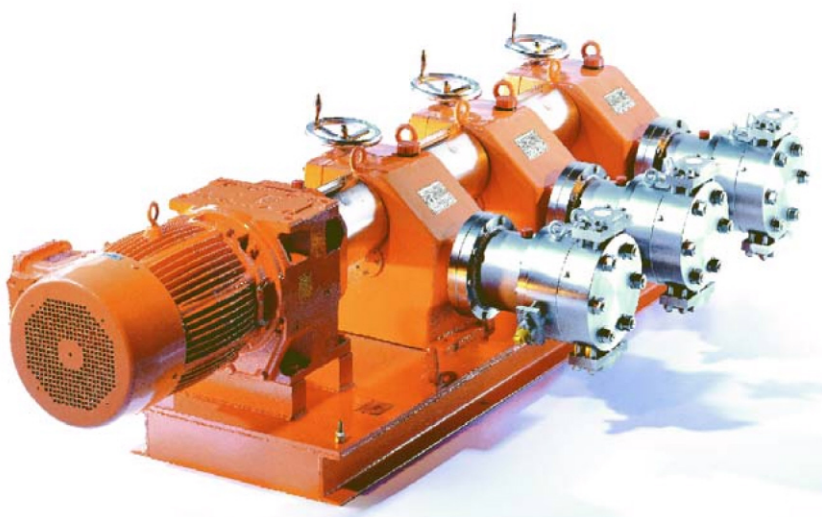
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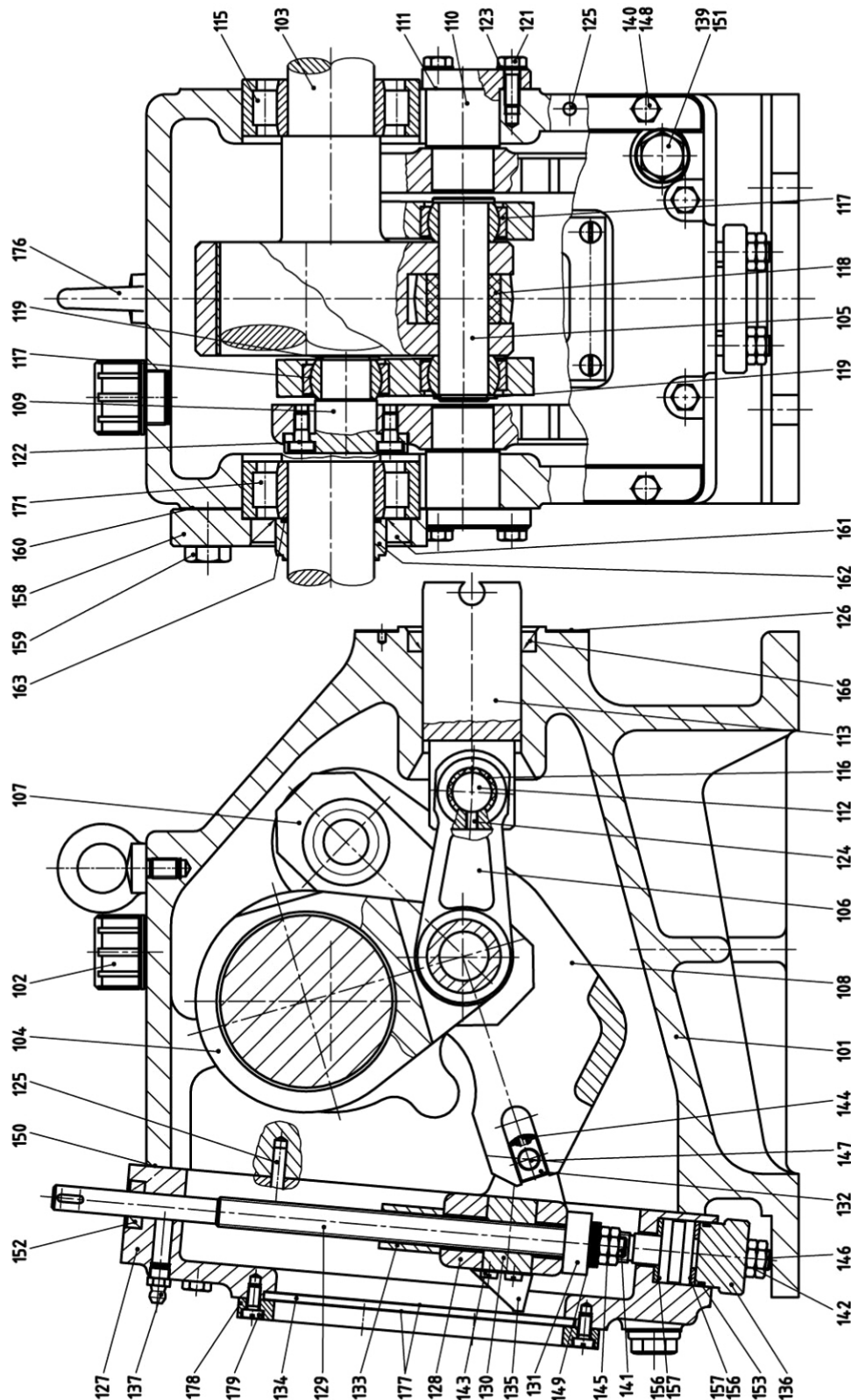
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CRANK GEAR S80 / S180 / S600 / S1400
Functional Description and Maintenance



Bemerkung / Remark:

Zur vereinfachten Darstellung sind einige Einzelteile und Bohrungen in eine Ebene versetzt gezeichnet!
For simplified view some individual parts and borings are described in one plane!

CRANK GEAR S80 / S180 / S600 / S1400

Functional Description and Maintenance

Functional description

The crank shaft (103) driven by motor and reduction gear transforms the rotating motion into an oscillating motion of the piston rod (113) by means of the eccentric connecting rod (104) and the piston connecting rod (106).

The adjusting lever bridge (108) is fixed in one center point and can be swivelled with the corresponding traverse (128) by the regulating spindle (129). Thereby the hinge point of the swivel rod (107) is dislocated in such a way that hence follows the required adjustment of stroke length of piston connecting rod (106) and piston rod (113).

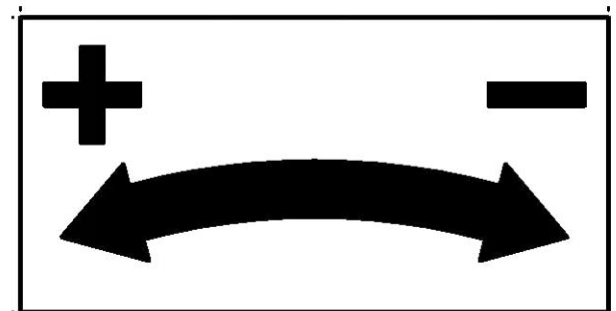
The infinitely variable adjustment of stroke from 0 to max. is effected by turning the handwheel.

Due to constructional design the adjusting force for the spindle is low and the adjusted stroke length can be observed exactly. A uniform low load for all components results from the gear kinematics.

The change of stroke is achieved by turning the handwheel.

CW: decrease stroke
 CCW: increase stroke

A label on the crank gear illustrates this.



Servo adjusting devices of electro-pneumatic or electric design (also available ex-protected) extend the range of manual stroke adjustment and therefore allow the application in automatic operating process.

CRANK GEAR S80 / S180 / S600 / S1400

Functional Description and Maintenance

Maintenance

Prior to commissioning the gear drive it is to be filled with oil up to the oil level sight glass according to our recommendations of lubricants. We recommend to use always the same kind of oil in order to avoid disturbance caused by saponification of different kind of oils.

Additionally the upper bearing of the regulating spindle is to be lubricated by means of its lubricating nipple at commissioning and at every oil change. In case of aggravating working conditions (i.e. under wet conditions) we recommend to shorten the intervals.

Oil filling quantities:

| | |
|--------|-------|
| S 80 | 3,5 l |
| S 180 | 10 l |
| S 600 | 15 l |
| S 1400 | 45 l |

Cycle of oil change after start-up

1. Oil change after 500 operating hours or after 3 months at 8 hours daily operation.
2. Regular oil change after each 8000 operating hours or longest after 12 months.

CRANK GEAR S80 / S180 / S600 / S1400

Functional Description and Maintenance

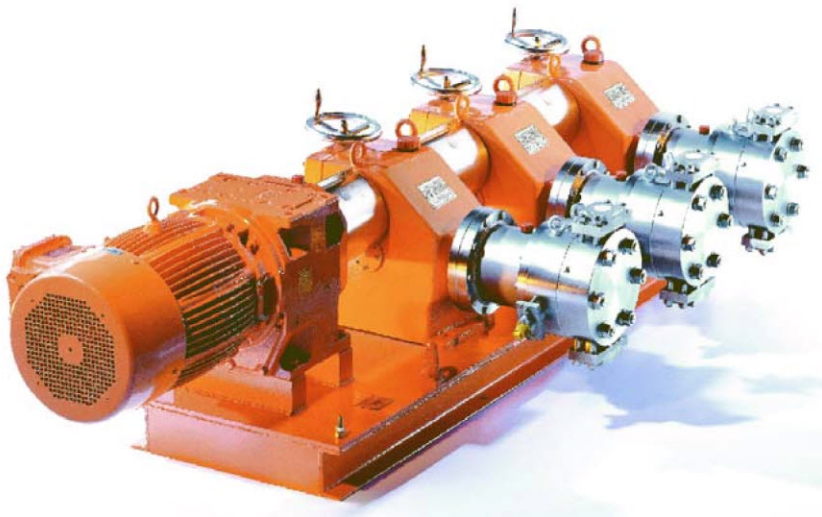
Trouble Shooting

| <u>Disturbance</u> | <u>Possible Reason</u> | <u>Removal</u> |
|---|---|---|
| Speed of suction stroke higher than speed of discharge stroke | Drive motor: wrong sense of rotation | Change poles of motor |
| Heavy knocking, short time | Heavy pump overload, e.g. pumping against closed piping system | Release piping system |
| Permanent knocking remaining at normal load | Permanent damages by overload | Overhauling of crank gear, replacement of damaged parts |
| Permanent noise of crank gear | Key of motor shaft worn out (caused by dynamic load peaks) | Renew key and replace shaft |
| | Different bearing parts of the lever mechanism worn out | Renew worn bearings or parts of lever mechanism |
| | Adjusting spindle loose | Re-adjust adjusting spindle |
| | Adjusting traverse broken | Renew adjusting traverse |
| No stroke appearing | Stroke adjusted at 0 | Readjust stroke, e.g. by means of handwheel |
| | Swivel lever, eccentric connection rod, bolt of regulating lever, pin of adjusting traverse broken due to over-load | Replace defect parts |
| No discharge, stoppage of crank gear after overload | Motor stoppage caused by release of thermal motor relays | Check motor relays |

Follow mounting instructions for pump repair and maintenance, disturbances caused by disregard are not considered.

OPERATING MANUAL

for Metering Pumps



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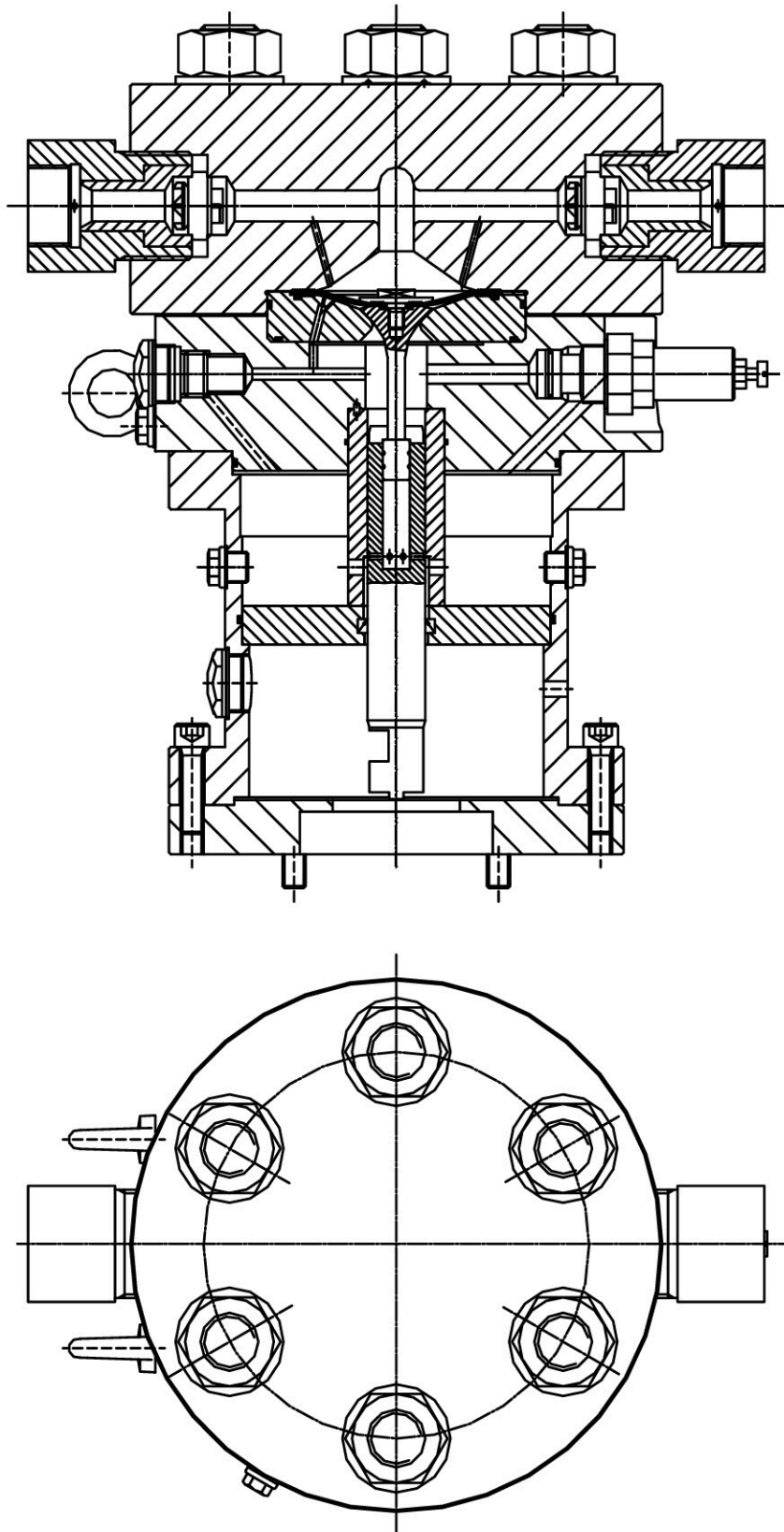
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Diaphragm Head Mf

with double PTFE diaphragm



Remark:

For simplified view some individual parts and borings are described in one plane!

Diaphragm Head Mf

with double PTFE diaphragm

Functional description

The diaphragm head consists of a multiple housing in which the essential functional parts diaphragm, piston, suction and discharge valve as well as the parts for controlling the hydraulic fluids are arranged.

The hydraulic fluid displaced by the oscillating motion of the piston is transmitted to the discharge medium by the PTFE diaphragms.

Thereby the hydraulic pressures are balanced between both sides of the diaphragm. Thus high discharge pressures can be realized.

The diaphragm hermetically separates hydraulic fluid and discharge medium. Thus environment and the moving parts in the pump head are protected against contamination by dangerous media.

At its back the diaphragm is connected with a metallic closure that shuts off the passage to the hydraulic fluid chamber at lacks of hydraulic fluid or if the pressure of the suction line is too high. Thus disturbances of the diaphragms are prevented. In case of low suction pressures an additional coupling that connects the piston with the metallic support of the diaphragm is actuated.

For good efficiency a small part of the hydraulic fluid passes cyclically a venting valve into the storage chamber and is deaerated hereby. This volume as well as the leakage caused by the piston clearance are completed by a control groove at the back dead point of the stroke which connects short-time the storage chamber with the hydraulic chamber. The control elements are such arranged that proper function is guaranteed for the whole range of stroke adjustment.

To safeguard the pressure of the hydraulic fluid and by this the crank gear the pump is equipped with a relief valve. In case of overload this valve effects the flow back of the hydraulic fluid into the storage chamber.

Start-up

1. Connect electric motors as described in the terminal scheme. The sense of rotation must be in accordance with the arrow on the flange of the gear drive or on the motor.
2. Check gear oil and replenish if necessary (see maintenance crank gear). On despatch (first start-up) the gear drives are empty and not filled with oil.

3. Before start-up the diaphragm head is to be filled with hydraulic fluid according to the table of lubricants. If the filling was carried out at workshop, check the level at the oil level sight glass/oil level gauge and re-fill the lacking quantity if necessary. Apply original hydraulic fluids only as per our recommendations and the applicable parts list.
4. For a trouble-free operation of the pump the diaphragm head must be totally vented. This is to be carried out when operating the pump at full stroke over several minutes (approx. 15 min). Please pay attention that the suction line is not pressurized.
5. If the oil level in the storage chamber diminishes during venting, a refilling is necessary until the oil reaches specified marking.
6. Afterwards the pump is ready for operation
7. If the pump is provided with spring loaded valves and there is no suction pressure available, a first filling of the pump head with liquid at the medium side is necessary. The suction line largely should be free of gas, too. Preferably the filling should occur with low suction pressure ($p \geq 0,3$ barg). After having carried out these actions the increased suction pressure can be set to original operating condition.

Maintenance

During operation the level of the hydraulic liquid in the diaphragm head is to be checked at the oil level glass or by means of a measuring stick. Colour changes of the fluid indicate diaphragm rupture or abrasion of seals. A diaphragm rupture also cause considerable fluctuations of the fluid level.

To maintain the function of the diaphragm head only original hydraulic liquids are to be used for re-filling and changes.

Temporarily the correct fastening of screw joints of diaphragm head, valves and piping connections has to be checked.

An exchange of the fluid is necessary when the colour has changed at:

- diaphragm rupture
- defective seals
- outside dirt accumulation

Diaphragm Head Mf

with double PTFE diaphragm

Storage requirements

For a longer operational standstill and storage please proceed as follows:

Remove the discharge medium from the pump head (disassembly suction and discharge valve).
Clean the pump parts contacted by the product.

Replace gear oil

Replace hydraulic oil in the pump head

Pump to be stored in a dry area (building, storage hall).

Diaphragm Head Mf

with double PTFE diaphragm

Trouble shooting

| <u>Disturbance</u> | <u>Possible reason</u> | <u>Removal</u> |
|-----------------------------|---|--|
| Pump does not discharge | Plunger does not move Diaphragm rupture, discharge fluid mixed in the hydraulic fluid Suction- or discharge line closed | See trouble shooting gear drive Replace diaphragms Open the line |
| Low discharge of pump | Stroke adjustment too low Valve do not close properly Solid particles in the valve Valves jammed Wear or defect valve Diaphragms defect Incorrect installation of diaphragm Outside contaminations incl. hydraulic liquid Suction height too high Filter clogged in the suction line Suction line not tight Cavitation | See trouble shooting gear drive Clean and lap valves respect Clean the valve Disassembly valves Clean, replace if necessary; worn parts to be replaced, re-lap if necessary Exchange diaphragm Install correctly Clean, install filter Reduce suction height or install air vessel Clean filter Check and seal suction line Install air vessel or reduce suction height |
| Outside-discharge of pump | Over-discharge by excessive pressure in the suction line Too high acceleration forces of the fluid in the suction or discharge line | Reduce suction pressure or increase counter pressure, if not possible install pressure valve Install air vessel |
| Leakages at the connections | Valves not installed correctly, valve sealing surfaces damaged | Check installation, install new valves |
| Valve noise or knockings | Cavitation | Install air vessel, increase suction pressure |
| Fluctuating discharge flow | Fluctuating counter pressure | Install pressure holding valve |

Disturbances caused by incorrect assembly or disassembly by the client are not considered. It is mandatory to follow the mounting instructions

NOTE: For diaphragm change the locking screw below the diaphragm head cover must be removed to let out traces of leakage. Afterwards close again the boring.

Diaphragm Head Mf

with double PTFE diaphragm

General

As the ORLITA Mf-pump programme is very comprehensive this instruction can be considered only as a general survey. ORLITA is not prepared to take responsibility for any possible damages occurred due to wrong assembly/disassembly.

Attention!

It is advisable to pay attention to the functional description of the Mf-pump head as it comprises the important characteristics of the pump head.

1. Disassembly of pump head

Close main switch of the pump (or adjust the corresponding gear drive to zero)

Decrease pressure of suction and pressure lines

Remove connections

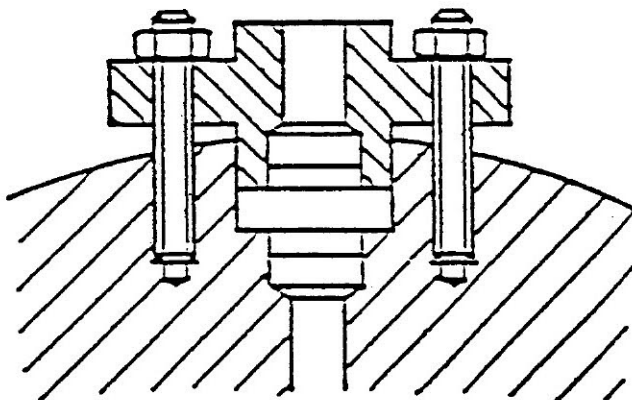
Disconnect and remove electrical connections

To prevent unauthorized switching-on remove safety fuses. This applies only if a diaphragm rupture control is installed.

1.1 Disassembly of pump head

In general two designs are applied

Abb. 1b/Fig. 1b



For design fig. 1a unscrew connection part with a key.

For design fig. 1b the holding screws have to be unscrewed stepwise.

Attention!

If this procedure is not observed a permanent leakage at the connection can occur due to tilting of the adjusting piece and the sealing surface.

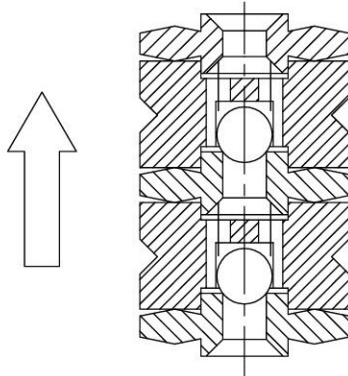
Diaphragm Head Mf

with double PTFE diaphragm

Even in case of improper clamping an instantaneous leakage can occur.

Clean valves carefully and check valve seat and valve cone with regard to wear. When assembling do not exchange as valve seat has been ground. Do not exchange pressure and suction valve.

Fig. 2 Do not exchange sides



As ORLITA use gravity valves the position of the valve must be always upwards (see fig. 2)

Tighten screws as described

1.2. Disassembly of pump head

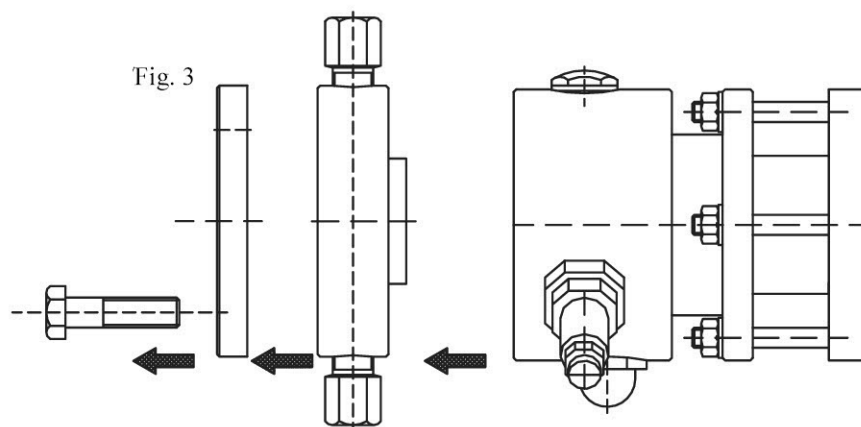
Use a barrel for collection of oil

Unscrew nuts and screws stepwise (loosening angle approx. 60°) and crosswise (see fig. 10)

Attention!

For screw constructions heating flange (if any) and diaphragm head cover have to be ensured against falling down.

Draw off carefully the diaphragm head cover from the diaphragm clamping surface



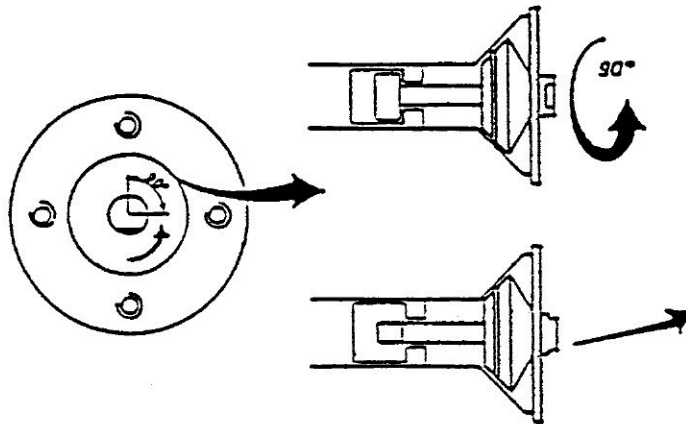
Diaphragm Head Mf

with double PTFE diaphragm

1.3 Exchange of diaphragm

First the mechanical coupling in the plunger has to be uncoupled. Therefore turn diaphragms with tension rod and diaphragm holding screw by 90° and pull them off (see fig. 4)

4/Fig. 4

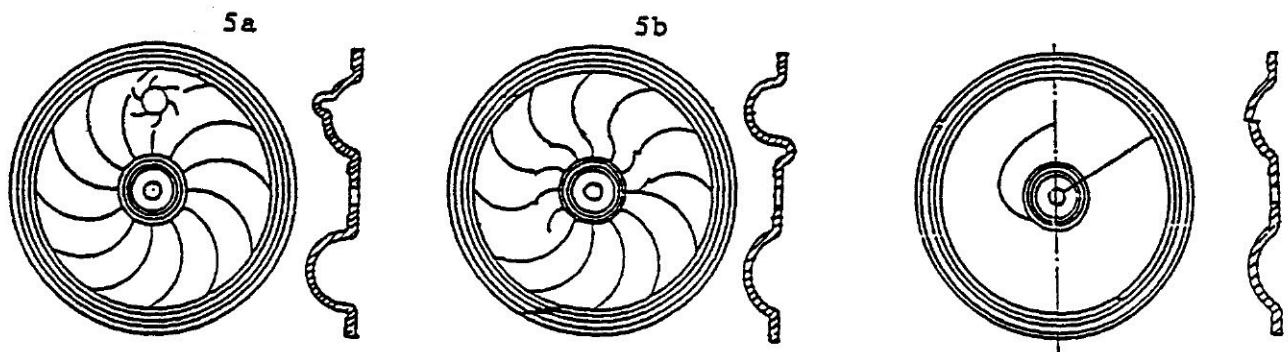


Zustand defekter Membranen

Abb. 5a/5b/5c

Condition of damaged diaphragms

Fig. 5a/5b/5c



to fig. 5a

Diaphragm is extremely arched, prints by borings, etc. in the diaphragm due to strong tightening at back space

Reasons: hydraulic oil is missing / high lost of leakage because of cracks, ventilation, etc. or in connection with suction pressure and longer stoppage - return plate is untight

to fig. 5b

double arch, not rotating

Reason: diaphragm is wrongly clamped

to fig. 5c

Cracks rotating in a radius directing inwards (straight crack)

Reason: external clamping is wrong and has not been pressed correctly

Diaphragm Head Mf

with double PTFE diaphragm

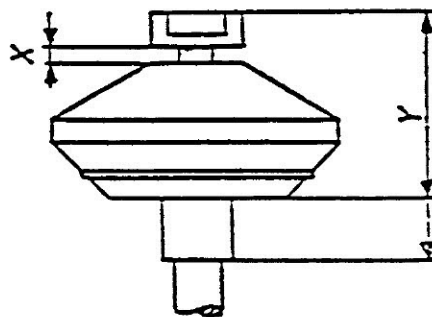
Measures

The tension rod has to be carefully clamped at its widest radius (vise) and the holding screw has to be unscrewed

Remove old diaphragm. Metallic diaphragm distance disk and internal rings have to be checked on damage and if necessary, they have to be replaced (see fig. 5)

1.4 Assembly of diaphragms

Fig. 6



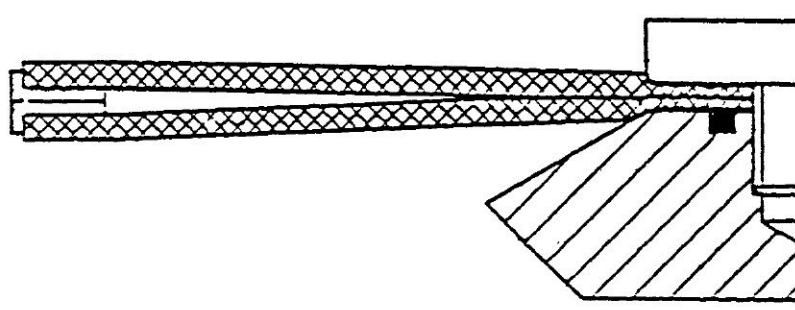
Unscrew holding screws, remove diaphragms and check on proper condition (a scratch/grain of sand can cause damages of the diaphragms)

Insert the diaphragms with diaphragm distance disks and tighten them carefully with the holding screw (**never insert used diaphragms!**)

Attention! The diaphragms have to be centered.

Now tighten the diaphragm holding screw stepwise. It is advisable to tighten in an interval of 3 x 10 minutes so that the PTFE will sufficiently flow into the grooves.

Fig. 7



By turning the electric motor fan the plunger is to be moved at full stroke to the front dead point position

Insert the tension rod and turn it by 90° (see fig. 4)

Assembly of diaphragm head cover see item 1.8

Diaphragm Head Mf

with double PTFE diaphragm

1.5 Measurement of back flow

The backflow system has been adjusted by manufacturer. However, due to wear the backflow system can change in course of time. To yield a better efficiency the backflow can then be readjusted.

The construction of backflow guarantees a constant efficiency by self-filling of the hydraulic part with oil that lacks due to crack losses and degasification. The overlapping of the two grooves has a very small tolerance because

a) when overlapping is too large starting-up of pressure will begin later and therefore efficiency will be decreased

b) when overlapping is too small no backflow can be effected and this entails destruction of diaphragms (see also functional description)

Procedures:

Remove diaphragm head cover and tension rod

Move the piston to the rear dead point position

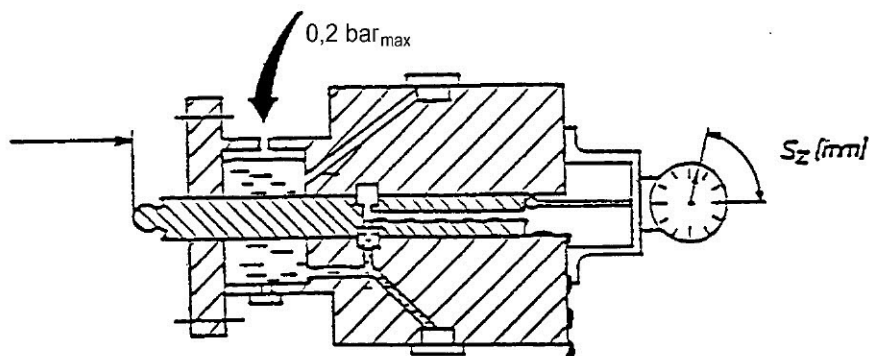
Tighten ventilation valve, overflow valve and oil outlet screw and fill up oil

Fit dial gauge according to fig. 8 and turn to zero

Air pressure has to be filled into oil (max. 0.2 bar) through the hole of the oil filling screw.

Attention! Oil level glass has to be checked

In case there is a good function of backflow oil emerges in front of plunger



Turn plunger at motor fan slowly to front dead point position until no oil emerges anymore. The value measured at the dial gauge corresponds to the length of the return feed edge SN

SN nominal size 0.2 - 0.5 mm +/- 0.1 mm per each pump head. In case there is no backflow you should call the ORLITA service.

Diaphragm Head Mf

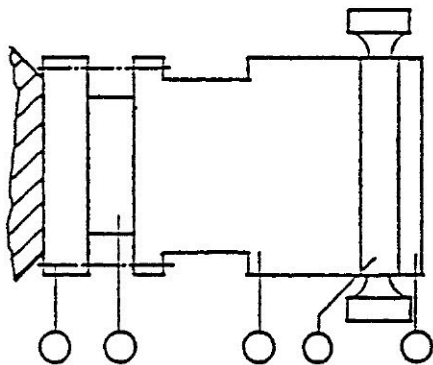
with double PTFE diaphragm

1.6 Disassembly of the diaphragm holder

Further disassembly is not advisable. The backflow system could be misplaced and therefore the efficiency could be decreased. In spite of this we enter into this matter for an emergency case. Nevertheless for subsequent damages due to wrong assembly.

ORLITA pumps are basically to be divided into two types of construction:

Abb. 9b/Fig. 9b



The exact design can be found in the sectional drawing of the pump head.

Drain the oil by outlet screw and/or overflow valve

Support diaphragm holder

Unscrew assembly screws crosswise

Remove diaphragm holder carefully

Attention! Do not damage lipseals

If necessary, ensure plunger against falling down

1.7 Check of plunger / cylinder

Check lipseals with regard to proper condition

Attention! The lipseal at crank drive has to seal the oil reservoir externally. The lip seal in front has to prevent that air comes through the gap into the hydraulic area. If this ring is defective and no spare part is available the pump can be operated for a short period with an oil-level being above the plunger.

Check cylinder and plunger with a view to grooves. Small grooves still grant a proper function. The grooves can be polished with fine 'Läpp-Schleifpapier' (grinding coat). In case of strong grooves the parts have to be replaced. There may be a risk of distroyment of plunger that causes more trouble than replacement of plunger and cylinder return the pump unit to our factory.

1.8 Assembly of pump head

Clean and oil construction parts

Put in the plunger and push on the constructional parts. Pay attention to the lipseal. Do not tilt the parts against each other. Do not shear off the O-rings in the parts fit

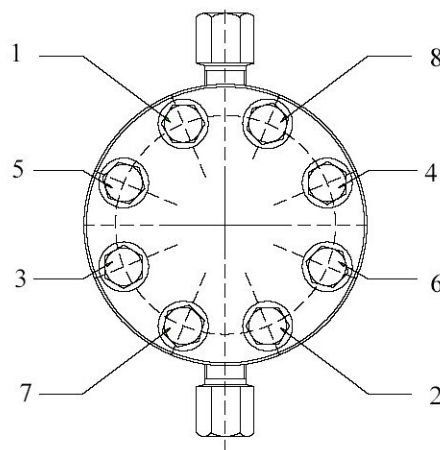
Tighten screws manually and then tighten them stepwise and crosswise with the specified torque

Assemble diaphragms in accordance with 1.3 and 1.4

Attention! Take care that the diaphragm is fixed centrically onto the surface. Otherwise there is a risk of shearing off. If necessary turn motor fan so that the plunger moves in direction to the rear dead point. By this the diaphragm can easily be pressed on its seat.

Put on the diaphragm head cover and tighten the screws (nuts) manually

Tightening has to be effected stepwise with specified torque according to fig. 10



Necessary torques see parts list / extra sheet

1. stage: 25% MA max.

2. stage: 50% MA max.

3. stage: 75% MA max.

4. stage: 100% MA max.

Fill in oil

1.9 Deaeration

In case there is air in the hydraulic area it will be compressed during pressure stroke and efficiency decreases rapidly.

Diaphragm Head Mf

with double PTFE diaphragm

When using an automatic ventilation valve the pump has to be started for deaeration and to be operated for a period of approx. 15 minutes at full stroke and without suction pressure.

When using a simple ventilation screw it has to be screwed and unscrewed several times for half a rotation (full stroke, without suction pressure)

A deaeration with suction pressure is possible only when using a special ventilation valve.

In case the oil level decreases in the storage space during deaeration, it is necessary to refill the oil until oil level is fixed to the specified marking.

Diaphragm rupture control

For the production of critical products with ORLITA diaphragm pumps type Mf diaphragm rupture control systems of reliable design are available.

Instead of one diaphragm only two diaphragms (one on the top of the other) have been installed. The thus existing intermediate space is now pressure-controlled by a switch.

In case one of the diaphragms gets untight, the pressure in the intermediate space increases in accordance with the operating pressure by intruding of product or hydraulic medium

At over-pressure the micro-switch actuates contacts for 250 V/5 A by the diaphragm movement of the control unit.

For the production of highviscous products such as fluid gas a connection of 1/8" is available for diffusion through the PTFE diaphragm on product side.

For viscous or contaminated products one has to taken into account a delay of the hydraulic pressure start for actuating the contacts due to clogging.