Off-line filter units

FGM 30/60

Installation and Operation Instructions

Original instructions
Read this instruction carefully prior to installation and/or use. Pay attention particularly to all advises and safety instructions to prevent injuries. Bühler Technologies can not be held responsible for misusing the product or unreliable function due to unauthorised modifications.

All rights reserved. Bühler Technologies GmbH 2019
Contents

1 Introduction ................................................................................................................................................. 2
  1.1 Intended use ........................................................................................................................................ 2
  1.2 Ordering instructions .......................................................................................................................... 2
  1.3 Scope of delivery ................................................................................................................................ 2
  1.4 Product description ............................................................................................................................ 2

2 Safety instructions ...................................................................................................................................... 3
  2.1 Important advice ................................................................................................................................. 3
  2.2 General hazard warnings .................................................................................................................... 4

3 Transport and storage ............................................................................................................................... 5

4 Installation and connection ....................................................................................................................... 6
  4.1 Requirements to the installation site ................................................................................................. 6
  4.2 Hydraulic connection ......................................................................................................................... 6
  4.3 Electrical connections ......................................................................................................................... 6

5 Operation and control ............................................................................................................................... 7
  5.1 Selecting screw-in cartridges ............................................................................................................. 7
  5.2 Before starting ..................................................................................................................................... 7
  5.3 During starting ..................................................................................................................................... 7
  5.4 Filter function notes ............................................................................................................................ 8
  5.5 Completing cleaning ........................................................................................................................... 8

6 Maintenance ............................................................................................................................................... 9
  6.1 Replacing the filter element .............................................................................................................. 10

7 Service and repair ..................................................................................................................................... 11
  7.1 Troubleshooting ............................................................................................................................... 11

8 Disposal ..................................................................................................................................................... 12

9 Appendices ............................................................................................................................................... 13
  9.1 Technical Data ..................................................................................................................................... 13
  9.2 Dimensions (mm/inch) ....................................................................................................................... 14
  9.3 Selecting the filter fineness ............................................................................................................... 15
  9.4 Installation torques and clamping range for cable fitting .................................................................. 16
  9.5 Screw torques .................................................................................................................................... 16
  9.6 Hose torques ...................................................................................................................................... 16
  9.7 Calculations ....................................................................................................................................... 16
    9.7.1 Calculating viscosity .................................................................................................................... 16
    9.7.2 Table of operational viscosity for VG oil ................................................................................... 17
    9.7.3 Calculating the pressure loss ...................................................................................................... 17

10 Attached documents ............................................................................................................................... 18
1 Introduction

1.1 Intended use
FGM off-line filters are used to maintain and extend the life of hydraulic fluids and lubricants. Their scope is indicated in the specifications. Any other applications require the prior approval of Bühler Technologies GmbH.

Since the fluids used are as a rule harmful to the environment, suitable tubing and fittings were used to ensure the screw-in cartridges can drain, the suction and pressure hoses are kept clean and any oil spills are caught.

1.2 Ordering instructions

<table>
<thead>
<tr>
<th>Filtration units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item no.</td>
</tr>
<tr>
<td>27002030IE3</td>
</tr>
<tr>
<td>27002020IE3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Screw-in cartridge (not included)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item no.</td>
</tr>
<tr>
<td>70541536</td>
</tr>
<tr>
<td>70541537</td>
</tr>
<tr>
<td>70541538</td>
</tr>
<tr>
<td>70541539</td>
</tr>
</tbody>
</table>

1.3 Scope of delivery
- 1 x mobile off-line filter
- Product documentation

1.4 Product description

Pump unit
The pump unit consists of a gerotor pump with electric drive motor. The transparent suction and pressure hoses allow visual inspection of the flow. The suction pipe has a coarse filter to protect the gerotor pump from coarse particles.

Filter
The built-in low pressure filter has a visual contamination indicator and a bypass valve. The flow is routed through both filter cartridges in parallel.
2 Safety instructions

2.1 Important advice

Operation of the device is only valid if:

– the product is used under the conditions described in the installation- and operation instruction, the intended application according to the type plate and the intended use. In case of unauthorized modifications done by the user Bühler Technologies GmbH can not be held responsible for any damage,

– when complying with the specifications and markings on the nameplates.

– the performance limits given in the datasheets and in the installation- and operation instruction are obeyed,

– monitoring devices and safety devices are installed properly,

– service and repair is carried out by Bühler Technologies GmbH,

– only original spare parts are used.

This manual is part of the equipment. The manufacturer keeps the right to modify specifications without advanced notice. Keep this manual for later use.

Signal words for warnings

<table>
<thead>
<tr>
<th>Signal word</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER</strong></td>
<td>Signal word for an imminent danger with high risk, resulting in severe injuries or death if not avoided.</td>
</tr>
<tr>
<td><strong>WARNING</strong></td>
<td>Signal word for a hazardous situation with medium risk, possibly resulting in severe injuries or death if not avoided.</td>
</tr>
<tr>
<td><strong>CAUTION</strong></td>
<td>Signal word for a hazardous situation with low risk, resulting in damaged to the device or the property or minor or medium injuries if not avoided.</td>
</tr>
<tr>
<td><strong>NOTICE</strong></td>
<td>Signal word for important information to the product.</td>
</tr>
</tbody>
</table>

Warning signs

In this manual, the following warning signs are used:

<table>
<thead>
<tr>
<th>Warning against hazardous situations</th>
<th>Warning against high pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning against electrical voltage</td>
<td>General notice</td>
</tr>
<tr>
<td>Warning against hot surface</td>
<td>Disconnect from mains</td>
</tr>
<tr>
<td>Warning against environmental hazard</td>
<td>Wear protection gloves</td>
</tr>
<tr>
<td>Warning against potentially explosive atmospheres</td>
<td></td>
</tr>
</tbody>
</table>
2.2 General hazard warnings

The equipment must be installed by a professional familiar with the safety requirements and risks.

Be sure to observe the safety regulations and generally applicable rules of technology relevant for the installation site. Prevent malfunctions and avoid personal injuries and property damage.

The operator of the system must ensure:

– Safety notices and operating instructions are available and observed,
– The respective national accident prevention regulations are observed,
– The permissible data and operational conditions are maintained,
– Safety guards are used and mandatory maintenance is performed,
– Legal regulations are observed during disposal,
– compliance with national installation regulations.
– Nearby equipment is EMC protected, e.g. through shielding.
– The current and voltage supply for the aggregate has a (mains) separator with adequate switching capacity. National requirements must be observed.

Maintenance, Repair

Please note during maintenance and repairs:

– Repairs to the unit must be performed by Bühler authorised personnel.
– Only perform conversion-, maintenance or installation work described in these operating and installation instructions.
– Always use genuine spare parts.

Always observe the applicable safety and operating regulations in the respective country of use when performing any type of maintenance.

### DANGER

**Electrical voltage**

Electrocution hazard.

- a) Disconnect the device from power supply.
- b) Make sure that the equipment cannot be reconnected to mains unintentionally.
- c) The device must be opened by trained staff only.
- d) Regard correct mains voltage.

### CAUTION

**Hot surface**

Burning hazard

Let the device cool down before maintaining.

### CAUTION

**High pressure**

Hazard of injury due to flung off parts or oil, environmental hazard due to oil.

- a) Before starting any maintenance or repair to the oil circuit, make sure that the device is depressurized. This applies to the locking screws as well.
- b) Avoid environmental pollution (oil spills) during cleaning or maintenance of the oil circuit.
- c) Use drip pans.

### DANGER

**Potentially explosive atmosphere**

Explosion hazard if used in hazardous areas.

The device is not suitable for operation in hazardous areas with potentially explosive atmospheres.
3 Transport and storage

Only transport the product inside the original packaging or a suitable alternative. Ensure secure fastening and mooring.

Only use the engine transport eyes to hoist the engine without add-ons.

Step on the wheel stops to prevent the unit from rolling away. Pull the stops up to release.

The equipment must be protected from moisture and heat when not in use. It must be stored in a covered, dry, dust-free room at room temperature.
4 Installation and connection

4.1 Requirements to the installation site

**Aggregate**
The aggregate must be set up to allow for unobstructed air flow and adequate room for maintenance/repairs. For outdoor operation, please note the protection rating of the motor (IP 55) and the electrical plug (IP 44), and if necessary ensure adequate protection from the weather.

Ensure the surface is suitable and level. If necessary, align the unit. Be sure the connection side faces the cleaning oil tank (machine). Secure the wheels with the wheel stop.

Additional chocks or tilt protection may be required on uneven surfaces.

When using a filter with visual service indicator, the aggregate must be set up so as not to block the service indicator.

**4.2 Hydraulic connection**

Carry out the hydraulic connection per the attached data. When connecting the tubes, make sure they are strain-free and without kinks. The max. oil temperature is 50 °C, or briefly 65 °C.

Tighten the hose lines with a suitable torque (see appendix).

Contaminated fluids impact the life of the fluid system, we therefore recommend a purity class of 23/19/13 per ISO 4406.

When permanently connecting the aggregate to a hydraulic system featuring switchover and shut-off valves, we recommend protecting it with an additional pressure relief valve. In this case the PVC tubes should also be replaced with conventional rubber tubes.

**4.3 Electrical connections**
The aggregate is equipped with a VDE-approved control. The pump unit is switched on and off via the main switch.

A 5-pin CEE plug is used to connect the unit. A motor circuit breaker is built in as a safety device which switches the motor off when overloaded.

<table>
<thead>
<tr>
<th>DANGER</th>
<th><strong>Electrical voltage</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electrocution hazard.</td>
</tr>
<tr>
<td>a)</td>
<td>Disconnect the device from power supply.</td>
</tr>
<tr>
<td>b)</td>
<td>Make sure that the equipment cannot be reconnected to mains unintentionally.</td>
</tr>
<tr>
<td>c)</td>
<td>The device must be opened by trained staff only.</td>
</tr>
<tr>
<td>d)</td>
<td>Regard correct mains voltage.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
<th><strong>Electric voltage</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>An incorrect mains voltage can destroy the unit</td>
</tr>
<tr>
<td></td>
<td>The connection must be made by a trained professional. Observe the mains voltage indicated on the type plate. Make sure the cables have sufficient strain relief.</td>
</tr>
<tr>
<td></td>
<td><strong>Fusing</strong></td>
</tr>
<tr>
<td></td>
<td>Fusing must comply with applicable standards!</td>
</tr>
<tr>
<td></td>
<td><strong>Polarity</strong></td>
</tr>
<tr>
<td></td>
<td>Please note the direction of rotation of the motor when connecting. The direction of rotation is indicated on the pump housing with “M” and an arrow. If the motor turns in the wrong direction after being switched on, correct the polarity inside the CEE socket.</td>
</tr>
</tbody>
</table>

The motor circuit breaker is set according to the current rating specified on the motor type plate. The motor comes standard with start connection. Operation outside the specified mains voltage and frequency range limits is prohibited.

Connect the protective earth of the motor to the protective earth on site. Protective earth per DIN VDE 0100 must be connected to the marked earth lead terminal.

**The operator of the equipment is responsible for ensuring lightning protection.**
5 Operation and control

**NOTICE**

The device must not be operated beyond its specifications.

5.1 Selecting screw-in cartridges

The contamination level must be determined to be able to select a screw-in cartridge suitable for the respective application. This requires sampling the fluid to be cleaned and determining the purity class.

Please refer to the chart in chapter Selecting the filter fineness on page 15 for the required purity class and system parameters for the necessary retention rate (βxValue).

5.2 Before starting

- Check all parts for damage. Do not put a damaged device into operation.
- Verify the connection is correct as described in chapter “Installation and connection”.
- Check if all valves or other parts which must be open during start-up were opened.
- Verify all screw connections and all sealing surfaces are tight.
- Ensure the screw-in cartridges required for the planned application are screw in correctly and you have sufficient spare elements.
- The suction and pressure hoses are tightly connected to the oil tank based on the task to be performed. If necessary, secure both hoses (or at least the suction tube) to prevent them from coming off. Make sure the tubes are not kinked!

5.3 During starting

Connect to power with the connecting cable. Do not crush or strain the cable.

Switch on the main switch. The pump will start immediately and the tubes fill with fluid.

Verify the pump turns counter-clockwise. Otherwise change the electrical connection inside the CEE socket. The direction of rotation is specified on the front of the pump housing with an arrow and "M".

**CAUTION**

**Hot surface**

Burning hazard
Let the device cool down before maintaining.

**CAUTION**

**High pressure**

Hazard of injury due to flung off parts or oil, environmental hazard due to oil.

a) Before starting any maintenance or repair to the oil circuit, make sure that the device is depressurized. This applies to the locking screws as well.

b) Avoid environmental pollution (oil spills) during cleaning or maintenance of the oil circuit.

c) Use drip pans.

**Noise level**

Our pump is supplied with a low noise. If the noise level increases significantly check if the suction line has the right dimension and if the pump works in the appropriate temp/viscosity range. Ask Bühler Technologies GmbH for technical advice.
Operation

For the highest efficiency the fluid to be cleaned should be at operating temperature. Therefore it’s almost always beneficial to clean it on running systems or immediately after use.

When cleaning silty systems you should aim the pressure hose in the tank so the cleaning jet disperses the dirt layer and moves it toward the filter. Be sure to also aim it at the corners and if necessary temporarily stop turning and insert the pressure hose in the different tank sections.

Depending on the contamination level the filter elements (screw-in cartridges) will already be depleted after a few minutes. In this case, switch off the main switch and replace the screw-in cartridges.

Determine the cleaning result after initially brief periods (on element change) by determining the purity class achieved. The cleaner the system, the longer the life of the screw-in cartridges. When the purity class is stable, cleaning can be stopped.

5.4 Filter function notes

The screw-in cartridges utilisation will be best when the fluid is at operating temperature (>30 °C). This is because at low temperatures the viscosity of the oil increases, resulting in a higher pressure difference through the filter. The screw-in cartridges are monitored via the visual contamination indicator, which measures the pressure difference from the filter.

Cold oil and increasing contamination of the screw-in cartridge increase the pressure difference and causes the contamination indicator to respond, i.e. the red button pops out. During this phase the bypass valve relieves excess pressure on the filter element. Once the fluid has heated (determined by touching the filter housing) the red button should be pushed in again. If it stays pushed in, the element has sufficient capacity left, if it immediately pops out again (check function), the pressure difference is still too high or the element capacity may be depleted. In this case replace the element.

If the fluid does not heat up properly due to the volume and the viscosity is above 300 mm²/s, the filter housing will be in constant bypass mode. In these worst cases, the target output cannot be achieved clearly and quickly. The purity class will not improve, as the filter element is partly being bypassed via the bypass valve, i.e. it also will not be depleted.

5.5 Completing cleaning

After completing the rinsing or cleaning process, remove the tubes from the tank, catch any oil drips, and insert in the holder on the unit. Secure the tubes on the transport hooks.
6 Maintenance

During maintenance, remember:
– The equipment must be maintained by a professional familiar with the safety requirements and risks.
– Only perform maintenance work described in these operating and installation instructions.
– When performing maintenance of any type, observe the respective safety and operation regulations.

**DANGER**

**Electrical voltage**
Electrocution hazard.

a) Disconnect the device from power supply.
b) Make sure that the equipment cannot be reconnected to mains unintentionally.
c) The device must be opened by trained staff only.
d) Regard correct mains voltage.

**CAUTION**

**Hot surface**
Burning hazard
Let the device cool down before maintaining.

**CAUTION**

**High pressure**
Hazard of injury due to flung off parts or oil, environmental hazard due to oil.

a) Before starting any maintenance or repair to the oil circuit, make sure that the device is depressurized. This applies to the locking screws as well.
b) Avoid environmental pollution (oil spills) during cleaning or maintenance of the oil circuit.
c) Use drip pans.

Under normal operating conditions the aggregates are maintenance free. Preventive maintenance must therefore be routinely carried out by the operating company.

When doing so, please pay attention to:
– Tight screw fittings,
– Tightness,
– Damage to the aggregate (replace damaged parts),
– Abnormal (unusual) noise and vibration,
– Check warning labels for legibility and damage.

Electrical connections must be checked annually by a licensed electrician.

Always ensure the suction pipe is inside the fluid to prevent running the gerotor pump dry. If leaks occur, tighten or if necessary replace the connections.

After long aggregate downtimes the suction hose may need to be filled with a little bit of oil to improve pump intake.

The wheel kit is maintenance free. You will only need to ensure the wheels and swivel casters are in good condition.

The outside of the motors, particularly the cooling ribs and cooling ducts as clean as possible to prevent compromising heat release.

Please note the specified protection against dust and moisture. Pressure cleaning is only permitted if the motor has the respective protection rating.

The motors feature ball bearings sealed on both sides. The grease filling is designed to last for the life of the unit. Greasing is not necessary.

The motor mounts may only be replaced by Bühler or a qualified specialist company.
Condensate drain holes at motors from manufacturer WEG

If the motor is used in surrounding with high humidity this could lead, depending on the ambient temperature, to formation of condensate inside the motor housing. Specially at longer nonoperation period. The motors of WEG have a condensate drain plug which can be used for draining off. Pull out the plug according to the pictures and push it then back. If the plug is not pushed back or completely removed, the motor losses the IP degree of protection.

6.1 Replacing the filter element

– Switch off the aggregate via the main switch.
– Pull the pressure hose out of the tank and secure above the oil level.
– Un-screw the two screw-in cartridges with a strap spanner, turning counter-clockwise.
– Lightly lubricate the seal with oil before screwing in the screw-in cartridges.
– Switch the aggregate on again.
7 Service and repair

This chapter contains information on troubleshooting and correction should an error occur during operation. Repairs to the unit must be performed by Bühler authorised personnel.

Please contact our Service Department with any questions:

Tel.: +49-(0)2102-498955 or your agent

If the equipment is not functioning properly after correcting any malfunctions and switching on the power, it must be inspected by the manufacturer. Please send the equipment inside suitable packaging to:

Bühler Technologies GmbH
- Reparatur/Service -
Harkortstraße 29
40880 Ratingen
Germany

Please also attach the completed and signed RMA decontamination statement to the packaging. We will otherwise be unable to process your repair order.

You will find the form in the appendix of these instructions, or simply request it by e-mail:

service@buehler-technologies.com.

7.1 Troubleshooting

<table>
<thead>
<tr>
<th>Problem / Malfunction</th>
<th>Possible cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter contamination indicator activated</td>
<td>Screw-in cartridge dirty</td>
<td>Replace screw-in cartridge</td>
</tr>
<tr>
<td>Motor pump is not taking in oil</td>
<td>Perforated sheet inside the suction pipe clogged</td>
<td>Clean perforated sheet</td>
</tr>
<tr>
<td></td>
<td>Suction pipe not inside the fluid</td>
<td>Immerse suction pipe in fluid</td>
</tr>
<tr>
<td></td>
<td>Pump motor not running</td>
<td>Check power supply and electrical connection</td>
</tr>
<tr>
<td></td>
<td>Incorrect direction of rotation</td>
<td>Check and correct polarity inside the CEE socket</td>
</tr>
<tr>
<td>Noisy pump operation</td>
<td>Pump is taking in air</td>
<td>Immerse suction pipe in fluid</td>
</tr>
<tr>
<td></td>
<td>Pump isn’t taking in oil</td>
<td>Check suction pipe for damage</td>
</tr>
<tr>
<td></td>
<td>Pump failure</td>
<td>Replace pump</td>
</tr>
<tr>
<td></td>
<td>Oil viscosity too high</td>
<td>Oil needs to be heated up if the motor circuit breaker is triggered</td>
</tr>
<tr>
<td>Pump motor not running</td>
<td>Motor circuit breaker was triggered</td>
<td>Reset motor circuit breaker</td>
</tr>
<tr>
<td></td>
<td>Electrical connection failure</td>
<td>Replace motor</td>
</tr>
<tr>
<td></td>
<td>Pump seized</td>
<td>Replace pump</td>
</tr>
<tr>
<td></td>
<td>Electric motor coil defective</td>
<td>Replace motor</td>
</tr>
<tr>
<td></td>
<td>Screw-in cartridges dirty</td>
<td>Replace cartridges</td>
</tr>
<tr>
<td>Visual contamination indicator</td>
<td>Failure</td>
<td>Replace</td>
</tr>
</tbody>
</table>

Tab. 1: Troubleshooting
8 Disposal

Dispose of the parts in such a way that does not present a danger to other people’s health or to the environment. Observe the legal requirements in the country of use for the disposal of electrical components and oils and coolants.
9 Appendices

9.1 Technical Data

Technical Data

| Pump: | Contaminant-resistant gerotor pump |
| Colour: | Motor RAL 7024/frame RAL 5002 |
| Operating fluids: | Mineral oils per DIN 51524 |
| Operating oil temperature: | max. 50 °C, briefly 65 °C |
| Seal: | Perbunan (NBR) or Viton (FPM) on request |
| Ambient temperature: | -15 °C to +40 °C |
| Electrical connection: | Protective motor switch, 5 m oil-proof connection cable with 5-pin CEE shrouded plug 16 A IEC60309/3L+N+PE |
| Filter housing: | PI 2728-57 with optical contamination indicator, parallel flow through filter cartridges |
| Filter bypass: | Opening pressure Δp 3.5 bar |
| Contamination indicator: | Response pressure Δp 2.2 bar |
| Wheel kit: | Steel frame with integrated drip pan with drain, large polyamide wheels, swivel wheels with brake, fold-away handle for pulling the aggregate, storage hooks for connecting cable and hoses |
| Oil hoses: | clear PVC hoses with integrated steel wire coil, with strainer as suction hose coarse filter, galvanised steel pipe pressure lance |

Electric motors

Voltage/frequency

| FGM 30: | 220/380 V - 230/400 V - 240/415 V 50 Hz; 460 V 60 Hz |
| FGM 60: | Electr. motor per NEMA; UL, CSA, EAC approval |

Thermal stability: Class of insulation F, utilisation per Class B

Design: three-phase asynchronous squirrel-cage induction motor totally enclosed, fan cooled

Degree of protection: Motor IP55, Plug IP44

on request: other voltages, higher motor power for higher viscosities, UL- or CSA-approved motors, higher protection class

The motors comply with the IEC 60034 standards

Aggregate

<table>
<thead>
<tr>
<th>FGM 30</th>
<th>FGM 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow rate:</td>
<td>29 L/min</td>
</tr>
<tr>
<td>Power output/number of pins/rated current at 400 V:</td>
<td>0.75 kW/4/1.6 A</td>
</tr>
<tr>
<td>Sound pressure level per ISO 3744:</td>
<td>61 dB(A)</td>
</tr>
<tr>
<td>Speed (rpm):</td>
<td>1410</td>
</tr>
<tr>
<td>max. working pressure:</td>
<td>7 bar</td>
</tr>
<tr>
<td>Suction pressure:</td>
<td>-0.4 bar</td>
</tr>
<tr>
<td>briefly:</td>
<td>-0.6 bar</td>
</tr>
<tr>
<td>max. oil viscosity:</td>
<td>500 mm²/s</td>
</tr>
<tr>
<td>Weight:</td>
<td>approx. 60 kg</td>
</tr>
</tbody>
</table>
### Accessories (included)

<table>
<thead>
<tr>
<th></th>
<th>30 L/min.</th>
<th>60 L/min.</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction hose</td>
<td>DN 25</td>
<td>DN 32</td>
<td>L = 2 m</td>
</tr>
<tr>
<td>Pressure hose</td>
<td>DN 20</td>
<td>DN 20</td>
<td>L = 2 m</td>
</tr>
</tbody>
</table>

Screw-in cartridge 3 μm, 6 μm, 10 μm, 25 μm (not included)

### 9.2 Dimensions (mm/inch)
### 9.3 Selecting the filter fineness

<table>
<thead>
<tr>
<th>System type</th>
<th>Recommend filter retention rate</th>
<th>Recommended element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly reliable control systems susceptible to sludge accumulations; laboratory or aerospace</td>
<td>1-2</td>
<td>Sm-N2</td>
</tr>
<tr>
<td>High performance servo systems and high pressure systems with a long life; e.g. aviation, machine tool, etc.</td>
<td>3-5</td>
<td>Sm-x3, Sm-x6</td>
</tr>
<tr>
<td>High-quality, reliable systems: general machinery construction</td>
<td>10-12</td>
<td>Sm-x10</td>
</tr>
<tr>
<td>General machinery construction and vehicles; moderate pressure, moderate capacity</td>
<td>12-15</td>
<td>Sm-x16</td>
</tr>
<tr>
<td>General machinery construction and vehicles; low-pressure systems in heavy machinery construction</td>
<td>15-25</td>
<td>Sm-x25 / Mic 10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Determining the contamination class per ISO 4406</th>
<th>System type</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;4 µm</td>
<td>&gt;6 µm, &gt;14 µm</td>
</tr>
<tr>
<td>13</td>
<td>11, 8 Highly reliable control systems susceptible to sludge accumulations; laboratory or aerospace</td>
</tr>
<tr>
<td>14</td>
<td>12, 9 High performance servo systems and high pressure systems with a long life; e.g. aviation, machine tool, etc.</td>
</tr>
<tr>
<td>16</td>
<td>13, 10 High-quality, reliable systems: general machinery construction</td>
</tr>
<tr>
<td>17</td>
<td>15, 11 General machinery construction and vehicles; moderate pressure, moderate capacity</td>
</tr>
<tr>
<td>20</td>
<td>17, 12 General machinery construction and vehicles; low-pressure systems in heavy machinery construction</td>
</tr>
<tr>
<td>23</td>
<td>19, 13</td>
</tr>
</tbody>
</table>

---

**Diagram:**

[Image of filtration group diagram with lines and labels indicating particle size and filter efficiency.]
9.4 Installation torques and clamping range for cable fitting

<table>
<thead>
<tr>
<th>Size</th>
<th>Strain relief clamping range (mm)</th>
<th>Installation torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12x1,5</td>
<td>3-6</td>
<td>1,5</td>
</tr>
<tr>
<td>M16x1,5</td>
<td>5-9,5</td>
<td>2,5</td>
</tr>
<tr>
<td>M20x1,5</td>
<td>8-13</td>
<td>3,5</td>
</tr>
<tr>
<td>M25x1,5</td>
<td>11-17</td>
<td>5</td>
</tr>
<tr>
<td>M32x1,5</td>
<td>15-21</td>
<td>5</td>
</tr>
<tr>
<td>M40x1,5</td>
<td>19-28</td>
<td>7,5</td>
</tr>
<tr>
<td>M50x1,5</td>
<td>27-35</td>
<td>7,5</td>
</tr>
<tr>
<td>M63x1,5</td>
<td>32-42</td>
<td>13</td>
</tr>
</tbody>
</table>

9.5 Screw torques

<table>
<thead>
<tr>
<th>Thread</th>
<th>Torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>3</td>
</tr>
<tr>
<td>M6</td>
<td>5</td>
</tr>
<tr>
<td>M8</td>
<td>12</td>
</tr>
<tr>
<td>M10</td>
<td>23</td>
</tr>
<tr>
<td>M12</td>
<td>40</td>
</tr>
</tbody>
</table>

9.6 Hose torques

<table>
<thead>
<tr>
<th>Connections/mounts</th>
<th>Torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hose connections DN20</td>
<td>180</td>
</tr>
<tr>
<td>Hose connections DN25</td>
<td>250</td>
</tr>
<tr>
<td>Hose connections DN32</td>
<td>350</td>
</tr>
</tbody>
</table>

9.7 Calculations

9.7.1 Calculating viscosity
Valid for VG-oil between 10 - 100 °C at an exactness from ± 5 %.

Definitions

- \( V_{40} \): oil viscosity at 40 °C in cst
- \( T \): temperature in °C
- \( \nu \): viscosity in cst

Example: oil VG 46

\[
\begin{align*}
V_{40} & = 46 \text{ cst} \\
T & = 25 \degree C
\end{align*}
\]

\[
\begin{align*}
b &= 159 \cdot \ln \left( \frac{V_{40}}{0.23} \right) \\
a &= 0.23 \cdot e^{\frac{-b}{877}} \\
\nu &= a \cdot e^{\frac{b}{T+95.2}}
\end{align*}
\]

\[
\begin{align*}
b &= 159 \cdot \ln \left( \frac{46}{0.23} \right) = 842.4325 \\
a &= 0.23 \cdot e^{\frac{-842.4325}{877}} = 0.08801 \\
\nu &= 0.08801 \cdot e^{\frac{842.4325}{25+95.2}} = 97.35 \text{ cst}
\end{align*}
\]
9.7.2 Table of operational viscosity for VG oil

<table>
<thead>
<tr>
<th></th>
<th>10 °C</th>
<th>20 °C</th>
<th>30 °C</th>
<th>40 °C</th>
<th>50 °C</th>
<th>60 °C</th>
<th>70 °C</th>
<th>80 °C</th>
<th>90 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>VG 46</td>
<td>264,45</td>
<td>131,96</td>
<td>73,58</td>
<td>46,00</td>
<td>29,13</td>
<td>20,04</td>
<td>14,43</td>
<td>10,78</td>
<td>8,32</td>
</tr>
<tr>
<td>VG 68</td>
<td>444,77</td>
<td>210,85</td>
<td>112,61</td>
<td>68,00</td>
<td>41,63</td>
<td>27,86</td>
<td>19,58</td>
<td>14,32</td>
<td>10,84</td>
</tr>
<tr>
<td>VG 220</td>
<td>2.120,17</td>
<td>861,60</td>
<td>404,31</td>
<td>220,00</td>
<td>121,71</td>
<td>74,99</td>
<td>49,00</td>
<td>33,61</td>
<td>24,01</td>
</tr>
<tr>
<td>VG 320</td>
<td>3.489,92</td>
<td>1.350,22</td>
<td>607,96</td>
<td>320,00</td>
<td>171,40</td>
<td>102,85</td>
<td>65,66</td>
<td>44,12</td>
<td>30,94</td>
</tr>
</tbody>
</table>

Viscosity given in cst (mm²/s)

9.7.3 Calculating the pressure loss

Valid for smooth straight piping per meter at laminar current.

<table>
<thead>
<tr>
<th>Definitions</th>
<th>Example: oil VG 46</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \nu ) Viscosity in cst</td>
<td>( \nu = 97,35 \text{ cst} )</td>
</tr>
<tr>
<td>( \rho ) spec. gravity in kg/dm³</td>
<td>( \rho = 0,8817 \text{ kg/dm}³ )</td>
</tr>
<tr>
<td>DN tube diameter in mm</td>
<td>DN 20 mm</td>
</tr>
<tr>
<td>V flow in m/s</td>
<td>V 3,18 m/s (60 l/min for tube DN 20)</td>
</tr>
<tr>
<td>PV pressure loss in bar</td>
<td>( PV = \frac{0.32 \cdot 97,35 \cdot 0,8817 \cdot 3,18}{20²} = 0,22 \text{ bar} )</td>
</tr>
</tbody>
</table>

\[ PV = \frac{0.32 \cdot \nu \cdot \rho \cdot V}{DN²} \]

NOTICE

Pressure loss increases significantly for bends and fittings. It might be necessary in some cases to determine the final shape of the suction line on site under specific conditions.

Please do not hesitate to contact us for help to calculate the pressure loss of the suction line for your specific application.

NOTICE

To avoid damage of the cooling system, make sure that the maximum pump pressure is not exceeded. High pressure may occur if the system is shut off or throttled at the pressure side.
10 Attached documents

– Declaration of Conformity KX270002
– RMA - Decontamination Statement
Hiermit erklärt Bühler Technologies GmbH, dass die nachfolgenden Produkte den wesentlichen Anforderungen der Richtlinie 2006/42/EG (MRL) in ihrer aktuellen Fassung entsprechen.

Die Produkte sind Maschinen nach Artikel 2 a).

Folgende Richtlinien wurden berücksichtigt:

2014/30/EU (EMV/EMC)
2014/35/EU (NSR/LVD)

Produkt / products: Nebenstromfilteraggregat / Off-line filter unit
Typ / type: FGM 30/60

Die Betriebsmittel dienen der Pflege und Lebensdauerverlängerung von Hydraulikflüssigkeiten und Schmierölen.

The equipment is suited for servicing and life care of hydraulic-liquids and lubricating oils.

Das oben beschriebene Produkt der Erklärung erfüllt die einschlägigen Harmonisierungsrechtsvorschriften der Union:

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

EN 60204-1:2006
EN ISO 4413:2010

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Dokumentationsverantwortlicher für diese Konformitätserklärung ist Herr Stefan Eschweiler mit Anschrift am Firmensitz.

The person authorised to compile the technical file is Mr. Stefan Eschweiler located at the company’s address.

RATINGEN, den 05.02.2019

Stefan Eschweiler
Geschäftsführer – Managing Director

Frank Pospiech
Geschäftsführer – Managing Director

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen, Tel. +49 (0) 21 02 / 49 89-0, Fax. +49 (0) 21 02 / 49 89-20
Internet: www.buehler-technologies.com

KX 27 0002


Firma/ Company

Name/ Name

Abt./ Dept.

Tel./ Phone

E-Mail

Serien-Nr./ Serial No.

Artikel-Nr./ Item No.

Grund der Rücksendung/ Reason for return

Kalibrierung/ Calibration

Modifikation/ Modification

Reklamation/ Claim

Reparatur/ Repair

andere/ other

Ist das Gerät möglicherweise kontaminiert?/ Could the equipment be contaminated?

☐ Nein, da das Gerät nicht mit gesundheitsschädigenden Stoffen betrieben wurde./ No, because the device was not operated with hazardous substances.

☐ Nein, da das Gerät ordnungsgemäß gereinigt und dekontaminiert wurde./ No, because the device has been properly cleaned and decontaminated.

☐ Ja, kontaminiert mit: Yes, contaminated with:

☐ explosive/ explosive

☐ entzündlich/ flammable

☐ brandfördernd/ oxidising

☐ komprimierte Gase/ compressed gases

☐ ätzend/ caustic

☐ giftig, Lebensgefährlich/ poisonous, risk of death

☐ gesundheitsschädlich/ health hazard

☐ umweltgefährlich/ environmental hazard

Bitte Sicherheitssdatenblatt beilegen!/ Please enclose safety data sheet.

Das Gerät wurde gespült mit: The equipment was purged with:


Falls die Ware nicht gereinigt, also kontaminiert bei uns eintritt, muss die Firma Bühler sich vorbehalten, diese durch einen externen Dienstleister reinigen zu lassen und Ihnen dies in Rechnung zu stellen.

Datum/ Date

rechtsverbindliche Unterschrift/ Legally binding signature
Die Analyse defekter Baugruppen ist ein wesentlicher Bestandteil der Qualitätssicherung der Firma Bühler Technologies.

Um eine aussagekräftige Analyse zu gewährleisten muss die Ware möglichst unverändert untersucht werden. Es dürfen keine Veränderungen oder weitere Beschädigungen auftreten, die Ursachen verdecken oder eine Analyse unmöglich machen.


Analysing defective assemblies is an essential part of quality assurance at Bühler Technologies.

To ensure conclusive analysis the goods must be inspected unaltered, if possible. Modifications or other damages which may hide the cause or render it impossible to analyse are prohibited.

Electronic assemblies may be sensitive to static electricity. Be sure to handle these assemblies in an ESD-safe manner. Where possible, the assemblies should be replaced in an ESD-safe location. If unable to do so, take ESD-safe precautions when replacing these. Must be transported in ESD-safe containers. The packaging of the assemblies must be ESD-safe. If possible, use the packaging of the spare part or use ESD-safe packaging.

Observe the above specifications when installing the spare part. Ensure the part and all components are properly installed. Return the cables to the original state before putting into service. When in doubt, contact the manufacturer for additional information.