Solenoid valve operating methods

**Direct-acting**
For small nominal diameters
No minimum differential pressure required.

**servo-assisted**
A minimum differential pressure of approx. 0.5 bar is required. Cannot open without differential pressure between input and output.

**Automatically servo-assisted**
(coupled) For differential pressures from 0 to maximum pressure. For universal application.

Fema piston-type solenoid valves are suitable for demanding applications, particularly in the field of heat, energy and gas technology. All valves of the product groups mentioned below are automatically servo-assisted and may therefore be used from 0 bar to maximum pressure. No minimum differential pressure is required. A DC coil is normally used. A rectifier is supplied for connection to a 230 VAC supply.

### Product Summary

<table>
<thead>
<tr>
<th>Series</th>
<th>Nom. diameter DN (mm)</th>
<th>M= screwed F= flange</th>
<th>Working pressure* (bar)</th>
<th>Piston</th>
<th>Seals</th>
<th>N = Normal type Ex-type</th>
<th>Operating-mode</th>
<th>DIN testing agency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TG</strong> for neutral media</td>
<td>15/20 25/32 40/50</td>
<td>M + F M + F M + F</td>
<td>0-40 0-32 0-20</td>
<td>NBR NBR NBR</td>
<td>-15 to +90 60°C for Ex</td>
<td>-15 to +60</td>
<td>N</td>
<td>+</td>
</tr>
<tr>
<td><strong>TGK</strong> for high temperatures</td>
<td>15/20 25/32 40/50</td>
<td>M + F M + F M + F</td>
<td>0-40 0-32 0-20</td>
<td>PTFE Stainl. cone EPDM</td>
<td>max. 180</td>
<td>-15 to +60</td>
<td>N</td>
<td>+</td>
</tr>
<tr>
<td><strong>K</strong> for fuel gases up to 4 bar</td>
<td>15/20 15/20 15/20 25/32 25/32 40/50</td>
<td>M F M F F</td>
<td>0-4 0-4 0-4</td>
<td>NBR NBR NBR</td>
<td>-15 to +60</td>
<td>-15 to +60</td>
<td>N</td>
<td>+</td>
</tr>
<tr>
<td><strong>K</strong> f. fuel gases over 4 bar</td>
<td>15/20 15/20 15/20 25/32 25/32 40/50</td>
<td>M F M F F</td>
<td>0-25 0-25 0-25</td>
<td>NBR NBR NBR</td>
<td>-15 to +60</td>
<td>-15 to +60</td>
<td>N</td>
<td>+</td>
</tr>
<tr>
<td><strong>K</strong> for liquid gases in liquid phase</td>
<td>15/20 15/20 15/20 25 25</td>
<td>M F M F F</td>
<td>0-25 0-25 0-25</td>
<td>NBR NBR NBR</td>
<td>-15 to +60</td>
<td>-15 to +60</td>
<td>N</td>
<td>+</td>
</tr>
<tr>
<td><strong>K</strong> for fuel oil</td>
<td>15/20 15/20 15/20 25/32 25/32 40/50</td>
<td>M F M F F</td>
<td>0-25 0-25 0-25</td>
<td>NBR NBR NBR</td>
<td>-15 to +60</td>
<td>15 to +60</td>
<td>N</td>
<td>+</td>
</tr>
<tr>
<td><strong>LG</strong> for hot water and steam up to 120°C</td>
<td>15/20 15/20 15/20 25/32 25/32 40/50</td>
<td>M + F M + F M + F</td>
<td>0-25 0-20 0-16</td>
<td>PTFE Stainl. cone EPDM</td>
<td>max. 120</td>
<td>+ 4 to +60</td>
<td>N</td>
<td>+</td>
</tr>
<tr>
<td><strong>LGK</strong> for hot water and steam up to 180°C</td>
<td>15/20 15/20 15/20 25/32 25/32 40/50</td>
<td>M + F M + F M + F</td>
<td>0-20 0-16 0-12</td>
<td>PTFE Stainl. cone EPDM</td>
<td>max. 180</td>
<td>+ 4 to +60</td>
<td>N</td>
<td>+</td>
</tr>
</tbody>
</table>

nc = normally closed, opened under voltage.
no = normally open, closed under voltage (identified in the Product Summary by the letter “U”).
* = The respective data sheet contains exact details of the limits of use.

Sealing materials:
- **NBR** = Perbunan
- **EPDM** = Ethylene-propylene rubber
- **PTFE** = Teflon
Suitable for all gases in accordance with DVGW Worksheet G 260, for liquid gas in the liquid phase (up to DN 25 inclusive) and for fuel oil. No minimum differential pressure required. For explosion-endangered areas (zone 1, 2 and 21, 22) solenoid actuators with pressure-proof encapsulated solenoid systems (II G/D EEx de IIC T4 IP65 T125°C) are available.

Reg. no.: PTB 04 ATEX 1026

K series
for gas, liquid gas and liquid fuels

Technical data
Type: 2/2-way
Operating mode: normally closed
Type of construction: Piston-type solenoid valve, coupled, no minimum differential pressure required

Valve class to DIN EN 161
B for DN 15 – DN 32, C for DN 40 – DN 50

Materials
Casing: Bronze Rg 5 to DIN 1705
Internal parts: Brass (CuZn40Pb) and corrosion-resistant steel
Piston: Perbunan (NBR), Nozzle: Perbunan (NBR), Static seal: Perbunan (NBR).

Mounting position
Standard version: Solenoid system upright.
Ex-version: Solenoid system upright.
Other mounting positions not permitted.

Outdoor installations
Standard version: fr = suitable for outdoor use Ex-version: Can be used with upright solenoid system in outdoor installations (see technical notes on Ex solenoid actuators).

Ambient temperature
-15°C to +60°C

Temperature of medium
-15°C to +60°C

Working pressure
See Product Summary

Flanges
To DIN 2501 Part 1, PN 40 for DN 15–32, PN 25 for DN 40/50
Recommended weld-on flanges
PN 40 to DIN 2635

Maintenance: The valve should be operated 5-10 times per month to prevent the piston from sticking. No further maintenance is required.

<table>
<thead>
<tr>
<th>DN (mm)</th>
<th>kv value (m³/h)</th>
<th>Working pressure (bar)</th>
<th>Connection</th>
<th>Registrations</th>
<th>Valve class</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>4.0</td>
<td>0–4</td>
<td>G 1/2&quot;</td>
<td>1, 5</td>
<td>B</td>
<td>K15G31M</td>
</tr>
<tr>
<td>20</td>
<td>4.8</td>
<td>0–4</td>
<td>G 3/4&quot;</td>
<td>1, 5</td>
<td>B</td>
<td>K20G31M</td>
</tr>
<tr>
<td>15</td>
<td>4.0</td>
<td>0–25</td>
<td>1, 2, 4, 5, 6</td>
<td>B</td>
<td>K15G31F</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>4.8</td>
<td>0–25</td>
<td>1, 2, 4, 5, 6</td>
<td>B</td>
<td>K20G31F</td>
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<tr>
<td>25</td>
<td>10</td>
<td>0–25</td>
<td>Flange</td>
<td>1, 2, 4, 5, 6</td>
<td>B</td>
<td>K25G31F</td>
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<tr>
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<td>13</td>
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<td>1, 2, 4, 5, 6</td>
<td>B</td>
<td>K32G31F</td>
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<tr>
<td>40</td>
<td>34</td>
<td>0–20</td>
<td>1, 2, 4, 5, 6</td>
<td>C</td>
<td>K40G31F</td>
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</table>

Ex-versions
<table>
<thead>
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<th>DN (mm)</th>
<th>kv value (m³/h)</th>
<th>Working pressure (bar)</th>
<th>Connection</th>
<th>Registrations</th>
<th>Valve class</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>4.0</td>
<td>0–4</td>
<td>G 1/2&quot;</td>
<td>1, 5</td>
<td>B</td>
<td>K15G35M-Ex</td>
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<tr>
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<td>4.8</td>
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<td>G 3/4&quot;</td>
<td>1, 5</td>
<td>B</td>
<td>K20G35M-Ex</td>
</tr>
<tr>
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<td>4.0</td>
<td>0–25</td>
<td>1, 2, 4, 5, 6</td>
<td>B</td>
<td>K15G35F-Ex</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>4.8</td>
<td>0–25</td>
<td>1, 2, 4, 5, 6</td>
<td>B</td>
<td>K20G35F-Ex</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>10</td>
<td>0–25</td>
<td>Flange</td>
<td>1, 2, 4, 5, 6</td>
<td>B</td>
<td>K25G35F-Ex</td>
</tr>
<tr>
<td>32</td>
<td>13</td>
<td>0–25</td>
<td>1, 2, 4, 5, 6</td>
<td>B</td>
<td>K32G35F-Ex</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>34</td>
<td>0–20</td>
<td>1, 2, 4, 5, 6</td>
<td>C</td>
<td>K40G35F-Ex</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>40</td>
<td>0–20</td>
<td>1, 2, 4, 5, 6</td>
<td>C</td>
<td>K50G35F-Ex</td>
<td></td>
</tr>
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</table>

Solenoid valves of the K series are tested according to PED 97/23/EC Module B, testing basis: DIN-EN 161, DIN 3394-1, DIN-EN 264

Degree of protection: IP 65

CE-Identification numbers:
K15G31...K15G35-Ex
K20G31...K20G35-Ex
K25G31...K25G35-Ex
K32G31...K32G35-Ex
K40G31...K40G35-Ex
K50G31...K50G35-Ex

Factory certified to Module D
Cert. no.: 01 202 931/Q-02 0010

NB:
To avoid heat build-up, the solenoid system must not be insulated or painted.


**T/K series**

**Solenoid actuators G 31 for standard version**

Only solenoids of the G 31 series are used to operate piston-type solenoid valves in non-explosion-proof installations. All G 31 solenoid actuators are generally equipped with a DC coil and plug connector with contact arrangement according to DIN 43 650. The solenoid coils are fully encapsulated in silicone rubber (to protect against moisture). All solenoid actuators are mutually interchangeable.

The name of the solenoid actuator forms part of the type designation of the complete solenoid valve. For example: T 40 G 31 F

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**Technical data**

- **Degree of protection**: IP 65 to DIN 40 050
  - fr = suitable for outdoor use.
- **Power consumption**: 50 VA with warm solenoid.
- **Nominal voltages**
  - Alternating current (AC):
    - 230 V, 45–60 Hz
  - Rectifier is built into the connection plug
  - Direct current (DC):
    - 24 V
  - Supplied without rectifier

**Important**: In all orders or enquiries, the supply voltage and current type (AC or DC) must be specified.

**Electrical connection for switching device G 31**

The AC power supply is connected to the terminals on the PCB inside the plug. The earth conductor is directly connected to the plug cube (underneath the PCB).

**Rectifier PCB circuit diagram**

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**Exchanging solenoid actuators**

Complete G 31 solenoid actuators can easily be replaced, even under pressure (undo the screw on the solenoid cover plate, remove the cover and lift out the solenoid). It is not possible to change the coil on its own.

**GS type**

Device socket with built-in rectifier for G 31 solenoid.

- **Primary**: 230 V, 50 Hz
- **Secondary**: approx. 220 V

**ST 5**

Connection plug with seal and fastening screw (without rectifier)
Solenoid valves
Piston-type solenoid valves

**T-Ex/K-Ex series**

Ex solenoid actuators

Solenoid valves of type G 35-Ex, of pressure-proof encapsulated design for use in explosion-endangered areas, are generally equipped with a DC coil which is mounted in a pressure-proof encapsulated cast steel housing and sealed with silicone rubber.

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**Technical data**

**Nominal voltages**

Alternating current (AC):
230 V, 45–60 Hz
Rectifier is built into the solenoid casing
Direct current (DC): 24 V, supplied without rectifier

**Ex-protection**

Pressure-proof encapsulation (Ex II2 G/D EEx de IIC T4 IP 65 T 125°C).
Suitable for Zone 1, 21.

**Can be used in outdoor installations.** Because of the deflagration gap specified for the solenoid, the solenoid actuator must be installed vertically.
A protective hood is needed to give the solenoid additional protection against weather conditions.

**Mounting position**

Ex-solenoid valves must only be installed with the solenoid system standing vertically. Other mounting positions are not permitted.

**Power consumption**

approx. 50 VA with warm solenoid.

**Duty cycle**

100% ED. Other technical data are the same as for G 31 solenoid actuators.

**Connection cables**

Heat-resistant cables must be used to connect the Ex-solenoid actuator. The solenoid temperature must not exceed 125°C.

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**Replacing solenoid actuators on Ex-solenoid valves G 35-Ex**

Solenoid actuators with the type designation G 35-Ex can also be replaced under pressure.

The procedure is as follows:

**Removing the old solenoid**

1. Turn off the power and remove the connection cable.
2. Loosen the three M6 Allen screws on the solenoid cover (aluminum hood), but do not remove them (2–3 turns of the screw are sufficient).
3. Remove the Allen screws on the bottom mounting flange of the solenoid and carefully lift up the whole solenoid.

**Fitting a new solenoid**

4. Before fitting the new solenoid, loosen the three Allen screws on the solenoid cover (aluminum hood), but do not undo them completely (2–3 turns of the screw are sufficient).
5. Put the solenoid in place carefully, moving it gently to and fro to allow the solenoid cover plate lying inside (not visible) to center itself on the guide tube. The mounting flange must lie squarely on the lower flange.
6. Align the solenoid head: The terminal connection box must face against the flow direction.
7. Tighten the 4 fastening screws on the lower flange.
8. Tighten the three M6 Allen screws on the solenoid cover.
9. Remove the terminal connection cover and carry out electrical connections in accordance with VDE guidelines.
10. Fit the terminal connection cover.
11. Commission the valve in accordance with the accompanying instruction manual.

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NB:

Solenoid actuators of older G3-Ex solenoid valves cannot be replaced under pressure.
Satisfactory operation demands expert installation with due observance of the technical regulations applicable to the planning and construction of the installation as a whole.

**Mounting position**

A vertical mounting position (solenoid system standing upright) is preferable if at all possible. In general, the solenoid system should not hang downwards. In the case of Ex-solenoids, only a vertical mounting position is permissible. For information about the mounting position of valves, refer to the individual data sheets.

**Installation location**

Solenoid valves contain moving parts which are subject to natural wear. Therefore, care must be taken to ensure that valves can be dismantled for repair.

**Risk of freezing**

If solenoid valves are operated at ambient or medium temperatures of 0°C or lower, or if it is possible that such temperatures may occur, the customer must take steps to ensure that valves cannot freeze up — due to condensation for example.

**Painting the solenoid**

Solenoid coils must not be painted or lacquered, as this will hinder the dissipation of heat.

**Stress-free mounting**

Stresses from the pipe system acting on the valve can cause the piston to stick, hindering or even preventing it from opening and closing. The solenoid casing must on no account be used as a lever during mounting (key faces are cast on the valve body for this purpose).

**Maintenance**

The valve should be operated 5-10 times per month to prevent the piston from sticking. No further maintenance is required.

**Back-pressure**

If the back-pressure (at the output of the valve) is 0.2 bar higher than the pressure on the input side, the piston or diaphragm is automatically lifted from the seat. In this case the medium may flow back through the solenoid valve.

**Commissioning**

Upon first commissioning, medium should be admitted to the valve very gently so as to allow any air trapped in the valve to escape. Sudden admission at working pressure on first commissioning may cause uncontrolled opening of the valve.

**Dirt trap**

The operation of solenoid valves is often impaired by impurities in the medium flowing through the valve. Welding beads, rust flakes, scale and other impurities may prevent a tight seal on the valve seat. Therefore it is advisable to install a dirt trap before every solenoid valve. This will greatly improve the reliability of the installation.

**Factory certificates and acceptance testing certificates**

Factory certificates in accordance with EN 10 204 and DIN 50 049, section 2.3 or 3.1 B, can be supplied for all piston-type valves if required, and enclosed with the delivery documents. The factory certificate contains information about the quality of the materials used and confirms that the solenoid valve was subjected to rigorous pressure tests, leak tests and function tests prior to delivery. The costs of the certificates are shown in the relevant price list.

**Spare parts**

For spare parts such as solenoids and connection plugs, refer to the relevant price list.
**Faults and troubleshooting**

If the valve does not function correctly, carry out the following checks:
1. Is the flow direction correct? Observe the arrow on the valve.
2. Is the power supply properly connected?
3. Is the operating voltage present?
4. Does the operating voltage correspond to the details on the rating plate?
5. Is the rectifier in working order?
6. Is the solenoid coil in working order?

The condition of solenoid coils and rectifiers can easily be checked by carrying out resistance, current and voltage measurements.

If the coils and rectifiers are satisfactory, solenoid actuators of the G 31 and G 35 series should give the following readings:

<table>
<thead>
<tr>
<th>Mains voltage</th>
<th>Coil resistance Ohms</th>
<th>Coil current consumption approx.</th>
</tr>
</thead>
<tbody>
<tr>
<td>230 V~/<del>/ =</del></td>
<td>990–1050</td>
<td>224 mA</td>
</tr>
<tr>
<td>24 V =</td>
<td>11.36–12.02</td>
<td>2.1 A</td>
</tr>
</tbody>
</table>

All values are measured on the DC side, i.e. after the rectifier, and are for a solenoid temperature of 20°C.

The values are approximate. If the measured values deviate significantly from those shown in the table, either the solenoid coil is faulty (broken or shorted coil) or the rectifier is damaged.

If a valve actuator with a DC coil is accidentally charged with alternating current at the same level, it will not be damaged but the valve will not operate. Voltage measurements on the secondary side of the rectifier without load (coil) are not meaningful, therefore you should never measure the DC voltage with the system unplugged.

**Replacing rectifiers on Ex-solenoid valves**

Rectifiers on Ex-solenoid valves must only be replaced by an authorised electrician. The greatest care must be taken, with due observance of safety regulations.

The following procedure must be observed:
1. Turn off the power and remove the terminal box cover.
2. Disconnect and remove the connection cable.
3. Undo the M6 Allen screws and remove the terminal connection housing.
   NB: Remove the terminal housing carefully to avoid tearing the coil connection wires.
4. Remove the clip (to do this you have to undo the two M3 screws).
5. Pull off the connection wire to the coil. NB: Use thin-nosed pliers and grip it by the plug; do not pull it by the connection cable (otherwise the coil wire may be torn off).
6. Detach the connecting wire on the primary side of the rectifier at the cable guides (use open-ended spanner SW 7).
7. Remove the rectifier (black plastic housing) including the white flat connector guide.
8. Install the new rectifier in the reverse order. Make sure the connection plug of the coil wire is fully inserted in the flat connector guide. The ends of the connector must not project beyond the flat connector guide.

When fitting the terminal connection housing on the solenoid housing, make sure the connection cables do not get caught.
### T/K series
Dimensioned drawings/weights

Series: TG, K, LG

<table>
<thead>
<tr>
<th>DN</th>
<th>Screwed version</th>
<th>Weight</th>
<th>Flange version</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>G M SW kg</td>
<td>F B D d LK b L i kg</td>
<td>H h</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>G 1/2 82 32 4.5</td>
<td>150 20 95 45 65 18 14 4</td>
<td>6.1 137.8 35</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>G 3/4 82 32 4.5</td>
<td>150 20 105 58 75 18 14 4</td>
<td>6.6 137.8 35</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>G 1 112 50 5.8</td>
<td>180 31 115 68 85 20 14 4</td>
<td>9.0 158.3 47.5</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>G 1/4 112 50 5.8</td>
<td>180 31 140 78 100 20 18 4</td>
<td>10.5 158.3 47.5</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>200 45 150 88 110 20 18 4</td>
<td>15.0 181.8 53</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>230 45 165 102 125 22 18 4</td>
<td>17.5 181.8 53</td>
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</table>

Series: TG-Ex, K-Ex, LG-Ex

<table>
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<th>Weight</th>
<th>Flange version</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>G M SW kg</td>
<td>F B D d LK b L i kg</td>
<td>H h</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>G 1/2 82 32 5.8</td>
<td>150 20 95 45 65 18 14 4</td>
<td>7.6 197.9 35</td>
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<tr>
<td>20</td>
<td>G 3/4 82 32 5.8</td>
<td>150 20 105 58 75 18 14 4</td>
<td>8.0 197.9 35</td>
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<td>25</td>
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<td>180 31 115 68 85 20 14 4</td>
<td>11.0 235.4 47.5</td>
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<td>32</td>
<td>G 1/4 112 50 8.0</td>
<td>180 31 140 78 100 20 18 4</td>
<td>12.5 235.4 47.5</td>
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<tr>
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<td>200 45 150 88 110 20 18 4</td>
<td>16.5 253.9 53</td>
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<tr>
<td>50</td>
<td></td>
<td>230 45 165 102 125 22 18 4</td>
<td>20.0 253.9 53</td>
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</table>
T/K series
Dimensioned drawings/weights

Series
TGK, LGK

<table>
<thead>
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<th>DN</th>
<th>Screwed version</th>
<th>Weight</th>
<th>Flange version</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>G M SW</td>
<td>F B</td>
<td>D d LK b L i</td>
<td>kg</td>
</tr>
<tr>
<td>15</td>
<td>G 1/2 82 32</td>
<td>5.6</td>
<td>150 20 95 45 65 18 14 4 7.5</td>
<td>238.3 35</td>
</tr>
<tr>
<td>20</td>
<td>G 3/4 82 32</td>
<td>5.6</td>
<td>150 20 105 58 75 18 14 4 7.8</td>
<td>238.3 35</td>
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<tr>
<td>25</td>
<td>G 1 112 50</td>
<td>7.2</td>
<td>180 31 115 68 85 20 14 4 10.5</td>
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<tr>
<td>32</td>
<td>G 1 1/4 112 50</td>
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