

Technical information TI-P11 SITEMA PowerStroke

Mold closing devices of FSK series

- ☑ Powerful forces on a short stroke
- ☑ Working force of up to 180 metric tons
- ☑ Style FSK-SVE for rods moving in and out



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1 Function

The PowerStroke FSK clamps a rod and presses the attached machine part in a specific direction. The direction of this power stroke is usually the closing direction of the mold. The acting working force is proportional to the working pressure.

For a detailed description, see *Assembly Instructions MA-P11*.

2 Purpose

The PowerStroke FSK with its integrated short stroke feature is typically used in applications that require high forces on a short working distance:

- Mold presses: to close and press the mold
- Injection molding: to close the mold and apply the closing force

3 Styles FSK and FSK-SVE

On the style FSK, the rod may not leave the PowerStroke during operation.

The style FSK-SVE (SVE, rod leaves unit) is additionally available. The FSK-SVE is designed for the rod to exit and enter the PowerStroke between each power stroke. All FSK sizes are available in the FSK-SVE style as well.

The style FSK-SVE is equipped with a hardened centering ring that centers the rod with respect to the clamping system.

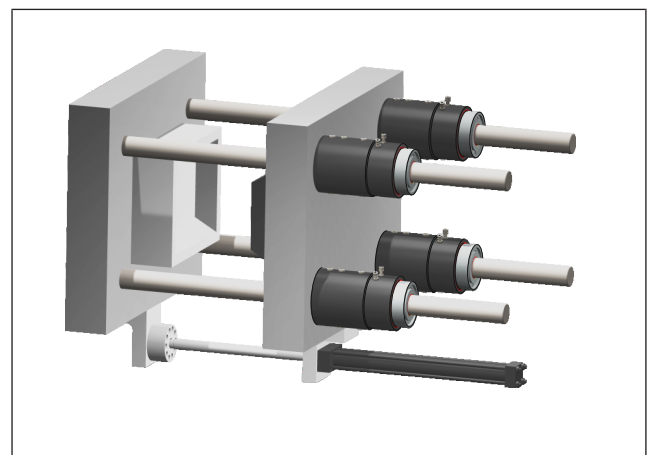


Fig. 1: Example of a mold press with 4 PowerStrokes of the FSK series



Fig. 2: Example of 4 PowerStrokes of the FSK-SVE series with rods moving in and out

4 Function description

4.1 Direction of the power stroke

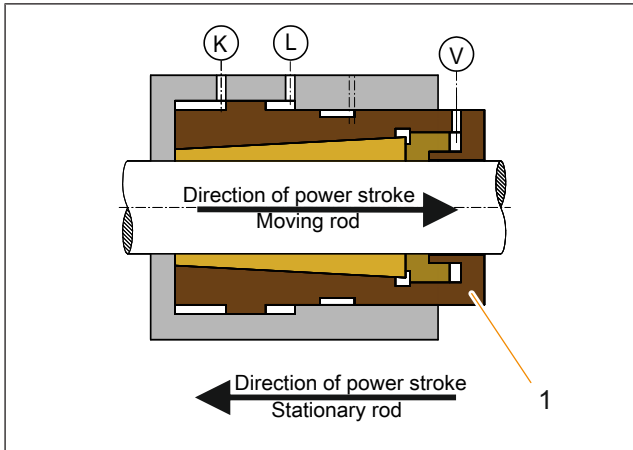


Fig. 3: Direction of the power stroke

The direction of the power stroke depends on how the PowerStroke is mounted on the machine.

Attachment to stationary machine part - rod is moving

If the PowerStroke is mounted on a stationary machine part, the rod is moving. In this case the power stroke pushes in the direction of the extending side (1).

Attachment to moving machine part - rod is stationary

If the PowerStroke is mounted on a moving machine part, the rod is stationary. In this case the power stroke pushes in the opposite direction of the extending side (1).

4.2 Functional principle

The following example shows the three operating states of the PowerStroke. In this example the PowerStroke is attached to a moving machine part. The rod is stationary and is the connection with the stationary machine part. The power stroke pushes in the opposite direction of the extending side.

Visit our website www.sitema.com to see an animation of the functional principle.

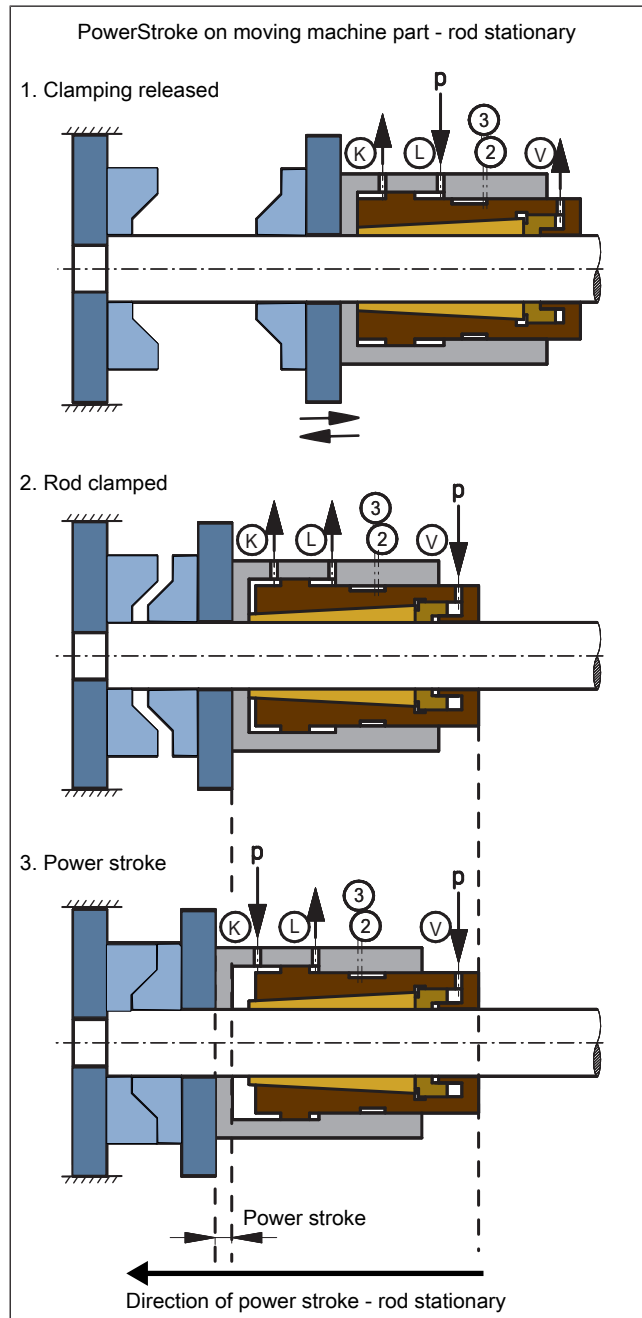


Fig. 4: Operating states of PowerStroke FSK

4.3 Design

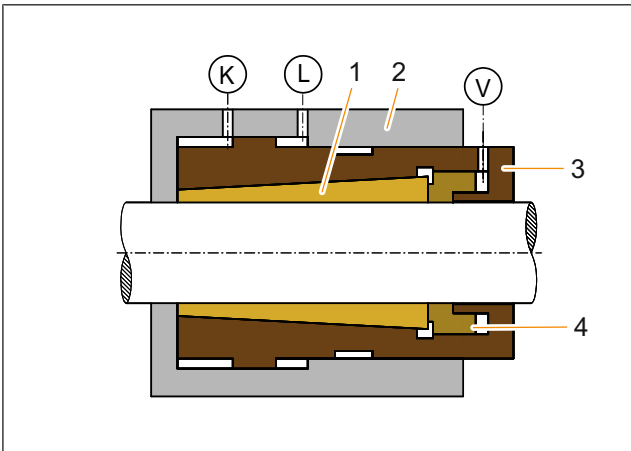


Fig. 5: Design of PowerStroke FSK

The clamping system consists of the clamping ring (3) and the clamping jaws (1). Clamping ring and clamping jaws are braced against each other by a separate pre-loading piston (4). The clamping ring can slide within the housing (2) and can be moved hydraulically via the pressure ports L and K. Pressure port V pressurizes the pre-loading piston.

i In special designs, springs may replace the pre-loading piston. In this case, the clamping ring and clamping jaws are braced against each other by springs. If pressure is applied to pressure port L, the clamping system is open. If pressure port L is depressurized, the clamping system clamps the rod (pressure port V is not required).

4.4 Releasing the clamping

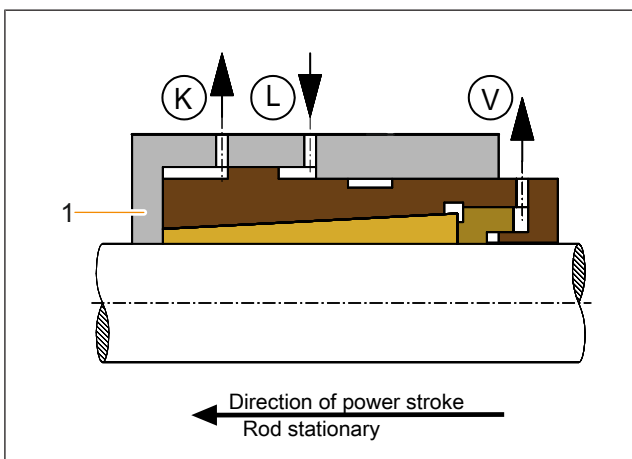


Fig. 6: Clamping released

If pressure is applied to pressure port L (pressure ports K and V not under pressure), the housing (1) moves against the direction of the power stroke until it reaches the internal stop and opens the clamping.

Proximity switch 2 signals "clamping released".

i Danger due to overpressure!

A pressure relief valve is required to prevent excessive overpressure at pressure port V. A pressure control valve with a downstream check valve is recommended to avoid sudden pressure drops (see Chapter 8 Actuation [▶ 5]).

4.5 Clamping the rod

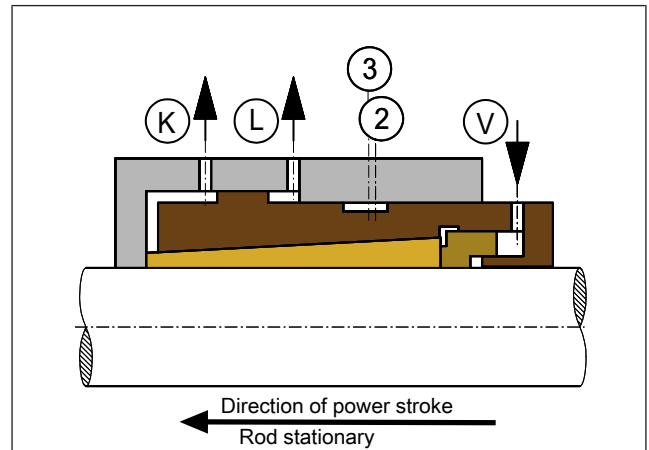


Fig. 7: Start of clamping

If pressure port L is depressurized and pressure is applied to pressure port V (no pressure at pressure port K), the PowerStroke clamps the rod. The unit is pre-loaded and ready for the power stroke.

Proximity switch 2 "clamping released" is no longer active.

4.6 Executing the power stroke

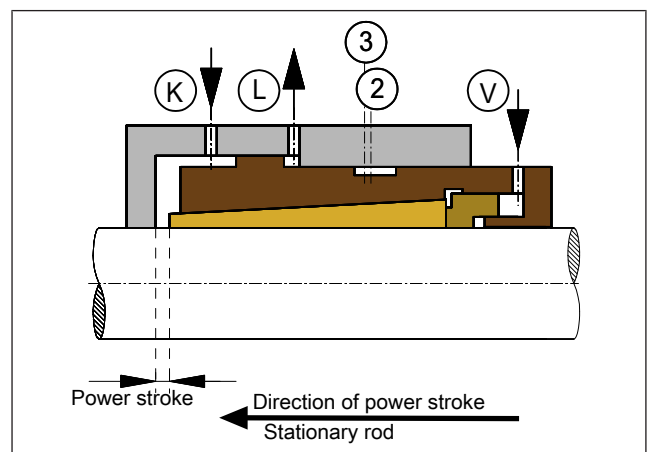


Fig. 8: Situation at the end of the power stroke

To execute the power stroke, the rod has to be clamped; then, in addition to pressure port V, pressure is also applied to pressure port K. The clamping force increases in a self-intensifying manner. The housing moves into the direction of the power stroke.

The power stroke ends when the force is reached which corresponds to the pressure applied at pressure port K.

Stroke limit

If during the power stroke no counter force from the machine/system acts on the PowerStroke, it travels the maximum stroke distance until it reaches the internal stop. Then, depending on design and operating conditions, the clamping system may open; that means that the rod is no longer clamped. Proximity switch 3 signals the error message "stroke limit reached". During normal operation, this signal should not be displayed.

Proximity switches 2 and 3 permanently monitor the proper functioning of the PowerStroke.

To release the clamping, pressure ports K and V are depressurized, and pressure is applied to port L. The housing travels back the distance covered by the power stroke that was just performed. The rod is released.

5 Installation

The SITEMA PowerStroke is installed at its mounting side in the plant (see *Assembly Instructions MA-P11*).

i *During installation, make sure there are no constraint forces occurring transverse to the rod. Often, this cannot be guaranteed through exact alignment or high-precision machining only.*

Vertical installation

To prevent the rod from dropping down after the clamping is released, the primary drive of the machine must apply a force that holds the weight of the moving machine part and of any add-on parts (weight compensation) during the return stroke and release process.

FSK: vertical installation

To avoid constraint forces transverse to the rod, either the PowerStroke FSK must be mounted loosely (radially floating) on the machine part or the rod or rod connection must be mounted loosely (radially floating). For vertical installation of the PowerStroke FSK, an FSK vertical attachment can also be used. The permissible radial misalignment of FSK vertical attachments in the standard design is ±1 mm (see *Technical Data Sheet TI-P30*).

FSK-SVE: vertical installation

With the FSK-SVE option, the use of the FSK vertical attachment is required for installation in the machine or plant. The permissible radial misalignment of FSK vertical attachments in the standard design is ±1 mm (see *Technical Data Sheet TI-P30*).

i *When using the FSK vertical attachment, pay attention to the different technical data concerning the total length and maximum extended length. See *Technical Data Sheet TI-P30*.*

Horizontal installation of the FSK and FSK-SVE

Appropriate measures, such as loose installation of the rod, must be taken to achieve precise alignment. Please consult SITEMA if necessary.

6 Requirements of the clamping rod

The PowerStroke only works correctly if it is used together with a clamping rod which fulfills all requirements mentioned here:

| Requirement | Diameter | Value |
|----------------------------------|----------------------------|--|
| ISO tolerance zone | all | f7 or h6 |
| Induction hardened | all | min. HRC 56 |
| Surface hardening depth | ø to 30 mm ø over 30 mm | min. 1 mm min. 1.5 mm |
| Surface roughness | all | Rz = 1 to 4 µm (Ra 0.15 to 0.3 µm) |
| Protection from corrosion | all | e.g. hard chromium plating: 20 ± 10 µm 800 - 1000 HV |
| FSK: lead-in chamfer rounded | ø 18 to 80 mm | min. 4 x 30° |
| | ø over 80 to 180 mm | min. 5 x 30° |
| | ø over 180 to 380 mm | min. 7 x 30° |
| FSK-SVE: lead-in chamfer rounded | ø 18 to 80 mm | min. 8 x 10° |
| | ø over 80 to 180 mm | min. 12 x 10° |
| | ø over 180 to 380 mm | min. 15 x 10° |

Table 1: Requirements of the clamping rod

Make sure the base material of the rod is of adequate strength. In the case of compression-loaded rods, the buckling resistance must be observed.

When the clamping is released, the rod must not be exposed to any tensile or compressive forces. Take this into account when designing the actuation with the primary drive.

IMPORTANT: The rod must not be greased.

i *Manufacturers of piston rods for cylinders or rods for linear ball bearings usually offer suitable clamping rods.*

7 Pressure fluid - hydraulic fluid

Use high-quality HM hydraulic fluid according to ISO 11158 (or HLP hydraulic fluid according to DIN 51524-2). Other pressure fluids may be used only in consultation with SITEMA.

8 Actuation

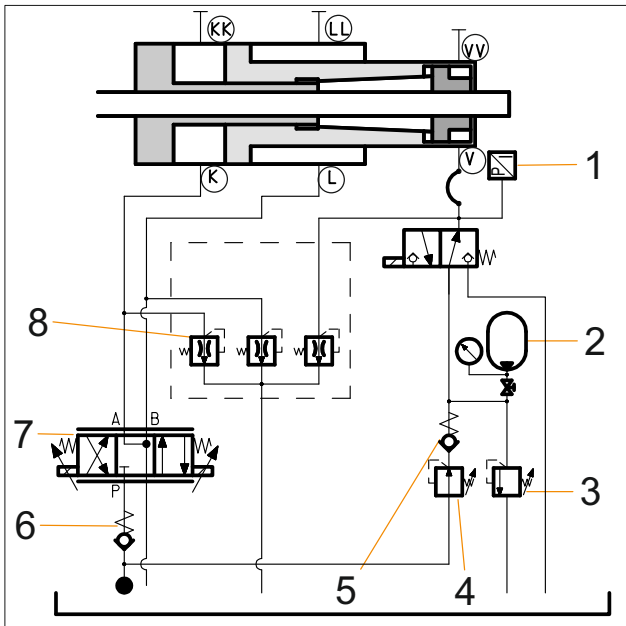


Fig. 9: Recommendation for actuation

Connect the pressure supply to pressure ports L, K, and V (alternatively LL, KK, VV). We recommend connecting auto-bleeders (8) to the ports that are not in use (available as option, see *Technical Information TI-Z10*).

The customer must design the hydraulic actuation in accordance with the applicable safety regulations, with the aid of the circuit diagram shown above. It shows primarily the logical connections. The manufacturer is responsible for adherence to the applicable regulations and also for the final check of all functions.

Valves

To avoid excessive overpressure through interactions with other pressure chambers, a pressure relief valve (3) is required. We recommend a pressure control valve (4) to adapt the system pressure efficiently to the pressure required at port V. A check valve (5) is recommended to maintain the required pre-loading pressure in the pressure accumulator if sudden pressure drops occur.

The proportional valve (7) allows flexible adaptation of the volumetric flow and pressure at ports L and K to the special application.

If the pressure (p) is not sufficiently constant (for example, pressure drop at the beginning of a downward movement), we recommend a check valve (6) in the p port of the valve.

Pressure port L: release clamping

If pressure port L is pressurized, the clamping is released. Pressure port L must be pressurized when the rod is inserted and/or moving.

i It should be avoided that the SITEMA PowerStroke clamps the rod if the primary drive is moving; this can lead to high dynamic braking forces. It may be necessary to take appropriate measures to avoid an unwanted pressure drop at port L.

Pressure port V: preload pressure

Operating pressure must be applied to pressure port V to activate the clamping and carry out the power stroke.

i We recommend to depressurize pressure port V when pressure is applied to pressure port L. This reduces material stress. If pressure is applied to pressure port V while pressure port L is pressurized, part of the working force could be used to force a tool open, for example.

Pressure port K: power stroke

When the rod is fully inserted and pressure port L is depressurized, pressure can be applied to port K. Pressure is also applied to pressure port V. The pressure sensor (1) monitors the pressure. If pressure is applied at port K, the working force is built up and the power stroke is carried out.

Pressure ports L and K must not be pressurized at the same time. Design the machine control in such a way that it is not possible to apply pressure at L and K at the same time.

Working force of the PowerStroke

The working force of the PowerStroke is proportional to the pressure. The lower the pressure applied to execute the function, the lower the material stress. To extend the service life of the PowerStroke, apply pressure that is in the lower range of the required pressure.

Fast response times

To achieve a fast response time of the PowerStroke, observe the following:

- Short line distances
- Suitably large valve and line cross-sections
- Fast valve response times
- Suitable controller

9 Status monitoring by proximity switches

Proximity switch 2 signals "clamping released". The signal is used to unlock the primary drive.

Proximity switch 3 signals "stroke limit reached"; this indicates that the maximum power stroke has been executed and the internal stop has been reached. The working force is not available in this case. For more information see *Chapter 4.6 Executing the power stroke* ▶ 3].

10 Operating conditions

The immediate vicinity of the PowerStroke in its standard version must be dry and clean.

An environment with contamination such as grease, dirt, grinding dust or chips may require special protective measures. Liquids such as coolants, conservation agents and other liquids or chemicals inside the housing can reduce the holding force.

The machine manufacturer must take appropriate measures to ensure that contamination cannot enter the interior of the housing.

The rod may never be lubricated with grease as this reduces the clamping force.

The permitted surface temperature is 0 to 60 °C (32 to 140 °F).

In case of doubt, contact SITEMA.

11 CE marking

The PowerStroke is intended as a component (partly completed machinery) for installation in a machine or system and, as such, cannot be issued with the CE marking. The commissioner of the machine or system must provide information about the PowerStroke in the overall documentation and, if necessary, must obtain the CE marking of the overall machine or system.

Technical Data Sheet - FSK PowerStroke FSK

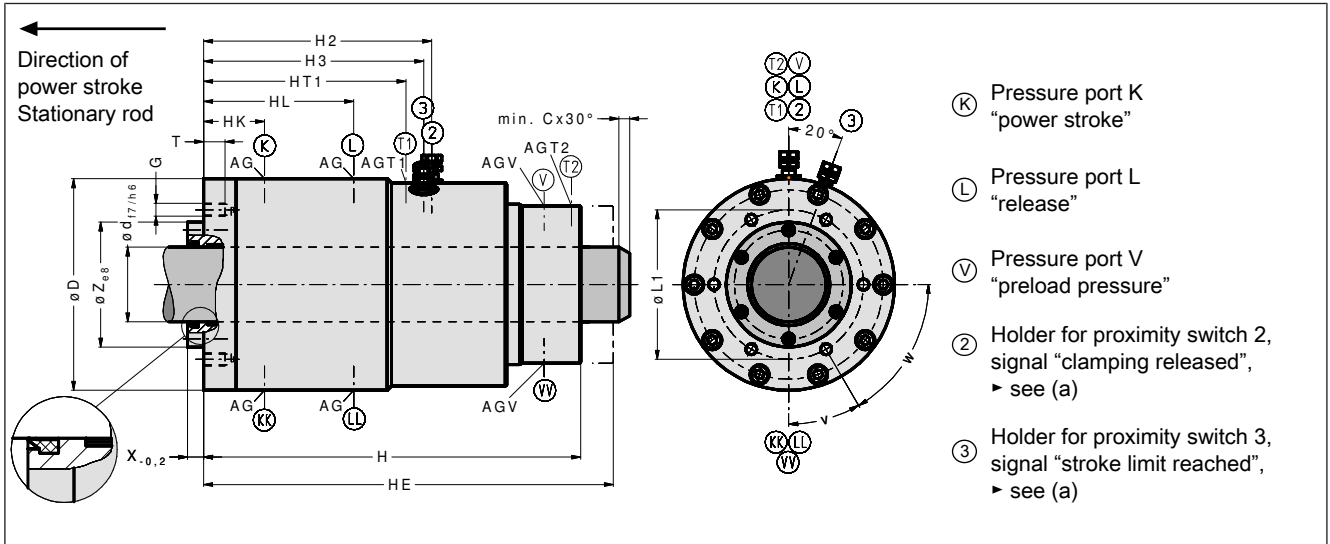


Fig. 10: Dimensions of PowerStroke FSK

| Type | | FSK 45 | FSK 70 | FSK 100 | FSK 125 | FSK 160 | FSK 180 | FSK 200 | |
|---|---|-----------------|------------|------------|------------|-------------|-------------|-------------|------------|
| ID no. (order no.) | | FSK 045 10 | FSK 070 10 | FSK 100 10 | FSK 125 10 | FSK 160 10 | FSK 180 10 | FSK 200 10 | |
| Working force at maximum working pressure at K | kN | 60 | 110 | 300 | 650 | 1000 | 1400 | 1800 | |
| Technical data | | | | | | | | | |
| d | Rod diameter | mm | 45 | 70 | 100 | 125 | 160 | 180 | 200 |
| C | Lead-in chamfer | mm | 4 | 4 | 5 | 5 | 5 | 5 | 7 |
| D | External diameter | mm | 160 | 198 | 268 | 328 | 417 | 476 | 546 |
| H | Total length | mm | 310 | 353 | 450 | 600 | 700 | 770 | 865 |
| HE | Max. extended length | mm | 341 | 384 | 483 | 633 | 736 | 806 | 903 |
| | Max. power stroke | mm | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| | Weight approx. | kg | 40 | 62 | 145 | 240 | 460 | 650 | 930 |
| Hydraulics | | | | | | | | | |
| K | Max. working pressure (max. perm. pressure) | bar | 100 | 100 | 125 | 200 | 200 | 200 | 200 |
| K | Hydraulic operating volume at complete stroke | cm ³ | 195 | 350 | 805 | 1080 | 1900 | 2550 | 3400 |
| L | Min. release pressure | bar | 75 | 75 | 100 | 160 | 160 | 160 | 180 |
| L | Max. release pressure | bar | 100 | 100 | 170 | 250 | 200 | 230 | 220 |
| L | Max. hydraulic operating volume | cm ³ | 85 | 150 | 215 | 320 | 750 | 850 | 1250 |
| V | Min. preload pressure | bar | 75 | 75 | 100 | 160 | 160 | 160 | 180 |
| V | Max. preload pressure | bar | 100 | 100 | 125 | 200 | 200 | 200 | 200 |
| V | Max. hydraulic operating volume | cm ³ | 15 | 40 | 60 | 105 | 160 | 190 | 320 |

Subject to modification without prior notice

(a) Proximity switch holders are provided for standard inductive proximity switches (M8 x 1, nominal switching distance 1.5 mm, flush mountable, NO (normally open)). For easier mounting, the proximity switch holders have a depth stop. They are preset to the correct depth. The proximity switches only need to be inserted to the stop and then clamped. The proximity switches are available as accessories.

(b) The surface of the housing parts is primed black. The mounting side is treated with corrosion protection wax.

Continued: PowerStroke FSK

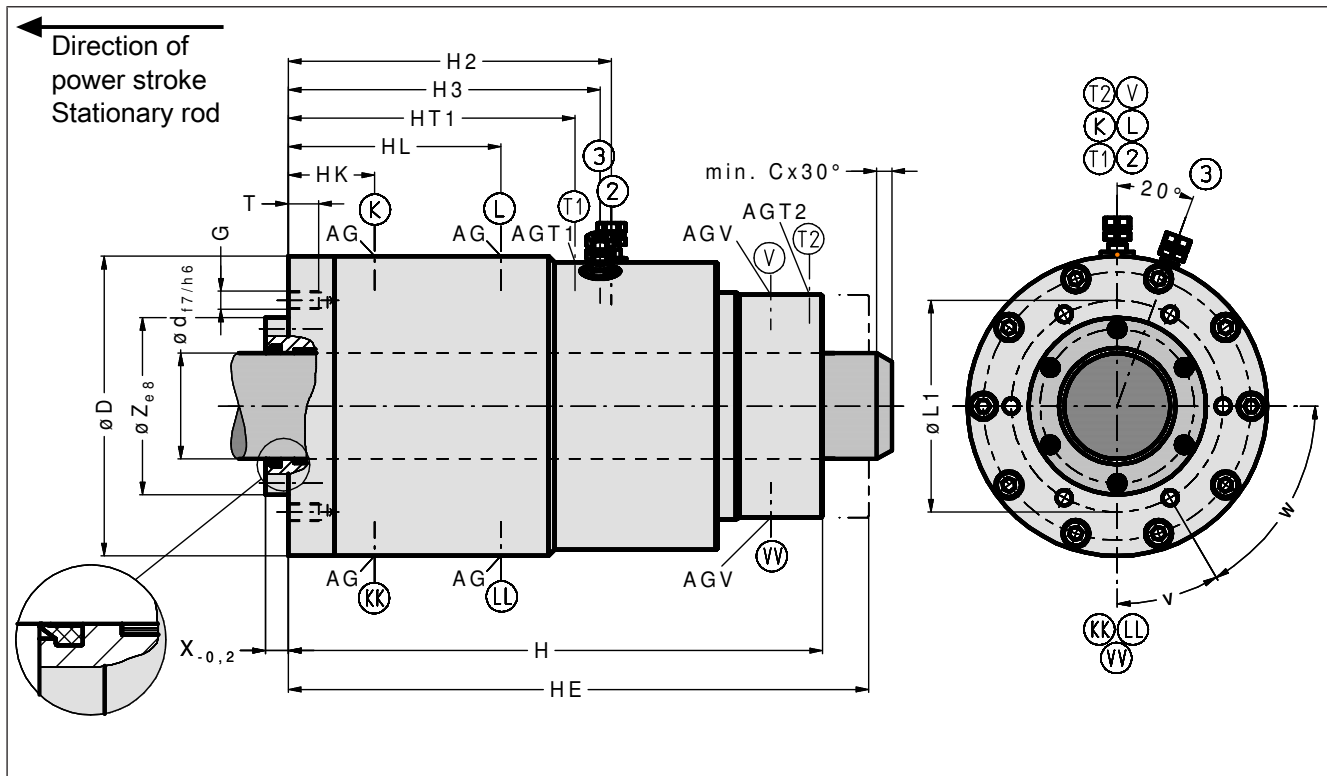


Fig. 11: Dimensions of PowerStroke FSK

| Type | | FSK 45 | FSK 70 | FSK 100 | FSK 125 | FSK 160 | FSK 180 | FSK 200 |
|------------------------------|----|------------|------------|------------|------------|------------|------------|------------|
| ID no. (order no.) | | FSK 045 10 | FSK 070 10 | FSK 100 10 | FSK 125 10 | FSK 160 10 | FSK 180 10 | FSK 200 10 |
| Connection dimensions | | | | | | | | |
| AG | | G1/4 | G3/8 | G1/2 | G1/2 | G3/4 | G3/4 | G3/4 |
| AGT1 | | G1/8 | G1/8 | G3/8 | G3/8 | G3/8 | G3/8 | G1/2 |
| AGT2 | | – | – | G1/8 | – | G1/4 | G3/8 | G3/8 |
| AGV | | G1/8 | G1/8 | G1/8 | G1/8 | G1/4 | G3/8 | G3/8 |
| G | | M10 | M12 | M16 | M20 | M20 | M24 | M30 |
| H2 | mm | 200 | 213.5 | 286 | 282 | 379.5 | 406 | 412 |
| H3 | mm | 193.5 | 206 | 276 | 274 | 371 | 394.5 | 404 |
| HK | mm | 49 | 57 | 97 | 103 | 117 | 112 | 119 |
| HL | mm | 135 | 140 | 195 | 188 | 231 | 227 | 236 |
| HT1 | mm | 174 | 189 | 215 | 17 | 26 | 24 | 35 |
| L1 | mm | 110 | 140 | 180 | 235 | 275 | 300 | 335 |
| T | mm | 16 | 20 | 25 | 32 | 32 | 40 | 50 |
| v | | 30° | 30° | 30° | 30° | 22.5° | 18° | 18° |
| w | | 6 x 60° | 6 x 60° | 6 x 60° | 6 x 60° | 8 x 45° | 10 x 36° | 10 x 36° |
| X | mm | 15 | 15 | 38 | 42 | 42 | 42 | 42 |
| Z | mm | 88 | 117 | 148 | 195 | 235 | 248 | 278 |

Subject to modification without prior notice

Technical Data Sheet - FSK-SVE

PowerStroke FSK-SVE (rod leaves unit)

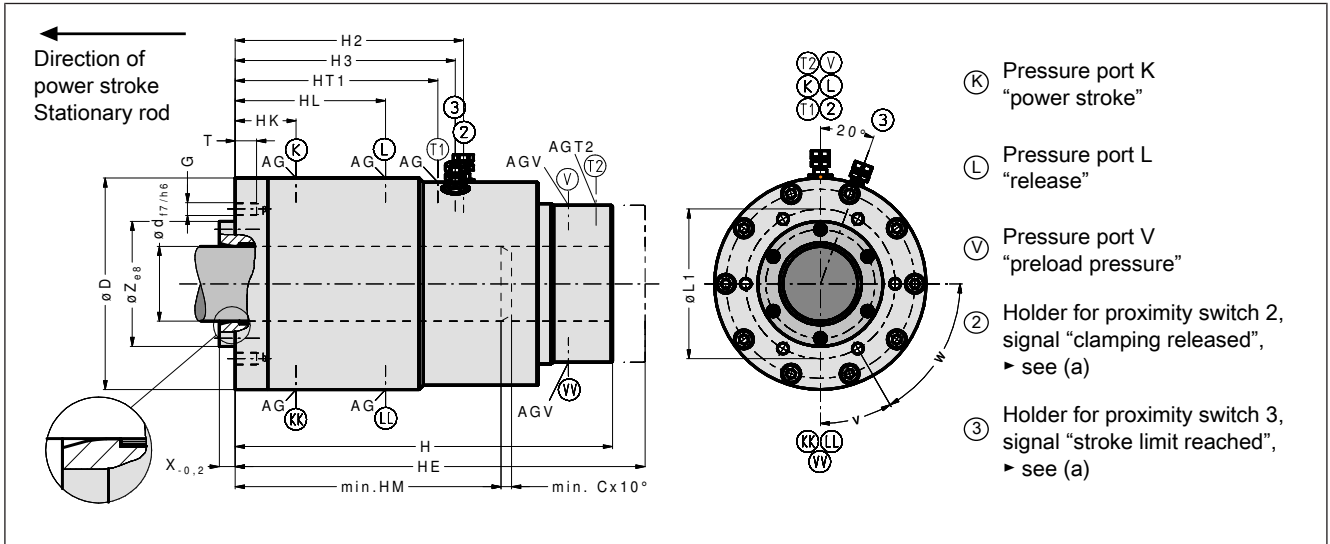


Fig. 12: PowerStroke FSK-SVE

| Type | FSK-SVE 45 | FSK-SVE 70 | FSK-SVE 100 | FSK-SVE 125 | FSK-SVE 160 | FSK-SVE 180 | FSK-SVE 200 | | |
|--|---|-----------------|-------------|-------------|-------------|-------------|-------------|------------|------------|
| ID no. (order no.) | FSK 045 11 | FSK 070 11 | FSK 100 11 | FSK 125 11 | FSK 160 11 | FSK 180 11 | FSK 200 11 | | |
| Working force at max. working pressure at K | kN | 60 | 110 | 300 | 650 | 1400 | 1800 | | |
| Technical data | | | | | | | | | |
| d | Rod diameter | mm | 45 | 70 | 100 | 125 | 160 | 180 | 200 |
| C | Lead-in chamfer | mm | 8 | 8 | 12 | 12 | 12 | 12 | 15 |
| HM | Minimum insertion depth | mm | 220 | 250 | 350 | 475 | 585 | 660 | 735 |
| D | External diameter | mm | 160 | 198 | 268 | 328 | 417 | 476 | 546 |
| H | Total length | mm | 310 | 353 | 450 | 600 | 700 | 770 | 865 |
| HE | Max. extended length | mm | 341 | 384 | 483 | 633 | 736 | 806 | 903 |
| | Max. power stroke | mm | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| | Weight approx. | kg | 40 | 62 | 145 | 240 | 460 | 650 | 930 |
| Hydraulics | | | | | | | | | |
| K | Max. working pressure (max. perm. pressure) | bar | 100 | 100 | 125 | 200 | 200 | 200 | 200 |
| K | Hydraulic operating volume at complete stroke | cm ³ | 195 | 350 | 805 | 1080 | 1900 | 2550 | 3400 |
| L | Min. release pressure | bar | 75 | 75 | 100 | 160 | 160 | 160 | 180 |
| L | Max. release pressure | bar | 100 | 100 | 170 | 250 | 200 | 230 | 220 |
| L | Max. hydraulic operating volume | cm ³ | 85 | 150 | 215 | 320 | 750 | 850 | 1250 |
| V | Min. preload pressure | bar | 75 | 75 | 100 | 160 | 160 | 160 | 180 |
| V | Max. preload pressure | bar | 100 | 100 | 125 | 200 | 200 | 200 | 200 |
| V | Max. hydraulic operating volume | cm ³ | 15 | 40 | 60 | 105 | 160 | 190 | 320 |

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serted to the stop and then clamped. The proximity switches are available as accessories.

(b) The surface of the housing parts is primed black. The mounting side is treated with corrosion protection wax.

Continued: PowerStroke FSK-SVE

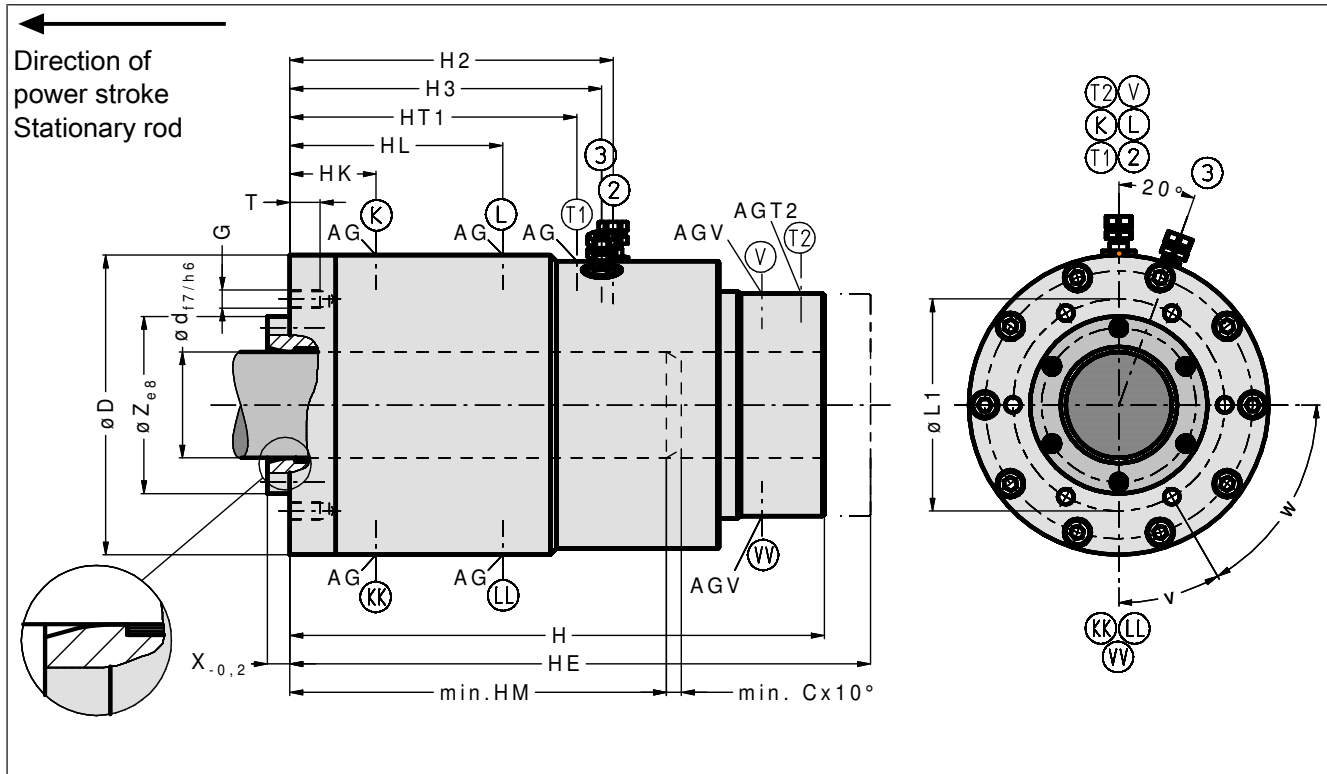


Fig. 13: Dimensions of PowerStroke FSK-SVE

| Type | | FSK-SVE 45 | FSK-SVE 70 | FSK-SVE 100 | FSK-SVE 125 | FSK-SVE 160 | FSK-SVE 180 | FSK-SVE 200 |
|------------------------------|----|------------|------------|-------------|-------------|-------------|-------------|-------------|
| ID no. (order no.) | | FSK 045 11 | FSK 070 11 | FSK 100 11 | FSK 125 11 | FSK 160 11 | FSK 180 11 | FSK 200 11 |
| Connection dimensions | | | | | | | | |
| AG | | G1/4 | G3/8 | G1/2 | G1/2 | G3/4 | G3/4 | G3/4 |
| AGT1 | | G1/8 | G1/8 | G3/8 | G3/8 | G3/8 | G3/8 | G1/2 |
| AGT2 | | – | – | G1/8 | – | G1/4 | G3/8 | G3/8 |
| AGV | | G1/8 | G1/8 | G1/8 | G1/8 | G1/4 | G3/8 | G3/8 |
| G | | M10 | M12 | M16 | M20 | M20 | M24 | M30 |
| H2 | mm | 200 | 213.5 | 286 | 282 | 379.5 | 406 | 412 |
| H3 | mm | 193.5 | 206 | 276 | 274 | 371 | 394.5 | 404 |
| HK | mm | 49 | 57 | 97 | 103 | 117 | 112 | 119 |
| HL | mm | 135 | 140 | 195 | 188 | 231 | 227 | 236 |
| HT1 | mm | 174 | 189 | 21.5 | 17 | 26 | 24 | 35 |
| L1 | mm | 110 | 140 | 180 | 235 | 275 | 300 | 335 |
| T | mm | 16 | 20 | 25 | 32 | 32 | 40 | 50 |
| v | | 30° | 30° | 30° | 30° | 22.5° | 18° | 18° |
| w | | 6 x 60° | 6 x 60° | 6 x 60° | 6 x 60° | 8 x 45° | 10 x 36° | 10 x 36° |
| X | mm | 15 | 15 | 38 | 42 | 42 | 42 | 42 |
| Z | mm | 88 | 117 | 148 | 195 | 235 | 248 | 278 |

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