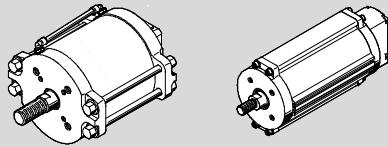


Linear drive

DFPI-...-...-ND2P-E-P-G2



FESTO

Festo AG & Co. KG
Postfach
73726 Esslingen
Germany
+49 711 347-0
www.festo.com

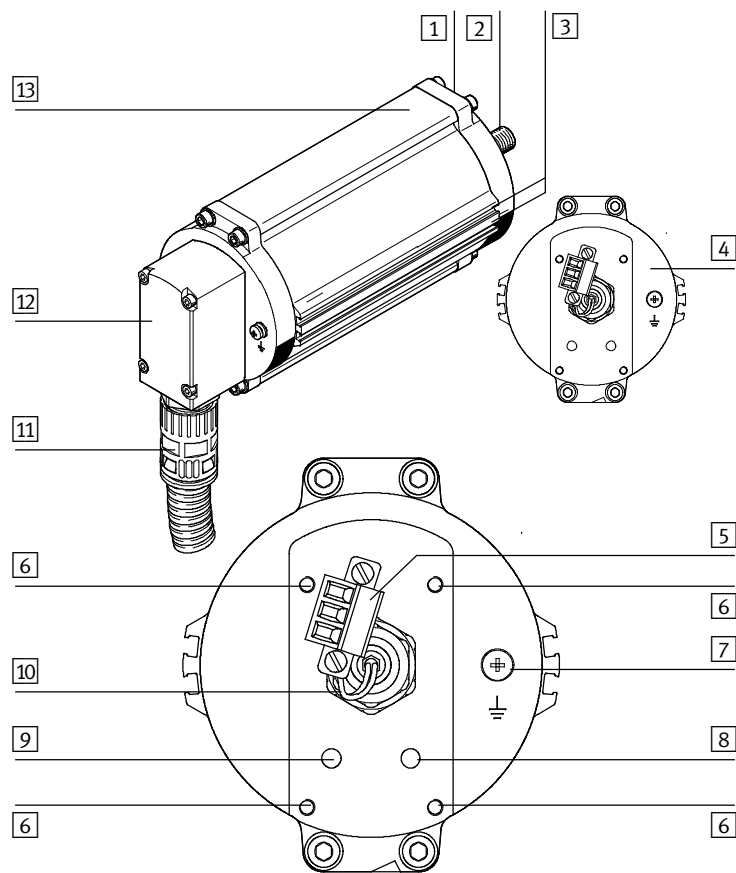
(en) Operating instructions

8029193
1309a
[8029195]

Original: de

Linear drive DFPI-...-...-ND2P-E-P-G2 English

1 Operating elements and connections using as an example the DFPI-100-...



- | | |
|---|---|
| 1 Mounting thread (reverse side, → Fig. 4) | 8 Pneumatic interface*) – channel 4 (extend piston rod) |
| 2 Piston rod with mounting thread for coupling and spanner flat for counter holding | 9 Pneumatic interface*) – channel 2 (retract piston rod) |
| 3 Slot for proximity sensor | 10 Electric cable (displacement encoder) |
| 4 Representation without flange receptacle | 11 Optional: connecting cable with protective conduit (accessories) |
| 5 Electrical connection behind the flange receptacle | 12 Flange receptacle; shape dependent on the piston diameter of the drive |
| 6 Thread for mounting the flange receptacle | 13 Cylinder barrel; version depends on the piston diameter of the drive |
| 7 Earth terminal; position depends on piston diameter of the drive | |

Fig. 1

2 Design

The DFPI-...-...-ND2P-E-P-G2 is an electro-pneumatic linear drive consisting of:

- a double-acting pneumatic cylinder with
- integrated displacement encoder (potentiometer) for determining the actual position.

The displacement encoder supplies an analogue signal proportional to the displacement in the form of a voltage (voltage divider). If necessary, proximity switches can be installed in the slots (→ Fig. 1 [3]) in order to provide binary interrogation of positions as well.

The electric and pneumatic connections are protected against external mechanical influences by a rugged flange receptacle.

A connecting cable with protective conduit (→ Fig. 1 [11]) is available as an accessory (→ www.festo.com/catalogue).

The product is available in various designs. These operating instructions describe the following product variants:

Features	Type codes	Description
Type	DFPI-	Double-acting pneumatic drive for process automation with integrated displacement encoder
Size of valve actuator	100- 125- 160- 200- 250- 320-	Piston diameter can be selected in steps; Specifications in [mm]
Stroke	...- (40 ... 990)	Stroke length freely selectable in the range from 40 to 990; specifications in [mm]
Cushioning	N	No cushioning
Displacement encoder	D2	Integrated analogue displacement encoder
Method of measurement	P-	Potentiometer
Attachment position of controller	E-	External (no controller integrated)
Connection type	P-	Protected pneumatic connections
Generation	G2	2nd generation

Fig. 2 Type code (e.g. DFPI-100-200-ND2P-E-P-G2)

The following characteristics of the linear drive are dependent on the piston diameter, and may differ from the representation shown in Fig. 1:

- Position of the earth terminal (→ identification on product),
- Shape of the cylinder barrel
- Shape of the flange receptacle.

In addition, for linear drives with a piston diameter ≥ 200 mm the compressed air supplied from one side is fed via an unprotected line parallel to the cylinder barrel. Tie rod screws are used to attach the cylinder end cap. For linear drives with a piston diameter ≤ 200 mm the compressed air is fed internally. The cylinder end caps are screwed to the housing.

3 Function

Pressurising and venting of the cylinder chambers cause the piston rod connected to the piston to move to and fro. The integrated displacement encoder transmits the current position to the higher-level system as an analogue signal.

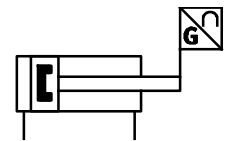


Fig. 3

The process valve (e.g. guided slide gate, penstock valve), which is connected via a coupling, opens or closes corresponding to the movement of the piston rod. The cross-sectional area of the piston rod causes differences of force between forward stroke and return stroke (→ www.festo.com/catalogue).

4 Application

The designated use of the DFPI linear drive is to drive linearly actuated, guided process valves in process automation systems – for example guided gate valve actuators and penstock valves. It is suitable for use in the process industry in the area of:

- water,
- sewage,
- industrial process water,
- silage and
- bulk goods technology.

The stroke length of the drive is generally at least equal to the nominal diameter of the process valve, so that the gate valve actuator can be opened and closed completely using the DFPI.

The product is tailored to the requirements of the process industry (→ catalogue www.festo.com/catalogue).

5 Transport and storage



Warning

Danger of crushing! Danger of shearing!

The DFPI can weigh up to about 86 kg, depending on the product version. Body parts can be crushed or cut off if the product falls.

- For product versions weighing more than 12 kg, always use suitable load-carrying equipment in order to handle the product safely during transport and assembly.

Ensure storage conditions as follows:

- Short storage times and cool, dry, shady corrosion-resistant storage locations.

6 Requirements for product use

Installation and commissioning are to be carried out only by qualified personnel in accordance with the operating instructions.



Note

Improper handling can result in malfunctions.

- Make sure that all the instructions in this chapter are always observed. The product will then function correctly and safely.



Note

Lateral forces on the piston rod can damage the piston rod bearing of the DFPI.

- Make sure that there are no lateral forces acting on the piston rods, e.g. through external guiding of the useful load (only guided process valves are permissible).



Note

Continuous operation at the limits of the specified ambient temperature and work frequency can reduce the service life of the drive.

- Use lubricated compressed air for continuous operation under extreme conditions. The oil must be chemically inert (chemically stable) and must not carbonize.

- Compare the maximum values specified in these operating instructions with your actual application (e.g. pressures, forces, torques, masses, speeds, temperatures). The product can only be used in compliance with the relevant safety guidelines if the maximum load limits are observed.
- Ensure that all applicable regulations for your location are adhered to, e.g. of the trade association or national institutions.
- Remove the packaging except for existing self-adhesive labels on the compressed air supply ports (danger of contamination). The material used in the packaging has been specifically chosen for its recyclability (exception: oil paper = residual waste).
- Take into consideration the ambient conditions at the location of use. Corrosive environments reduce the service life of the product.
- Use the product in its original status, without any unauthorised product modifications.
- Protect the device from fluctuations in pressure and excess operating temperature. Use control valves for regulating pressure and excess pressure.
- Ensure that the compressed air is properly prepared (→ Technical data in chapter 13).
- Use only unlubricated compressed air under normal conditions. The product has an initial lubrication which suffices for the complete service life. Using lubricated compressed air flushes out the initial lubrication. The product may then only be operated with lubricated compressed air.
- Make sure that cut-off tube ends are cut off square and are free of burrs. This way you prevent damage to internal O-rings of the DFPI when the compressed air tubes are inserted.
- Please select the corresponding accessories, e.g. connecting lines and proximity sensors, from our catalogue (→ www.festo.com/catalogue).
- Use only proximity sensors approved for the product from our catalogue (→ www.festo.com/catalogue).

7 Installation



Note

When proximity sensors are used: Ferrous materials (e.g. steel parts and metal sheets) in the immediate vicinity of proximity sensors can result in accidental switching signals. When linear drives are installed too close to each other, a cylinder magnet can trigger switching of the proximity sensor on the neighbouring linear drive.

- During assembly, maintain the required minimum distances from ferrous materials. The required distances must be determined during mounting for each specific case!
- When installing more than one linear drive, make sure that the area of effect of each cylinder magnet does not affect any proximity sensors of neighbouring linear drives.

If there are high media temperatures in the tubing and in processing valve:

- Use a heat-insulated coupling extension.

7.1 Mechanical installation

For attachment, the linear drive has a mounting hole pattern in accordance with DIN 3358. Through this, the linear drive is screwed to the process valve or penstock valve. The mounting orientation is any desired.

- Mount the DFPI with 4 screws.
- Tighten the mounting screws evenly. Tightening torques: with M8 thread 25 Nm \pm 5 %; with M10 thread 46 Nm \pm 5 %.

The piston rod has a male thread for mounting the slide gate.

The spanner flat at the piston rod is used as a counter holder to avoid impermissible torques at the piston rod when mounting – spanner size → technical data in chapter 13.

- If necessary, use the corresponding adapters for attachment (→ catalogue www.festo.com/catalogue).

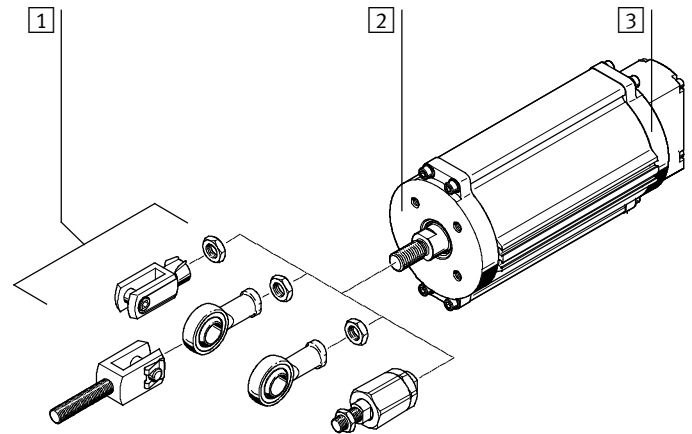


Fig. 4

- 1 Adapter for attachment of the slide gate – examples
- 2 Bearing cap with mounting thread (4) for mounting on slide process valve with hole pattern in accordance with DIN 3358
- 3 End cap

The adjacent illustration shows an example for the mechanical connection of a DFPI (→ Fig. 5 [1]) to a process valve (→ Fig. 5 [2]). Observe the following during installation:

- Mount the DFPI in such a way that there are no lateral forces acting on the piston rod bearings.
- Install the DFPI in such a way that the required mode of operation for opening and closing the processing valve or penstock valve is implemented.

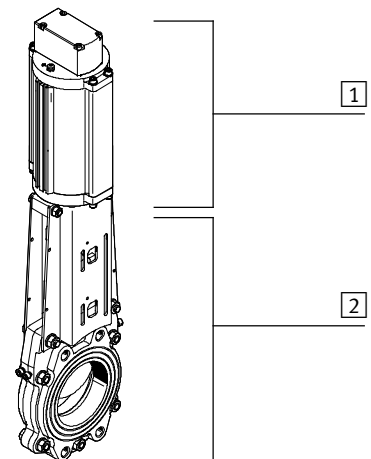


Fig. 5

When using additional proximity sensors:

- Place the proximity sensors in the corresponding grooves. Cover rails over the grooves fasten the cables and protect them against dirt.
- During assembly, maintain the required minimum distances from ferrous materials.

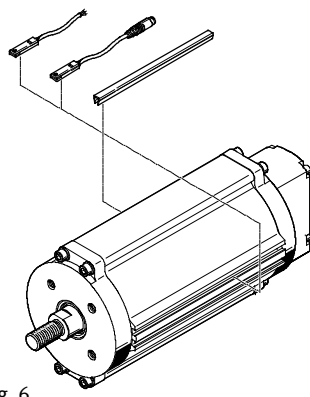


Fig. 6

7.2 Electrical installation



Warning

- Use only power sources which guarantee reliable electrical isolation of the operating voltage in accordance with IEC/DIN EN 60204-1. Observe also the general requirements for PELV power circuits in accordance with IEC/DIN EN 60204-1.



Note

Installation errors can damage the electronics or cause malfunctions.

- Make sure that the length of the displacement encoder cable does **not** exceed the permissible length of 30 m.
- Connect the earth terminal (Fig. 1 [7]) to the earth potential with low impedance (short cable with large cross-section) – tightening torque 5 Nm ± 10 %.
- Observe the pin allocation (→ Fig. 8). The displacement encoder may only be used as a voltage divider – **not** as a variable resistor.
- Use an electric connecting cable, with at least 3 wires, with an outside diameter of 6.5 to 8 mm – wire cross section [mm²] 0.75 ... 1.5.

- Recommendation: Use the pre-assembled connecting cable NHSB with protective conduit according to accessories (→ www.festo.com/catalogue).

The electrical connection is covered by the flange receptacle (→ Fig. 1).

To perform electrical installation you will have to dismantle the flange receptacle.

The structure of the flange receptacle and the cable conduit fitting are shown in the following illustration:

- 1 Mounting screws – tightening torque → Fig. 9
- 2 Seals (O-rings)
- 3 Mounting thread (M32 x 1.5) for connecting cable (accessories) – tightening torque 15 Nm ± 10 %.

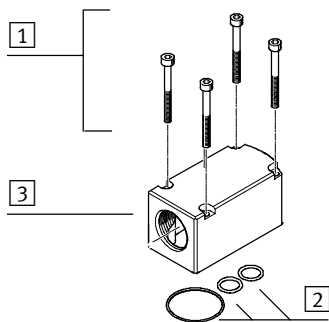


Fig. 7

1. Loosen the mounting screws of the flange receptacle (→ Fig. 7 [1]) and carefully remove the flange receptacle.
2. If necessary, loosen the cable conduit fitting of the connecting cable (available optionally in combination with the connecting cable) in accordance with the related assembly instructions.
3. Plug the electrical connecting cable through the passage of the flange receptacle (→ Fig. 10 [1]).
4. If necessary, loosen the socket strip of the electrical connection, which is fastened with two screws.
5. Use the wire end sleeves appropriate for the connection and wire the socket strip according to the pin allocation (→ Fig. 8) – tightening torque 0.22 Nm ... 0.25 Nm.

The 3-pin connection is used to supply voltage to the integrated displacement encoder and to make the sensor signal available.

Pin	Assignment 1)	Connection
1	Operating voltage -	
2	Output actual value (0 ... 15 V DC)	
3	Operating voltage +	

1) Maximum permissible operating voltage 15 V DC

Fig. 8

6. Carefully plug the wired socket strip onto the plug.
7. Refasten the socket strip with the two screws – tightening torque: 0.5 Nm ± 10 %.
8. Remount the flange receptacle. When doing so, make sure that the seals and O-rings are correctly seated.
9. When tightening the mounting screws of the flange receptacle, observe the tightening torque (→ Fig. 9).

Tightening torque of the mounting screws of the flange receptacle

Design	DFPI-100-...-E-P-G2 up to DFPI-160-...-E-P-G2	DFPI-200-...-E-P-G2 up to DFPI-320-...-E-P-G2
Tightening torque [Nm]	2.7 ± 10 %	6 ± 10 %

Fig. 9

7.3 Pneumatic installation

- Use the pre-assembled connecting cable NHSB with protective conduit according to accessories (→ www.festo.com/catalogue) or externally calibrated pneumatic connection lines with outside diameter of 8 mm. Suitable, for example, is the plastic conduit PUN-8x1,25 from Festo.
- Check the necessity of check valves. You will then prevent the moveable mass sliding down if there is a drop in pressure when the product is in a vertical or sloping mounting position.

The flange receptacle has two threaded holes (→ Fig. 10). Push-in fittings are pre-assembled in the factory (included in scope of delivery).

Connect the tubing of the DFPI as follows:

1. If necessary, loosen the cable conduit fitting of the optional connecting cable (→ assembly instructions of the accessories).
 2. Remove the blanking plugs at the push-in fittings, if necessary.
- 1 Passage for electric cables
 - 2 Pneumatic connection 2: retract piston rod
 - 3 Flange receptacle
 - 4 Pneumatic connection 4: advance piston rod

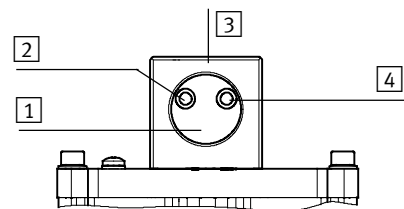


Fig. 10

3. Connect the tubing of the DFPI to the compressed air supply ports (→ Fig. 10). To do this, plug the respective tube into the corresponding push-in fitting up to the stop.
 - Air supply at port 2 (→ Fig. 10 [2]): Piston rod retracts (open process valve)
 - Air supply at port 4 (→ Fig. 10 [4]): Piston rod advances (close process valve)
4. Only in the unpressurized status: Check the reliable hold of the tubing connection by lightly pulling on the tubing.
5. With use of the connecting cable available as an accessory: Mount the cable connector, if necessary, and protective conduit in accordance with the related assembly instructions.

Loosening a tube

1. Press down on the disconnect ring (blue) of the push-in fitting and hold it down.
2. Carefully pull the tube out of the push-in fitting. Cut off the damaged part before further use of the tube.

8 Commissioning

The product is ready for operation as soon as it is installed and connected.

- Make sure that the operating conditions lie within the permitted ranges (technical data → chapter 13).
- Make sure that a slide gate (process valve) attached to the linear drive can be positioned without hindrance.
- If necessary, adjust the linear drive adapter attached to the piston rod. This setting serves to optimise the opening or closing reaction of the connected process valve or penstock valve.
- Slowly pressurise the linear drive.
For slow start-up pressurisation use soft-start valve type HEL.
- At first, select a slow travel speed.

9 Operation



Warning

Fast moving parts can cause injury to people in the vicinity of the DFPI.

- Make sure that, in the positioning range:
 - Nobody can place his/her hand in the path of moving components (e.g. by providing a protective guard).
 - There are no foreign objects in the path of the moving components.

It should not be possible to touch the DFPI until the mass has come to a complete rest.

10 Maintenance and care

If used as intended in the operating instructions, the device will be maintenance-free.

11 Disassembly and repair

Make sure that the following energy sources are switched off:

- electrical power supply
- compressed air supply.

1. Remove the slide gate from the piston rod.
2. Remove the screws on the flange of the processing valve or penstock valve.
3. Remove the drive (if necessary including mounting adapter and coupling extension).

Recommendation: Send the product to our repair service. This way, the required fine tuning and tests will be taken into special consideration.

Information about spare parts and accessories → www.festo.com/spareparts.

12 Troubleshooting

Malfunction	Possible cause	Remedy
Piston rod does not move in the desired direction	Compressed air tubes interchanged	Correct the tubing connection
	Displacement encoder cable incorrectly connected at positioning controller or DFPI (e.g. connections at pin 1 and pin 3 interchanged).	Correct the connection

Fig. 11

13 Technical data

DFPI-...-ND2P-E-P-G2	-100- ...	-125- ...	-160- ...	-200- ...	-250- ...	-320- ...
Based on standard	DIN 3358					
Type of mounting	on flange in accordance with DIN 3358					
Flange hole pattern	F07	F10		F10, F14		
Width across flats, spanner flat on the piston rod	22	27		36		
Design	Piston rod, cylinder barrel					
Cushioning	No cushioning					
Mounting position	Any					
Mode of operation	Double-acting					
Position sensing	With integrated displacement encoder					
Measuring principle of displacement encoder	Potentiometer					
Operating voltage range [V DC]	0 ... 15					
Max. operating voltage [V DC]	15					
Independent linearity [% FS]	±0.04					
Hysteresis [mm]	0.33					
Repetition accuracy [mm]	±0.12					
Resistance value of displacement encoder (on the T.E.P.) dependent on the stroke length ¹⁾						
– ≤ 290 mm [kΩ]	5					
– > 290 mm to 590 mm [kΩ]	10					
– > 590 mm to 990 mm [kΩ]	20					
Electrical connection	3-pin; straight plug; screw terminal					
Pneumatic connection	For tubing outside ∅ 8 mm					
Operating pressure [bar]	3 ... 8					
Nominal operating pressure [bar]	6					
Operating medium	Compressed air in accordance with ISO 8573-1:2010[7:4:4]					
Note on the operating medium	Operation with lubricated medium possible (in which case lubricated operation will always be required)					
Max. cable length [m]	30					
Protection class - in mounted status	IP65, IP67, IP68, IP69K, NEMA 4					
Stroke [mm]	40 ... 990					
Stroke reserve [mm]	3			4		
Ambient temperature [°C]	–20 ... +60					
Relative air humidity [%]	0 ... 100 condensing					
Use in exterior	C1 – weather-protected areas in accordance with IEC 60654					
Product weight						
– Basic weight with 0 mm stroke [g]	3476	5530	6529	13 946	22 569	35 359
– Additional weight per 10 mm stroke [g]	80	145	159	187	325	399
– Additional weight of displacement encoder per 10 mm [g]	2					
– Moving mass with 0 mm stroke [g]	1228	1944	2250	4722	7059	11417
– Additional weight of moving mass per 10 mm stroke [g]	27	52		87		
Materials						
– Cylinder barrel	Anodised wrought aluminium alloy				High-alloy stainless steel	
– Cap (end cap)	Anodised wrought aluminium alloy or Anodised and painted wrought aluminium alloy or Cast aluminium painted					
– Bottom cap (bearing cap)						
– Piston rod	High-alloy stainless steel					
– Screws	Steel ²⁾					
– Seals	NBR, PU		NBR			
Note on materials	Contains PWIS (paint-wetting impairment substances), RoHS-compliant					
Vibration resistance in accordance with DIN/IEC 68, Part 2-6	0.35 mm path at 10 ... 60 Hz; 5 g acceleration at 60 ... 150 Hz					
Continuous shock resistance in accordance with DIN/IEC 68, Part 2-82	±15 g at 6 ms duration; 1000 shocks per direction					
CE certification (see declaration of conformity → www.festo.com)	in accordance with EU Explosion Protection Directive (ATEX) ³⁾					

1) T.E.P. = theoretical electrical path

2) Steel and high-alloy stainless steel

3) Certification-specific special documentation must be considered (→ www.festo.com/sp).

Fig. 12