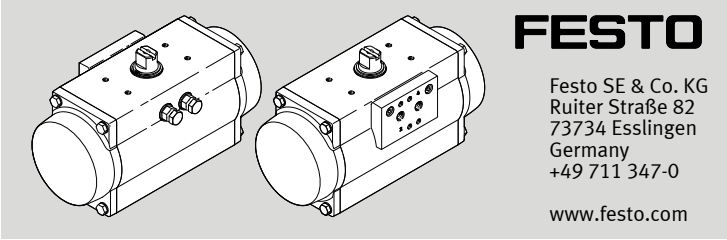


DFFD-...
Semi-rotary drive



Operating instructions

8147709
2020-11d
[8147711]



Translation of the original instructions

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1 About this document

1.1 Purpose of the document

This document describes the use of the above-mentioned product. The document contains additional information for the use of the product in safety-oriented systems (safety handbook in accordance with IEC 61508).

1.2 Applicable documents

All available documents for the product -> www.festo.com/sp.

Table with 2 columns: Document, Contents. Rows include Operating conditions EX, Certification documents.

Tab. 1 Applicable documents

1.3 Target group

The document is targeted towards individuals who install and operate the product. The document is additionally targeted towards individuals who are entrusted with the planning and application of the product in a safety-oriented system.

1.4 Specified standards

Table with 2 columns: Version, Contents. Rows list IEC standards: IEC 61508-1:2010, IEC 61508-2:2010, IEC 61508-4:2010, IEC 61508-7:2010, IEC 61511:2016.

Tab. 2 Specified standards

2 Safety

2.1 General safety instructions

- Only use the product in original status without unauthorised modifications.
- Only use the product if it is in perfect technical condition.
- Take into consideration the legal regulations for the installation location.
- Take into consideration the ambient conditions at the location of use. Corrosive environments reduce the service life of the product.
- Observe the specifications on the product labelling.
- Observe labelling on the product.
- Prior to mounting, installation and maintenance work: Switch off compressed air supply and secure it from being switched back on.
- Exhaust drive prior to assembly, installation and dismantling.
- Product must be regularly tested by a qualified technician, and the test must be documented -> 9 Maintenance.
- Protect the device from pressure fluctuations. Use overpressure valves and pressure regulators.

Operating medium

- Use compressed air only in accordance with the specifications -> 14 Technical data.
- Use only unlubricated compressed air under normal conditions. Once the product has been used with lubricated compressed air, it must continue to be operated with lubricated compressed air only.

Return to Festo

Hazardous substances can endanger the health and safety of personnel and cause damage to the environment. To prevent hazards, the product should only be returned upon explicit request by Festo.

- Consult your regional Festo contact.
- Complete the declaration of contamination and attach it to the outside of the packaging.
- Comply with all legal requirements for the handling of hazardous substances and the transport of dangerous goods.

2.2 Intended use

The product is intended to actuate process valves, such as ball valves and butterfly valves with a rotation angle from 0° (valve closed) to 180° (depending on the version).

NOTICE!

The operating torque of the drive must not be greater than the maximum permissible torque listed in ISO 5211 in relation to the size of the mounting flange and of the coupling.

2.2.1 Information on functional safety

2.2.1.1 Achievable safety classification

The product is suitable for use as an element in a safety-oriented system in accordance with IEC 61511.

- in Low Demand Mode up to SIL 2
- in High Demand Mode up to SIL 1

Considering the necessary minimum hardware fault tolerance of HFT = 1, the product can also be used up to SIL 3 in a redundant execution of the entire system.

NOTICE!

The suitability for certain applications can only be determined in connection with the assessment of further components of the subsystem. These must achieve the same safety level.

2.2.1.2 Safety function

Single-acting semi-rotary drives DFFD-...-RS/DFFD-...-LS

The element safety function consists of the control valve moving to the switching position when the compressed air is switched off. It is returned by spring force.

Double-acting semi-rotary drives DFFD-...-RD/DFFD-...-LD

The element safety function consists in the execution of a complete working stroke (opening or closing the process valve) within a defined time.

2.2.1.3 Operating conditions

- General information on safe operation -> 2.1 General safety instructions.
- Periodic tests (function test) -> 9 Maintenance.
- Ambient conditions and additional technical specifications -> 14 Technical data.

2.2.1.4 Limitations of use

If used in a safety-oriented system, the service life is limited to 8 years subject to compliance with the operating conditions.

- Recommended interval for a complete function test: 1 year
- Maximum permissible interval for a complete function test: 3 years

If function tests are negative, maintenance work must be performed immediately.

2.2.1.5 Characteristic values

Table with 3 columns: Safety characteristic (in accordance with IEC 61508), Value. Rows include: Probability of dangerous failure on demand (PFDspec), Assumed test interval (T1), Confidence level (1-alpha), Hardware fault tolerance (HFT), Diagnostic coverage (DC), Type of subsystem (Type A), Mode of operation (Low Demand and High Demand), Degree of detection of dangerous errors by the proof test (PTC), Assumed demands per year (n_op), Failure rate for dangerous errors not detected (lambda_DU), Mean time to failure (MTTFD), Low Demand Mode (double-acting), Failure rate for dangerous errors not detected (lambda_D), Mean probability of dangerous failure on demand (PFDavg), Mean probability of dangerous failure on demand (PFDavg), Low Demand Mode (single-acting), Failure rate for dangerous errors not detected (lambda_D).

Safety characteristic (in accordance with IEC 61508)		Value
Mean probability of dangerous failure on demand (Average Probability of Failure on Demand) 1oo1	$PFD_{avg} (T_1 = 1 \text{ a})$	$7.80 \cdot 10^{-4}$
Mean probability of dangerous failure on demand (Average Probability of Failure on Demand) 1oo2	$PFD_{avg} (T_1 = 1 \text{ a})$	$7.87 \cdot 10^{-5}$
High Demand Mode		
Assumed demands per year (Assumed Demands per Year)	n_{op}	8760/a
Mean frequency of a dangerous failure per hour (Probability of dangerous Failure per hour)	PFH	$1.01 \cdot 10^{-7}/h$

Tab. 3 Safety characteristics

2.3 Training of qualified personnel

Work on the product should only be conducted by qualified personnel.

3 Additional information

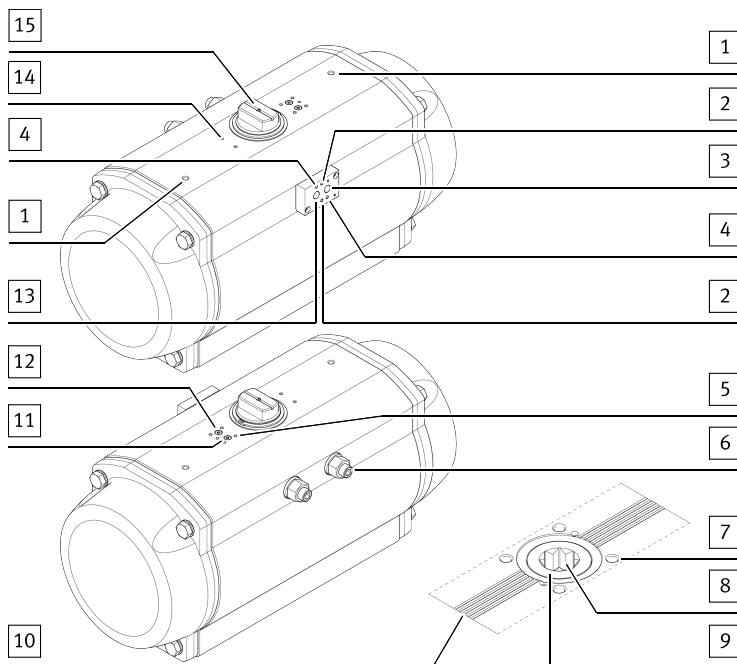
- Accessories → www.festo.com/catalogue.
- Spare parts → www.festo.com/spareparts.

4 Service

Contact your regional Festo contact person if you have technical questions
→ www.festo.com.

5 Product overview

5.1 Product design



- | | |
|--|---|
| 1 Thread for transport lugs (DFPD-2300 only) | 8 Coupling for process valve |
| 2 Mounting thread for coding pin | 9 Centring ring for mounting on adapter bridge (only -C-...) |
| 3 Supply port (4) | 10 Leakage slot |
| 4 Mounting thread for pneumatic NAMUR switching valve | 11 Supply port (2) (only -VDE2) |
| 5 Mounting thread adapter according to VDI 3847-2 (only -VDE2) | 12 Supply port (4) (only -VDE2) |
| 6 End-position adjustment on both sides | 13 Supply port (2) |
| 7 Mounting thread for process valve according to ISO 5211 | 14 Mounting thread for limit switch or position sensor |
| | 15 Transmission shaft (shaft groove shows the process valve position – here closed) |

Fig. 1 Product structure (DFPD-2300 as an example)

A shaft projects outward through the housing on both sides. It transmits the reaction torque to a process valve and, if applicable, a limit switch or position sensor. The end stops can be adjusted in the range of $\pm 5^\circ$ using the end-position adjustment on both sides [6].

5.2 Function

The piston movement of the semi-rotary drive is converted into a swivel motion of the transmission shaft by Rack & Pinion kinematics (gear rack pinion).

Double-acting semi-rotary drives

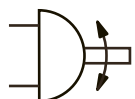


Fig. 2 Symbol for double-acting semi-rotary drive

Pressurisation and exhaust of the cylinder chamber results in an opening/closing motion of the drive.

Single-acting semi-rotary drives

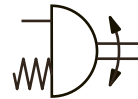


Fig. 3 Symbol for single-acting semi-rotary drive

Return is by spring force.

Symbol on the rating plate

Type	Mode of operation	Symbol
DFPD-RD-...	double-acting, closes to the right	–
DFPD-LD-...	double-acting, closes to the left	
DFPD-RS-...	single-acting (spring return), closes to the right	
DFPD-LS-...	single-acting (spring return), closes to the left	

Tab. 4 Symbols for mode of operation

6 Transport and storage

⚠ WARNING!

Danger of crushing. Danger of shearing.

Body parts can be crushed or severed if the product falls.

- Use appropriate load handling equipment.
 - For DFPD-2300: screw suitable transport lugs into the specified threaded holes. Lift the drive by the transport lugs.
- When dispatching used products: comply with all legal requirements for the handling of hazardous substances and the transport of dangerous goods. For return to Festo → 2.1 General safety instructions.
 - Remove all attachments.
 - Store the product in a cool, dry, UV-protected and corrosion-protected environment. Ensure that storage times are kept to a minimum.
 - For long-term storage: test the function of the product regularly.
 - Observe environmental and storage conditions .
 - Seal pneumatic ports.
 - Protect coupling parts with grease or protective oil.
 - Store the product on a level wooden pallet to prevent damage to the coupling flange.

7 Mounting and installation

7.1 Assembly without adapter bridge

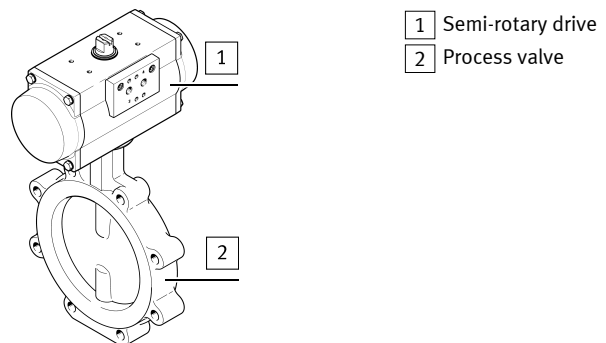


Fig. 4 Assembly without adapter bridge

1. Prepare process valve.
Adjust the control shaft of the process valve to implement the desired operating method for opening and closing.
2. Place the semi-rotary drive on the control shaft of the process valve. The control shaft must sit in the coupling of the semi-rotary drive (→ Fig.1, [8]) without tilting.
3. Mount the semi-rotary drive on the connecting flange of the process valve using 4 corrosion-resistant screws, retaining rings and nuts (material: CI).
4. Tighten the screws crosswise → Tab. 12 Tightening torques for flange.

7.2 Assembly with adapter bridge

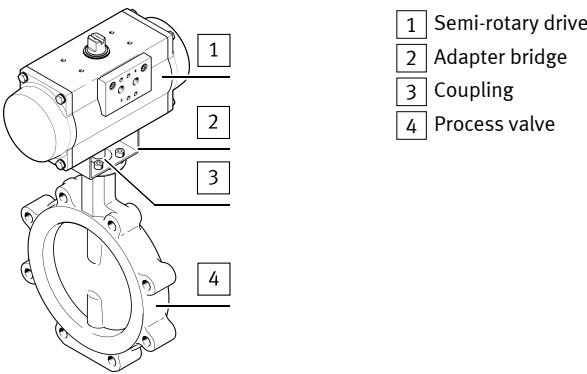


Fig. 5 Assembly with adapter bridge

- Have adapter bridge and coupling ready → www.festo.com/catalogue.
- Mount the adapter bridge [2] on the semi-rotary drive.
 - Align studs of the adapter bridge lengthwise to the drive.
 - Align open side of the adapter bridge with the process valve.
 - Do not jam the centring ring in the drilled hole for the adapter bridge.
 - Screw in the screws but do not tighten them yet.
- Prepare process valve.
Adjust the control shaft of the process valve to implement the desired operating method for opening and closing.
- Insert the coupling [3]. The square of the coupling must sit in the coupling of the semi-rotary drive without tilting (→ Fig. 1, [8]).
- Place the semi-rotary drive with adapter bridge and coupling on the control shaft of the process valve. The square of the process valve must sit in the coupling without tilting.
- Mount the adapter bridge on the connecting flange of the process valve using 4 corrosion-resistant screws, retaining rings and nuts (material: VA).
- Tighten the screws at both the drive and process valve crosswise → Tab. 12 Tightening torques for flange.

7.3 Pneumatic port

Single-acting semi-rotary drive

- Prevent corrosive atmosphere in the spring space. If there is a corrosive atmosphere, use a rebreather block.
- Mount a filter element on the exhaust port 4 (A) to prevent ingress of dirt.

Type	Supply port	Effect
DFPD-RS-...	2	Air supply; always connected
DFPD-LS-...	4	Pressurisation of spring space

Tab. 5 Supply port for single-acting semi-rotary drive

Double-acting semi-rotary drive

Type	Supply port	Effect ¹⁾
DFPD-RD-...	2	Air supply direction of rotation anti-clockwise
	4	Air supply direction of rotation clockwise
DFPD-LD-...	2	Air supply direction of rotation clockwise
	4	Air supply direction of rotation anti-clockwise

1) viewed from the connection point of the accessories

Tab. 6 Supply port for double-acting semi-rotary drive

8 Commissioning

Requirements

- The drive is fully mounted and connected.

Commissioning the drive

- Pressurise drive slowly.
- Check correct function at low travel speed.
 - Direction of rotation of drive
 - Position of process valve

9 Maintenance

9.1 General

- Low Demand Mode:
When used as intended, the product is maintenance-free.
- High Demand Mode DFPD-...-T4
Grease the product again after 20,000 switching cycles.
- High Demand Mode DFPD-...-T6
For safety-oriented applications, replace consumable parts after max. 20,000 switching cycles.

9.2 Proof test (Proof Test)

The proof test consists of a Full Stroke test of the drive. Here, the complete rotation of the shaft is checked at the connection to the process valve dependent on the switching position of the control valve. The switching position of the shaft can be determined visually (position of the shaft groove), using a position sensor or using another suitable auxiliary means.

- Perform the proof test at least once in every 3 years.

i

During the proof test, the safety of the application must be ensured.

- Trigger rotation of the shaft at the control valve.
- Measure the time until the semi-rotary drive has performed a complete rotation of the shaft.
 - The test is successful if the semi-rotary drive completes the movement within the switching time intended for control by the control valve.
- Check the drive externally (visual inspection).
 - The test is successful if no defect, leakage, or contamination is detected.
- Document test results.

10 Malfunctions

NOTICE!

Repairs to the product are not permissible. In the event of malfunctions or failure: Replace the product and let Festo know about the failure. Return defective products to Festo.

Fault description	Cause	Remedy
Drive does not move in the desired direction	Compressed air connections connected incorrectly	Correct the tubing connection

Tab. 7 Malfunctions

11 Modification

11.1 Replacing the spring package

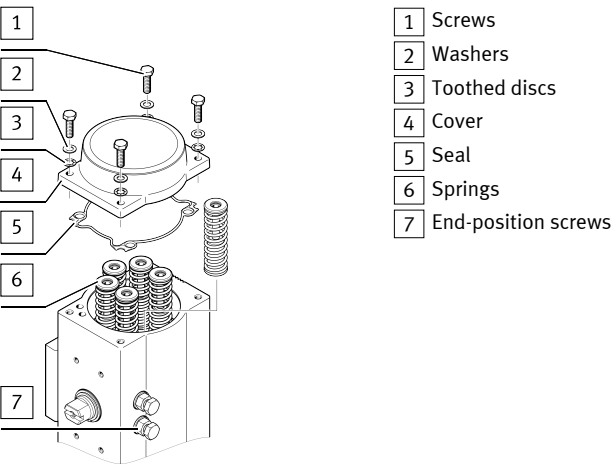


Fig. 6 Replacing the spring package

WARNING!

Risk of injury from flying objects.

A faulty spring package can result in the cover being ejected during disassembly and causing injury.

- If the cover is still under spring force when the gap width is reached, do not proceed with the disassembly.
- Replace the actuator.

Requirements

- Mounting position is vertical. Drive is secured to prevent tilting.
- Drive is removed → 12 Dismounting.
- Unscrew end position screws.
 - Drive is in neutral position.
- Loosen screws crosswise until the gap width is reached.
 - Cover is no longer under spring force.
 - Gap width between cover and drive: ≤ 6 mm
- Unscrew screws completely.
- Remove cover.
 - Spring package can now be replaced.
- Remove springs.
- Insert new springs in the desired configuration.
- Mount cover. Observe correct position of the seal.
- Insert the screws and tighten them crosswise .

11.2 Configuring the spring package

The configuration of the spring package is different depending on the nominal operating pressure.

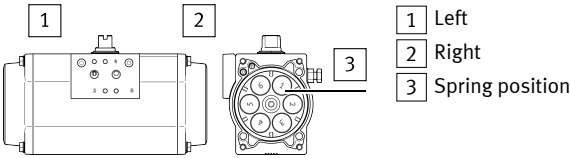


Fig. 7 Configuring the spring package

Spring configura- tion	Spring position		Number of springs
	Left	Right	
[–]	–	–	0
[20]	2-5	2-5	4
[25]	2-5	2-4-6	5
[30]	2-4-6	2-4-6	6
[35]	2-4-6	1-3-4-6	7
[40]	1-3-4-6	1-3-4-6	8
[45]	1-3-4-6	1-3-4-5-6	9
[50]	1-3-4-5-6	1-3-4-5-6	10
[55]	1-3-4-5-6	1-2-3-4-5-6	11
[60]	1-2-3-4-5-6	1-2-3-4-5-6	12

Tab. 8 Spring configuration

12 Dismounting

1. Switch off the energy supply (compressed air, electricity).
2. Loosen the pneumatic connections.
3. Remove external attachments.
4. Undo the retaining screws of the drive at the process valve and remove the drive.

13 Disposal

--- ENVIRONMENT!

Dispose of the product and packaging according to the applicable provisions of environmentally sound recycling.

14 Technical data

General information		DFPD-...-[]-...	DFPD-...-T4-...	DFPD-...-T6-...
Standard connection to valve body		ISO 5211		
Cushioning		none		
Mounting position		any		
Design		Gear rack/pinion		
Ambient temperature [°C]		-20 ... +80	0 ... +150	-50 ... +60
Valve connection conforms to standard		VDI/VDE 3845 (NAMUR)		
Operating medium		Compressed air to ISO 8573-1:2010 [7:4:4]		
Note on the operating medium		Pressure dew point at least 10 °C below outside temperature, lubricated operation possible (required in further operation)		
Operating pressure		[MPa]	0.2 ... 0.8	0.3 ... 0.8
		[psi]	29 ... 116	43.5 ... 116
		[bar]	2 ... 8	3 ... 8
Swivel angle				
DFPD-...-90		[°]	0 ... 90	
DFPD-...-120		[°]	0 ... 120	
DFPD-...-135		[°]	0 ... 135	
DFPD-...-180		[°]	0 ... 180	
End-position adjustment range		[°]	±5	
Material				
Housing		Anodised wrought aluminium alloy		
Cover		Coated die-cast aluminium Anodised die-cast aluminium (only DFPD-...-C)		
Shaft		Nickel-plated steel Stainless steel (only DFPD-...-R3)		
Screws		Stainless steel		
Seal		NBR	FKM	FVMQ

Tab. 9 Technical data – General

Nominal operating pressure

Type	[MPa]	[psi]	[bar]
DFPD-...-RD, DFPD-...-LD	0.55	79.75	5.5
DFPD-...-...S-20	0.2	29	2.0
DFPD-...-...S-25	0.25	36.25	2.5

Type	[MPa]	[psi]	[bar]
DFPD-...-...S-30	0.3	43.5	3.0
DFPD-...-...S-35	0.35	50.75	3.5
DFPD-...-...S-40	0.4	58	4.0
DFPD-...-...S-45	0.45	65.25	4.5
DFPD-...-...S-50	0.5	72.5	5.0
DFPD-...-...S-55	0.55	79.75	5.5
DFPD-...-...S-60	0.6	87	6.0

Tab. 10 Nominal operating pressure

Air consumption

Type		Air consumption per cycle at 0.6 MPa (87 psi, 6 bar) operating pressure ¹⁾
DFPD-10-RP-90-D	[l]	1.0
DFPD-20-RP-90-D	[l]	1.8
DFPD-20-RP-90-S	[l]	0.8
DFPD-40-RP-90-D	[l]	3.4
DFPD-40-RP-90-S	[l]	1.5
DFPD-40-RP-180-D	[l]	5.2
DFPD-60-RP-90-D	[l]	5.7
DFPD-60-RP-90-S	[l]	2.4
DFPD-80-RP-90-D	[l]	7.4
DFPD-80-RP-90-S	[l]	3.1
DFPD-120-RP-90-D	[l]	10.4
DFPD-120-RP-90-S	[l]	4.3
DFPD-120-RP-180-D	[l]	12.8
DFPD-160-RP-90-D	[l]	14.0
DFPD-160-RP-90-S	[l]	5.9
DFPD-240-RP-90-D	[l]	20.3
DFPD-240-RP-90-S	[l]	8.6
DFPD-240-RP-180-D	[l]	25.5
DFPD-300-RP-90-D	[l]	26.4
DFPD-300-RP-90-S	[l]	11.0
DFPD-480-RP-90-D	[l]	40.5
DFPD-480-RP-90-S	[l]	17.2
DFPD-480-RP-180-D	[l]	61.4
DFPD-700-RP-90-D	[l]	58.8
DFPD-700-RP-90-S	[l]	24.5
DFPD-900-RP-90-D	[l]	75.9
DFPD-900-RP-90-S	[l]	34.5
DFPD-1200-RP-90-D	[l]	105.0
DFPD-1200-RP-90-S	[l]	43.5
DFPD-2300-RP-90-D	[l]	204.0
DFPD-2300-RP-90-S	[l]	84.4

1) Theoretical value for a complete swivel motion (0° - max. swivel angle - 0°)

Tab. 11 Air consumption per cycle

Flange type	F03	F04	F05	F07	F10	F12	F14	F16
Tightening torque [Nm]	5 ... 6		9 ... 10	22 ... 24	46 ... 50	80 ... 84	190 ... 200	370 ... 390

Tab. 12 Tightening torques for flange

Type	Thread size	Tightening torque [Nm]
DFPD-10/-20	M5	6 ... 8
DFPD-40/-60/-80	M6	10 ... 11
DFPD-120/-160/-240	M8	22 ... 25
DFPD-300/-480/-700	M10	38 ... 43
DFPD-900	M12	60 ... 70
DFPD-1200	M14	70 ... 80
DFPD-2300	M16	115 ... 125

Tab. 13 Tightening torques for cover screws