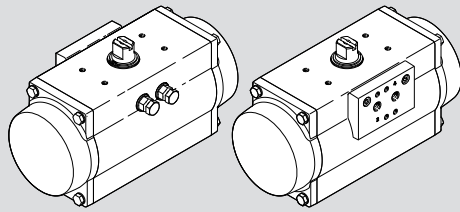


# DFPD-...

## Semi-rotary drive



# FESTO

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8202412

Operating instruction

8202412  
2023-11f  
[8202414]

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. It contains additional information for the use of the product in safety-related systems (safety manual in accordance with IEC 61508).

### 1.2 Applicable documents

All available documents for the product → [www.festo.com/sp](http://www.festo.com/sp).

### 1.3 Target group

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

### 1.4 Product version

This document refers to the standard version of the quarter turn actuator DFPD of the following product versions.

- DFPD-10 ... -2300: product labelling without revision number
- DFPD-10 ... -300: product labelling with revision number [Rev. 01]

This document does not apply to the variants DFPD- ... -T4 and DFPD- ... -T6 with extended temperature range.

### 1.5 Specified standards

Version	
IEC 61508-1:2010	IEC 61508-7:2010
IEC 61508-2:2010	IEC 61511:2016
IEC 61508-4:2010	

Tab. 1: Specified standards

## 2 Safety

### 2.1 General safety instructions

- Only use the product in its original condition without unauthorised modifications.
- Only use the product if it is in perfect technical condition.
- Observe the identifications on the product.
- Before working on the product, switch off the compressed air supply and lock it to prevent it from being switched on again.
- Take into account the ambient conditions at the location of use. Corrosive environments reduce the service life of the product.
- Protect the product from fluctuations in pressure: use a pressure control valve.

### Return to Festo

Hazardous substances can endanger the health and safety of persons and cause damage to the environment. To prevent hazards, the product should only be returned if explicitly requested 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 quarter-turn actuator operates process valves in fluid systems, (e.g. ball valves or butterfly valves).

## NOTICE

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

## NOTICE

Depending on the design, part-turn actuators that are moved to a defined switching position by spring force in a de-energised state lose at least 30% of their calculated torque as a result of the relaxation of the spring assemblies and friction.

- Take an appropriate safety factor into account in the application.

### 2.3 Training of qualified personnel

Work on the product may only be carried out by qualified personnel who can evaluate the work and detect dangers. The qualified personnel have knowledge and experience in process automation.

## 3 Additional information

- Contact the regional Festo contact if you have technical problems → [www.festo.com](http://www.festo.com).
- Accessories and spare parts → [www.festo.com/catalogue](http://www.festo.com/catalogue).

## 4 Information on functional safety

### 4.1 Achievable safety classification

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

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

Taking into account the required minimum hardware fault tolerance (HFT = 1), the product can also be used up to SIL 3 in a redundant configuration 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.

### 4.2 Safety function

#### Double-acting semi-rotary drives DFPD-...-RD/-LD

The safety function is to switch the actuator to the defined safety switching position. This switching movement is achieved by pressurising the corresponding pressure chamber with compressed air. The value of the torque generated depends on the pressure difference between the two pressure chambers separated by the piston.

#### Single-acting semi-rotary drives DFPD-...-RS/-LS

The safety function is to switch the actuator to the defined safety switching position when the compressed air is switched off and the spring chamber is exhausted. This switching movement is achieved through the spring force of the spring assembly.

### 4.3 Operating conditions

- General information on safe operation → 2 Safety.
- Periodic tests (function test) → 11 Maintenance, → 11.1 General.
- Ambient conditions and other technical specifications → 15 Technical data.

### 4.4 Limitations of use

If used in a safety-related 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
- When a function test is negative, maintenance work must be carried out immediately.

## 5 Product overview

### 5.1 Product structure

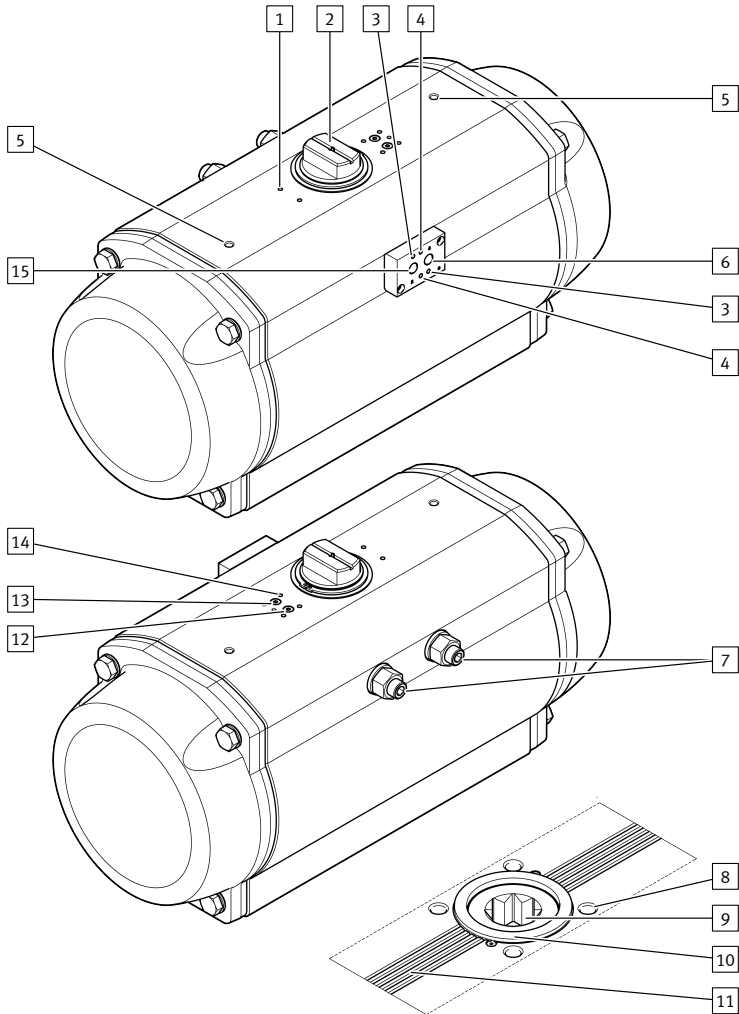


Fig. 1: Product structure (taking DFPD-2300 as an example)

- |   |   |
|---|---|
| <p>1 Mounting thread for limit switch or position sensor in accordance with VDI/VDE 3845-1</p> <p>2 Transmission shaft</p> <p>3 Mounting thread for NAMUR interface</p> <p>4 Mounting thread for coding pin</p> <p>5 Thread for transport lugs (DFPD-2300 only)</p> <p>6 Supply port 4 when the NAMUR interface is used</p> <p>7 End-position adjustment on both sides</p> <p>8 Mounting thread for process valve in accordance with ISO 5211</p> | <p>9 Coupling for process valve in accordance with ISO 5211</p> <p>10 Centering ring for mounting on adapter bridge, DFPD-...-C only</p> <p>11 Leakage slot</p> <p>12 Supply port 2 when the VDE2 interface is used</p> <p>13 Supply port 4, when the VDE2 interface is used</p> <p>14 Mounting thread for adapter in accordance with VDI 3847-2, DFPD-...-VDE2 only</p> <p>15 Supply port 2 when the NAMUR interface is used</p> |
|---|---|

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 5° thanks to end-position adjustment on both sides.

### 5.2 Function

The piston movement of the quarter-turn actuator is converted into a swivel movement of the transmission shaft by Rack & Pinion kinematics (gear rack/pinion). The swivel angle is 90° to a maximum of 180°, depending on the product version.

DFPD-...	-RD	-LD	-RS	-LS
Mode of operation	Double-acting, closes to the right	Double-acting, closes to the left	Single-acting (spring return), closes to the right	Single-acting (spring return), closes to the left
Symbol on product label				

Tab. 2: Product version and mode of operation

### Double-acting quarter-turn actuator: DFPD-...-RD/-LD

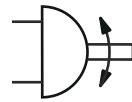


Fig. 2: Symbol for double-acting quarter-turn actuator

The switching movement is achieved by pressurising the corresponding pressure chamber with compressed air. The value of the torque generated depends on the pressure difference between the two pressure chambers separated by the piston.

### Single-acting quarter-turn actuator: DFPD-...-RS/-LS

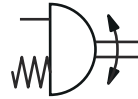


Fig. 3: Symbol for single-acting quarter-turn actuator

The switching movement is achieved through the spring force of the spring assembly.

## 6 Transport

### ⚠ 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 → 2 Safety.

## 7 Storage

- Remove all attachments.
- Store the product in a cool, dry environment protected from UV and corrosion. Keep storage times short.
- Note the ambient and storage conditions.
- When storing for a long period, test that the product is working at regular intervals.
- Seal the pneumatic ports.
- Protect the coupling parts with grease or protective oil.
- Store the product on a level wooden pallet to prevent damage to the coupling flange.

## 8 Assembly

### 8.1 Assembly without adapter bridge

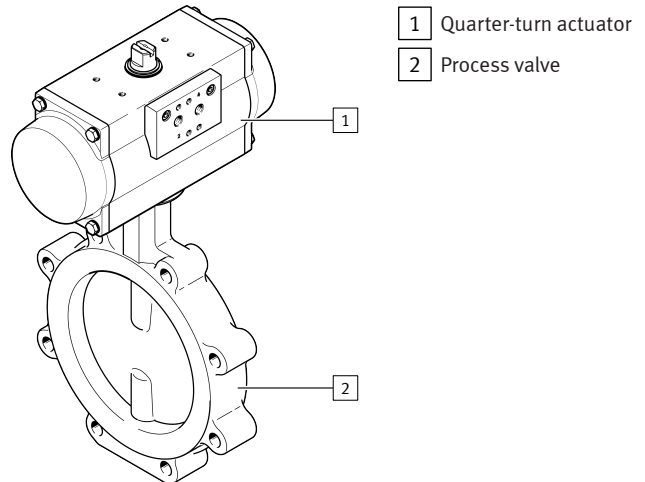


Fig. 4: Assembly without adapter bridge

1. Prepare the process valve. Adjust the control shaft of the process valve to implement the desired operating method for opening and closing.
2. Place the quarter-turn actuator on the control shaft of the process valve.
  - ↳ The control shaft must sit in the coupling of the quarter-turn actuator without tilting → 5.1 Product structure.
3. Mount the quarter-turn actuator on the connecting flange of the process valve using 4 corrosion-resistant screws and retaining rings.
4. Tighten the screws crosswise to the tightening torque. Note the flange type of the quarter-turn actuator.

DFPD-...	-F03	-F04	-F05	-F07
Tightening torque for the screws	[Nm] 5.5 ± 0.5	5.5 ± 0.5	9.5 ± 0.5	23 ± 1

Tab. 3: Tightening torques for the flange, DFPD-...-F03 ... -F07

DFPD-...		-F10	-F12	-F14	-F16
Tightening torque for the screws	[Nm]	48 ± 2	82 ± 2	195 ± 5	380 ± 10

Tab. 4: Tightening torques for the flange, DFPD-...-F10 ... -F16

## 8.2 Assembly with adapter bridge

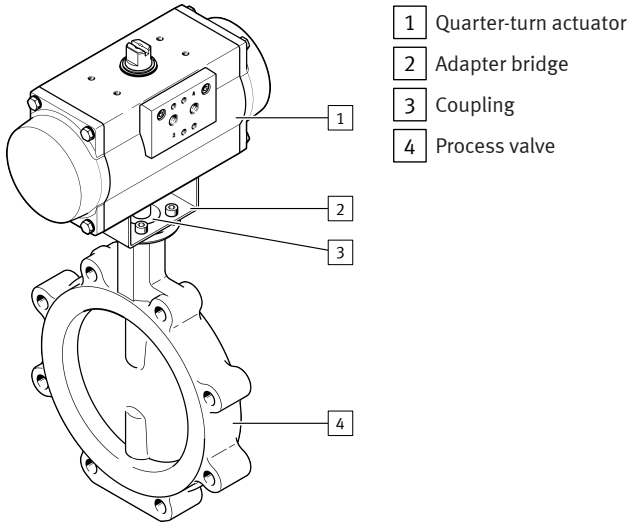


Fig. 5: Assembly with adapter bridge

- Have the adapter bridge and coupling ready → [www.festo.com/catalogue](http://www.festo.com/catalogue).
- Mount the adapter bridge on the quarter-turn actuator.
  - Align the studs of the adapter bridge lengthwise to the quarter-turn actuator.
  - Align the open side of the adapter bridge with the process valve.
  - Do not jam the centering ring in the drilled hole for the adapter bridge.
  - Screw in the screws, but do not tighten them yet.
- Prepare the process valve.  
Adjust the control shaft of the process valve to implement the desired operating method for opening and closing.
- Insert the coupling.
  - The square of the coupling must sit in the coupling of the quarter-turn actuator without tilting → 5.1 Product structure.
- Place the quarter-turn actuator with the 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.
- Tighten the screws on the quarter-turn actuator and the process valve crosswise to the tightening torque. Note the flange type of the part-turn actuator.

DFPD-...		-F03	-F04	-F05	-F07
Tightening torque for the screws	[Nm]	5.5 ± 0.5	5.5 ± 0.5	9.5 ± 0.5	23 ± 1

Tab. 5: Tightening torques for the flange, DFPD-...-F03 ... -F07

DFPD-...		-F10	-F12	-F14	-F16
Tightening torque for the screws	[Nm]	48 ± 2	82 ± 2	195 ± 5	380 ± 10

Tab. 6: Tightening torques for the flange, DFPD-...-F10 ... -F16

## 9 Installation

### 9.1 Double-acting quarter-turn actuator: DFPD-...-RD/-LD

Depending on the form of attachment chosen, supply ports are available on the housing or on the NAMUR interface → 5.1 Product structure.

- Connect the air supply to supply port 2 and supply port 4.
- Seal unused supply ports with blind plugs.

Supply port	Effect <sup>1)</sup>
DFPD-...-RD	
2	Air supply, anti-clockwise direction of rotation
4	Air supply, clockwise direction of rotation
DFPD-...-LD	
2	Air supply, clockwise direction of rotation
4	Air supply, anti-clockwise direction of rotation

1) Direction of rotation from the connection point of the accessory.

Tab. 7: Supply port for the double-acting quarter-turn actuator

### 9.2 Single-acting quarter-turn actuator: DFPD-...-RS/-LS

Depending on the form of attachment chosen, supply ports are available on the housing or on the NAMUR interface → 5.1 Product structure.

- Prevent a corrosive atmosphere in the spring chamber. Use a rebreather block if the atmosphere is corrosive.
- To prevent dirt from penetrating, fasten a filter element to supply port 4.
- Connect the air supply to supply port 2.
- Seal unused supply ports with blind plugs.

Supply port	Effect
2	Air supply; always connected
4	Pressurisation of spring chamber

Tab. 8: Supply port for single-acting quarter-turn actuator

## 10 Commissioning

Requirement: The quarter-turn actuator must be fully assembled and connected.

- Ventilate the quarter-turn actuator slowly.
- Check that it is working correctly at a low speed:
  - Direction of rotation of the quarter-turn actuator
  - Position of the process valve

## 11 Maintenance

### 11.1 General

Low Demand Mode:

- The product is maintenance-free in intended use.

High Demand Mode:

- Check that the product is working properly at regular intervals. The check interval depends on the operating conditions.

### 11.2 Proof test (Proof Test)

The proof test consists of a Full Stroke test of the actuator. Full rotation of the shaft is tested 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 something else suitable.

- Carry out the proof test at least once every 3 years.

### i

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

- Trigger the rotation of the shaft at the control valve.
- Measure the time taken until the quarter-turn actuator has caused the shaft to rotate fully.
  - The test is successful if the quarter-turn actuator completes the movement within the switching time intended for control by the control valve.
- Check the actuator externally (visual inspection).
  - The test is successful if no defect, leakage or contamination is detected.
- Document the test results.

## 12 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.

Malfunction	Cause	Remedy
The actuator will not move in the desired direction.	The supply ports are not connected correctly.	– Adjust the tubing.

Tab. 9: Fault clearance

## 13 Modification

### 13.1 Replacing the spring assembly for DFPD-...-RS/-LS

#### Requirements

- The mounting position is vertical. The quarter turn actuator is secured against tipping.
- The quarter turn actuator is demounted → 14 Disassembly.

### 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.

### NOTICE

#### Plastic deformation of the screws

- Replace the screws after loosening them → [www.festo.com/spareparts](http://www.festo.com/spareparts).

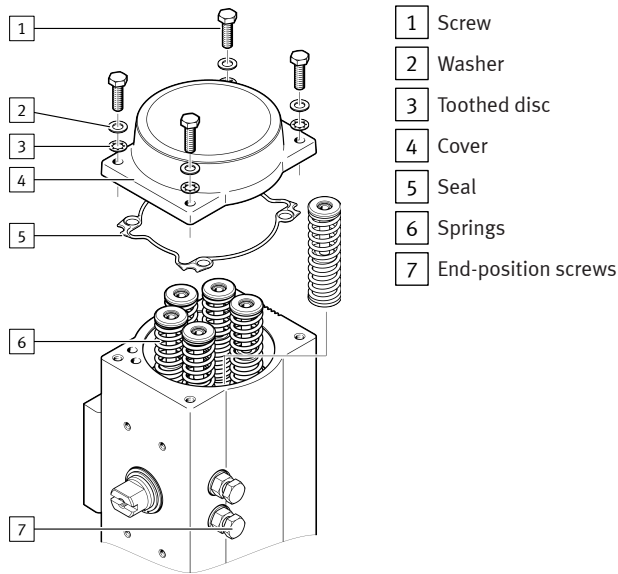


Fig. 6: Replacing the spring assembly

### Replacing the spring assembly

- Remove the end-position screws.
  - The actuator is in the neutral position.
- Loosen the screws on the cover crosswise until there is a maximum gap of 6 mm between the cover and the actuator.
- Check that the cover is not subject to spring force.
  - If the cover is subject to spring force, stop the disassembly.
  - If the cover is not subject to spring force, remove the screws.
- Remove the cover.
  - The spring assembly can be replaced.
- Remove the springs.
- Insert the new springs in the desired configuration.
- Mount the cover. Ensure the seal is in the correct position.
- Insert the new screws and tighten them crosswise to the tightening torque.

DFPD	-10	-20	-40	-80	-120
Thread size	M5	M5	M6	M6	M8
Tightening torque					
DFPD, without revision number	[Nm] 7 ± 5 %	7 ± 5 %	10.5 ± 5 %	10.5 ± 5 %	23.5 ± 5 %
DFPD-..., [Rev. 01]	[Nm] 4 ± 15 %	4 ± 10 %	8.8 ± 15 %	9 ± 10 %	20 ± 10 %
DFPD-...-C, [Rev. 01]	[Nm] 4.5 ± 10 %	5 ± 15 %			

Tab. 10: Cover screws, DFPD-10 ... -120

DFPD	-160/ -240	-300	-480/ -700	-900	-1200	-2300
Thread size	M8	M10	M10	M12	M14	M16
Tightening torque						
DFPD, without revision number	[Nm] 23.5 ± 5 %	40.5 ± 5 %	40.5 ± 5 %	65 ± 5 %	75 ± 5 %	120 ± 5 %
DFPD-..., [Rev. 01]	[Nm] 20 ± 15 %	35 ± 15 %	-	-	-	-

Tab. 11: Cover screws, DFPD-160 ... -2300

### 13.2 Configuring the spring assembly for DFPD-...-RS/-LS

The configuration of the spring assembly varies depending on the nominal operating pressure.

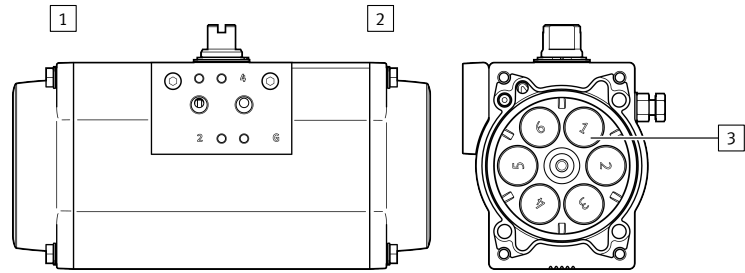


Fig. 7: Configuring the spring assembly

- 1 Left
- 2 Right
- 3 Spring position

DFPD-...	-20	-25	-30	-35	-40
Number of springs	4	5	6	7	8
Spring position					
Left	2-5	2-5	2-4-6	2-4-6	1-3-4-6
Right	2-5	2-4-6	2-4-6	1-3-4-6	1-3-4-6

Tab. 12: Number of springs and spring position, DFPD-...-20... -40 spring configuration

DFPD-...	-45	-50	-55	-60
Number of springs	9	10	11	12
Spring position				
Left	1-3-4-6	1-3-4-5-6	1-3-4-5-6	1-2-3-4-5-6
Right	1-3-4-5-6	1-3-4-5-6	1-2-3-4-5-6	1-2-3-4-5-6

Tab. 13: Number of springs and spring position, DFPD-...-45... -60 spring configuration

### 14 Disassembly

- Switch off the power supply: compressed air supply, operating voltage.
- Loosen the pneumatic connections.
  - The quarter-turn actuator is vented.
- Remove the external attachments.
- Loosen the fastening screws of the quarter-turn actuator on the process valve, and remove the quarter-turn actuator.

### 15 Technical data

#### 15.1 Technical data, safety engineering

##### Approval information, safety engineering

Type-examination	The functional safety engineering of the product has been certified by an independent testing body → <a href="http://www.festo.com/sp">www.festo.com/sp</a>
Certificate issuing authority	TÜV Rheinland Industrie Service GmbH
Certificate no.	968/V 1106.01/23

Tab. 14: Approval information, safety engineering

Safety characteristic in accordance with IEC 61508	Value	
Results of Assessment		
Route of Assessment		2H/1s
Type of Subsystem		Type A
Mode of Operation		Low Demand Mode / High Demand Mode
Systematic Capability		SC 3
Diagnostic Coverage	DC	0
Hardware Fault Tolerance	HFT	0
Proof Test Coverage	PTC	99%
Low Demand Mode, double-acting drives		
Dangerous Failure Rate	$\lambda_D$	$2.46 \cdot 10^{-7}/h$
Average Probability of Failure on Demand 1001	$PFD_{avg}(T_1)$	$1.10 \cdot 10^{-3}$ Assumptions: DC = 0%, $T_1 = 1$ year, MRT = 72 h
Low Demand Mode, single-acting drives		
Dangerous Failure Rate	$\lambda_D$	$1.24 \cdot 10^{-7}/h$
Average Probability of Failure on Demand 1001	$PFD_{avg}(T_1)$	$5.52 \cdot 10^{-4}$ Assumptions: DC = 0%, $T_1 = 1$ year, MRT = 72 h
High Demand Mode, DFPD-...-10/20/40/80/120/160/240/300-...-90		
Assumed Demands per Year	nop	8760/a
Nominal Lifetime <sup>1)</sup>	$B_{10d}$	492700

Safety characteristic in accordance with IEC 61508		Value
Average Frequency of a Dangerous Failure per Hour	PFH	2.03 * 10 <sup>-7</sup> /h
Mean time to failure, dangerous	MTTF <sub>D</sub>	562 a
High Demand Mode, DFPD-...-40/120/240-...-120/135/180		
Assumed Demands per Year	nop	8760/a
Nominal Lifetime <sup>2)</sup>	B <sub>10d</sub>	245578
Average Frequency of a Dangerous Failure per Hour	PFH	4.07 * 10 <sup>-7</sup> /h
Mean time to failure, dangerous	MTTF <sub>D</sub>	280 a
High Demand Mode, DFPD-...-480/700/900/1200/2300		
Assumed Demands per Year	nop	8760/a
Nominal Lifetime <sup>3)</sup>	B <sub>10d</sub>	986500
Average Frequency of a Dangerous Failure per Hour	PFH	1.01 * 10 <sup>-7</sup> /h
Mean time to failure, dangerous	MTTF <sub>D</sub>	1126 a

- 1) Value determined with 60% load, in accordance with DIN EN 15714.  
2) Value determined with 60% load, in accordance with DIN EN 15714.  
3) Values determined without load

Tab. 15: Safety characteristics

## 15.2 Technical data, general

DFPD		
Certificates, declaration of conformity	→ www.festo.com/sp	
Standard for connection to angle seat fitting	EN ISO 5211	
Cushioning	None	
Mounting position	Any	
Design	Gear rack/pinion	
Standard for valve connection	VDI/VDE 3845-1 (NAMUR)	
Ambient temperature [°C]	-20 ... +80	
Swivel angle		
DFPD-...-90 [°]	90	
DFPD-...-120 [°]	120	
DFPD-...-135 [°]	135	
DFPD-...-180 [°]	180	
End-position adjustment range [°]	±5 <sup>1)</sup>	
Material		
Housing	Anodised wrought aluminium alloy	
Screws	Stainless steel	
Cover		
DFPD-...	Coated die-cast aluminium	
DFPD-...-C	Anodised die-cast aluminium	
Shaft		
DFPD-...	Nickel-plated steel	
DFPD-...-R3	Stainless steel	
Seal	NBR	

- 1) Operation outside of the end-position adjustment range is not permitted and results in undefined loading of the end cap.

Tab. 16: Technical data, general

## 15.3 Technical data, pneumatic

DFPD-...		
Operating medium	Compressed air to ISO 8573-1:2010 [7:4:4]	
Information on the operating medium	Lubricated operation possible, in which case lubricated operation will always be required	
	Pressure dew point at least 10 °C below the outside temperature	
Operating pressure [MPa]	0.2 ... 0.8	
[bar]	2 ... 8	
[psi]	29 ... 116	

Tab. 17: Operating medium and operating pressure

DFPD-...-RD/-LD	
Nominal operating pressure [MPa]	0.55
[bar]	5.5
[psi]	79.75

Tab. 18: Nominal operating pressure, DFPD-...-RD/-LD

DFPD-...-RS/-LS	-20	-25	-30	-35
Nominal operating pressure [MPa]	0.2	0.25	0.3	0.35
[bar]	2.0	2.5	3.0	3.5
[psi]	29	36.25	43.5	50.75

Tab. 19: Nominal operating pressure, DFPD-...-RS/-LS-20... -35

DFPD-...-RS/-LS	-40	-45	-50	-55	-60
Nominal operating pressure [MPa]	0.4	0.45	0.5	0.55	0.6
[bar]	4.0	4.5	5.0	5.5	6.0
[psi]	58	65.25	72.5	79.75	87

Tab. 20: Nominal operating pressure, DFPD-...-RS/-LS-40... -60

## Air consumption per cycle at 0.6 MPa (6 bar, 87 psi) operating pressure

Theoretical value for a full swivel movement:

0° ... maximum swivel angle ... 0°

DFPD-10	-RP-90-D [l]	1.0
DFPD-20	-RP-90-D [l]	1.8
	-RP-90-S [l]	0.8
DFPD-40	-RP-90-D [l]	3.4
	-RP-90-S [l]	1.5
	-RP-180-D [l]	5.2
DFPD-80	-RP-90-D [l]	7.4
	-RP-90-S [l]	3.1
DFPD-120	-RP-90-D [l]	10.4
	-RP-90-S [l]	4.3
	-RP-180-D [l]	12.8
DFPD-160	-RP-90-D [l]	14.0
	-RP-90-S [l]	5.9
DFPD-240	-RP-90-D [l]	20.3
	-RP-90-S [l]	8.6
	-RP-180-D [l]	25.5
DFPD-300	-RP-90-D [l]	26.4
	-RP-90-S [l]	11.0
DFPD-480	-RP-90-D [l]	40.5
	-RP-90-S [l]	17.2
	-RP-180-D [l]	61.4
DFPD-700	-RP-90-D [l]	58.8
	-RP-90-S [l]	24.5
DFPD-900	-RP-90-D [l]	75.9
	-RP-90-S [l]	34.5
DFPD-1200	-RP-90-D [l]	105.0
	-RP-90-S [l]	43.5
DFPD-2300	-RP-90-D [l]	204.0
	-RP-90-S [l]	84.4

Tab. 21: Air consumption