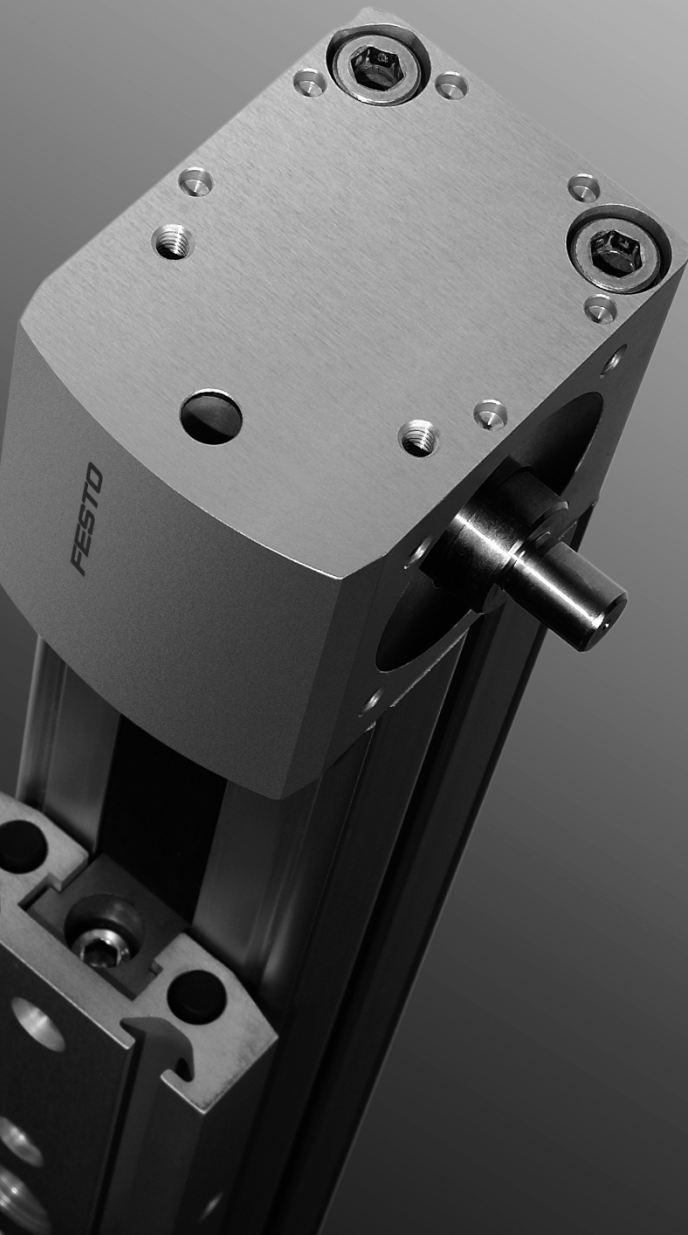


Toothed belt axis

DGE-...-ZR-RF



FESTO

(en) Operating
instructions

8074332
2017-11e
[8074334]

Translation of the original instructions

Symbols:



Warning

Installation and commissioning may only be performed in accordance with these instructions by technicians with appropriate qualifications.



Caution



Note



Environment



Accessories

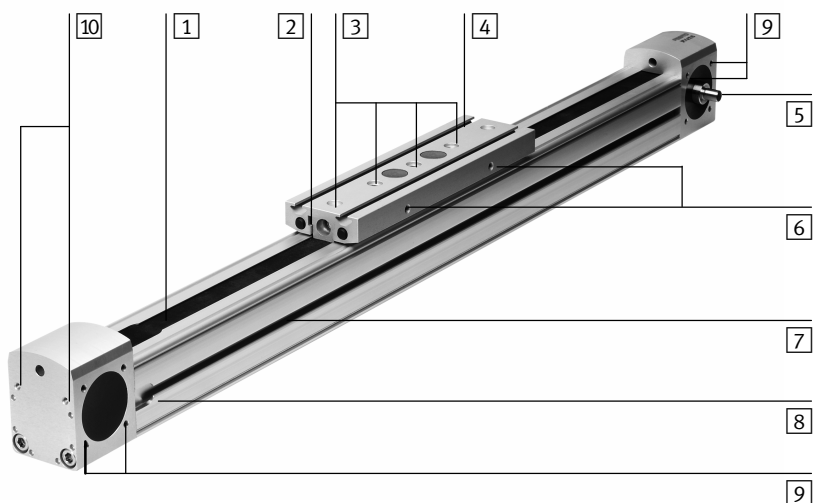
Documentation on the product



For all available product documentation → www.festo.com/pk

Toothed belt axis DGE-...-ZR-RF

1 Operating elements and connections



- 1 Toothed belt
- 2 Greasing nipple
- 3 Centring recesses with or without fastening thread
- 4 Slide with grooves for fastening the work load
- 5 Drive shaft
- 6 Internal thread for fastening the switch lug
- 7 Groove for fastening the sensor support
- 8 Slot for inserting the sliding blocks (only size 25)
- 9 Internal thread for fastening the motor mounting kit
- 10 Internal thread for fastening the axis

Fig. 1

2 Function and application

A toothed belt on a drive shaft converts the rotary movement of a motor into a linear movement. The slide then moves backwards and forwards.

The slide is carried by rollers and guide rods inside the cylinder barrel.

The DGE-...-ZR-RF is intended for the exact and fast positioning of effective loads.

It is approved for operation in slide mode and yoke mode (observe loading limits).

The DGE-...-ZR-RF is not permitted for use in applications in which vegetable water-soluble fats or oils could penetrate into the axis.

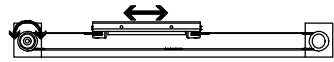


Fig. 2

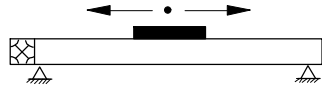


Fig. 3: Slide operation

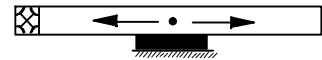


Fig. 4: Yoke operation



Note

The toothed belt axis DGE-...-ZR-RF is not self-locking: When input torque is not applied, the slide can be moved freely.

Generally, a latching function of the complete system can be achieved with motors with an integrated holding brake or other suitable means, such as clamping systems, motors with high gear ratios or self-locking gears. The choice of suitable means depends on the application and safety requirements.

- Please select the appropriate motor from our catalogue
→ www.festo.com/catalogue
You will then be operating two devices which are especially matched to each other.
- To design the DGE-...-ZR-RF, use the Festo design software “Positioning Drives” (→ www.festo.com).
- Adhere to the maximum permitted values for forces, torque and speeds
→ chapter 12 “Technical data”.

3 Transport and storage

- Take into consideration the weight of the DGE-...-ZR-RF.
The DGE-...-ZR-RF weighs up to 120 kg, depending on the design.
- Ensure the following storage conditions:
 - short storage times
 - cool, dry, shaded storage locations protected from corrosion
 - no oils, greases or grease-dissolving fumes.

In this way you can ensure the capability of the toothed belt.

4 Conditions for the safe use of the product



Warning

Unexpected fast-moving masses can cause injury to people or damage to property (danger of fingers being crushed).

- Apply power to the drive motor, at first limited to low speeds and torques.



Note

Malfunctions will occur if the device is not used correctly.

- Make sure that the specifications in this chapter are always observed. In this way the product will perform as intended.
- Compare the maximum values specified in these operating instructions with those of your actual application (e.g. forces, torques, temperatures, masses, speeds).
Operation of the product in compliance with the relevant safety regulations is contingent on adherence to the load limits.
- Take into consideration the ambient conditions at the location of use.
Corrosive elements in the environment (e.g. ozone) will reduce the service life of the product.
- Please comply with national and local safety laws and regulations.
- Remove transport packaging such as foils and cardboard.
It is intended that the packaging be recycled on the basis of its constituent materials (exception: oiled paper = other waste).
- Unauthorised product modification is not permitted.
- Note the warnings and instructions on the product and in the relevant operating instructions.
- Take the tolerance of the tightening torques into account. Unless specified otherwise, the tolerance is $\pm 20\%$.



5 Installation

Mechanical installation

- Do not modify the settings of screws and threaded pins if there is no direct requirement to do so in these operating instructions.
- Fit the motor onto the axis in accordance with the assembly instructions for the motor mounting kit recommended in the catalogue.

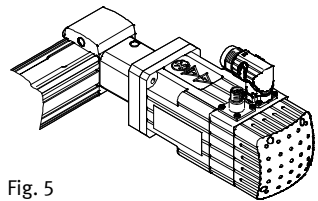


Fig. 5

Preparing the product for fitting



Note

Please note that in the case of heavy loadings the axis must not be fastened only by the front cover. Excessive tensile loads will cause the cover screws to be pulled out.

With use of the upper threaded holes in the end caps:

- Ensure the maximum screw-in depth of 7 mm (with use of HP-25: use screw M4x10).

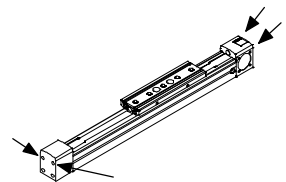


Fig. 6

Installing the product:

- Select the necessary mounting position.
- Check whether additional protection against entry of drops (grease, oil, water) and particles is needed.

	Protection against penetration of drops and particles	
	Low	Better
Installation position	Vertical, diagonal or horizontal with toothed belt on top	Diagonal or horizontal with toothed belt at bottom

Fig. 8

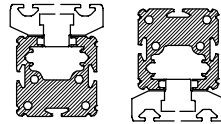


Fig. 7: Low Better

Fitting in a vertical or sloping position:



Warning

Masses falling suddenly can cause personal injury and material damage (crushing). If there is a power cut or if the toothed belt breaks, the work load will slide down.

- Make sure that you only use motors with an integrated spring-loaded holding brake.
- Check whether additional external safety measures are required to prevent the work load from sliding down (e.g. toothed latches, moving bolts or emergency buffers).

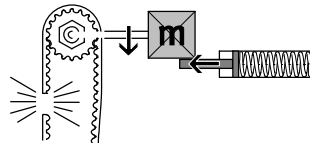


Fig. 9

With all mounting positions:

- Place the DGE-...-ZR-RF so that all the operating parts are accessible.
- Make sure that the device is fitted free of mechanical stress and distortion (evenness of mounting surface: 0.2 mm / 30 cm).

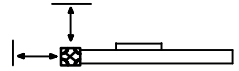


Fig. 10

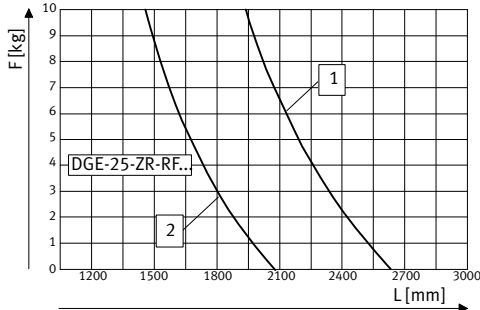


Fig. 11

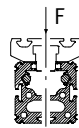
Products with long stroke lengths:

- Use the centre support MUP-...

Fig. 12 shows the distances between supports required for the DGE-...-ZR-RF.



Installation position 1



Installation position 2

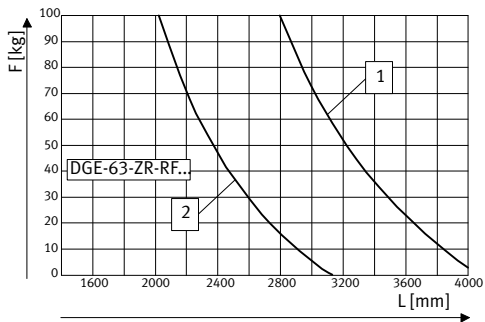
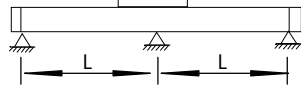
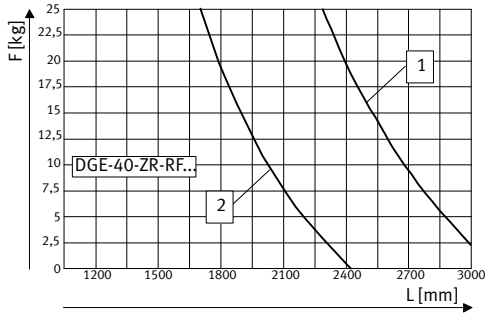
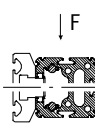
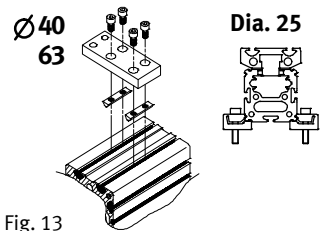


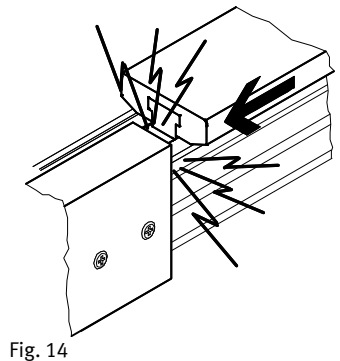
Fig. 12: Distances between supports L required for the DGE-...-ZR-RF as a factor of mounting position, rated size and useful load F

When fitting centre supports:

- Position the centre supports at equal distances over the complete axis length, not only over the stroke path.
- Fasten the centre supports on the DGE-...-ZR-RF as shown in Fig. 13.
If the device is tilted, the sliding blocks of the centre supports will slide into the groove at any point on the profile.



- Make sure that the centre supports are outside the positioning range of the slide by pushing it once over the complete positioning path.
- Tighten the fastening screws evenly.



To fasten the work load:

- Use the fastening thread or slot nuts (accessories).
- Place the useful load so that the tilting torque of the force parallel to the movement axis and lever arm “a” remains low.

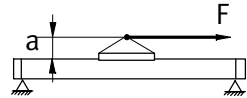


Fig. 15

Useful loads with their own guide:

- Adjust the guides of the useful load and the DGE-...-ZR-RF so that they are exactly parallel.

Only in this way can you avoid overloading on the slide (permitted forces → chapter “Technical data”).

The service life of the DGE-...-ZR-RF will then remain as expected.

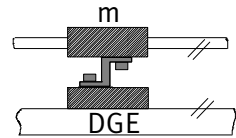


Fig. 16

With hard and stiff work loads (steel):

Note

If the aluminium slide becomes bent against a buckled useful load, the service life of the guide will be reduced.

- Make sure that the mounting surface of the useful loads is even to within $t \leq 0.01$ mm.

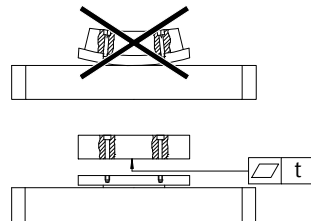


Fig. 17

For useful load geometries with projection in the longitudinal direction of the slide:

- Make sure that the useful load does not strike against the motor.

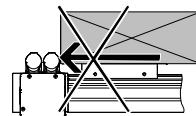


Fig. 18

Installing external accessories

Preparations for fitting the external accessories

- Check to see which interrogation variant is required for your application.

Interrogation variant	1. The controller requires a separate reference point	2. The controller does not require a separate reference point	Additional to points 1 and 2. irrespective of the type of controller
Necessity of scanning elements	1 reference point switch 2 hardware limit switches	Only 2 hardware limit switches	Always 2 safety limit switches
Mounting requirements	Reference point switch overlaps with a hardware limit switch. The hardware limit switch overlaps with the safety limit switches.	Hardware limit switches as reference point switches overlapping a safety limit switch	With safety distance from mechanical end position

Fig. 19

- Use scanning elements with the following features:

Scanning element	Version	Purpose	Remark
Safety limit switch	Mechanical roller switch with switching function: N/C contact	Triggering the EMERGENCY STOP function	<ul style="list-style-type: none"> – In accordance with accident prevention regulations – Will only prevent consequent damage in the case of programming errors
Hardware limit switch	Switching function: N/C contact	Triggering the maximum braking (emergency ramp)	<ul style="list-style-type: none"> – Still enables damage-free braking in the case of programming errors
Software limit switch	–	Limits of the positioning range through programmed control	<ul style="list-style-type: none"> – Are not usually overrun
Reference point switch	Switching function: N/O contact	Definition of a basis point for the DGE-...-ZR-RF	Regular checks of the position are recommended

Fig. 20

Making sure there is a controlled braking path:

- Make sure that this condition is always observed: $s \succ n$.
Only in this way can you avoid states with undefined positions after incorrect programming of the product.
 - **Braking distance n**, which can be achieved at the maximum speed (ascertain: empirically under load or calculated from the motor braking torque)
 - **Switching path s** of the SIE-...

DGE-...-ZR-RF	Switching travel s
...-25-...	97 mm
...-40-...	159 mm
...-63-...	222 mm

Fig. 21

Deviations with $s < n$:

- Use the proximity sensors specified in our catalogue under “Accessories” as reference and hardware limit switches (➔ www.festo.com/catalogue).

If inductive or mechanical limit switches are used:

- Use switching lugs of length d (➔ Fig. 25).

If you are using inductive limit switches:

- Avoid external influence caused by magnetic or ferritic parts in the vicinity of the reference point switches and limit switches.

With use of inductive proximity switches SIE-...:

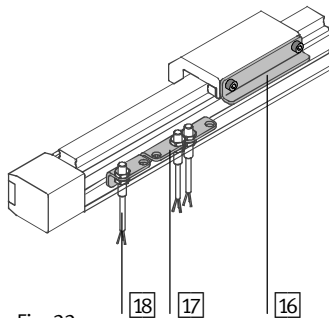


Fig. 22

- 16 = sensor lug
- 17 = sensor support
- 18 = proximity sensor

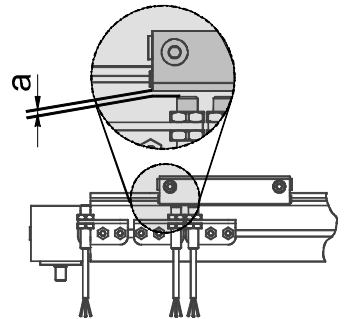


Fig. 23



With small sizes, hammer head screws (accessories) can be used for fastening the sensor support in the groove.

These use the recess in the cover as a guide channel.

A 90° turn will bring the hammer head screw into its holding position.

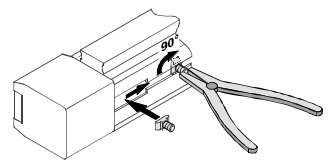



Fig. 24

Increased protection against subsequent damage:

- Use shock absorbers or fixed stops of sufficient size outside the safety limit switches.

The effective stroke of the product may be shorter, depending on the mounting situation.



Carrying out the fitting of external accessories

For placement of the proximity switches:

1. Place the **safety limit switches** in the mechanical end positions (W) as shown in Fig. 25.
2. Place the **hardware limit switches** near the mechanical end positions.
At first the limit switches can still be shifted in the longitudinal direction (cable reserve; for accurate positioning → chapter “Commissioning”).
3. If necessary, place a **reference point switch** between both hardware limit switches (exact positioning: see chapter “Commissioning”).

- Take into account the following plan for positioning the proximity switches:

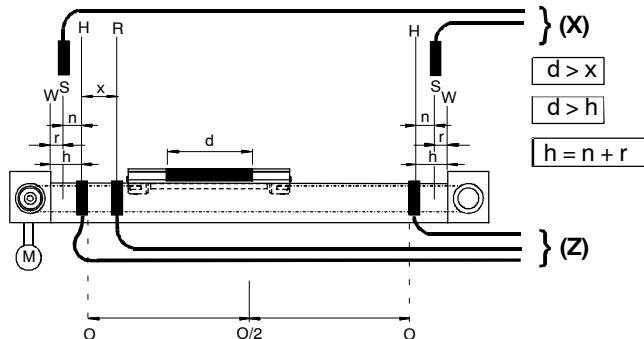


Fig. 25

(M) = Motor

(X) = Interface to emergency stop circuit

(Z) = Interface to controller

W = Mechanical end position

S = Safety limit or switching point of the safety limit switches

H = Switching point of the hardware limit switches

R = Reference point position

O = Positioning limits of the software controller

O/2 = Stroke centre

d = Switch lug length

h = Stroke reserve

n = Braking distance 1

r = Braking distance 2

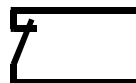
x = Distance of the reference point switch from the hardware limit switch close to the motor

If proximity sensors are used as limit switches:

- Use proximity sensors with normally-closed function. (N.C.= normally closed)

These will protect a DGE with a fractured proximity-sensor cable against overrunning the end position.

Fig. 26



To prevent soiling:



- Use cover rails (accessories) in all unused grooves.

Fitting electric components

- Connect the electric control elements (in accordance with the relevant operating instructions).
 - Connect the motor to the controller (Z) and the main power supply via an intermediately switched power amplifier.
 - Connect the reference point switch to the controller power supply and the controller (Z).
 - Connect the safety limit switch to the controller power supply and the separately switched EMERGENCY STOP device (X) (→ chapter “Connecting electric circuits”).
 - Connect the hardware limit switch to the controller power supply and to the controller (Z).

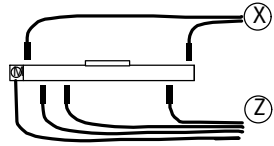


Fig. 27

Installing circuitry



Note

If used in safety-relevant applications, additional measures are necessary. In Europe, for example, the standards in the EC machinery directive must be observed.

Without additional measures in accordance with statutory minimum requirements, the product is not suitable for use in safety-related sections of control systems.

6 Commissioning

Preparing for commissioning



Warning

Moving masses can cause personal injury and material damage (crushing).

- Make sure that, in the travel range,
 - nobody can place his/her hand in the path of the moving load (e.g. by use of a protective crate),
 - there are no foreign objects.
- It should not be possible to touch the DGE until the mass has come to a complete standstill.

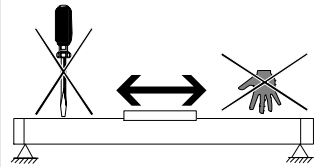


Fig. 28



Note

Incorrect specification values of the braking ramp in STOP situations (e.g. EMERGENCY STOP, Quick Stop) result in an overloading of the toothed belt axis and can destroy it or drastically reduce the service life.

- Check the settings of all braking ramps in your controller or the higher-level controller (deceleration values and jerk).
- Make sure that the deceleration values (braking deceleration, deceleration times), taking into account the speed of travel, moving load and mounting position, are set so that the maximum drive torque or maximum feed force of the used toothed belt axis are not exceeded.
- To design the toothed belt axis, use the Festo design software “PositioningDrives” → www.festo.com.



Note

Block-shaped acceleration profiles (without smoothing) cause high peaks in the drive force, which can result in drive overload. In addition, through overswing effects, positions outside the permissible range can occur. A smoothed acceleration specification reduces vibrations in the overall system and has a positive effect on the mechanical equipment load.

- Check which regulator settings can be adjusted (e.g. smoothing, flattening of the acceleration profile).

Positioning the limit switches

1. First push the cantilever arm into a mechanical end position (W) → Fig. 30.
2. Then position the slide at the distance h (safety distance) from the mechanical end position ($h = n + r$) → Fig. 25.

Type	Distance h
DGE-25-ZR-RF	63 mm
DGE-40-ZR-RF	100 mm
DGE-63-ZR-RF	172 mm

Fig. 29

3. Push the **hardware limit switch** for the relevant end position in the direction of the switching lug up to its switching point.
4. Fasten the hardware limit switch exactly at this point.
5. Repeat the last four points in the other end position.
6. Push the slide into the end positions.

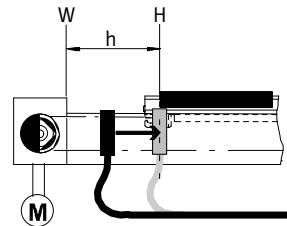


Fig. 30

7. Push the slide into the end positions.
You can thus check whether the hardware limit switches function correctly and whether the switching lug is seated free of play.
7. Fasten the **safety limit switches** between the relevant mechanical end position (W) and the nearby hardware limit switch (H).

The following then applies:

- A braking path of length n remains between the response point of the hardware limit switch and the response point of the safety limit switch (→ also Fig. 25).
- The response ranges of the safety limit switch and the hardware limit switch overlap. In this way you can avoid undefined operating states when the axis is switched on.
- In spite of the defined end position (S) being overrun, the safety limit switches remain actuated up to the mechanical end position (W).

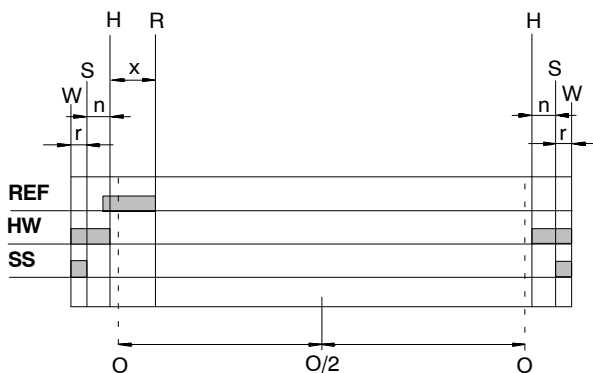


Fig. 31

REF = reference point switch
 HW = hardware limit switch
 SS = safety limit switch

- Fasten the **reference point switch** (if necessary) between the hardware limit switches under the following condition:
 There must be a point at which both the reference point switch as well as the hardware limit switch near the motor respond simultaneously ($x < d$, → Fig. 25).

Checking the functions

1. Push the slide into a mechanical end position.
2. Check whether the safety limit switches and the reference point switches function correctly and whether the switching lug is seated free of play.

Repeat points 1 to 2 in the other end position.

Carrying out commissioning

1. Check travel	2. Homing run	3. Test run
Determining the direction of movement of the motor	Adjusting the real situation with the image in the controller	Checking the complete behaviour

Fig. 32: Definitions

1. Start **check travel** limited to low dynamics.
In spite of equal control, motors of the same type sometimes turn in the opposite direction due to the circuitry.
2. Start **reference travel** in accordance with the operating instructions for your motor drive system limited to low dynamics up to the reference switch.
3. Start **test run** limited to low dynamics.
4. Check whether the DGE fulfils the following conditions:
 - The slide unit must be able to move through the complete intended positioning cycle.
 - The slide unit must stop as soon as it reaches a limit switch.
5. If the proximity sensors do not respond: → chapter 11 “Eliminating malfunctions” and follow the operating instructions for the proximity sensors.

In the case of deviations from the nominal behaviour:

- Check these points on your installation:
 - Motor
 - Motor mounting kit
 - Mechanical fitting
 - Electrical connections
 (→ also chapter “Eliminating malfunctions”).

7 Operation



Warning

- Make sure that, in the travel range of the article,
 - nobody can place his/her hand in the path of the moving load (e.g. by providing a protective screen)
 - there are no foreign objects.

It must not be possible to touch the DGE until the mass has come to a complete standstill.

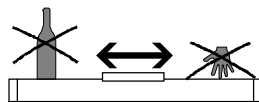


Fig. 33

Fitting in a vertical or sloping position:



Warning

Masses falling suddenly can cause personal injury and material damage (crushing). If there is a power cut or if the toothed belt breaks, the work load will slide down.

- Make sure that you only use motors with an integrated spring-loaded holding brake.
- Check whether additional external safety measures are required to prevent the work load from sliding down (e.g. toothed latches, moving bolts or emergency buffers).

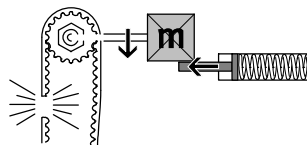


Fig. 34



Note

A motor from Festo with spring-loaded holding brake holds masses at standstill securely in position. This type of brake is not suitable for braking masses in movement. Frequent braking increases wear.

If the motor is turned around:



Note

When the motor is removed (e.g. turning the motor) the reference position is lost.

- Start a homing run as detailed in the chapter 6 “Commissioning” in order to set the new reference position.

8 Service and maintenance



Warning

Controller signals can cause the DGE to make unintentional movements.

- Switch off the controller for all maintenance work on the DGE and secure it to prevent it from being switched back on unintentionally.

- Do not adjust screws or threaded pins for which there are no direct demands for modification in the operating instructions.

Lubricating the roller guide:

- Lubrication intervals: as needed, but theoretically no more than every 10000 km.
- Note that lubrication must be undertaken more often in the case of:
 - dusty and dirty environments,
 - very short work strokes (running-in at one position).
- Lubricate the DGE-...-ZR-RF at the lubrication nipples on both sides of the slide.

Oil: e.g. Constant OY 390 from Klüber, Munich

Grease gun: → Accessories chapter

If space is limited:

- Use lubrication adapter B (output axial) or C (output radial) instead of the standard lubrication adapter A.

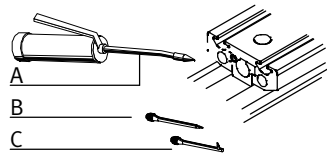


Fig. 35

- Move through the nominal stroke once completely in order to distribute the oil evenly in the interior of the DGE-...-ZR-RF.
- Recommendation:
Return the product to Festo for inspection after every 10,000 kilometres run.

During each servicing process:

- Check that the slide is set free of play and distortion.
If there are signs of play or distortion → Eliminating malfunctions chapter.

9 Repair



Note

Retensioning of the toothed belt reduces its service life considerably.

In addition, the technical data, e.g. the feed constant, will be modified.

- Make sure that the toothed belt has not been retensioned.
The toothed belt is pretensioned so that it does not have to be retensioned during its life.

- Recommendation: Return the DGE to our repair service.
The necessary fine adjustments and tests will then be taken into account.
- Information on spare parts and aids can be found under:
www.festo.com/spareparts

10 Accessories



Note

- Please select the appropriate accessories from our catalogue
www.festo.com/catalogue

Designation	Type	Part number
Grease gun with pointed nozzle	LUB-1	647 958 *)
Lubrication adapter, outlet axial	LUB-1-TR-I	647 959 *)
Lubrication adapter, outlet radial	LUB-1-TR-L	647 960 *)
*) → Spare-parts catalogue under www.festo.com/spareparts		

Fig. 36

11 Eliminating malfunctions

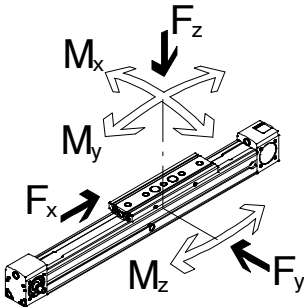
Malfunction	Possible cause	Remedy
Imprecise positioning	Tooth overjumped due to high inertial forces	Reduce dynamic loading, new homing run, if necessary return to Festo
	Toothed belt damaged	Return product to Festo
	Reference point switch loose or switching lug loose	Fasten
	Outside the axis	Check the peripherals (e.g. motor, controller...)
	Fastening of interface to effective load on slide loose	Fasten again as described in the "Fitting" chapter
	Clamping hub spins	Check how the motor mounting kit is fitted (coupling)
	Play in roller guide	Return product to Festo
	Defective bearing of shafts, etc.	
Loud running noises	Roller guide damaged	Return product to Festo
	Play in roller guide	
	Insufficient lubrication (of the slide bearing)	Lubricate, if necessary return product to Festo
	Toothed belt damaged	Return product to Festo
	Outside the axis (e.g. motor including motor mounting kit or external devices)	Check peripherals for parts in contact with each other
	Wear on the actuating lug	Return product to Festo

Malfunction	Possible cause	Remedy
Missing or undefined switching functions	Proximity sensor or cable defective	Fit new proximity sensor or replace cable
	Sensor support or switching lug incorrectly fitted	Redo settings
	Switching gap set incorrectly	Readjust
	Incorrect switch or incorrect connection	Use correct switch or connection
Jamming	Excessive dirt under toothed belt	Repair cause and return product to Festo
	Axis badly damaged due to crash or similar	Return product to Festo
	Outside the axis (e.g. drive package including motor mounting kit or external devices)	→ Instructions
Permitted dynamics not reached	Incorrect toothed belt tensioning e.g. due to belt damage	Return product to Festo
“Locking in” at one position	Long downtime	Disappears after a start-up phase
Vibrations	Axis overloaded	Observe maximum loading values
	Dynamics too high	If necessary, check modifications to project planning
	Incorrect arrangement of the centre of gravity of the effective load	Shift centre of gravity
	External coupling on base stand or in multi-axis system	Eliminate interference
Motor speed cannot be transmitted to product	Clamping hub spins	Check how the motor mounting kit is fitted (coupling)
	Toothed belt torn or teeth worn	Return product to Festo

12 Technical Data

	Size		
	DGE-25-ZR-RF	DGE-40-ZR-RF	DGE-63-ZR-RF
Design	Electric linear unit with rotating toothed belt		
Permitted temperature range (storage/operation)	0 ... +60 °C		
Protection class	IP40		
Assembly position	As desired		
Permitted effective load horizontal	15 kg	30 kg	60 kg
Permitted effective load vertical	5 kg	12.5 kg	25 kg
Feed constant **)	90 mm/rev	125 mm/rev	232 mm/rev
Max. permissible slide speed	10 m/s		
Max. radial force on the drive shaft ***) Stability calculation: For 10000 km of running:	260 N 110 N	935 N 100 N	2490 N 1050 N
Max. permissible linear acceleration	Depends on mass		
Mass moment of inertia (J_A) related to drive pin	$J_A = J_0 + H \cdot J_H + J_K + m \cdot J_L$ Stroke length (H), effective load (m)		
Mass moments of inertia [kgmm ²] – for zero stroke J_0 – per metre stroke J_H – per kg effective load J_L – of the coupling J_K	175.4 (274.97) 18.84 205.2 6.06	989.4 (1537) 93.33 395.8 42.3	10811 (15670) 760.54 1363.4 417
Repetition accuracy as per DIN 230, part 2	±0.1 mm		
Perm. axial feed force F_x [N] *)	260	610	1500

	DGE-25-ZR-RF	DGE-40-ZR-RF	DGE-63-ZR-RF
Perm. traverse load F_y, F_z [N]	150	300	600
Permitted torque loading: M_x [Nm] M_y [Nm] M_z [Nm]	7 15 (30) 15 (30)	18 60 (120) 90 (180)	65 170 (340) 300 (600)
Max. driving torque at drive pin M_{max} [Nm]	3.7	12.1	55.4
<p>() Values in brackets for variant GV *) Theoretical; for expected service life **) This is a nominal value and varies due to component tolerances. ***) – The point of application of the radial force is at the journal end- – The values refer to a radial force on a journal- – The bearing basic load rating limits the radial force at corresponding run performance.</p>			
Materials	Housing, cylinder barrel, cover : Al Rollers, screws, slot nuts: St Buffers, wiper: Rubber, felt Toothed belt: Polychloroprene with nylon fabric and fibreglass body Toothed belt discs: St, stainless Guide rods: St		



$$\frac{|M_x|}{M_{x_{max}}} + \frac{|M_y|}{M_{y_{max}}} + \frac{|M_z|}{M_{z_{max}}} + \frac{|F_y|}{F_{y_{max}}} + \frac{|F_z|}{F_{z_{max}}} \leq 1$$

DGE-...-ZR-RF

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