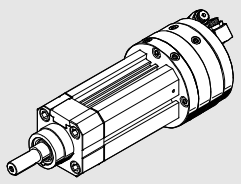
DSL-16 ... 40-270-...-B



Operating instructions
Original instructions

Festo SE & Co. KG
Ruiter Straße 82
73734 Esslingen,
Germany
+49 711 347-0
www.festo.com

8067760 [8067762]

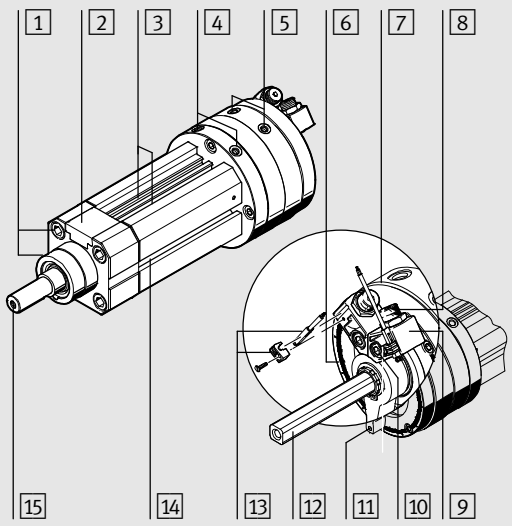
1701b

➔ ..... **Note**

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

Note the warnings and instructions on the product and in the relevant operating instructions.
The specifications/instructions in the relevant documentation supplied with the product must be observed.

First read through all the operating instructions supplied with the product. In this way you can avoid extra expense due to any necessary corrective measures.



1 Thread for fastening
2 Cover cap
3 Double groove for proximity switch
4 Compressed air connections for linear component
5 Compressed air supply ports for swivel component
6 Angle scale
7 Snap ring for protective cap
8 Shock absorber with locking nut (optional)
9 Shock absorber retainer (optional)
10 Locking screw for absorber retainer
11 Stop lever with integrated magnet for position monitoring
12 Square (projecting length depending on position of linear component)
13 Sensor support with proximity switch (optional)
14 Groove for fastening with slot nuts
15 Extendable piston rod with thread and feather key

Fig. 1

Swivel/linear unit ..... **en**
Type DSL-16 ... 40-270-...-B

1 Applicable documents

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

2 Function and application

The combination of swivel component and linear component in one product permits overlapping movements.
When the compressed air ports are pressurised alternately, the inner vane in the housing swivels backwards and forwards. This swivel movement is transmitted to the outer stop lever and converted to a rotary movement on the piston rod. The angle of rotation can be limited for the stop lever by means of adjustable shock absorber elements (elastomer absorbers or shock absorbers).
Irrespective of this, the piston rod extends or retracts when the relevant compressed air ports are pressurised alternately.
The DSL swivel-linear module has been designed for the combined movement of work loads which do not have to carry out a complete revolution.

3 Transport and storage

- Take into account the weight of the DSL:
  It weighs up to 7 kg.
- Ensure storage conditions as follows:
  – Storage times should be kept to a minimum
  – cool, dry, shaded storage locations protected from corrosion.

4 Conditions of use

➔ ..... **Note**

Malfunctions will occur if the device is not used correctly.
- Ensure that the specifications in this chapter are always observed.
- Note the warnings and instructions on the product and in the relevant operating instructions.

- Compare the maximum values specified in these operating instructions with your actual application (e.g. pressures, forces, torques, temperatures, masses).
  The product can only be operated in accordance with the relevant safety guidelines if the maximum loading limits are observed.
- 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.
- Ensure that all applicable safety regulations are observed, e.g. from trade associations or national authorities.
- Remove the packaging.
  It is intended that the packaging be recycled on the basis of its constituent materials (exception: oiled paper = other waste).
- Ensure that the compressed air is properly prepared (➔ Technical specifications).
- Use the same medium composition throughout the service life of the product. Example:
  If unlubricated compressed air is selected at the outset, then unlubricated compressed air should be used during the complete service life of the product.
- Pressurise your complete system slowly until the operating pressure is reached. This ensures that all actuator movement is controlled.
  For slow start-up pressurisation use safety start-up valve type HEL.
- Use the product in its original state. Unauthorised modification is not permitted.

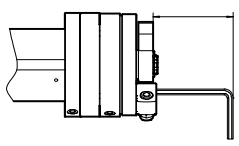
5 Fitting

5.1 Fitting mechanical components

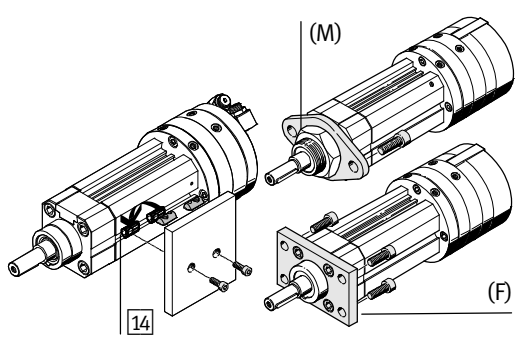
Definition
moving mass = work load (+ mass of any levers)

- Handle the DSL with care so that the piston rod or square is not damaged. This applies in particular to the following points:

- Position the DSL so that you can easily reach the operating parts.

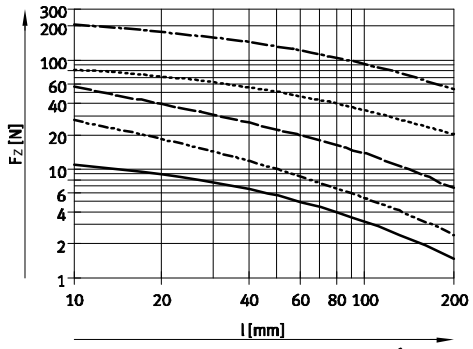


- Fasten the DSL as follows:
  – with at least 2 screws and slot nuts in the groove 14 on the linear component of the DSL
  – on the central nut (M) on the DSL-16
  – over a flange (F) on the centring collar on the drive take-off side of the DSL-20 ... 40.



Using the square 12 for optional purposes:
- Avoid lateral forces on the square 12.
  Additional optional purposes are e.g.:
  – axial, touching scanning
  – axial cushioning.
  A light additional element (e.g. a stop or switching cam) can be mounted on the square.

- When placing the moveable mass, make sure that the following points are observed:
  – the device must not be tilted,
  – permissible radial force Fz (diagram below),
  – effective power Fx (➔ Technical data),
  – permissible mass moment of inertia (➔ Technical specifications).

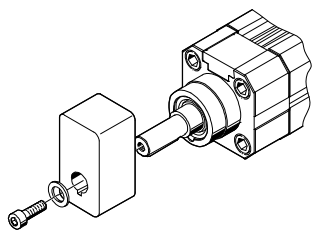


The mass moment of inertia of the moveable mass should be calculated. Lever arms, jibs and masses, as well as masses on the square must be taken into consideration in the calculation.
The permissible mass moment of inertia (➔ Catalogue specifications) depends on the specific situation:
– the size of the DSL
– the type of end-position cushioning
– the swivel time
– the swivel angle
– the stroke time

Definition
Swivel time = rotation time of the inner vane + cushioning time from the shock absorber DYSC

DSL-...-270-...-B	16	20	25	32	40
DYSC-...	5-5	7-5		8-8	12-12
Cushioning time [s]	0.1			0.25	0.3

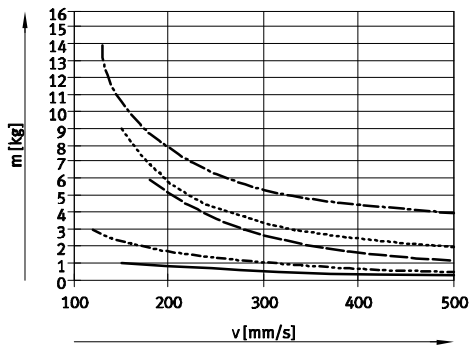
Fastening the work load
- Push the moveable mass onto the piston rod:



- Make sure that the moveable mass cannot slide down from the piston rod.
  The thread in the piston rod serves this purpose.
  When tightening the screws, counter-lock at the work load.
- Note the following tightening torque:

DSL-...-270-...-B	16	20	25	32	40
Tightening torque [Nm]	1.2	5.5			10

- Note the following correlation of permitted work load and piston speed v:
  Eccentric masses on the horizontal lever arm increase the inner friction. The effective power of the linear movement is thereby reduced (not with DSL-...-KF).



5.2 Adjusting the DSL with an internal stop system

Using **external** stops and shock absorbers

➔ ..... **Note**

- Make sure that the following points are observed:
  – The target point in the mass moment of inertia (important with eccentric masses on the lever arm)
  – The permitted radial force Fz (➔ Chapter “Fitting mechanical components”)
  – Using protective devices (e.g. cover cap ➔ Accessories)

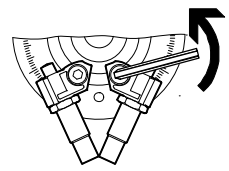
➔ ..... **Note**

Operation without shock absorbers will destroy the DSL.

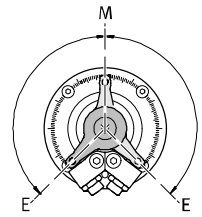
1. Remove the protective cap of the DSL from the housing (if present).
2. Screw the shock absorber elements (elastomer absorbers or shock absorbers) into the shock absorber retainer.
   The accompanying documentation must be observed.
3. Swivel the moveable mass to the desired end position:
   – by hand
   – with open-end wrench on the square 12.
     (not with DSL-...-KF)
   The angle scale on the housing ring serves as a first orientation.

DSL-...-270-...-B	16	20	25	32	40
Degree setting (1 graduation =) [°]	2			1	

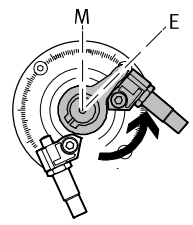
4. Unscrew the locking screws for the shock absorber retainers. To shift the shock absorber retainers it is sufficient to slacken the locking screws until they can just barely be shifted.



5. If possible use symmetric angle settings that follow line of symmetry M of the DSL. These produce a more even movement between right-hand and left-hand rotation.



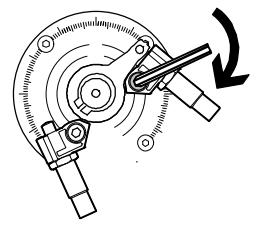
6. Push the nearby shock absorber retainer towards the stop lever against the force of the shock absorber until the fixed stop of the shock absorber (elastomer absorber or shock absorber) touches the stop lever.
   If necessary, counter-lock on the work load.



➔ ..... **Note**

Shock absorber retainers that are fastened with an insufficient tightening torque may shift under operating conditions, resulting in damage to the DSL.

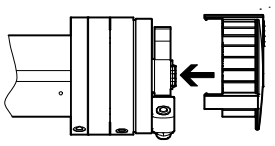
7. Tighten the locking screw of the shock absorber retainer again with the following tightening torque.
   Only with the specified tightening torque will the toothing of the shock absorber retainer bite into the housing material.



DSL-...-270-...-B	16	20	25	32	40
Locking screw	M3	M4	M5	M6	M8
Tightening torque [Nm]	2.1	4.9	10	16.5	40

8. Repeat the adjustment for the other end position.

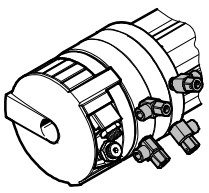
9. Press the protective cap of the DSL back onto the snap ring of the housing (if present).
   The protective cap can also be snapped onto freely positioned shock absorber retainers if the elements are broken through at the predetermined breaking point. Observe the fitting instructions for the cover cap.



When all stops have been adjusted:
- Check whether additional shock absorbers or stops are necessary.
  Additional shock absorbers or stops are necessary in the following cases:
  – for movable masses with a calculated mass moment of inertia greater than the **permitted** mass moment of inertia
  – when the DSL is operated without an air cushion on the exhaust side (e.g. after long breaks between the individual swivel movements).
  Shock absorber retainers for internal fitting of shock absorbers/elastomer absorbers can be ordered separately and installed on the DSL (➔ Accessories).

5.3 Fitting pneumatic components

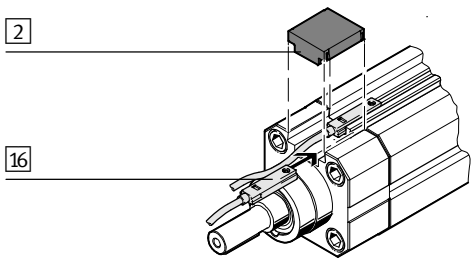
- Use GRLA one-way flow control valves for setting the swivel speed and stroke speed.
  These are screwed directly into the compressed air ports.



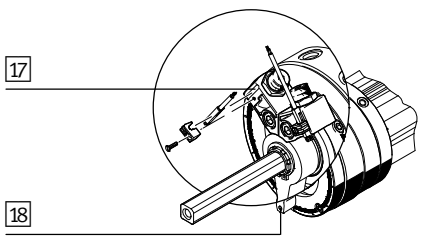
With eccentric masses:
- Check whether HGL controlled non-return valves or a VZS compressed air reservoir are necessary.
  In this way you can prevent the moveable mass from sliding down suddenly if there is a sudden drop in pressure.

5.4 Fitting electric components

For sensing the cylinder end positions:
- Place the proximity switches 16 in the double groove of the profile.
  1. Lift up the cover cap 2 with a flat screwdriver.
  2. Push a proximity switch 16 for each of the end positions into a groove.
  3. Press the cover cap tight again.



For sensing the swivel end positions:
- Place the proximity switches on the guide rim 17 of the absorber retainers.
  Sensor supports (➔ Accessories) are required for fastening the proximity switches.
  The proximity switch is actuated by the magnet 18 in the stop lever.



6 Commissioning

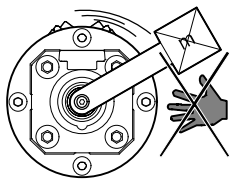
6.1 Commissioning the complete system

- Pressurise your entire system slowly.
  This will prevent uncontrolled movements from occurring.

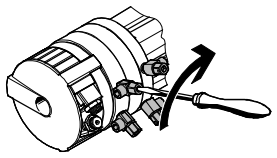
6.2 Commissioning an individual unit

⚠ ..... **Warning**

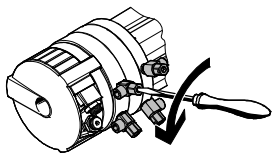
Risk of injury from rotating masses.
- Make sure that the DSL is set into motion only when the safeguards are fitted.
- Make sure that:
  – nobody can reach into the swivel/positioning range of the DSL
  – no objects lie in the positioning path (e.g. by providing an individual protective screen).



1. Tighten the two upstream one-way flow control valves
   – first close completely
   – then loosen approximately one turn.



2. Make sure that the operating conditions lie within the permitted ranges.
3. Pressurise the drive in one of the following ways:
   – **slow** pressurisation of one side of the swivel or linear component
   – simultaneous pressurisation of both sides with subsequent exhausting of one side.
4. Start a test run.
5. During the test run check whether the following settings on the DSL need to be modified:
   – the swivel range of the moveable mass
   – the swivel speed of the moveable mass.
6. Unscrew the one-way flow control valves slowly until the desired swivel speed is set. The stop lever 6 should reach the end position, but not strike hard against it.



➔ ..... **Note**

If the impact is too hard, it will cause the stop lever to rebound out of the end position, resulting in a reduction of the service life.

If the stop lever can be heard to strike hard:
7. Interrupt the test run.
   Causes of hard knocking may be:
   – Mass moment of inertia of the moveable mass too high.
   – Swivel speed of the moveable mass too high.
   – No compressed air cushion on the exhaust side.
   – Insufficient shock absorption.
8. Make sure you remedy the above-mentioned causes.
9. Repeat the test run.

When all necessary corrections have been undertaken:
10. Conclude the test run.

6.3 Fine adjustment of the end positions

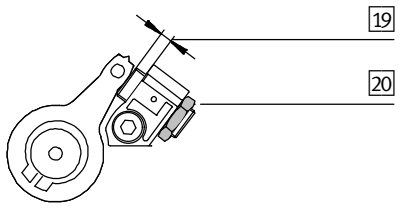
➔ ..... **Note**

A shock absorber that is screwed too far in or out results in the stop lever:
– either hitting the shock absorber retainer without shock absorption
  or
– hitting the shock absorber at an impermissible angle.
In such a case there is a risk of the DSL or the shock absorber being damaged.
- Make sure that you do not screw the shock absorber in or out any further than shown in the following table.
  Otherwise the shock-absorbing performance of the shock absorber/elastomer absorber will be insufficient or even completely ineffective.

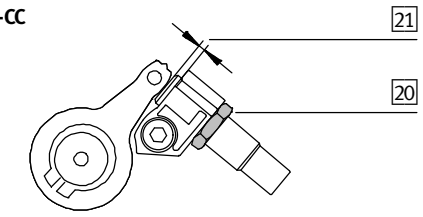
- Pressurise the desired end position on the DSL.
  The end positions can be adjusted under pressure.

1. Remove the protective cap from the housing (if present).
2. Unscrew the locking nut 20 of the shock absorber.
   The unscrewing length of the shock absorber (Elastomer absorber 19 or shock absorber 21) can be used to compensate the deviation of the end position.
   This occurs during pre-adjustment when the shock absorber is moved against the unpressurised stop lever.

DSL-...-P



DSL-...-CC



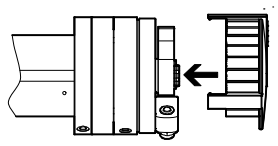
3. Screw the shock absorber into or out of the shock absorber retainer using a hexagon spanner.
   The permissible unscrewing lengths are summarised in the following table.

DSL-...-270-...-B		16	20	25	32	40
Unscrewing length 19	[mm]	0 ... 2.5	0 ... 3	0 ... 4	0 ... 4.5	0 ... 5.4
Screwing-in length 21	[mm]	0 ... 1.25	0 ... 1.5	0 ... 2	0 ... 2.25	0 ... 2.7

When all stops have been adjusted:
4. Tighten the locking nuts 20 of the shock absorbers again.
   The necessary tightening torques are summarized in the following table.

DSL-...-270-...-B		16	20	25	32	40
Tightening torque of the locking nut 20	[Nm]	2	3	3	5	20

5. Check that the proximity switches function correctly.
6. Press the protective cap of the DSL back onto the snap ring (if present).



7. Repeat the test run.

7 Operation

With several uninterrupted swivel cycles:
- Make sure that the maximum permitted swivel frequency is not exceeded (➔ Technical specifications). Otherwise, functional reliability will be impaired by excessive heating.

To extend the service life of the shock absorbers:
- Apply a thin coating of grease to the stop caps of the shock absorbers.

Checking for proper functioning:
- Check the shock absorbers for oil loss after every 2 million switching cycles.
- Change shock absorbers with visible oil loss or at the latest every 5 million switching cycles (➔ Accessories).

8 Care and maintenance

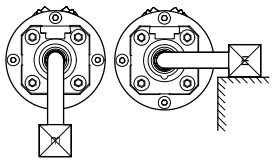
If the device is dirty:
- Clean the DSL with a soft cloth.
  All non-abrasive cleaning agents are permitted (e.g. warm soap suds up to +60 °C).

9 Dismantling and repairs

With eccentric masses on the lever arm:

⚠ ..... **Warning**

Risk of injury from masses that slide down suddenly if there is a drop in pressure.
- Make sure that the mass has reached a stable position before the DSL is exhausted (e.g. the lowest point).



Recommendation:
- Return the product to our Repair Service.
  The necessary accurate 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.

11 Eliminating faults

Fault	Possible cause	Remedy
Uneven movement of the moveable mass	Flow control valves inserted incorrectly	Check the flow control valve function (exhaust air flow control)
	Asymmetric angle setting	Symmetric setting preferred
– Hard impact at the end position – Piston rod does not remain in the end position	Residual energy too high	– Select smaller stroke or swivel speed – Use external shock absorbers – Move only against residual air cushion on the exhaust side – Select a lighter mass
Piston rod moves only with great difficulty or not at all	Bending stress via the drive rod	Avoid bending stress (especially on the square 12)

12 Technical specifications

DSL-...-270-...-B		16	20	25	32	40
Constructional design		Combined stroke/rotary cylinder with swivel vane – in each case double-acting				
End position cushioning						
– Linear motion		P – not adjustable at either end				
– Swivel component		None (may only be operated with shock absorption)				
Mounting position		as desired				
Min. stroke length	[mm]	10				
Max. stroke length **DSL**	[mm]	160			200	
Max. stroke length **DSL-KF**	[mm]	100				160
Pneumatic connection		M5			G1⁄8	
Operating medium		Filtered compressed air, lubricated or unlubricated				
Operating pressure	[bar]	2.5 ... 8				
Ambient temperature	[°C]	–10 ... +60				
Theoretical effective power F_x at 6 bar						
– advancing **DSL**	[N]	102.5	159	246	422.5	660
– retracting **DSL**	[N]	73.5	120.5	173.5	294	495
– advancing **DSL-KF**	[N]	103.5	158	248	403.5	603
– retracting **DSL-KF**	[N]	73.5	120.5	173.5	294	495
Permitted dynamic load torque **DSL-KF**	[Nm]	0.17	0.35	0.7	1.0	5.4
Torque at 6 bar	[Nm]	1.25	2.5	5	10	20
Max. piston speed of linear component	[mm/s]	500				
Note on materials		free of copper and PTFE				
Materials: – housing, flange stop lever, cover – piston rod / shaft – swivel vane, cap – stop screw, stops, screws – seals		anodised aluminium steel, nickel-plated fibreglass-reinforced plastic stainless steel galvanised steel polyurethane				

DSL-...-270-P-...-B		16	20	25	32	40
End position cushioning		Elastomer shock absorbers				
End position adjustment		via elastomer shock absorbers with fixed stop				
Max. permissible mass moment of inertia	[10^{-4} kg m^2]	0.35	0.7	1.1	1.7	2.4
Swivel angle	[°]	270				
Swivel angle adjustment	[°]	-6				
Shock absorbing angle, single	[°]	1.8	1.4	1.2	1.4	2
Swivel frequency	[Hz]	2				
Weight	[kg]					
– Basic weight **DSL**		0.70	1.09	1.61	2.99	5.30
– Basic weight **DSL-KF**		0.75	1.18	1.66	3.02	5.21
– Linear component per 10 mm stroke		0.033	0.052	0.067	0.109	0.175

DSL-...-270-CC-...-B		16	20	25	32	40
End position cushioning		Shock absorbers				
End position adjustment		via shock absorbers with fixed stop				
Max. permissible mass moment of inertia	[10^{-4} kg m^2]	7	12	16	21	40
Swivel angle	[°]	246				240
Swivel angle adjustment	[°]	-3				
Shock absorbing angle, single	[°]	15	12	10	12	16
Swivel frequency with 2 shock absorbers – at max. swivel angle – at smaller swivel angles		 1.5 2	 1 1.5	 1 1.5	 0.7 1.5	 0.7 1.5
Weight	[kg]					
– Basic weight **DSL**		0.7	1.13	1.61	3.02	5.21
– Basic weight **DSL-KF**		0.75	1.22	1.75	3.30	5.36
– Linear component per 10 mm stroke		0.033	0.052	0.067	0.109	0.175