Miniature linear actuator with toothed belt drive

Series MLFI20-ZR

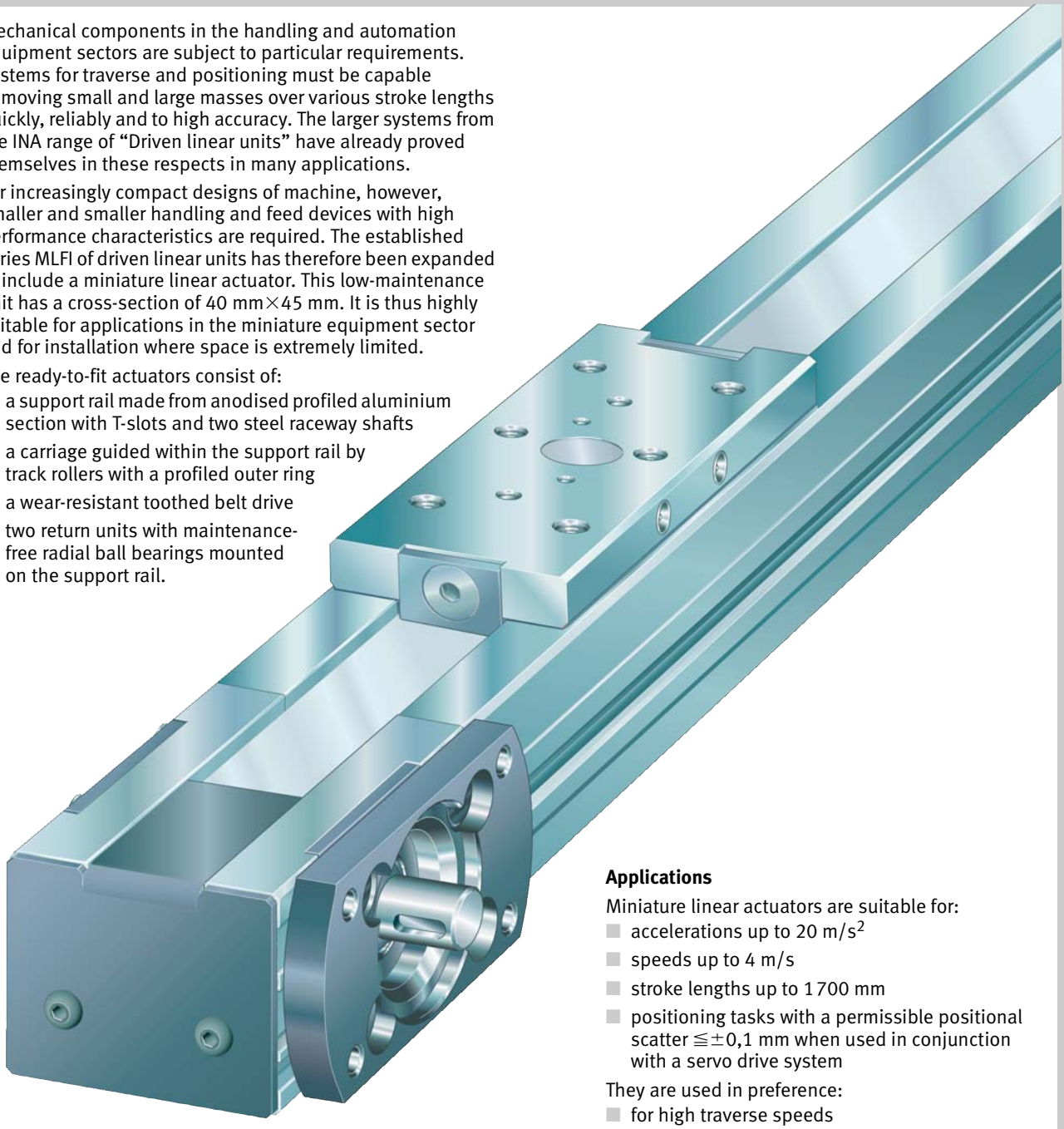
Highly compact, very high performance

Mechanical components in the handling and automation equipment sectors are subject to particular requirements. Systems for traverse and positioning must be capable of moving small and large masses over various stroke lengths quickly, reliably and to high accuracy. The larger systems from the INA range of “Driven linear units” have already proved themselves in these respects in many applications.

For increasingly compact designs of machine, however, smaller and smaller handling and feed devices with high performance characteristics are required. The established series MLFI of driven linear units has therefore been expanded to include a miniature linear actuator. This low-maintenance unit has a cross-section of 40 mm×45 mm. It is thus highly suitable for applications in the miniature equipment sector and for installation where space is extremely limited.

The ready-to-fit actuators consist of:

- a support rail made from anodised profiled aluminium section with T-slots and two steel raceway shafts
- a carriage guided within the support rail by track rollers with a profiled outer ring
- a wear-resistant toothed belt drive
- two return units with maintenance-free radial ball bearings mounted on the support rail.



Applications

Miniature linear actuators are suitable for:

- accelerations up to 20 m/s^2
- speeds up to 4 m/s
- stroke lengths up to 1700 mm
- positioning tasks with a permissible positional scatter ≦±0,1 mm when used in conjunction with a servo drive system

They are used in preference:

- for high traverse speeds
- in the handling and automation equipment sectors
- in applications requiring very small design envelopes.

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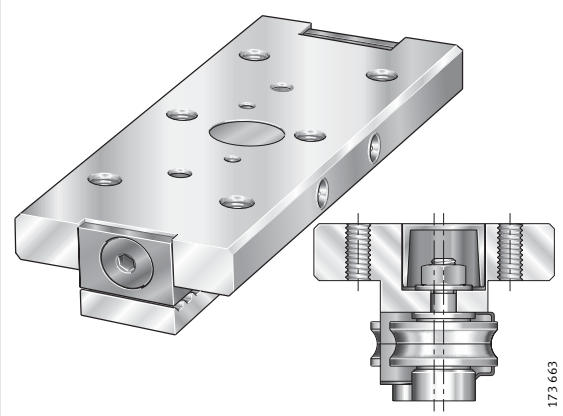
Miniature linear actuator with toothed belt drive

Features

Linear actuators with track roller guidance system and toothed belt drive

- are complete units comprising:
  - a support rail with two shafts made from high alloy steel in a parallel arrangement
  - one carriage guided within the support rail – guidance by three track rollers
  - a toothed belt drive
  - two return units
- can support forces from all directions and moments about all axes
- are suitable for light loads
- can also be fitted with more than one driven carriage
- have a clearance-free guidance system
  - the track rollers are adjusted against the raceways by means of an eccentric bolt
- run with high positional accuracy
  - the positional scatter is ≦±0,1 mm with a servo drive system
- are suitable for:
  - accelerations up to 20 m/s^2
  - speeds up to 4 m/s
  - operating temperatures from –20 °C to +80 °C
- are easy to fit
  - the support rail has T-slots for movable T-nuts. The components can therefore be easily screwed to the adjacent construction
- are particularly suitable, due to the clamping slots, for modular constructions
- are low-maintenance; the raceways can be relubricated
  - the toothed belt drive and return units require no maintenance (they are greased for life)
  - the raceways of the track rollers can be relubricated via the lateral lubrication nipples in the carriage by means of felt lubrication devices
- are versatile in application due to a comprehensive range of accessories.

Carriage



- saddle plate made from anodised profiled aluminium with threaded holes
- three maintenance-free track rollers
- eccentric bolt for clearance-free adjustment of track rollers against raceway
- driven by toothed belt
- means for gripping the toothed belt on both sides
- lubrication nipples on longitudinal faces

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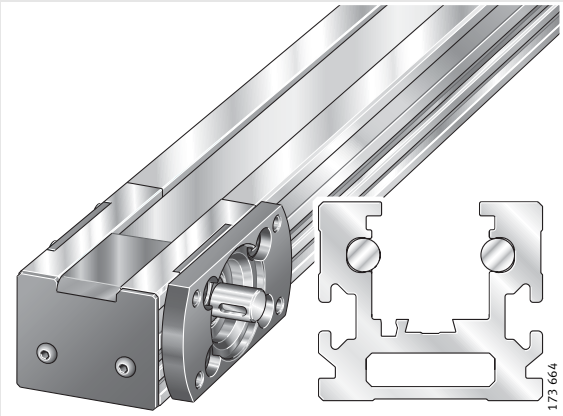
Support rail with return unit



- support rail
  - composite guideway comprising anodised aluminium support rail and rolled-in shafts made from high alloy steel
- return unit
  - housing made from anodised profiled aluminium
  - return shaft with maintenance-free ball bearings

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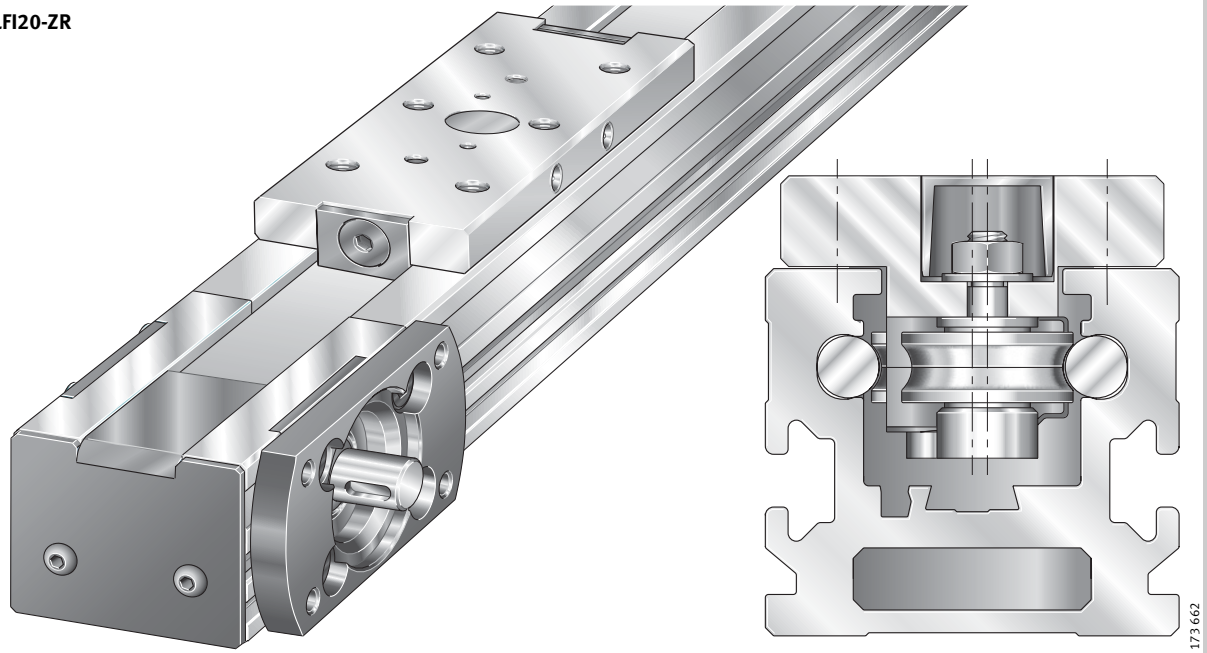
Miniature linear actuator – scope of basic delivery

MLFI20-ZR



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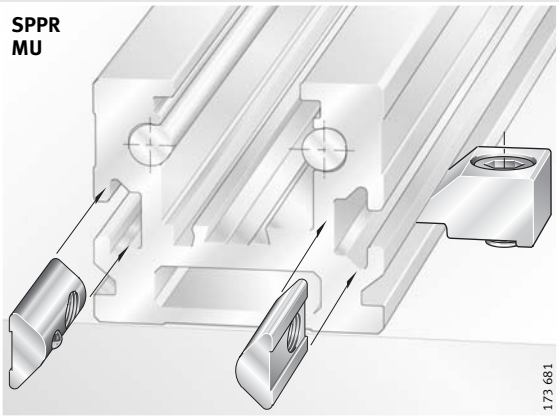
Accessories

SPPR
MU



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- SPPR
  – clamping lug
- MU
  – positionable T-nut

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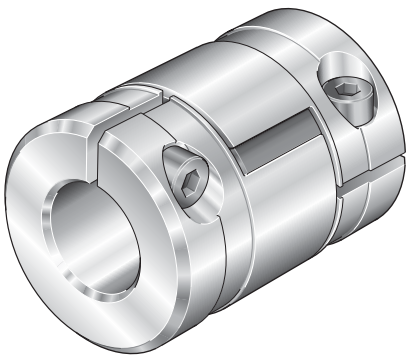
KUP



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- clearance-free shaft coupling for positioning drives
- clamping hubs made from anodised aluminium
- elastic plastic toothed ring
- fixing by means of clamping screws

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Design and safety guidelines

Drive variants

The possible positions of the drive are shown in Figure 1.
Description of the suffixes: see Table 1.

Table 1 · Drive variants – suffixes

Drive system Suffix	Design
AR	Drive shaft on right side
AL	Drive shaft on left side
RL	Drive shaft on both sides (right and left)

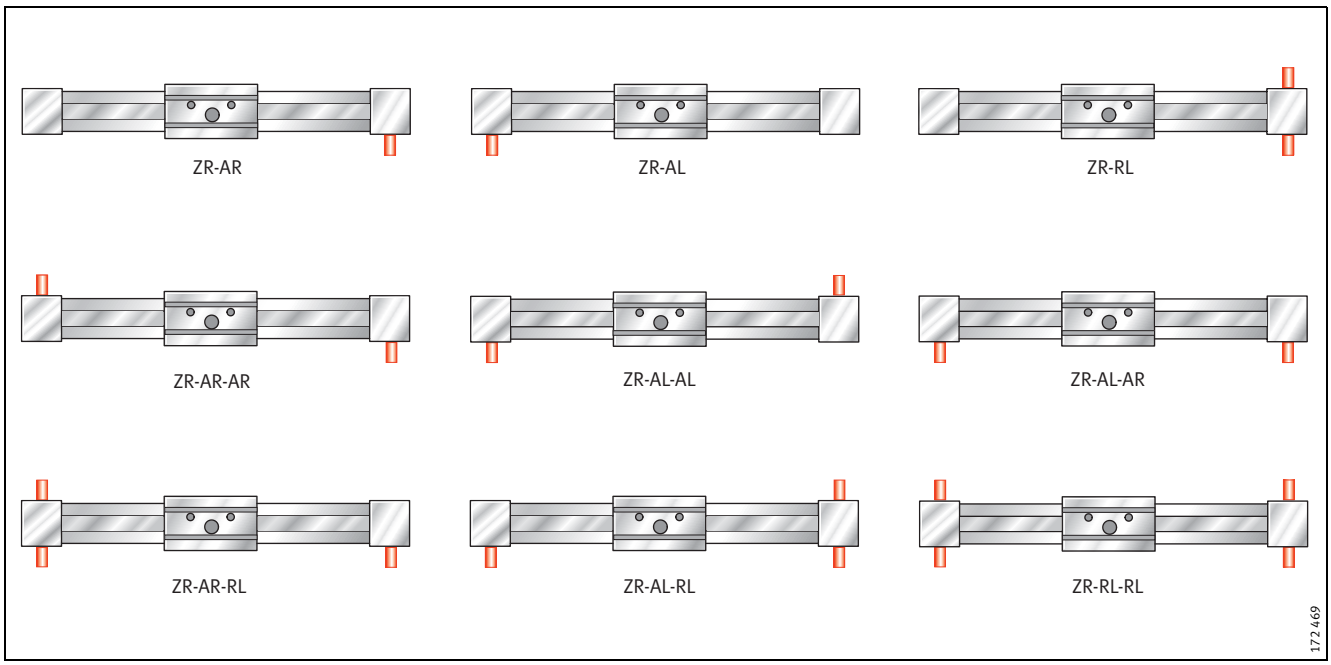


Figure 1 · Positions of the drive – schematic

Lubrication

Track rollers

The track rollers in the carriages are greased with a high quality lithium complex soap grease in accordance with DIN 51825–K3K–30 and are maintenance-free.

Raceways

The raceways for the track rollers must be lubricated at particular intervals.

The relubrication intervals are essentially dependent on:

- the travel speed
- the load
- the operating temperature
- the stroke length
- the environmental conditions; the cleaner the operating environment, the lower the lubricant consumption.

Since it is not possible to calculate all the influencing factors, the time at which relubrication must be carried out and the quantity of lubricant which must be used can only be determined under actual operating conditions.
Guide values for oil quantities: see Table 2.

Relubrication must be carried out at the latest when fretting corrosion first occurs – this can be identified by a reddish discolouration of the raceways or the outside surface of the track rollers. The subsequent lubrication intervals must be shortened.

The oil quantity given in Table 2 must be distributed equally to both lubrication points on one side of the carriage.

The support rail raceways are lubricated by an oil-soaked felt insert. Relubrication is carried out via two lubrication nipples ① on each longitudinal side of the carriage ② (Figure 2).
Lubricant must always be provided to both lubrication nipples. Relubrication can be carried out from either the left or right side.

The felt inserts are impregnated with oil:

- viscosity ISO VG 460, USDA H1 approval for the food industry.

⚠ The oil gun, lubrication nipple, the area around the lubrication nipple and the oil must be clean.

Return unit

The radial ball bearings cannot be relubricated.
They are greased for life.

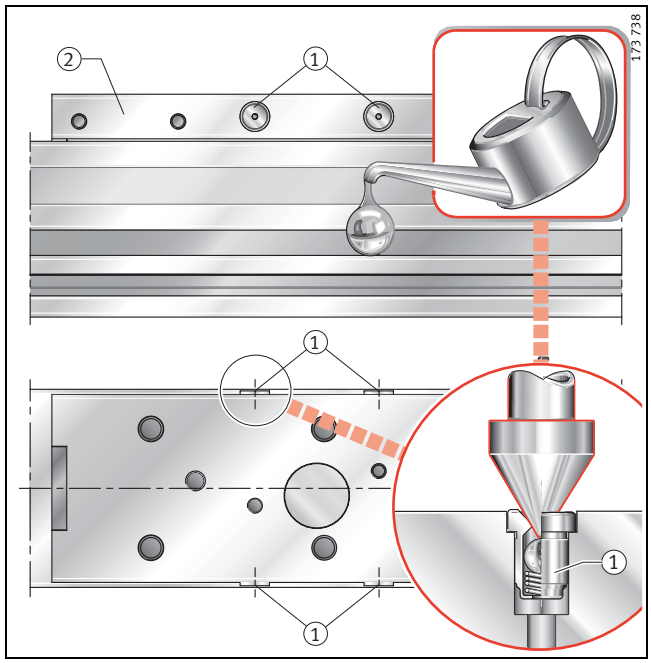


Figure 2 · Lubrication points – MLFI20-ZR

Table 2 · Relubrication quantities – guide values

Linear actuator	Oil quantity per carriage ml
MLFI20-ZR	2 to 3

Accuracy

The linear actuators are precision straightened and the tolerances are better than DIN EN 12 020-2. The tolerances are arithmetic mean values.

The method for determining the straightness of the support rails is shown in Figure 3.

Table 3 · Length tolerance of linear actuators

Length of actuator L_{tot} mm	Tolerance mm
L_{tot} < 1000	±2
1000 ≦ L_{tot} < 2000	±3

Table 4 · Straightness tolerance of support rails

Length of support rail	MLFI20-ZR		
	t_2	t_3	Torsion
mm	mm	mm	mm
< 1000	0,6	0,5	0,8
1000 ≦ 2000	0,8	0,6	1

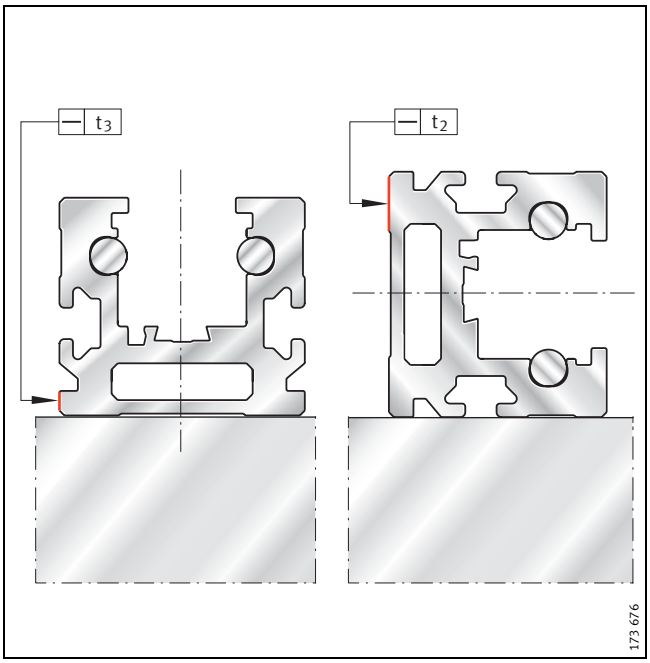


Figure 3 · Straightness tolerance of support rails for MLFI20-ZR

Accessories

Clearance-free shaft coupling

Clearance-free shaft couplings are available for positioning drives (Figure 4).

The clamping hubs are made from anodised aluminium. A plastic toothed ring is fitted as an elastic linking element between the clamping hubs. Clamping screws are used to fix the coupling to the motor and actuator.

Designation of shaft coupling:

- KUP-Rotex-GS12-10H7-12H7.

Technical data

Torque transfer capacity (of clamping hub)		5 Nm
Torsional rigidity	static	$2{,}4\times10^2$ Nm/rad
	dynamic	$7{,}2\times10^2$ Nm/rad
Mass moment of inertia		$2{,}7\times10^{-6}$ kg · m^2
Elastic toothed ring (hardness)		98 Shore A

T-nuts

Positionable T-nuts are available to locate the support rails in modular constructions (Figure 5, ①).

Designation of T-nuts:

- MU-M5×5-POS.

Other fasteners

Due to the special T-slots in the support rails, the following are also suitable as fasteners:

- hexagon nuts M5 to DIN EN 24 032
- T-bolts M5×5 to DIN 787.

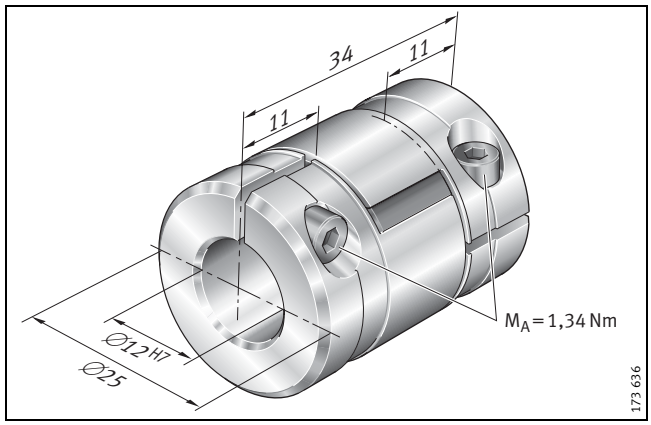


Figure 4 · Clearance-free shaft coupling

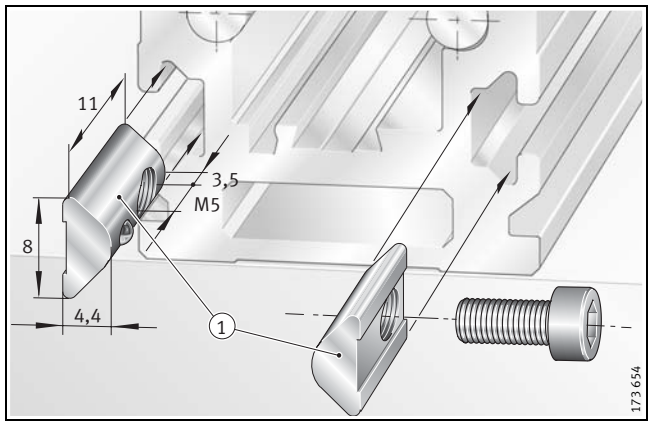


Figure 5 · Positionable T-nut

Clamping lugs

Clamping lugs are available to locate the actuators (Figure 6 and Figure 7).

The clamping lugs are used to fix the support rails to the adjacent construction (Figure 6, ①). This fixing method is easy to use and very economical.

If the support rail is fully supported over a maximum length of 1 000 mm, at least 3 clamping lugs must be fitted on each side of the rail (Figure 6, ①).

⚠ If higher loads are present, additional clamping lugs should be used.

Drives and controls

Electric motors and controllers are available for electrical applications. Please consult us on this subject.

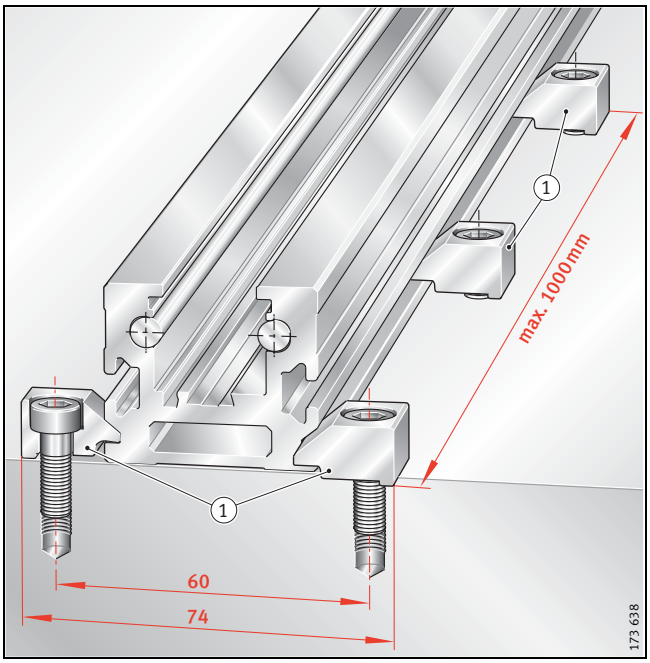


Figure 6 · Clamping lugs for locating the support rails

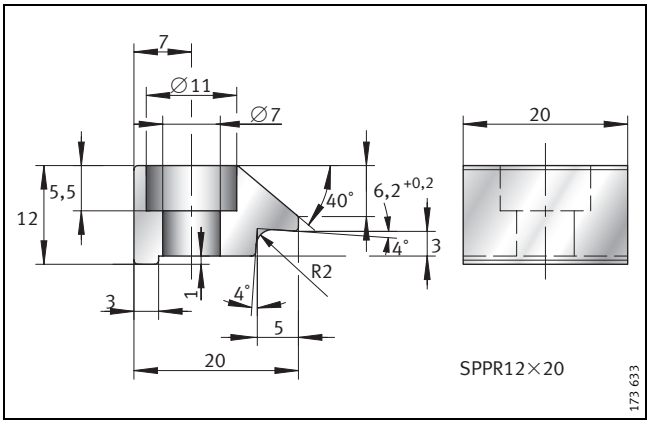


Figure 7 · Clamping lug

Ordering example and ordering designation

Ordering example

Miniatur linear actuator MLFI20-ZR

Linear actuator with enclosed track roller guidance system		MLFI
Size		20
Drive	one toothed belt	ZR
Drive shaft	left side	AL
Total length	L_{tot}	2 000 mm
Total stroke	(effective stroke +2×S)	1 694 mm

Ordering designation:

MLFI20-ZR-AL/2000-1694 (Figure 8).

Note

Note total length of carriage.

For a second carriage, use the suffix W2.

If two or more carriages are arranged in series, the distance between the carriages must be stated in the order.

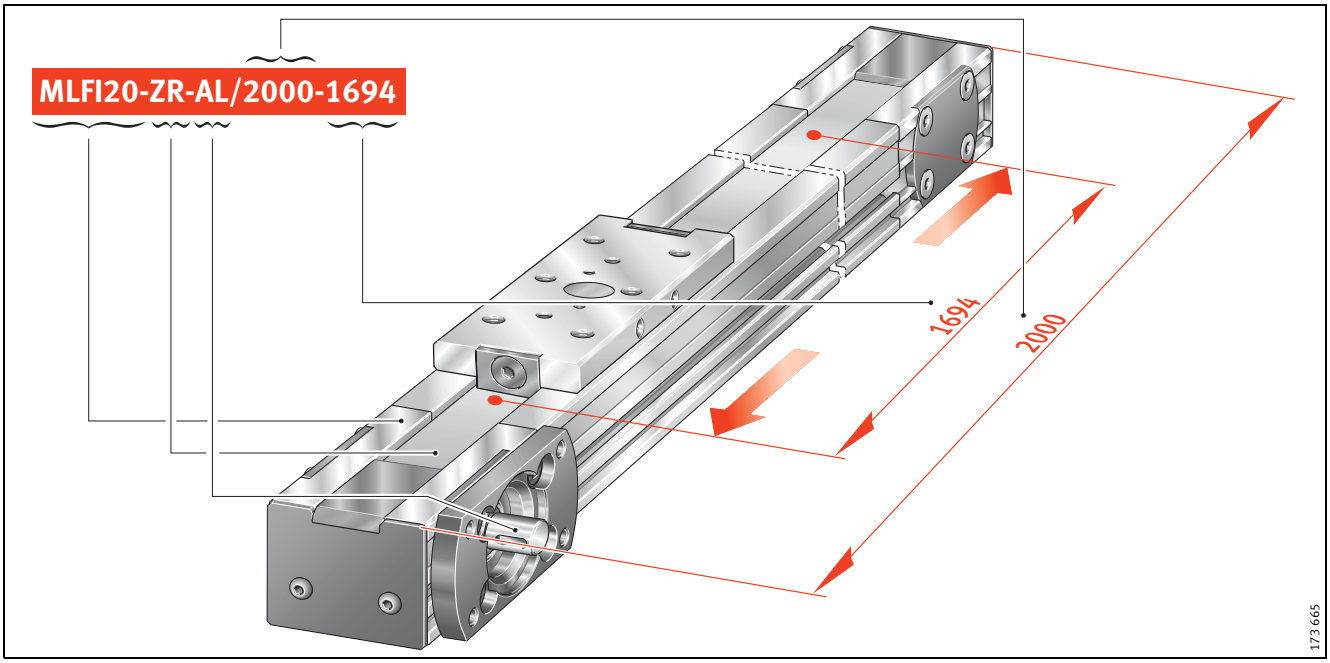
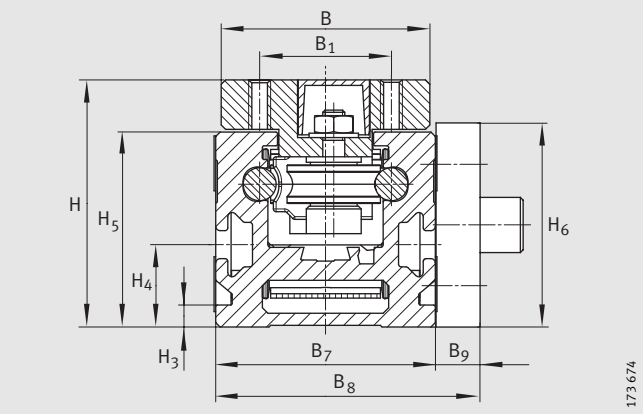


Figure 8 · Ordering example and ordering designation – miniature linear actuator MLFI20-ZR-AL/2000-1694

Miniature linear actuator with toothed belt drive

Series MLFI20-ZR



MLFI20-ZR

Dimension table · Dimensions in mm

Designation	Mass		Dimensions			Mounting dimensions													
	G_{tot} ≈kg	G_{Law}[1] ≈kg	H	B	L	B_1	B_7	B_8	B_9	B_{10}	D_1	H_1	H_3	H_4	H_5	H_6	J	J_1	L_1	L_4
MLFI20-ZR	$(L_{tot} - 110) \times 0{,}0017 + 0{,}9$	0,2	45	38	110	24	40	48	8	56	25	18,8	4	15	35,5	37	52	27	35	78

L_2 = total stroke + L + 40.
L_{tot} = total stroke + L + 40 + 2×L_4.

Total stroke = effective stroke + 2×S (mm).

⚠ The allowance S designates a safety range suitable for the particular application and should be at least 40 mm; total stroke in mm.

Maximum support rail length 2 000 mm, longer support rails may be available by agreement.

1) G_{Law} = mass of carriage.

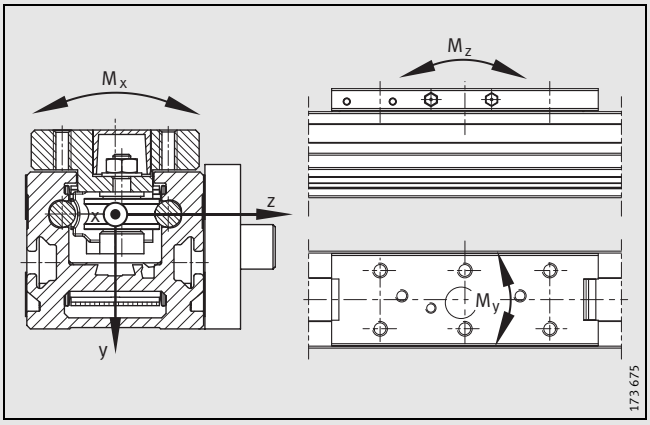
2) The values are single loads and apply when the underside of the actuator is fully supported. These must be reduced for combined loads. For design criteria of the linear guidance system, see *INA Catalogue "801"*.

3) In relubrication, lubricant must always be provided to both lubrication points on one side.

⚠ The drive connection is designed for a total mass (motor, coupling and gearbox) of max. 1 kg, if the axis itself undergoes acceleration. If the mass is higher, please consult INA.

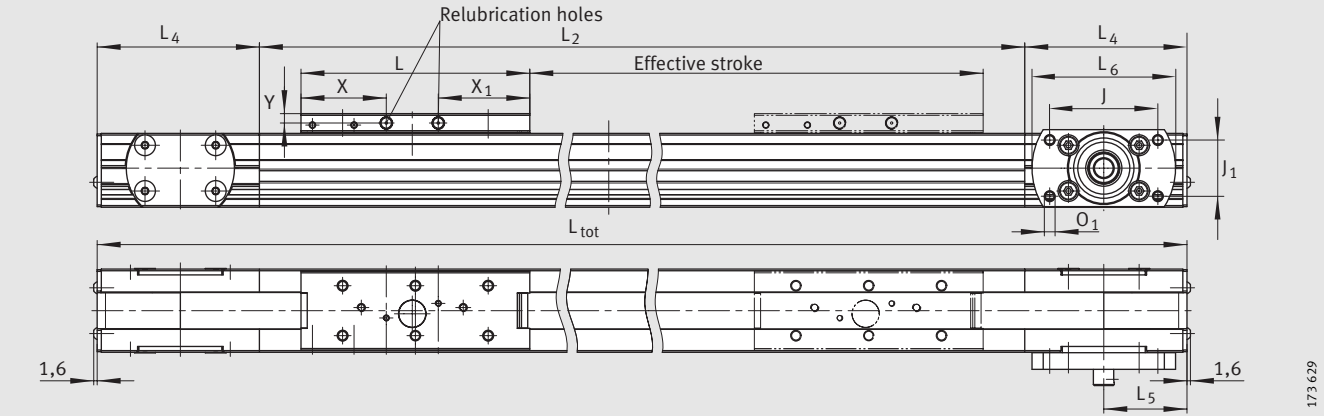
4) 6×M5. Usable thread length = 8 mm.

5) Tolerance –0,3 / –0,5.



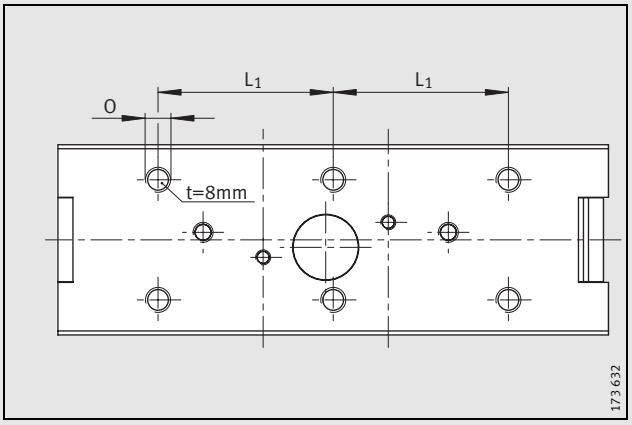
Load directions

Linear actuator	Toothed belt/gears					
Designation	Toothed belt	Permissible toothed belt operating force	Maximum drive torque	Mass of toothed belt	Feed	Mass moment of inertia of both gears
	Type	N	Nm	kg/m	mm/rev.	kg · cm^2
MLFI20-ZR	20AT3	175	2,3	0,044	81	2,4×10^{-2}

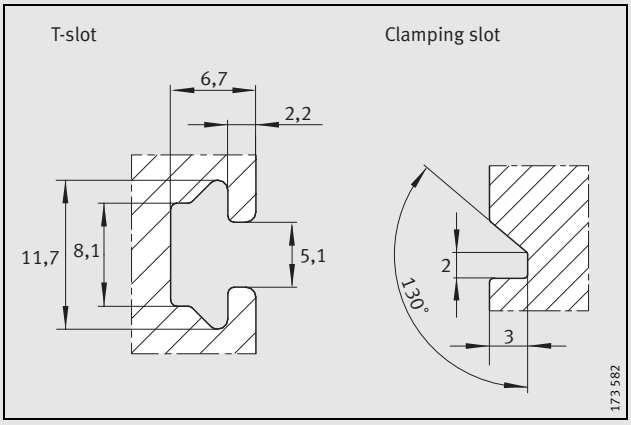


MLFI20-ZR

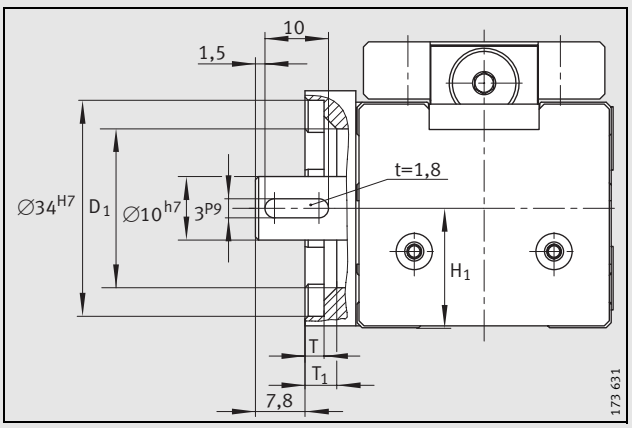
									Permissible load on carriage guidance system[2]				Permissible torque on carriage guidance system[2]						Geometrical moment of inertia of support rail	
L_5	L_6	O[4]	O_1	T[5]	T_1	X	X1	Y	$F_{y\,perm}$ N	$F_{0y\,per\,m}$ N	$F_{z\,perm}$ N	$F_{0z\,per\,m}$ N	$M_{x\,perm}$ Nm	$M_{0x\,per\,m}$ Nm	$M_{y\,perm}$ Nm	$M_{0y\,per\,m}$ Nm	$M_{z\,perm}$ Nm	$M_{0z\,per\,m}$ Nm	I_y cm^4	I_z cm^4
40	69	M5	M5×8	3	5	41	44	4,5	120	190	290	290	1,45	2,35	7	10,7	3,35	3,9	11,96	7,7



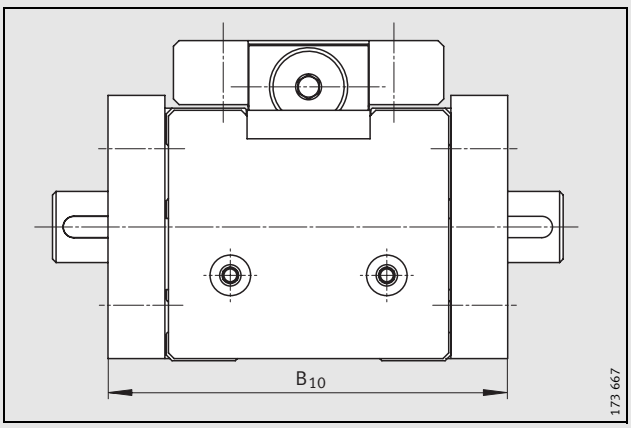
Carriage



T-slot and clamping slot



Drive flange/drive shaft



Drive shaft on both sides – variant RL

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