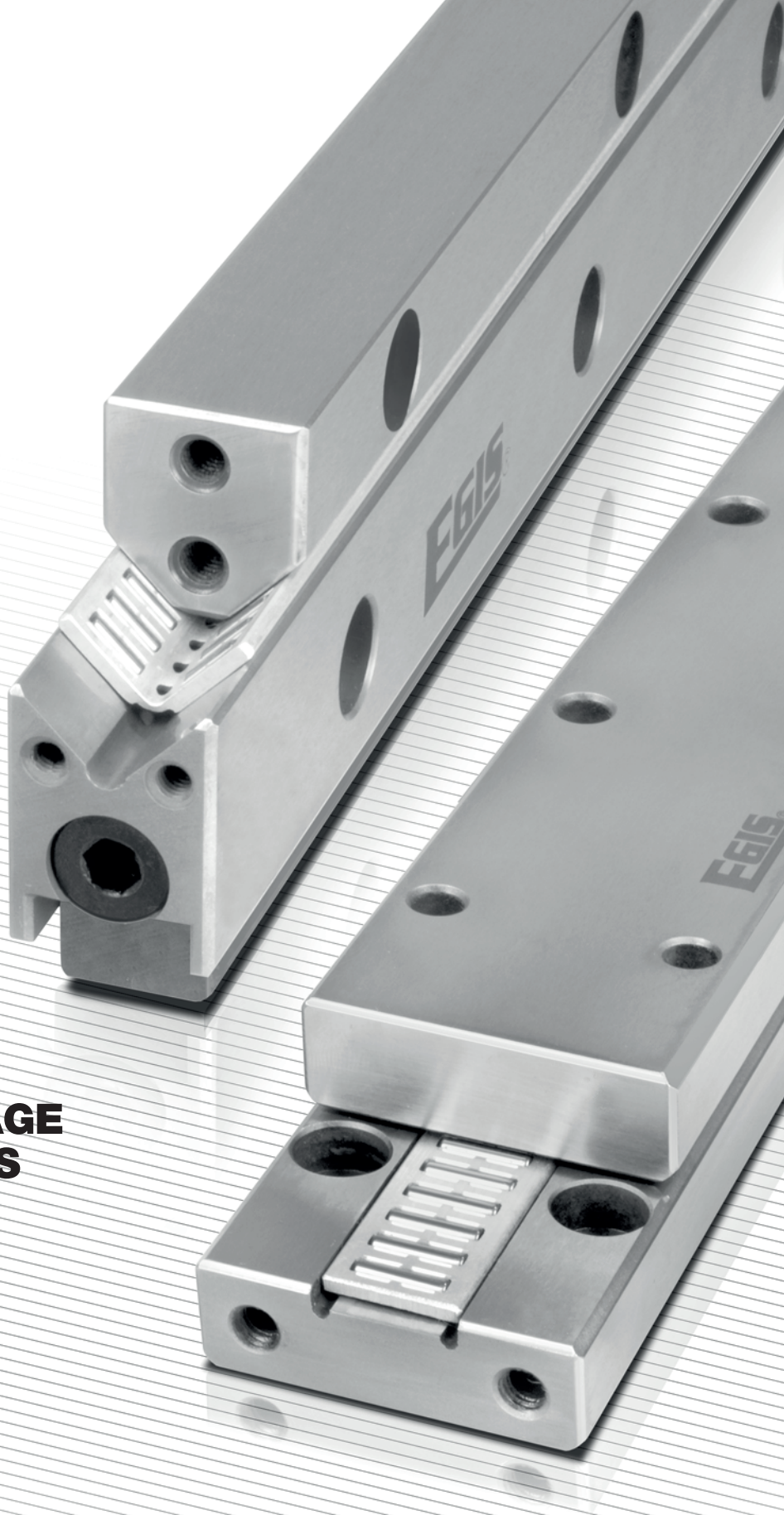
EGIS



PRECISION FLAT CAGE GUIDANCE SYSTEMS

Linear guidance systems with rolling elements

have established a position for themselves in the machine building industry as have roller bearings for rotary motion. They are essential wherever the requirement is smooth running combined with minimal construction and maintenance expenditure. Characteristics such as load carrying capacity, rigidity and precision also have an important role to play. Moreover, a wide range of tailor-made solutions are required which have to be adapted to each individual construction requirement.

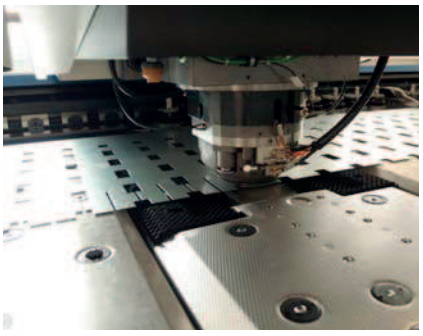
If a high level of precision, load carrying capacity and rigidity are required, as is generally the case with machine tools, precision linear guidance systems with needle or cylindrical roller flat cage assemblies without recirculating rolling elements offer an optimum solution. Compared with other linear systems, they require a smaller construction space, are used as locating or non-locating bearings depending on the configuration and are suitable for high accelerations. Due to the relative movement of the cage along the two raceways, they are particularly suitable for limited strokes. In contrast to linear guidance systems with recirculating rolling elements, the rolling elements are positioned between the raceways throughout the entire motion sequence. This guarantees exceptionally quiet running and a high level of running accuracy.

If specific space requirements are taken into account, the needle roller offers the longest bearing length together with the largest possible number of supporting rolling elements. The large number of linear contact points guarantees a significant load carrying capacity and rigidity. If the need for rigidity is not particularly important, the cylindrical roller provides a guidance system with greater elasticity. In this case, the high load carrying capacity which is characteristic of all these guidance systems is maintained.

Just as machine manufacturers automatically entrust specialised companies with the production of ball, roller or needle roller bearings, it is also advisable that they contact qualified specialists to produce linear guidance systems with rolling elements. EGIS, a medium-sized Swiss company, has been specialising for 50 years in the production of high-precision linear guidance systems which are essentially used in the following fields:

Machine tool construction
Printing machines
Measurement technology
Automation
Robotics
Optics
Productronics
Medical technology

In addition to a detailed technical section, this catalogue contains comprehensive information on the far-reaching EGIS programme for precision guideways in standard and made-to-measure lengths and the associated flat and angled flat cage assemblies as well as instructions relating to manufacturing possibilities for special parts to suit customers' requirements.



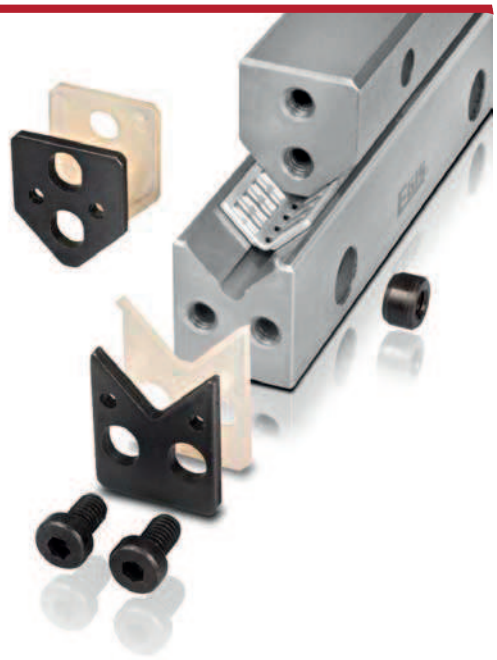
PRODUCT OVERVIEW

M AND V GUIDEWAYS
WITH NEEDLE OR CYLINDRICAL
ROLLER FLAT CAGE ASSEMBLY

M and V guideways are combined with angled flat cage assemblies and are particularly suitable for high load carrying capacities, rigidity, minimal friction and a high level of accuracy. They are used as linear locating bearings. They are manufactured in standard lengths up to a maximum of 1,000 mm which allows for rapid delivery.

In order to respond to specific customer requirements, the guideways in this range can also be supplied in made-to-measure lengths, i.e. in any required length up to the maximum length specified in the dimension table.

The guidance systems can be set to be free of clearance or can be preloaded to enhance rigidity using pressure screws.



ML GUIDEWAYS
WITH ADJUSTING GIB
FOR NEEDLE ROLLER FLAT CAGE ASSEMBLIES

This series combines an M guideway with an adjusting gib which distributes the preload equally over the entire length of the guidance system.

The pitch of the gib surface is 1.5%. ML guideways fulfil optimum requirements in terms of rigidity and precision.

MVZ (M/V/ML) GUIDEWAYS
WITH INTEGRATED TOOTHED RACK
FOR POSITIVE CONTROL OF THE NEEDLE
ROLLER FLAT CAGE ASSEMBLY

In this series, the angled flat cage assembly is subjected to positive control by an integrated toothed wheel / toothed rack unit. This guarantees perfect movement for the flat cage assembly even under difficult operating conditions.

M AND ML GUIDEWAYS
WITH SLIDING LAYER

The guideways in this series consist of an unhardened guideway with a layer fixed by adhesive. They are combined with V guideways and possess the same mounting dimensions as the M/ML and V guideways with flat cage assemblies. They are used in particular when an increased level of friction is required to provide damping or when static or pulsating loads are involved.

S AND J GUIDEWAYS
WITH NEEDLE ROLLER FLAT CAGE ASSEMBLY

These guideways are used in combination with needle roller flat cage assemblies as linear non-locating bearings. They are supplied in two versions, one of which possesses a flat structure and is therefore space-saving whilst the other has the same dimensions as the corresponding M and V guideways.

LUE COUNTERSTAY SYSTEM
WITH NEEDLE ROLLER AND
CYLINDRICAL ROLLER FLAT CAGE ASSEMBLIES

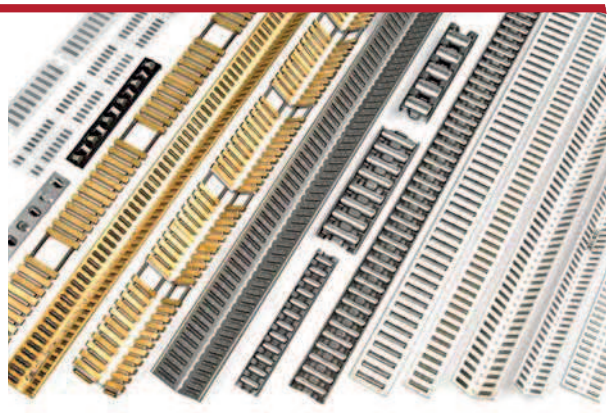
These units consist of a locating guidance system, a non-locating guidance system and an L counterstay which preloads the two guidance systems. This arrangement prevents the system from becoming distorted by thermal expansion.

The LUE counterstay system provides the highest level of precision of all linear guidance systems with rolling elements.

FLAT CAGE ASSEMBLIES

Flat cage assemblies consist of a basic cage made from plastic or metal and a large number of precisely guided rolling elements. Needle rollers provide a minimal construction height and optimum load carrying capacity and rigidity whilst cylindrical rollers are less demanding with regard to the connecting structure and have a slightly less rigidity. Balls create the lowest level of friction of all rolling bearings.

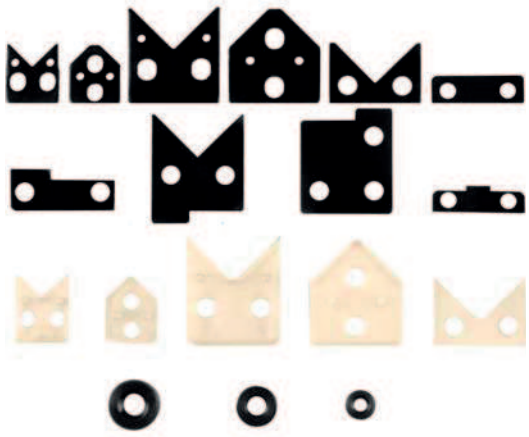
Flat cage assemblies are designed for use with precision guideways but can also be used directly with customer-specific elements with appropriate raceways.



ACCESSORIES
END PIECES, WIPERS, INSERT NUTS

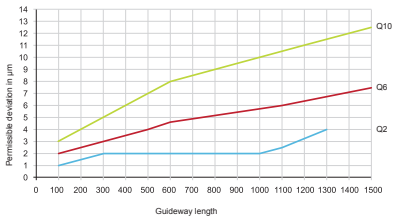
End pieces prevent the cage assembly from moving out of the loaded zone. Wipers protect the raceways against soiling under normal operating conditions.

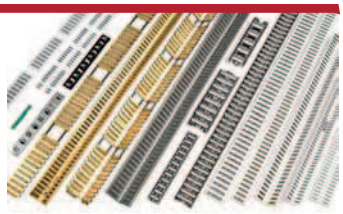
Insert nuts allow for the transforming of a counterbore into a threaded hole.



SPECIAL DESIGNS

Guideways for cross roller and ball flat cage assemblies
Guideways for hydrostatic guidance systems
Guideways for air bearings
Guideways with specific shapes and dimensions
Linear recirculating roller bearings (RUSW and U-100)





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PRODUCT TECHNOLOGY

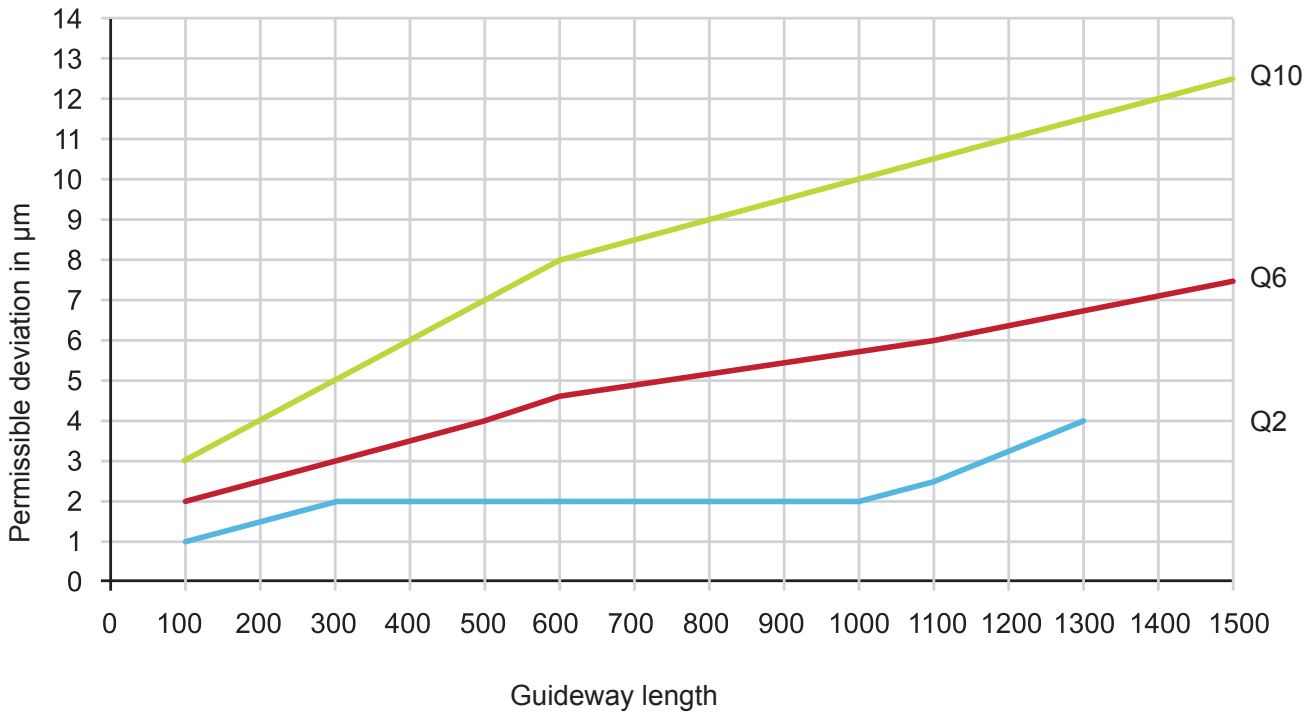


TABLE OF CONTENTS

1.1 UNITS AND DEFINITIONS

B	**mm**	Guideway width
B1	**mm**	Cage width
b	**mm**	Distance between guidance system centres
b1	**mm**	Distance between rear guideway surfaces
C	**N**	Basic dynamic load rating for cage length of 100 mm
C_w	**N**	Effective dynamic load rating
C_{we}	**N**	Corrected effective dynamic load rating
C_L	**N/mm**	Rigidity of the flat cage guidance system
C_0	**N**	Basic static load rating for cage length of 100 mm
C_{0we}	**N**	Corrected effective static load rating
C_{0w}	**N**	Effective static load rating
D_w	**mm**	Ball diameter
e	**mm**	Eccentricity of the load
f_H	-	Dynamic hardness factor
f_{H0}	-	Static hardness factor
f_α	-	Dynamic load direction factor
$f_{\alpha 0}$	-	Static load direction factor
F	**N**	Operating load, guide loading
F_i	**N**	Variable load
F_R	**N**	Displacement resistance
F_{R0}	**N**	F_R, lubricant friction percentage
F_{R1}	**N**	F_R, load-dependent rolling friction percentage
F_{RA}	**N**	Displacement resistance, wiper percentage
F_{RV}	**N**	Carriage displacement resistance, preloaded
F_w	**N**	Limiting load for effective cage length
H	**mm**	Distance from extreme stroke positions
k_F	-	Dynamic load factor
k_{0F}	-	Static load factor
K	-	Type factor for determination of rigidity
L	**mm**	Guideway length
L	**10^5m**	Nominal rating life
L1	**mm**	Distance between the first hole and the start of the guideway
L1	**mm**	Distance between the first or last pocket centre and the end of the cage
L2	**mm**	Distance between the last hole and the end of the guideway
L1, $L2_{min}$	**mm**	Minimum value for L1 and L2
LA	**mm**	Hole distance in guideways
LA	**mm**	Spacing distance in flat cages
L_h	**h**	Nominal rating life in operating hours
L_K	**mm**	Cage length
L_R	**mm**	Guideway length with running surface for the wiper
n	-	Maximum possible number of hole distances LA
n_{osz}	**min^{-1}**	Number of double strokes per minute
p	-	Rating life exponent
p	**N/mm^2**	Contact pressure for sliding layer
P	**N**	Dynamic equivalent load
P_0	**N**	Static equivalent load
q_i	**%**	Proportion of total duration
RS	**N**	Damping force in direction of movement
S_0	-	Static load safety factor
t	**mm**	Depth of thread in T03 holes
v_i	**m/min**	Variable speed
$\bar{v}$	**m/min**	Dynamic equivalent speed
x	-	Number of holes
Z	-	Number of rolling elements per row
α	**°**	Load direction angle deviating from main load direction
δ	**µm**	Elastic deformation at contact points
µ	-	Friction coefficient
ν	**mm^2s^{-1}**	Kinematic viscosity
Δh	**µm**	Permissible height variation

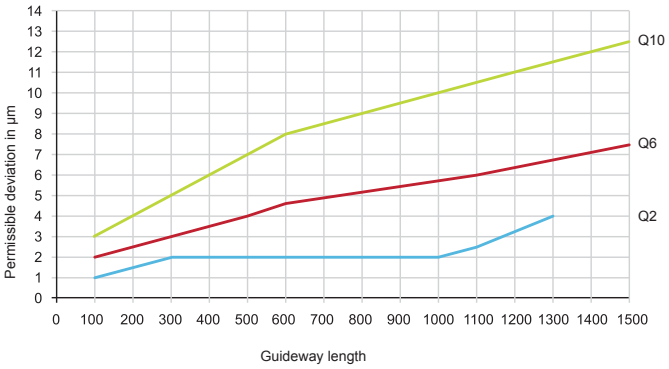
1.2 PRECISION AND TOLERANCES

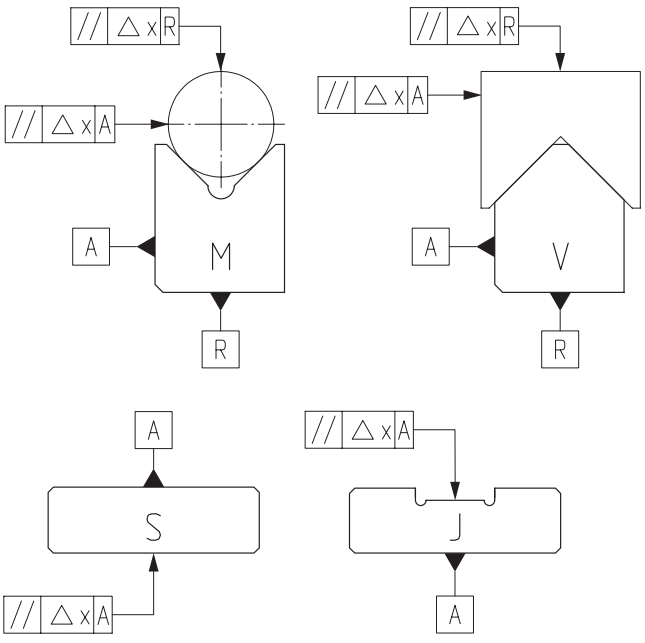
1.2.1 QUALITIES

The raceways and locating surfaces are precision-ground.

The guideways are supplied in 3 qualities (parallelism tolerance of the raceways to the reference sides of the guideway in relation to a defined length).

Q10: normal quality for general machine construction
Q6: precise quality for machine tool construction
Q2: particularly precise quality for exceptionally demanding structures





1.2.2 PROFILE TOLERANCES

See product chapter

1.2.3 LENGTHS, HOLE DISTANCES

Length: the length tolerance is defined using the formula ± [0.2+(0.0012* length L)].

Guideways which exceed the maximum length indicated (see “normal lengths” table) are manufactured in several sections. These sections are matched precisely. It is important not to interchange the guideways in order to maintain the tolerance during assembly.

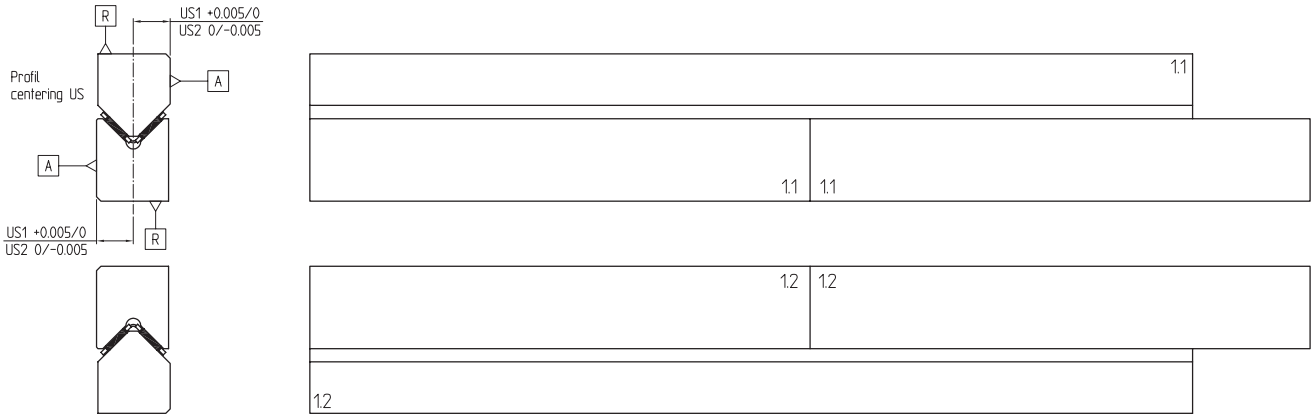
Hole distances: the tolerance of the hole distances is calculated to ensure that guideways can be assembled on a pre-drilled hole pattern up to the maximum normal length. The tolerance is measured between the first and last guideway hole and is distributed evenly over the length.

For guideways which exceed the maximum normal length, the suffix “P” is required in order to maintain the corresponding tolerance.

1.2.4 MATCHING

Guideways of the same design (same order reference) are manufactured, labelled and packed in pairs. Paired matching is based on the distance between the centre of the profile and the mounting surface “A”.

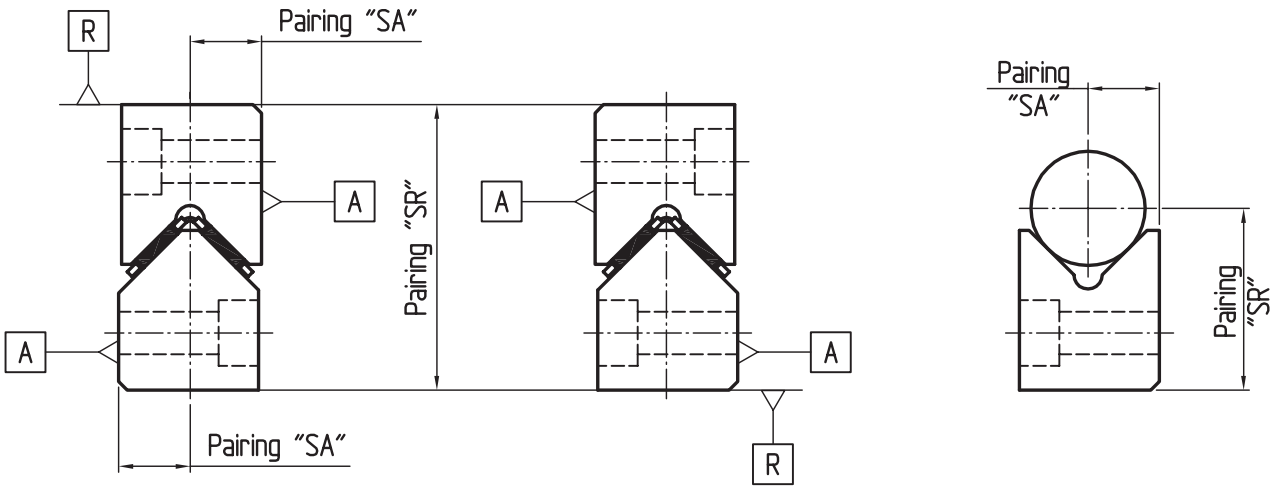
Standard matching (US1/US2) allows parts to be exchanged whilst maintaining a very narrow tolerance. In the highest tolerance category or at the customer’s request, the guideways are matched and labelled by more narrow tolerances.



For guideways with different order references which still have to be matched in pairs, the suffix “X” has to be added to the order references, e.g.

1M + 1ML = 2SX or
1M + 1V + 1J + 1S = 4SRX or
1V…T15 + 1V…T03 = 2SX

Matching possibilities:



Paired matching code	Number of guideways matched together	In relation to reference side
2SA	2	Reference side A
3SA	3	Reference side A
4SA	4	Reference side A
etc…	Number of guideways	Reference side A
2SR	2	Reference side R
3SR	3	Reference side R
4SR	4	Reference side R
etc…	Number of guideways	Reference side R
2SAR	2	Reference sides A + R
3SAR	3	Reference sides A + R
4SAR	4	Reference sides A + R
etc…	Number of guideways	Reference sides A + R

1.2.5 STRAIGHTNESS

Straightness as well as parallelism is checked in the factory (tolerances according to DIN 644).

Straightness variances can be balanced out by tightening against the locating surface during assembly.

1.2.6 ROLLING ELEMENTS

Flat cage assemblies comprise needle or cylindrical rollers with a diameter tolerance of 2 µm and a geometrical accuracy of 1 µm.

For particularly challenging requirements, especially for guideways with a quality level of 2, specially designed needle or cylindrical rollers can be supplied with a diameter tolerance of 1 µm and a geometrical accuracy of 0.5 µm.

The diameter tolerance amounts to 1 µm and the geometrical accuracy 0.13 µm for ball bearings.

See table (page 76), in chapter 8 on flat cage assemblies.

1.3 APPLICATION FEATURES

1.3.1 CHOICE OF ARRANGEMENT TYPE

Closed layout M/V

This layout can carry loads and moments in any direction, can be adapted to any operating position and can be preloaded (preloading page 34).

It is a locating/locating bearing and consists of two M / ML and two V guideways with the corresponding angled flat cage assemblies.

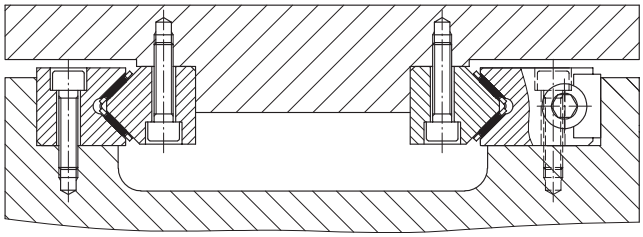


Figure 1. Closed layout M/V

Open layout

This layout is extremely assembly-friendly and is mainly used for applications with loads acting centrically or vertically.

It is a locating/non-locating bearing and consists of M and V guideways with the corresponding angled flat cage assembly and J and S guideways with the corresponding flat cage assembly.

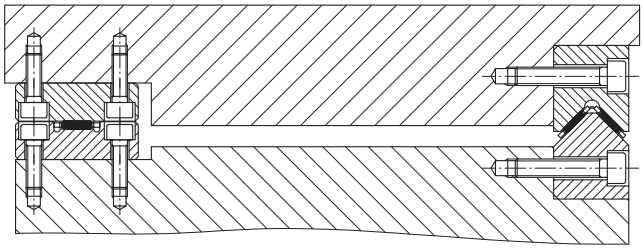


Figure 2. Open layout M/V, J/S

Closed layout LUE

This layout can carry loads and moments in any direction in response to the most demanding precisions requirements. The system is preloaded by components which have been adjusted against one another in terms of dimensions.

The subdivision into locating and non-locating bearings prevents the system from becoming distorted by thermal expansion. The guidance system consists of M and V guideways, J and S guideways, LU counterstays, angled flat and flat cage assemblies.

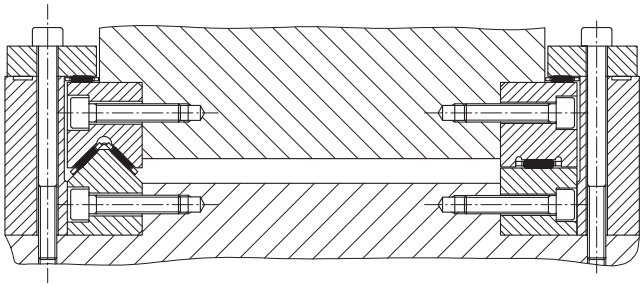


Figure 3. Closed layout LUE

1.3.2 DETERMINATION OF GUIDEWAY CAGE LENGTHS

The rigidity and load carrying capacity of the guidance system are determined by the size and length of the flat cage assembly (L_K). The load bearing capacity and load carrying capacity increase for moments along the longitudinal axis (rolling) in proportion to the cage length whilst the permissible moments along the vertical axis (yawing) and the diagonal axis (pitching) increase in square with the cage length.

Layout principles:

– The cage assembly always travels half of the stroke of the moving guideway
– The entire length of the cage assembly must always remain between the two guideways
– Wipers must always remain on the raceways

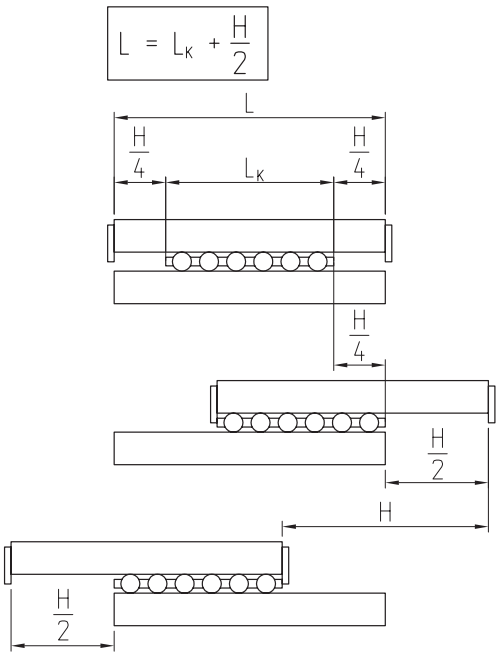
Recommendations for minimum cage lengths dependent on the stroke:

$L_K \geq 1.5 \cdot H$	for open layout in order to maintain the operation limit (figure 12, page 26)
$L_K \geq H$	for closed layout

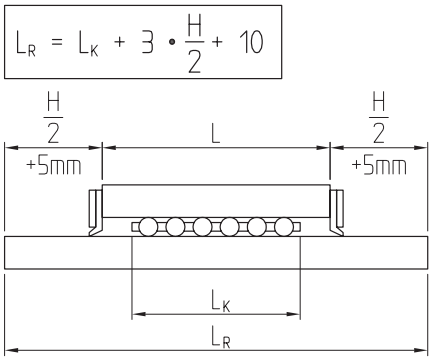
H	**mm**	distance from extreme stroke positions

A) Calculation of guideway lengths L, L_R
With preset cage length and stroke:

Guidance systems without wipers

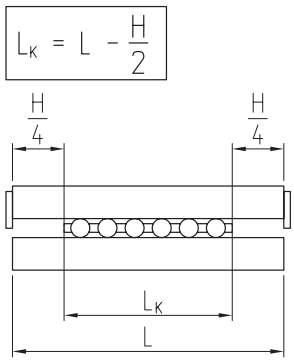


Guidance systems with wipers



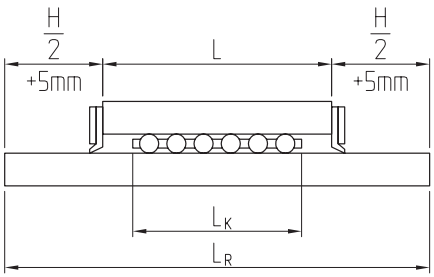
B) Calculation of cage length L_K
With preset guideway lengths and stroke:

Guidance systems without wipers



Guidance systems with wipers:

$$L_K = L_R - 3 \cdot \frac{H}{2} - 10$$



The necessary cage size can be selected on the basis of load and rigidity parameters.

Special length ratios:

If the lengths are configured according to the equations above, the flat cage assembly will be in every stroke position between the raceways.

In order to achieve the maximum load carrying capacity or a significant stroke, the lengths can be configured under normal operating conditions in such a way that the flat cage assembly extends beyond the ends of the guideways. Raceway lead areas should be provided in this case (suffix E2).

1.3.3 HOLE TYPES AND HOLE PATTERNS

Guideways are attached with screws. EGIS guideways are supplied with 4 hole types (figure 4).

EGIS guideways of standard lengths in the M and V ranges are hardened and pre-ground with T15 sink holes. By adding ESM insert nuts, these guideways can be attached in the same manner as with a threaded hole (T03, figure 5).

The insert nuts must be ordered separately and stuck into the counterbores (T13, accessories, page 91).

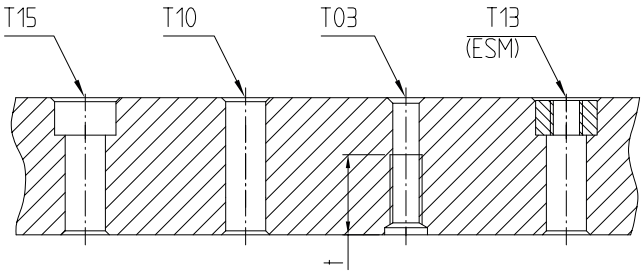


Figure 4. Hole types

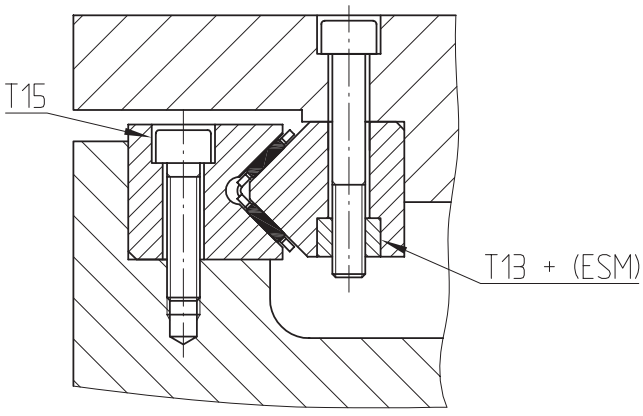


Figure 5. Attachment with hole type T13

With no particular specifications, the hole distances L1 and L2 at both ends of the guideways are of the same size and dependent on the guideway length (symmetrical hole pattern, figure 6).
Guideways with non-symmetrical hole patterns may also be supplied on request.
In this case the following values must apply: $L1 \geq L1_{min}$ and $L2 \geq L2_{min}$.

△ Particular attention should be paid to the position of the L1 distance. For the definition of the position of L1 see figure 7.

Suffix LA (L1/L2)

Determining the hole patterns

Number of spacing distances

$$n = \frac{(L-2 \cdot L1_{min})}{LA} \text{ whole number}$$

Distances L1 and L2

$$L1+L2 = L-n \cdot LA$$

Guideways with symmetrical hole pattern

$$L1 = L2 = (L-n \cdot LA)/2$$

Number of holes

$$x = n+1$$

L	**mm**	Length of guideway
LA	**mm**	Hole distance
L1,L2	**mm**	Distance between the start or end of the guideway and the next hole
$L1_{min}$, $L2_{min}$	**mm**	Minimum value for L1 and L2 (Tables dimensions)
n	**-**	Maximum possible spacing distances
x	**-**	Number of holes

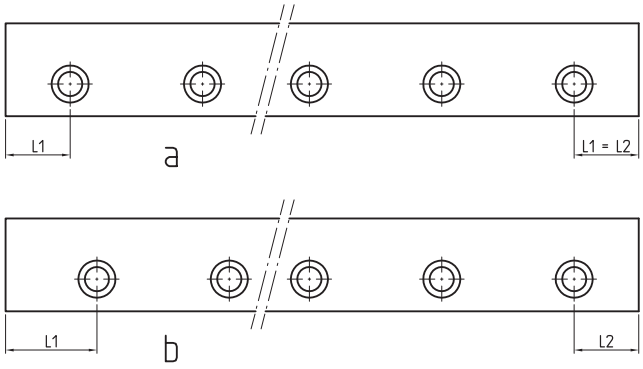


Figure 6. Symmetrical (a) and non-symmetrical (b) hole pattern with a series of holes

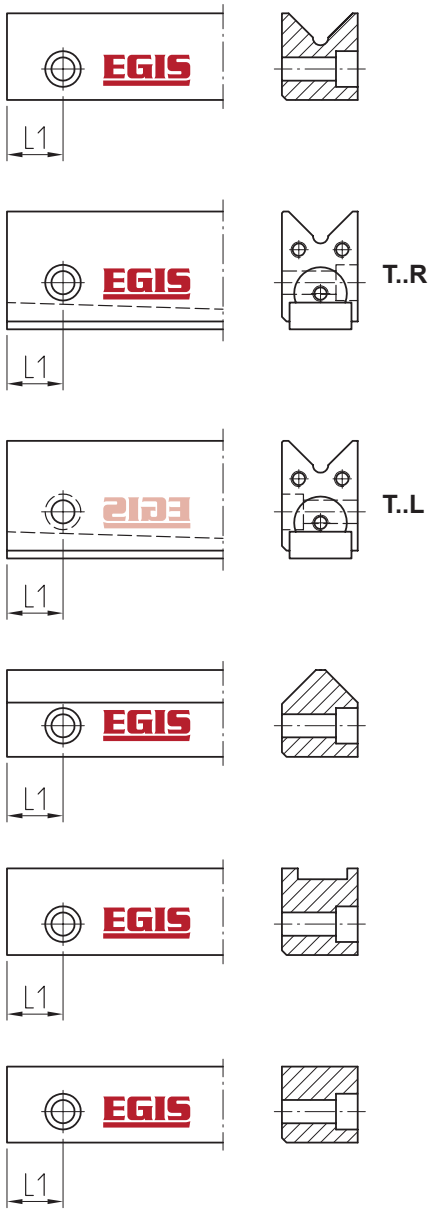


Figure 7. Position of distance between first hole and beginning of guideway L1

1.3.4 END PIECES AND WIPERS

End pieces or end pieces with wipers hold the cage assembly in place correctly in the final stroke positions. Two end pieces need to be mounted for each cage. If this is not possible, parts of the connecting structure should be used to assume the function of the end pieces.

△ End pieces or wipers must not be used to limit the stroke.

△ End pieces or wipers must not be allowed to cross over (figure 8)

In specific application scenarios, e.g. with rapid accelerations, extreme loads in the final stroke positions or in the case of alternating partial stroke which nevertheless remain constant over long periods, the cage positioning may no longer be guaranteed with normal end pieces. In such cases, it is possible when wipers are used to assemble additional end pieces before the wipers or to subject the cage to positive control by an integrated gear/toothed rack unit as an optimum solution (MVZ series, page 54).

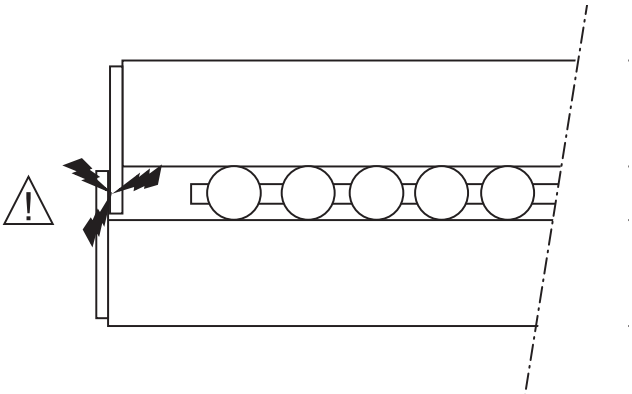


Figure 8. Incorrectly assembled end pieces or wipers

1.3.5 LOAD RATING, LOAD CARRYING CAPACITY

The dynamic and static load ratings are used as a reference for the layout of a flat cage guidance system. The load ratings for linear guidance systems without recirculating rolling elements are defined according to the ISO 14728 international standard.

1.3.5.1 BASIC STATIC LOAD RATING

The basic static load ratings C_0 are the loads which bring a permanent deformation of the raceways and rolling elements in a ten thousandth of the rolling element diameter.

Static load safety factor

The static load safety factor S_0 is the security in relation to the permanent deformation in the rolling contact.

$$S_0 = \frac{C_{0w}}{P_0}$$

S_0		Static load safety factor
C_{0w}	N	Effective static load rating (page 24)
P_0	N	Maximum static equivalent load

△ Particular attention should be paid to the load safety factor.

According to ISO 14728, the static safety $S_0 = C_0/P_0$ must not fall below the value of 2.

If strict requirements apply in terms of the running accuracy and smoothness, the static load safety factor should not fall below $S_0 = 3$.

1.3.5.2 STATIC LOAD CARRYING CAPACITY

The permissible static load for a flat case guidance system is limited by the following characteristics:

– Basic static load rating of the flat cage assemblies: recommendations for S_0 should be observed.
– Load carrying capacity of the raceways: required hardness HRC 58 min.
– Load carrying capacity of the connecting structure: the connecting structure is generally configured with a high degree of rigidity and therefore sufficient strength.
– Load carrying capacity of the screw connection: the layout of the guideway attachment is based on the screw strength 8.8 and the corresponding tightening torque taking the standard materials for the connecting structure into account. Screws of this level of strength allow for the transferral of loads whilst scarcely affecting the precision of the guidance system.

  When screws of a higher strength category are used, the tightening torque according to the strength category 8.8 should not be exceeded in the interest of accuracy (exception: LUE system counterstay, see page 73).

△ It is important to check the screw connection where $S_0 < 3$ when tensile and / or moment loads are predominant.

LOAD RATING, LOAD CARRYING CAPACITY

1.3.5.3 BASIC DYNAMIC LOAD RATING

The basis for the basic dynamic load rating C is the nominal rating life of 100,000 m displacement distance obtained or exceeded with a reliability of 90%.

1.3.5.4 DYNAMIC LOAD CARRYING CAPACITY AND RATING LIFE

The dynamic load carrying capacity is determined by the fatigue behaviour of the bearing components. The fatigue period (the rating life in hours) is obtained from the load and the movement speed of the guidance system as well as the statistical probability of damage occurring.

Nominal rating life

$$L = \left(\frac{C_w}{P}\right)^p$$

$$L_h = \frac{8.33 \cdot 10^5}{H \cdot n_{osz}} \cdot \left(\frac{C_w}{P}\right)^p$$

$$L_h = \frac{1666}{\bar{v}} \cdot \left(\frac{C_w}{P}\right)^p$$

L	**10^5 m**	Nominal rating life
L_h	**h**	Nominal rating life in operating hours
C_w	**N**	Effective dynamic load rating (p. 24)
P	**N**	Dynamic equivalent load
p	**-**	Rating life exponent

For flat cage guidance systems with rollers: p=10/3
For flat cage guidance systems with balls: p=3

H	**mm**	Distance from extreme stroke positions
n_{osz}	**min^{-1}**	Number of double strokes per minute
$\bar{v}$	**m/min**	Dynamic equivalent speed

△ According to ISO 14728, the dynamic equivalent load must not exceed the value $P = 0.5 \cdot C_W$.

LOAD RATING, LOAD CARRYING CAPACITY

Equivalent load and speed

The life calculation equation require a constant load and speed. If this is not the case, equivalent operating values may be used for the calculation.
(ISO 281 standard)

General dynamic equivalent load

$$P = \sqrt[p]{\left(\int_0^T |v(t) \cdot F^P(t)| dt\right) / \left(\int_0^T |v(t)| dt\right)}$$

General dynamic equivalent speed

$$\bar{v} = \frac{1}{T} \int_0^T |v(t)| dt$$

Gradually alternating load

$$P = \sqrt[p]{\frac{q_1 \cdot F_1^p + q_2 \cdot F_2^p + ... + q_2 \cdot F_z^p}{100}}$$

Gradually alternating speed

$$\bar{v} = \frac{q_1 \cdot v_1 + q_2 \cdot v_2 + ... + q_z \cdot v_z}{100}$$

Gradually alternating load and gradually alternating speed

$$P = \sqrt[p]{\frac{q_1 \cdot v_1 + F_1^p \cdot q_2 \cdot v_2 \cdot F_2^p + ... + q_2 \cdot v_z \cdot F_z^p}{q_1 \cdot v_1 + q_2 \cdot v_2 + ... + q_2 \cdot v_z}}$$

P	**N**	Dynamic equivalent load
p	**-**	Rating life exponent:

For flat cage guidance systems with rollers: p=10/3
For flat cage guidance systems with balls: p=3

q_i	**%**	Proportion of total duration
F_i	**N**	Variable load
v_i	**m/min**	Variable speed
$\bar{v}$	**m/min**	Dynamic equivalent speed

Operating life

The operating life is the actual expected rating life of a flat cage guidance system. It may differ from the nominal rating life.

Potential causes include wear and tear and/or fatigue due to:

– Soiling
– Insufficient lubrication
– Misalignment
– Movements with minimal strokes
– Vibrations during dead time (false brinelling).

The operating life of a flat cage guidance system cannot be calculated precisely in advance due to the wide range of installation and operating conditions. The most reliable information is obtained from comparisons with similar installations.

1.3.5.5 EFFECTIVE LOAD RATING

The basic dynamic and static load ratings C and C_0 given for the different products relate to a cage with a theoretical length of 100 mm. This allows direct comparisons to be made between the load carrying capacities of flat cages of different series and dimensions. The effective dynamic and static load ratings C_w and C_{0w} are calculated according to the following equations for the effective cage lengths.

For needle roller flat cage assemblies:

$$C_w = C \cdot \left(\frac{L_K - 2L1 + LA}{100}\right)^{\frac{3}{4}} \cdot \left(\frac{L_K - 2L1}{100 - LA}\right)^{\frac{1}{36}}$$

$$C_{0w} = C_0 \cdot \left(\frac{L_K - 2L1 + LA}{100}\right)$$

For ball flat cage assemblies:

$$C_w = C \cdot \left(\frac{L_K - 2L1 + LA}{100}\right)^{\frac{2}{3}} \cdot \left(\frac{L_K - 2L1}{100 - LA}\right)^{\frac{1}{36}}$$

$$C_{0w} = C_0 \cdot \left(\frac{L_K - 2L1 + LA}{100}\right)$$

C	**N**	Basic dynamic load rating for a cage length of 100 mm (table dimensions)
C_0	**N**	Basic static load rating for a cage length of 100 mm (table dimensions)
C_w	**N**	Effective dynamic load rating
C_{0w}	**N**	Effective static load rating
L_K	**mm**	Cage length (figure 9)
L1	**mm**	Distance between the first and last pocket centre and the end of the cage (figure 9)
LA	**mm**	Spacing distance in the flat cage (figure 9, table dimensions)

The values for C_{0w} and C_w correspond to the load rating calculation according to ISO 14728

△ The equations only provide precise results when the cage length Lk is based on a whole number of rolling elements per row.

Equation for verification of Z:

$$Z = \frac{L_K - 2L1}{LA} + 1 = \text{whole number}$$

Z - number of rolling elements per row (figure 9)

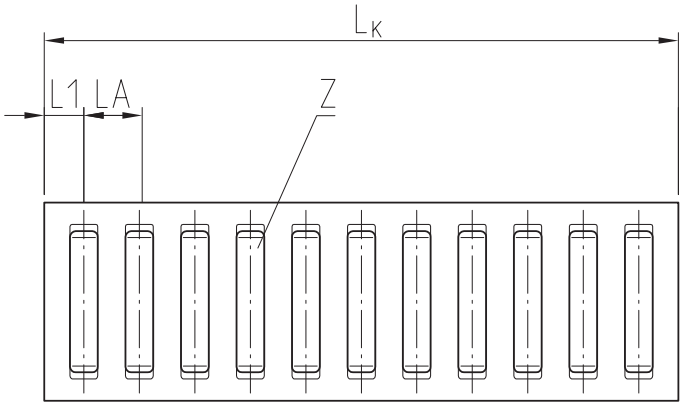


Figure 9. Dimensions to determine the effective load rating

1.3.5.6 CORRECTION FACTORS FOR LOAD CARRYING CAPACITY

The basic load ratings given for the different products only apply subject to the following requirements:

– Raceway hardness ≥ HRC 58 (670HV)

– Centric load direction

Deviating conditions are to be taken into account using the following correction factors:

– Hardness factors f_{H0} or f_H

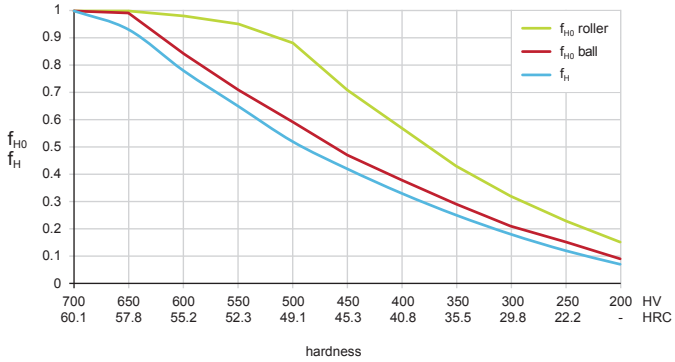


Figure 10. Hardness factors

– Load direction factor f_α or $f_{\alpha 0}$
The basic load ratings for the different products only apply provided that the load operates in symmetry with the cage shanks ($\alpha = 0°$). The correction factor for other load directions can be obtained from the figure:

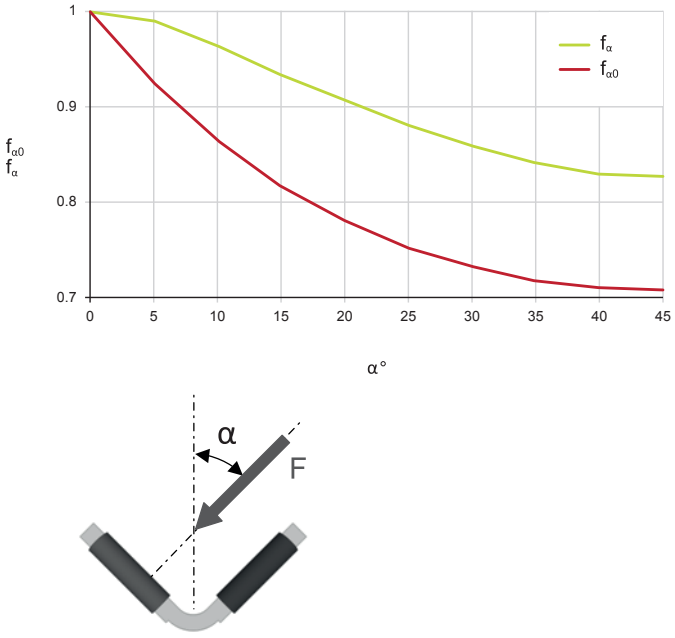


Figure 11. Load direction factor

Static load rating

$$C_{0we} = f_{\alpha 0} \cdot f_{H0} \cdot C_{0w}$$

C_{0we}	N	Corrected effective static load rating
$f_{\alpha 0}$	-	Static load direction factor
f_{H0}	-	Static hardness factor
C_{0w}	N	Static load rating for the effective cage length

Dynamic load rating

$$C_{we} = f_\alpha \cdot f_H \cdot C_w$$

C_{we}	N	Corrected effective dynamic load rating
f_α	-	Dynamic load direction factor
f_H	-	Dynamic hardness factor
C_w	N	Dynamic load rating for the effective cage length

1.3.5.7 ECCENTRIC LOAD

In a linear guidance system without recirculating rolling elements, the flat cage always travels half the stroke of the mobile guideway and thus alters its position in relation to the load. It therefore does not generally carry an equal load. However, the load ratings given for the different products only apply with an equal load distribution.

Eccentric load with open layout

Open layout: see application features (page 16, figure 2)
In the case of an eccentric load, the load carrying capacity can be determined with the static equivalent cage load (figure 12).

$$P_0 = k_{0F} \cdot F$$

P_0	**N**	Static equivalent load
k_{0F}	-	Static load factor
F	**N**	Guide loading

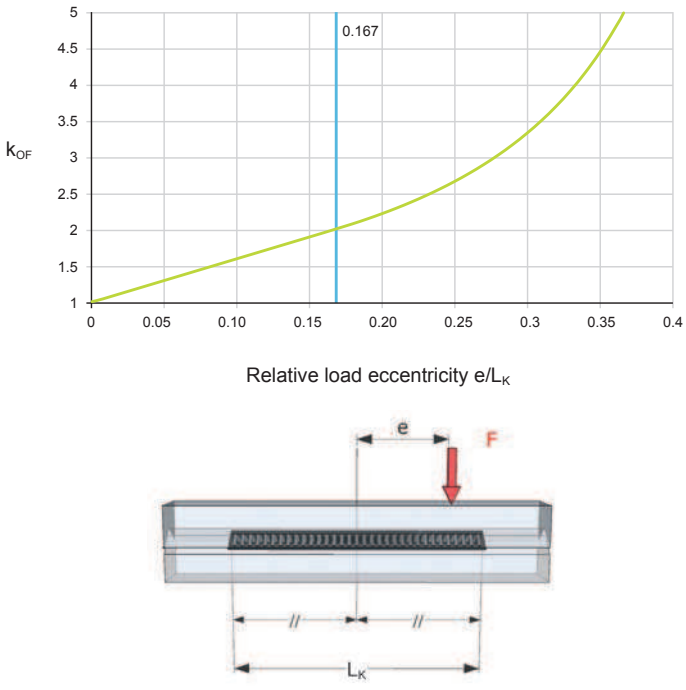


Figure 12. Static load factor for eccentrically loaded flat cages and open layout

△ If a load eccentricity of > 0.167 is exceeded, only part of the rolling element is loaded. This is extremely detrimental to the load carrying capacity and rigidity of the guidance system.

Eccentric load with closed layout

Closed layout: see application features, (page 16, figure 1)

Linear guidance systems with a closed layout can carry additional loads and tilting moments. In these cases, the calculation of the equivalent cage load is fairly complex. EGIS offers support with corresponding calculation programmes on request (pages 28 to 31).

1.3.5.8 CALCULATION

Example

Input data

Guideways			M 5025 and V 5025
Flat cage assembly			E-HW15
Basic dynamic load rating for a cage length of 100 mm	C	=	25960 N
Basic static load rating for a cage length of 100 mm	C_0	=	88900 N
Operating load, functioning centrically on the guidance system (factors f_α, $f_{\alpha 0}$, k_{0F} = 1)	F	=	9500 N
Dynamic equivalent load	P	=	9500 N
Static equivalent load	P_0	=	9500 N
Distance from extreme stroke positions	H	=	100 mm
Number of double strokes per minute	n_{osz}	=	50 min^{-1}
Cage length	L_K	=	300 mm

Required data

Static load safety factor	S_0
Nominal rating life	L and L_h

Calculation

Verification of number of rolling elements per row (LA, L1, dimension tables)

$$Z = \left(\frac{L_K - 2L1}{LA} \right) + 1 \qquad Z = \left(\frac{300 - 7}{4.5} \right) + 1 = 66$$

For calculation:

$$L_K = (Z-1) \cdot LA + 2L1 = 299.5 \text{ mm}$$

Effective static load rating

$$C_{0w} = C_0 \cdot \frac{L_K - 2L1 + LA}{100}$$

$$C_{0w} = 88900 \cdot \frac{297}{100} = 264000 \text{ N}$$

Static load safety factor S_o

$$S_0 = \frac{C_{0w}}{P_0} \qquad S_0 = \frac{264000}{9500} = 27.8$$

Effective dynamic load rating C_w:

$$C_w = C \cdot \left(\frac{L_K - 2L1 + LA}{100} \right)^{3/4} \cdot \left(\frac{L_K - 2L1}{100 - LA} \right)^{1/36}$$

$$C_w = 25960 \cdot \left(\frac{295}{100} \right)^{3/4} \cdot \left(\frac{288}{95.5} \right)^{1/36} = 60250 \text{ N}$$

Nominal rating life L:

$$L = \left(\frac{C_w}{P} \right)^{10/3} \qquad L = \left(\frac{60250}{9500} \right)^{10/3} = 472 \cdot 10^5$$

Nominal rating life Lh

$$L_h = \frac{8.33 \cdot 10^5}{H \cdot n_{osz}} \cdot \left(\frac{C_w}{P} \right)^{10/3}$$

$$L_h = \frac{8.33 \cdot 10^5}{100 \cdot 50} \cdot 472 = 78600 \text{ h}$$

Calculation programme

The calculation on pages 21 to 27 can be used to establish an initial layout for flat cage guidance systems.
The equations are based on a defined static system.
In practice, however, an undefined static system is generally used. This does not allow for simple calculations; in order to obtain a precise calculation, the preload and internal load distribution have to be taken into account.
The load carrying capacity and rigidity for different loads can be calculated using a corresponding EGIS calculation programme.

The calculation programme determines the following data:
– Static load safety factor
– Displacement stemming from the elasticity of the bearing.

The non-linear deflection of the rolling elements is taken into account in this context.
The connecting structure is assumed to be rigid.

The following details are required for the calculation of every load scenario (figure 14 and datasheet, page 29):
– Size and position of the elements of the guidance system
– Position of the drive axis
– Position of the loading point and external load components
– Shear-free moments
– Position of the balance points and size of weights
– Kinetic valves
– Duration of particular steps

The geometry and loads can be described simply using the following datasheet.
A right-handed coordinate system is used for the description. The right-hand rule applies for moments.

Position of co-ordinate origin:
– Carriages in central stroke position
– x: centre of bearing cage length
– y: centre plane of guideways
– z: central between the guideways

One or more stroke positions deviating from the central position may be used for the calculation.

The data entered in the datasheet correspond to the guidance system presented in figure 15 as an example.

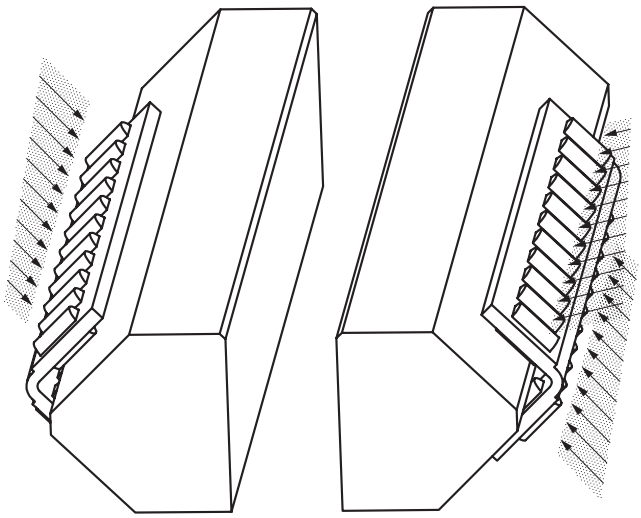


Figure 13. Internal load distribution in the case of loads produced by loads and moments

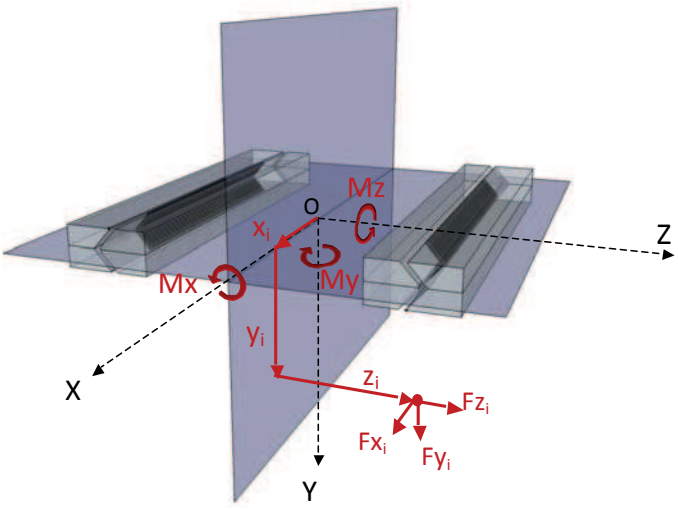


Figure 14. Coordinate system

Datasheet

Project : Example

Guidance system : Horizontal drilling carriage

Guidance geometry
- Guideway size: 4020
- Cage length L_K: 200 mm
- Distance between rear guideway surfaces b1: 145 mm
- Installation layout: XI

Stroke
- H: 110 mm

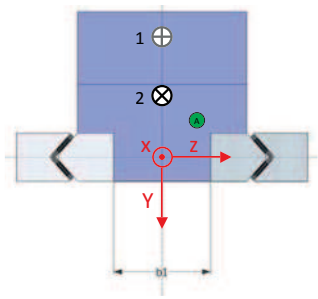
Position of drive axis
- y_A: -32 mm
- z_A: 30 mm

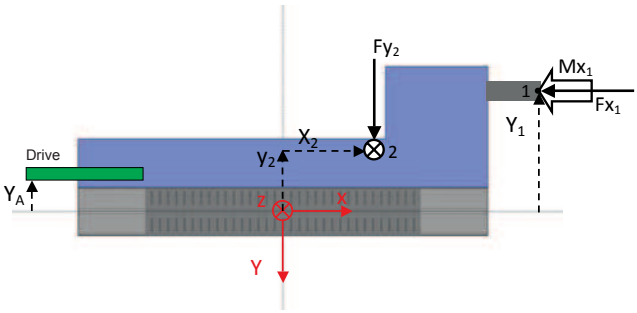
Load case No./ description: Nr. 1 Drilling

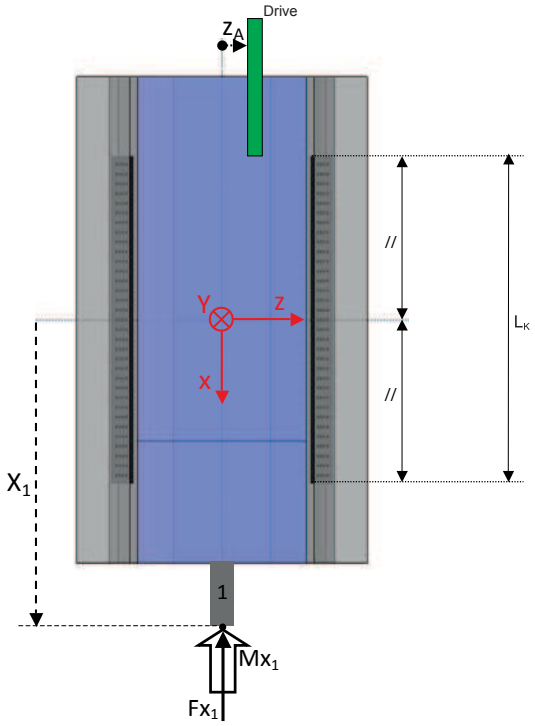
Carriage position(s) for the calculation x_B	50				mm
Speed v	3				m/min
Duration of particular step q	50				%

Point i	Description	Coordinates			Loads, components			Moments		
		x_i	y_i	z_i	F_{xi}	F_{yi}	F_{zi}	M_{xi}	M_{yi}	M_{zi}
		mm	mm	mm	N	N	N	Nmm	Nmm	Nmm
1	Drilling tool: drilling pressure, torque	195	-90	0	-1200			-20000		
2	Carriage + shaft weight	55	-40	0		800				
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

Example: horizontal drilling carriage







Installation layout

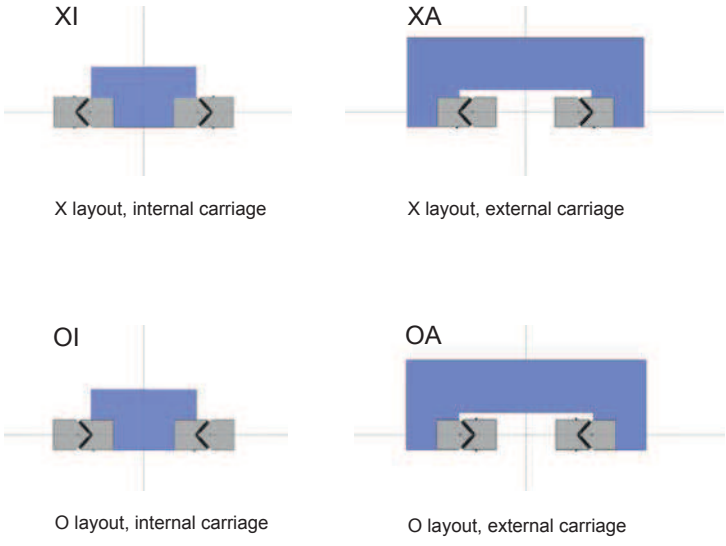


Figure 15. Geometry and load details

Example: horizontal drilling carriage

Results

Power on carriage drive	**Fx =**	-1200	N
Resulting load on guidance system:	**Fy =**	800	N
	Fz =	0	N
	Mx =	-20000	Nmm
	My =	-36000	Nmm
	Mz =	-82400	Nmm
Required preload power	**Pv =**	3050	N
Percentage rate of static load carrying capacity	**C_0:**	2.54	%
Displacement of the guidance system:	**del y =**	0.13992	µm
	del z =	-0.00719	µm
	phi x =	-0.00152	mrad
	phi y =	-0.00389	mrad
	phi z =	-0.00863	mrad
Static load safety factor:	**S_0 =**	31.6	

Displacement at point i (µm)

Nr.	del ix	del iy	del iz
1	-0.27622	0.18561	0.04155
2	-0.77686	-1.54327	0.88915
3	-0.34527	-0.33483	0.26788

The calculated displacements only include the effect of the deflection of rolling elements and raceways.
The deformation of the connecting structure is not taken into account.

1.4 RIGIDITY

Flat cage guidance systems use needle rollers, cylindrical rollers or balls as load-bearing rolling elements. Needle rollers and cylindrical rollers possess a line contact in the rolling contact whilst balls possess a point contact. The operating load F creates an elastic deformation at the contact points and therefore causes the raceways to converge around the deflection δ.

Rigidity is the relationship between the load and deformation:

$$C_L = \frac{F}{\delta}$$

Guidance systems with needle rollers are significantly more rigid than those with cylindrical rollers given the same space requirement due to the large number of contact lines.
The rigidity of guidance systems with balls is considerably lower on account of the point contact (figure 16).

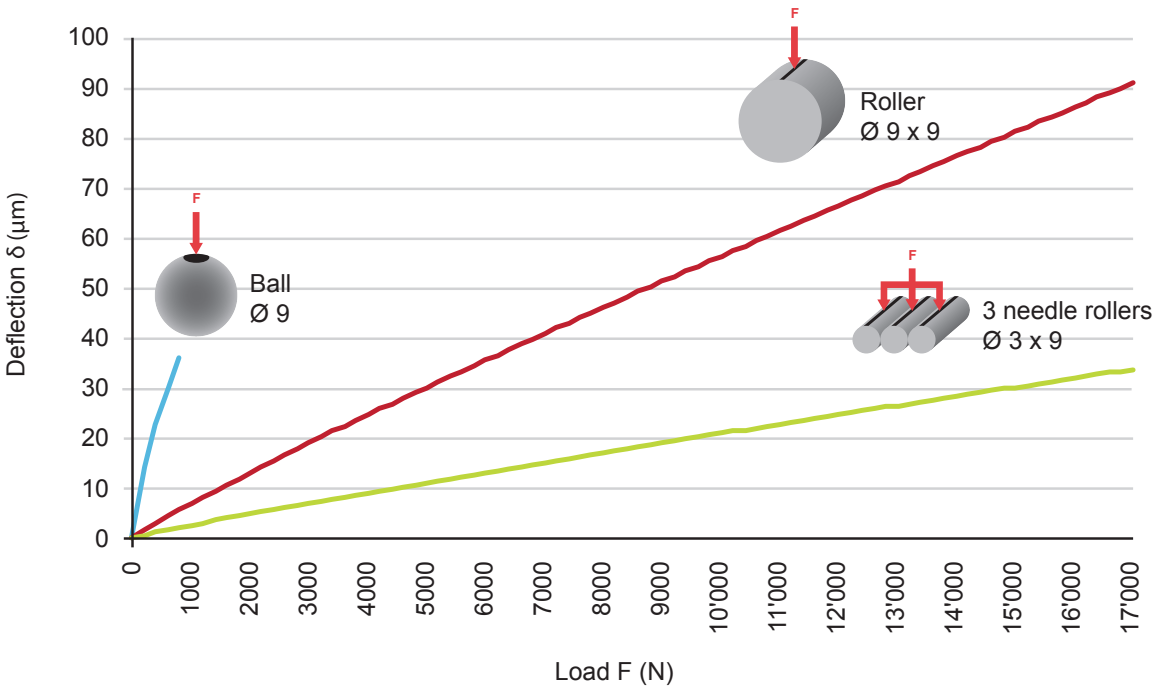


Figure 16. Comparison between rolling element types with the same space requirement

△ Deformations of the connecting structure, settlement phenomena, etc. are not taken into account. Deformation can therefore be more significant in practice.

In guidance systems with M and V guideways in a closed layout, the rigidity can be increased by preloading (preloading, page 34).

The rigidity is dependent on the load and the number and geometry of the rolling elements.

Flat cage guidance systems with line contact

$$\delta = K \cdot (F/Z)^{0.9} / L_w^{0.8}$$

$$C_L = 1/K \cdot F^{0.1} \cdot Z^{0.9} \cdot L_w^{0.8}$$

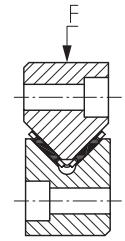
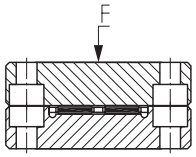
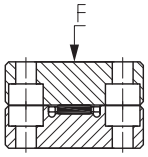
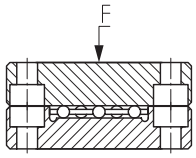
Flat cage guidance systems with point contact

$$\delta = K \cdot (F/Z)^{2/3} / D_w^{1/3}$$

$$C_L = 1/K \cdot F^{1/3} \cdot Z^{2/3} \cdot D_w^{1/3}$$

δ	**µm**	Elastic deformation at the contact points, convergence of the two raceway levels
K	**-**	Factor for the determination of elastic deformation dependent of the type (table 17)
F	**N**	Operating load
Z	**-**	Number of rolling elements per row
L_w	**mm**	Rolling element length
C_L	**N/µm**	Rigidity of the flat cage guidance system
D_W	**mm**	Ball diameter.

Table 17: factor K for the determination of elastic deformation

Guideway Type	Factor K	Guideway Type	Factor K
	**0.0822**		**0.0426**
	**0.0794**		**0.8776**

Calculation example

Guideway	M 5025 and V 5025
Flat cage assembly	E-HW15 x 300
Operating load	F = 9500 N
Number of rolling elements per row	Z = 66
Rolling element length	L_w = 6.8 mm
Type factor (table)	K = 0.0822

Elastic deformation calculation:

$$\delta = K \cdot (F/Z)^{0.9} / L_w^{0.8}$$

$$\delta = 0.0822 \cdot (9500/66)^{0.9} / 6.8^{0.8} = 1.6\ \mu m$$

Rigidity calculation:

$$C_L = 1/K \cdot F^{0.1} \cdot Z^{0.9} \cdot L_w^{0.8}$$

$$C_L = 1/0.0822 \cdot 9500^{0.1} \cdot 66^{0.9} \cdot 6.8^{0.8} = 6100\ N/\mu m$$

1.5 PRELOAD

The preload of flat cage guidance systems can be useful for the following reasons:

– Increase of rigidity
– Improvement of running accuracy
– Improvement of load distribution and reduction of maximum load on the outer rolling elements
– Increase of permissible moments

The preload influences the displacement resistance and rating life.

Reference value for the preload: 2 to 3% of C_0.
The optimum preload for concrete load datas can be determined using EGIS calculation programmes.

An optimum preload reduces the possibility of uncontrolled movement in the flat cage assembly (cage roaming).

In order to guarantee that the rigidity of our linear guidance systems is fully optimised, care must be taken to ensure that the connecting structure is sufficiently rigid and precise.

In the case of imprecise connecting structures or ones which can be easily deformed, angle errors may occur between the raceways which create an increased load at the ends of the rolling elements.

This would not result in increased rigidity but rather the end load would reduce the operating life.

1.5.1 SETTING THE PRELOAD

The preload can be measured and set using different methods:

– using pressure screws with a setting torque according to the table on page 35
– by means of FRV carriage displacement resistance (see below)
– by measuring the deformation of the connecting structure.

$$F_{RV} = \frac{C_{0w}}{40'000}$$

F_{RV}	**N**	Carriage displacement resistance
C_{0w}	**N**	Effective static load rating

Requirements:

– Preload 2,5% C_0
– Lubricated guidance system without operating load
– Movement at approx. 0,05 m/s

1.5.1.1 PRESSURE SCREWS

In the case of small loads (S_0>5) the guidance system can be preloaded by means of pressure screws.
A smaller effective span can be obtained by inserting the pressure screws (stud screws according to ISO 4026, DIN 913) between the attachment screws and at the end of the guideway (table 18, figure 19).

1.5.1.2 GUIDEWAYS WITH ADJUSTING GIB

The use of ML guideways with an adjusting gib is recommended where a high degree of rigidity is required or with larger loads (S_0<5). This ensures that the preload is distributed evenly over the entire guideway length.

TABLE 18. PRESSURE SCREWS / SETTING TORQUE

Guideways	Flat cage assembly	Pressure screw		Setting torque
		Dimension	Distance / mm	M_E[1] / Nm
M / V 3015	E-HW10	M4	40	0.34
M / V 4020	E-HW15	M6	80	1.2
M / V 5025	E-HW16	M6	80	1.8
M / V 4525	E-HRW50	M6	80	1
M / V 6035	E-HW20	M8	100	2.9
M / V 6535	E-HRW70	M8	100	3.5
M / V 7040	E-HW25	M10	100	5.7
M / V 8050	E-HW30	M12	100	7.7

1) Torque for a preload of 2,5% C_0

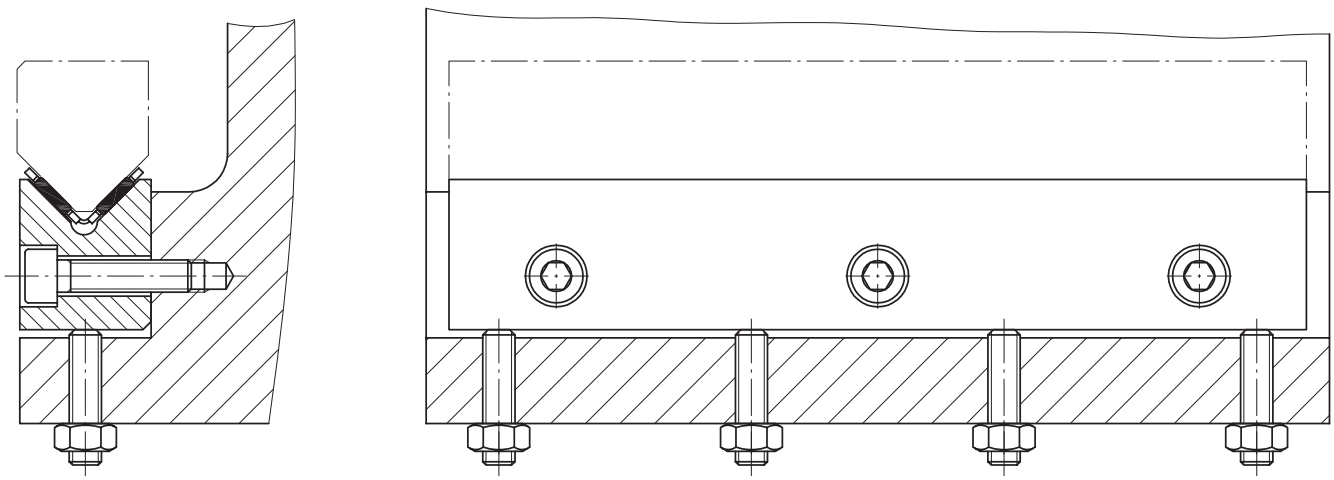


Figure 19. Position of the pressure screws

1.6 LUBRICATION

Machine performance is influenced considerably by the installed flat cage guidance systems. Lubrication plays an important role in this context.

The lubricant minimises friction and wear in the rolling contact and at the bearing points between the cage and the rolling elements. Lubricants also protect against corrosion and offer a support to the seal.

1.6.1 LUBRICANTS

Grease or oil can be used as lubricants.
The choice of lubrication procedure is made on the basis of technical and economic considerations:

Advantages of lubrication with grease:
– long relubrication intervals
– reduced structural expenditure when relubrication is not required
– thickener in the grease creates emergency operation features
– support to the seal

Advantages of lubrication with oil:
– excellent lubrication application
– dirt is flushed out
– heat is dissipated

Flat cage guidance systems only require minimal lubrication. They are supplied with a preservative. The preservative is compatible with grease and oils.

Flat cage guidance systems are generally operated in areas of mixed friction. For this reason, doped lubricants with high-pressure additives should be used (code letter P according to DIN 51502).

△ Cooling lubricants must not be used as they thin out the lubricants and can cause corrosion. Lubricants with solid additives must not be used.

1.6.2 LUBRICATING WITH GREASE

General recommendation:
Lithium-soap, EP-doped grease with mineral oil base.
Specification according to DIN 51825: KP2N-20
Base oil viscosity: ISO-VG 150 to ISP-VG220.

△ S_0<8 essential with large loads
EP-doped greases with base oil viscosity of ISO-VG 220 should be used.

1.6.2.1 PRIMARY OPERATION AND GREASE QUANTITY

The guidance system must be protected against soiling before and during assembly.

Without relubrication equipment:
For the first lubrication application, spread the grease quantity according to the table over both sides in the cage pockets and thinly lubricate the guideway raceways.

With relubrication equipment:
First fill the feed line with grease and thinly lubricate the raceways. Then assemble the guidance system and feed in the grease according to the table. Move the guide system several times during this procedure over the entire stroke to ensure that the grease is evenly distributed.

TABLE 20. GREASE QUANTITIES FOR PRIMARY LUBRICATION (GUIDELINES)

Flat cage/Series	Grease quantity for primary lubrication g/100 mm cage length [1]
E-HW 10	0.6
E-HW 15[2] / E-FFW 2025 / E-FF 2025 ZW	0.6
E-HW 20[2] / E-FFW 2535 / E-FF 2535ZW	1
E-HW 25[2] / E-FFW 3045 / E-FF 3045 ZW	1.3
E-HW 30[2] / E-FFW 3555 / E-FF 3555 ZW	2.1
E-HRW 50	1.5
E-HRW 70	3.5
E-HRW 100	6.6
E-H 10[2] / E-FF 2010	0.3
E-H 15[2] / E-FF 2515	0.5
E-H 20[2] / E-FF 3020	0.7
E-H 25[2] / E-FF 3525	1.1

1) In case of high speeds only about 25% of the quantity
2) With flat cage assemblies with damping about 80% of the quantity

1.6.2.2 RELUBRICATION

Relubrication should be carried out at least once a year with approximately 50% of the grease quantity used for the primary lubrication. More frequent relubrication with partial quantities is recommended. The optimum time and quantities can only be determined under operating conditions and with an adequate observation period.

1.6.3 LUBRICATING WITH OIL

General recommendation:
CLP lubricating oils according to DIN 51517 and HLP according to DIN 51524

Operating temperatures from 0 °C to +70 °C:
Viscosity between ISO-VG 32 and ISO-VG 68

Low temperature range:
Viscosity ISO-VG 10 to ISO-VG 22

CGLP raceway oils can be used up to ISO-VG 220

Oil is fed in by oil impulse or drop feed. Pneumatic oil lubrication is recommended for working conditions with a significant risk of soiling. The slight excess pressure occurring in the guidance system enhances the effectiveness of the existing seals.

It is important to observe the layout (figure 21) when feeding in the lubricating oil so that the lubricant can reach all the rolling element rows.

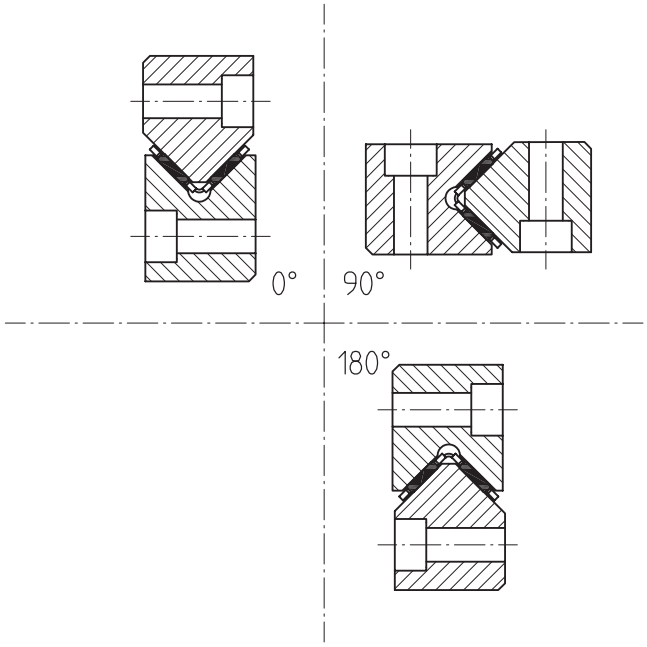


Figure 21. Layouts

If the oil manufacturer has not provided any details or experiences, the behaviour of the lubricating oil must be verified under operating conditions in comparison with the materials used in the guidance system.

Mineral oils can generally be mixed together.

However, synthetic oils must be verified in relation to miscibility and compatibility.

In case of doubt, contact the lubricant supplier.

Primary operation
Oil the guidance system and protect it against soiling during assembly.

1.7 FRICTION

As is the case of all roller bearings, flat cage guidance systems have virtually low friction during the start-up process and in motion. This means that no “stick-slip effect” is produced compared with sliding friction.

Friction (displacement resistance FR) is made up of the following components with different dependencies:

$$F_R = F_{R1} + F_{R0} + F_{RA}$$

Friction component		Dependency
Rolling friction	F_{R1}	Load/lubrication condition
Lubricant friction	F_{R0}	Cage dimensions Stroke speed Lubricant
Wiper friction	F_{RA}	Configuration, preload

Load-dependent rolling friction F_{R1}

$$F_{R1} = \mu \cdot F$$

F_{R1}	**N**	Load-dependent friction component
F	**N**	Flat cage load
μ	**-**	Friction coefficient

With lubrication, the friction coefficient amounts to
0.00035 for flat cage assemblies
0.00050 for angled flat cage assemblies

Lubricant friction F_{R0}

$$F_{R0} = f_0 \cdot (\nu \cdot v)^{2/3} \cdot B1 \cdot L_K{}^{1/3} \cdot 10^{-6}$$

F_{R0}	**N**	Lubricant friction component in displacement friction
f_0	**-**	Type factor
		f_0 = 85 for flat cage assemblies
		f_0 = 120 for angled flat cage assemblies
ν	**mm^2s^{-1}**	Lubricant viscosity at operating temperature
		Viscosity of base oil with grease lubrication
v	**m/min**	Speed
B1	**mm**	Cage width
L_K	**mm**	Bearing cage length

Primary lubrication or relubrication produce temporarily raised lubrication friction.

Wiper friction F_{RA}

The wiper friction arise from the length of the wiper lip and the lip preload. This can be influenced considerably by the wiper assembly.

Reference value per wiper:

Profile shape M/V $F_{RA} = 0.20 \cdot B$

Profile shape J/S $F_{RA} = 0.15 \cdot B$

F_{RA}	**N**	Friction per wiper
B	**mm**	Guideway width

1.8 PROTECTION AGAINST SOILING

In order to ensure that flat cage guidance systems operate safely it is extremely important to protect them against soiling.

In many cases, wipers will suffice to keep the raceways clean. They must be positioned on the raceways throughout the entire movement.

Complete solutions for M and V guideways with standard wipers and integrated longitudinal seals (suffix ..ZZ, ..PP) or seals in the connecting structure may be used for more demanding cases.

1.9 OPERATING LIMITS

Operating temperatures

Linear guidance systems with metallic flat cages are suitable for continuous temperatures of up to +150 °c.

Suitable lubricants must be used in this case.
The guideways must be heat-stabilised at higher operating temperatures (further information can be obtained from EGIS).

Linear guidance systems with flat cages made from plastic are suitable for temperatures of up to +120°C.

An operating temperature of +100 °C must not be exceeded when using wipers.

Acceleration

If high accelerations are recorded in a linear guidance systems, EGIS light metal flat cages are particularly recommended due to their reduced weight.
They can be used for accelerations up to 250 m/s^2.

1.10 INSTALLATION GUIDELINES

1.10.1 PRECISION OF THE CONNECTING STRUCTURE

The precision of the locating surfaces has a decisive influence on the accuracy and smooth running of a linear guidance system.

Perpendicularity and parallelism

The right angle between the locating surfaces must be maintained precisely
(permissible error ± 0,3 mrad)

⊥ 0.003/10

Parallelism errors on the locating surfaces must not be significantly greater than the corresponding tolerances of the guideways.

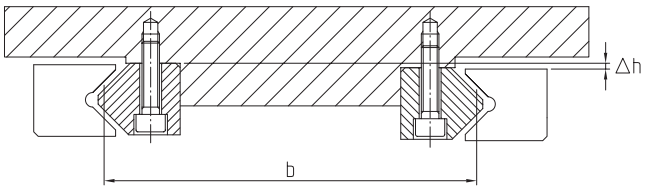


Figure 22. Height variation with a closed layout

Height variation

In order to ensure that the load is distributed as equally as possible over the length of the rolling element, the height variation Δh should not be exceeded (figures 22 and 23).

Permissible height variation for needle roller flat cage assemblies
$\Delta h < 0{,}1 \cdot b$
Permissible height variation for cylinder roller flat cage assemblies
$\Delta h < 0{,}3 \cdot b$

Δh	**µm**	Permissible height variation
b	**mm**	Distance between guidance system centres

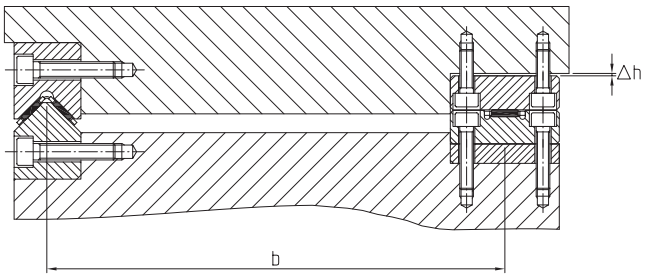


Figure 23. Equalisation of the height variation with an open layout with an insert plate

Surface

No particular demands are placed on the surface roughness of the locating surfaces from an operational point of view. In order to maintain a high level of form precision and a suitable measurement basis, it is nevertheless recommended that the surfaces should be precision machined and the holes carefully deburred.

1.10.2 ASSEMBLY INSTRUCTIONS

1.10.2.1 PRIOR TO INSTALLATION

Guideways are preserved and delivered packed in anticorrosion paper. Parts are matched by dimensions, packed in sets and numbered accordingly.

Numbering: **1 . 2**

set number | Joint number

Unpack guideways shortly before assembly and remove the corrosion protection where applicable. Light oiling protects the guideways against corrosion during assembly. Position parts with identical set number.

Particular attention should be paid to the following points:

– Guideways with the same set number should be inserted in the same guidance system during assembly.
– Attention should be paid to the joint number at the joints.
– The M and V guideways may have different set numbers in the closed layout (figure 24).

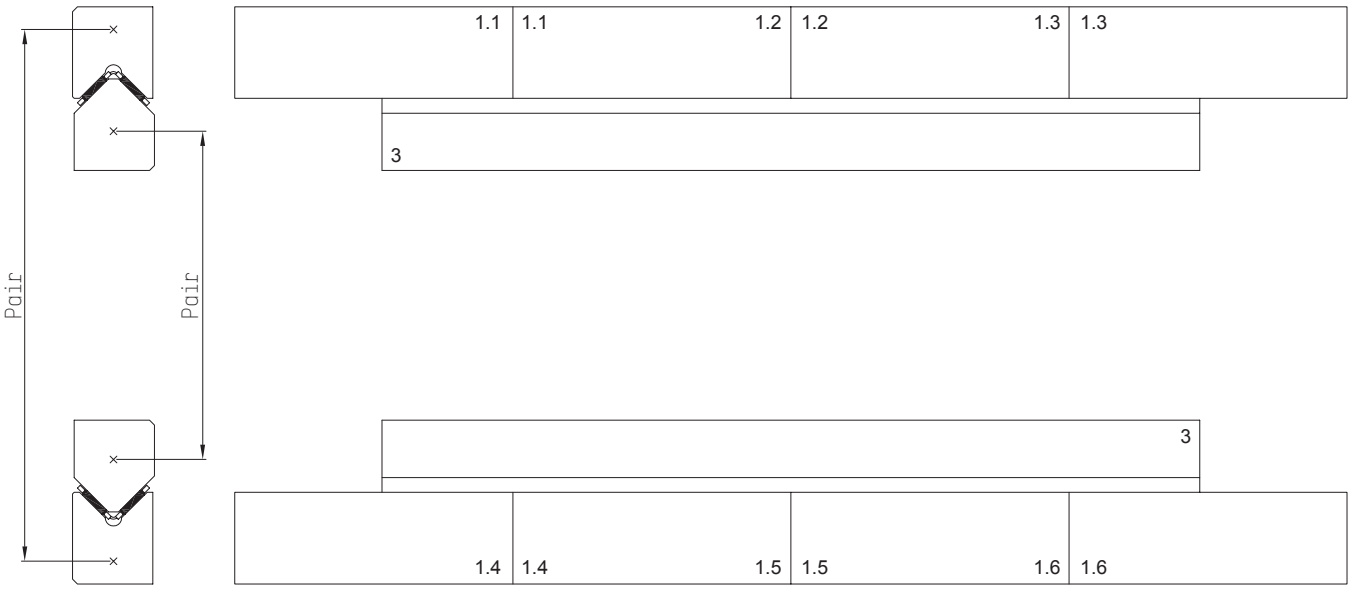


Figure 24. Numbering of single and multi-part guideways

1.10.2.2 CLOSED LAYOUT

△ Guideways which are packed in pairs must always be installed in the same guidance system.

The guideway locating faces are unlabelled and comprise significant chamfer.

Assemble the guideway pair which does not require adjustment (1) (figure 25). Clamp the guideways against the rear locating face and check for parallelism before tightening the fixing screws (figure 26).

Assemble the stationary opposing guideway (2)

Attach the adjusting guideway (3), only tightening screws slightly so that the guideway can still move.

Insert guidance system lengthways, insert cage assemblies between the guideways and position so that they do not lie against the end pieces in the final positions.

Preload adjusting guideway (3) with pressure screws (4) (figure 27) (with gib for ML guideways) (figures 29 to 31).

Initially preload around twice the required value in order to anticipate settling. Release and then set the preload to the required value. Tighten fixing screws. Screw on wipers or end pieces.

When preloading with pressure screws, adjust the latter in two steps to the required tightening torque and tighten with a counter nut or screw locking device.

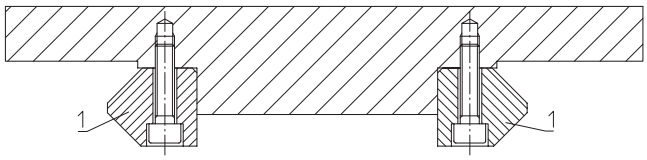


Figure 25. Assembly.

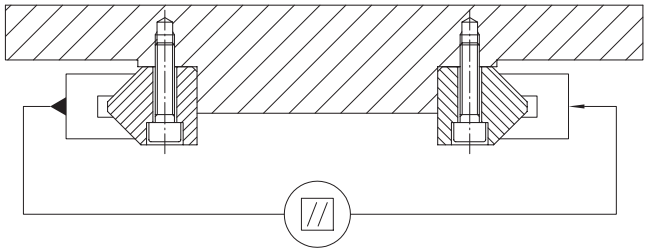


Figure 26. Parallelism verification

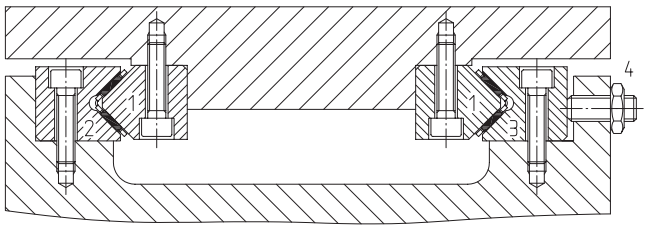


Figure 27. Preload.

△ Only tighten pressure screws which are supported by the flat cage assembly (see figure 28).

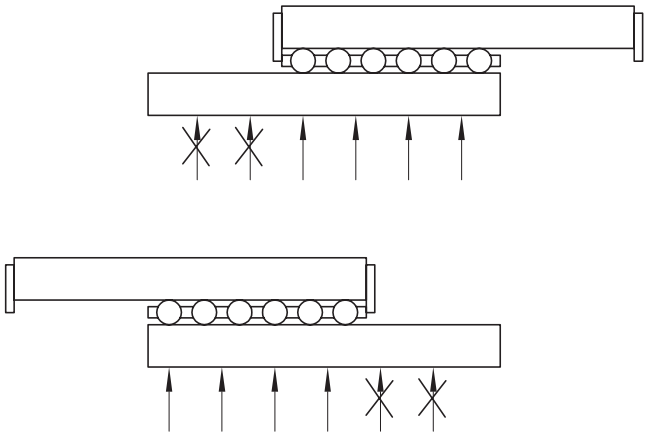


Figure 28. Preload adjustment.

If the preload force is adjusted over ML- guideways with an adjusting gib, the following procedure should be followed: push the adjusting gib under the ML guideway and adjust the guidance system free from clearance (figure 29). Shorten the unhardened gib on the adjustment side of the guideway so that it is approximately 3 mm short of the front side of the guideway (figure 29). Shorten the opposite side of the gib flush with the end of the guideway.

Preload the gib by inserting a soft bolt (figure 30).
A 1 mm displacement of the gib produces a height adjustment of 15 µm.

After setting, attach the adjusting gib to the front side of the guideway with the hexagonal socket screw (figure 31).

See chapter entitled “Setting the preload” to verify the preload

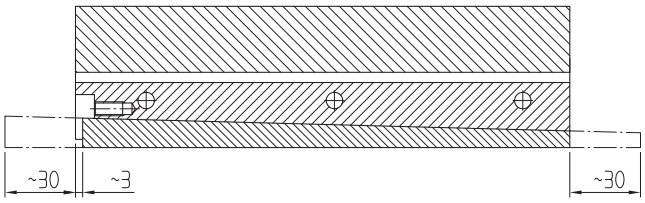


Figure 29. Inserting and shortening the adjusting gib

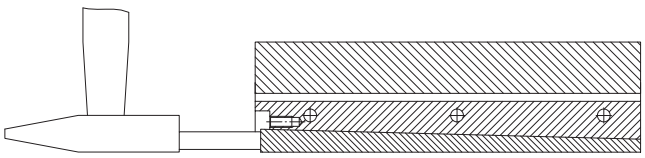


Figure 30. Setting the preload

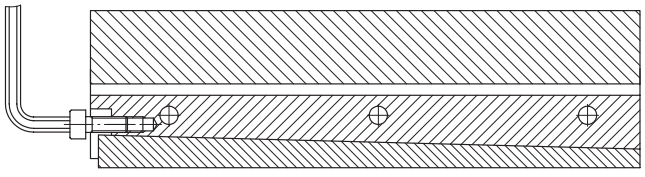


Figure 31. Attaching the adjusting gib

1.10.2.3 OPEN LAYOUT

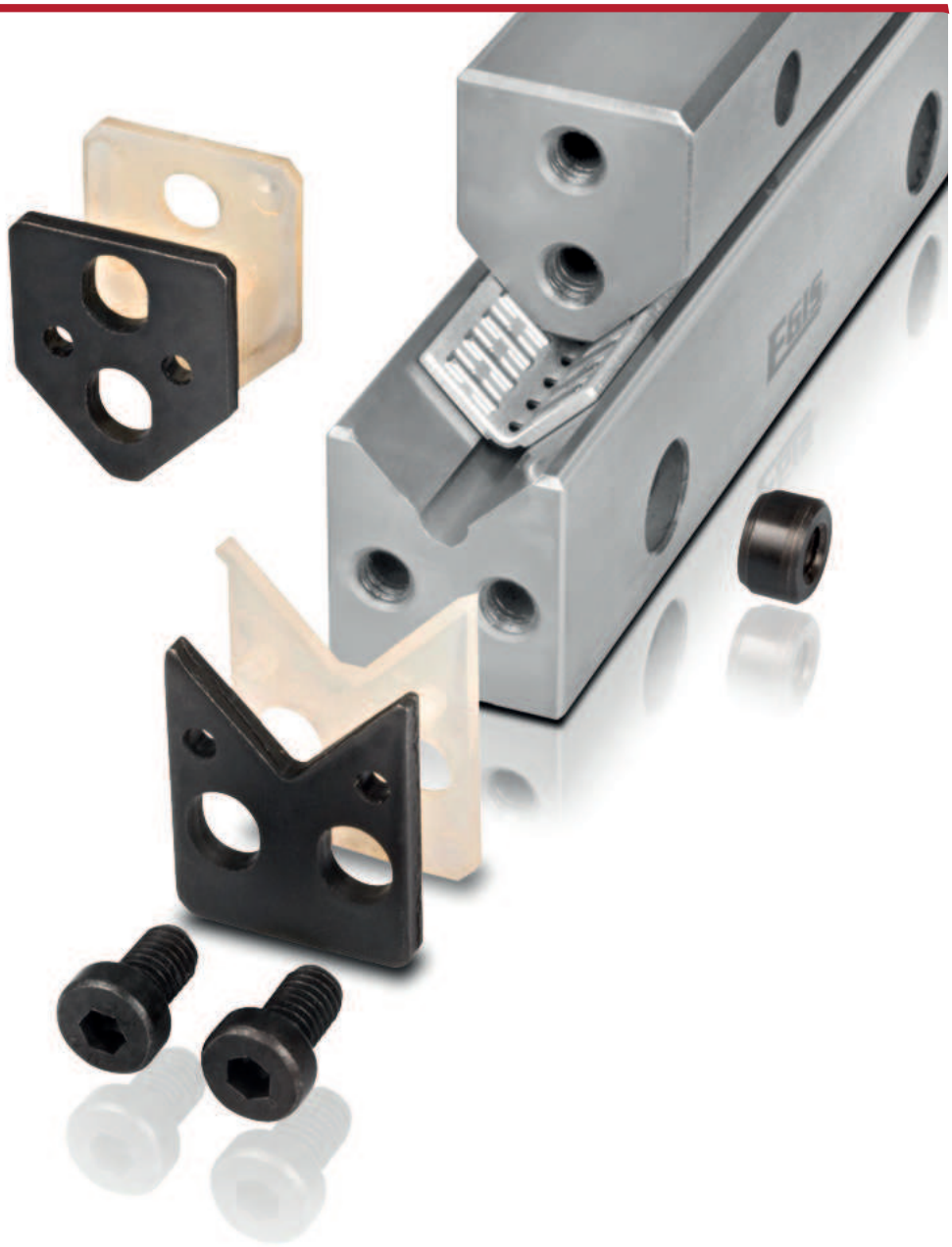
After the precision of the locating faces has been checked, particularly the height variation (see chapter on the precision of the connecting parts), the guideways can be assembled in the required sequence.

Guideways which are labelled in sets (4SX matching) must be assembled accordingly.

PRODUCT PROGRAMME

2

M AND V GUIDEWAYS
WITH NEEDLE OR CYLINDRICAL ROLLER FLAT CAGE ASSEMBLY



A MATERIAL

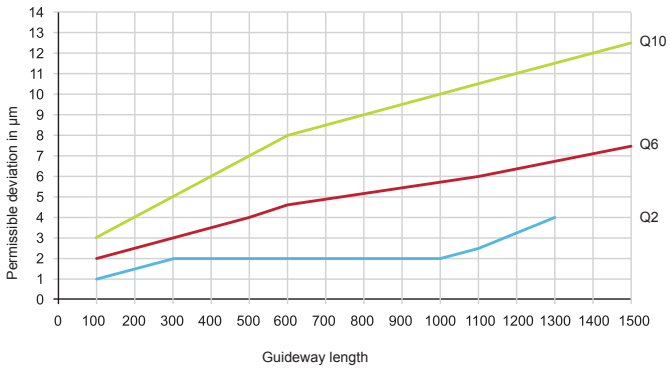
Hardened tool steel 1.2842 HRc 58 – 62.

B QUALITY

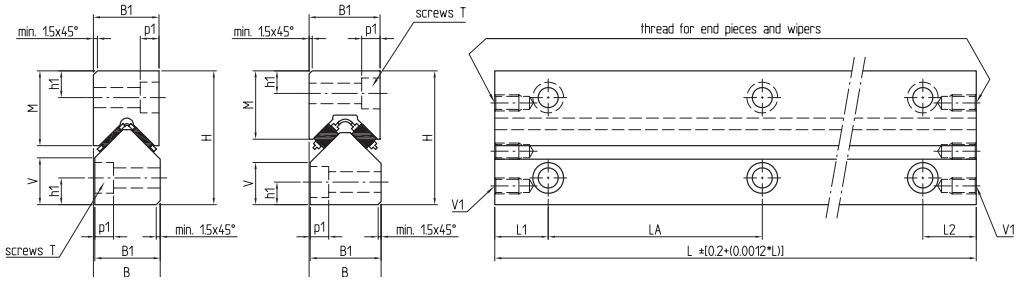
Raceways and locating faces are precision ground.

The guideways are available in 3 qualities (parallelism tolerance of the raceways on the reference sides of the guideway in relation to a defined length).

Q10: normal quality for general machine construction
Q6: precise quality for machine tool construction
Q2: particularly precise quality for exceptionally demanding structures



SPECIAL EXECUTIONS
SEE CHAPTER 10 ALTERNATIVE VERSIONS



DIMENSIONS IN MM

Type		Dimensions					Fixing holes							Threads
		H	B	B1	M	V	Screws T	h1	p1	t	LA***	L1**	L2**	V1
		0/-0.2	0/-0.1	0/-0.2			****			min.		min.	min.	
M3015		30	15	15	15.75	-	M4	5.5	4.6	15	40*	15	15	M3
	V3015	30	15	15	-	10.5	M4	5.5	4.6	15	40*	15	15	M3
M3115		31	15	15	16	-	M4	6	5.2	15	50*	25	25	M3
	V3115	31	15	15	-	11	M4	6	5.2	15	50*	25	25	M3
M4020		40	20	20	22.5	-	M6	7.5	6.9	20	80*	15	15	M5
	V4020	40	20	20	-	13.5	M6	7.5	6.9	20	80*	15	15	M5
M4422		44	22	22	23.1	-	M6	9	6.9	22	80*	15	15	M5
	V4422	44	22	22	-	16.6	M6	9	6.9	22	80*	15	15	M5
M4525		45	25	25	22.75	-	M6	7.5	6.9	15	80*	20	20	M6
	V4525	45	25	25	-	14	M6	7.5	6.9	15	80*	20	20	M6
M5025		50	25	25	28	-	M6	10	6.9	15	80*	20	20	M6
	V5025	50	25	25	-	17	M6	10	6.9	15	80*	20	20	M6
M6035		60	35	35	35	-	M8	11	9.1	20	100	20	20	M6
	V6035	60	35	35	-	20	M8	11	9.1	20	100	20	20	M6
M6535		65	35	35	33.25	-	M8	11	9.1	20	100	20	20	M6
	V6535	65	35	35	-	20	M8	11	9.1	20	100	20	20	M6
M7040		70	40	40	40	-	M10	13	11.1	25	100	20	20	M6
	V7040	70	40	40	-	24	M10	13	11.1	25	100	20	20	M6
M8050		80	50	50	45	-	M12	14	13.1	30	100	20	20	M6
	V8050	80	50	50	-	26	M12	14	13.1	30	100	20	20	M6
M8550		85	50	50	42.25	-	M12	14	13.1	30	100	20	20	M6
	V8550	85	50	50	-	26	M12	14	13.1	30	100	20	20	M6

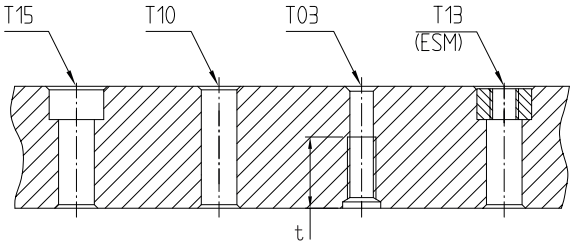
* M/V3015: length (L) 100mm, hole distances (LA) = 35mm
M/V4422: length (L) 100mm, hole distances (LA) = 50mm
M/V5025: length (L) 100mm, hole distances (LA) = 50mm

* M/V4020: length (L) 100mm, hole distances (LA) = 50mm
M/V4525: length (L) 100mm, hole distances (LA) = 50mm

** L1 and L2 are the same size at both ends of the guideways and dependent on the guideway length without any specific requests being made

*** The tolerance of the hole distances (LA) is in proportion to the length tolerance

**** 4 hole types in the guideways for screw size T (according to the drawing below)



T15: Sinkhole for screws ISO 4762
T10: Clearance hole
T03: Threaded hole, thread length “t”
T13: Sinkhole as T15, but with insert nuts ESM

STANDARD LENGTHS (MM)

Dimensions		100	150	200	300	400	500	600	700	800	900	1000	Made-to-measure lengths up to L max
M3015	**V3015**	●	●	●	●	●	●	○					600
M3115	**V3115**	○	○	○	○	○	○	○					600
M4020	**V4020**	●	●	●	●	●	●	●	●	●	○	○	1000
M4422	**V4422**	○		○	○	○	○	○	○	○	○	○	1000
M4525	**V4525**	○		○	○	○	○	○	○	○	○	○	1000
M5025	**V5025**	●		●	●	●	●	●	●	●	○	○	1300
M6035	**V6035**			○	○	○	○	○	○	○	○	○	1300
M6535	**V6535**			○	○	○	○	○	○	○	○	○	1300
M7040	**V7040**			○	○	○	○	○	○	○	○	○	1300
M8050	**V8050**				○	○	○	○	○	○	○	○	1300
M8550	**V8550**				○	○	○	○	○	○	○	○	1300

● = ex stock, hardened, pre-ground
○ = ex stock, non-hardened, non-ground
Special lengths available on request

CAGE ALLOCATION

Guideways	Rolling elements	Plastic	Aluminium	Steel	Brass	Brass (with damping)
M/V3015	Needle rollers			E-HW10 F	E-HW10 MS	
M/V3115	Needle rollers			E-HW10 F	E-HW10 MS	
M/V4020	Needle rollers	E-FFW2025	E-HW15	E-HW15 F	E-HW15 MS	E-HGW15
M/V4422	Needle rollers	E-FFW2025	E-HW15	E-HW15 F	E-HW15 MS	E-HGW15
M/V4525	Cylindrical rollers		E-HRW50			
M/V5025	Needle rollers	E-FFW2025	E-HW15 E-HW16	E-HW15 F	E-HW15 MS E-HW16 MS	E-HGW15
M/V6035	Needle rollers	E-FFW2535	E-HW20	E-HW20 F	E-HW20 MS	E-HGW20
M/V6535	Cylindrical rollers		E-HRW70			
M/V7040	Needle rollers	E-FFW3045	E-HW25	E-HW25 F	E-HW25 MS	E-HGW25
M/V8050	Needle rollers	E-FFW3555	E-HW30	E-HW30 F	E-HW30 MS	E-HGW30
M/V8550	Cylindrical rollers		E-HRW100			

3

ML GUIDEWAYS
WITH ADJUSTING GIB AND
V GUIDEWAYS
WITH NEEDLE ROLLER FLAT CAGE ASSEMBLY

A MATERIAL

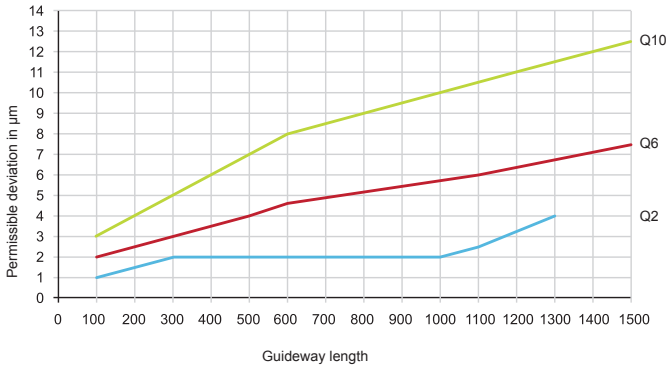
Hardened tool steel 1.2842 HRc 58 – 62
(non-hardened adjusting gib).

B QUALITY

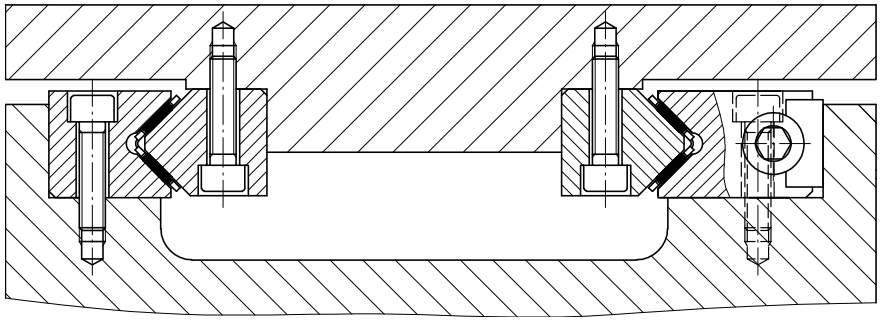
Raceways and locating faces are precision ground.

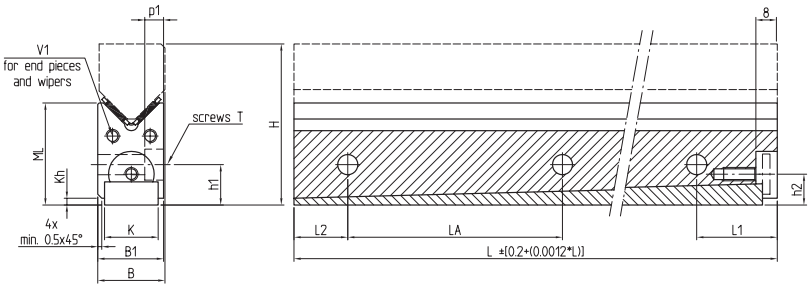
The guideways are available in 2 qualities for the ML guideways and 3 qualities for the V guideways (parallelism tolerance of the raceways on the reference sides of the guideways in relation to a defined length).

Q10: normal quality for general machine construction (ML and V)
Q6: precise quality for machine tool construction (ML and V)
Q2: particularly precise quality for exceptionally demanding structures (V)



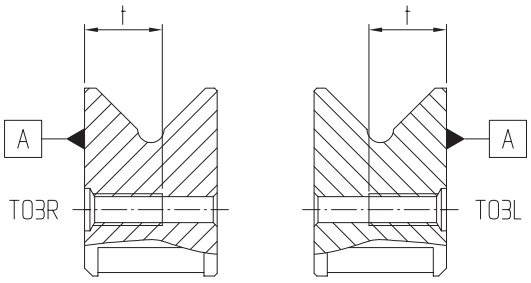
SPECIAL EXECUTIONS
SEE CHAPTER 10 ALTERNATIVE VERSIONS



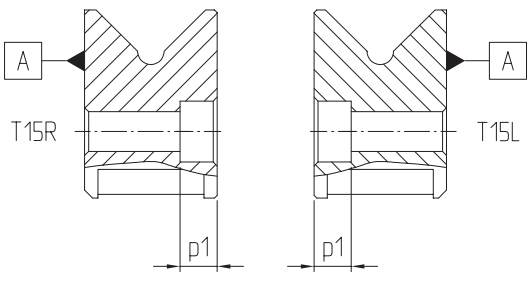


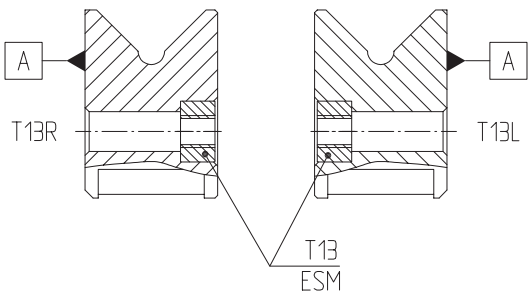
Type	Dimensions						Fixing holes							Gib screws	Threads
	H*	B 0/-0.1	B1 0/-0.2	ML*	K	Kh*	Screws T ****	h1*	p1 min.	t	LA	L1*** min.	L2*** min.	h2	V1
ML5020	50	20	20	32.5	15	5.5	M6	17.5	6.8	20	80**	30	15	15	M4
ML5520	55	20	20	37.5	15	6	M6	22.5	6.8	20	80	30	15	20	M4
ML5525	55	25	25	32.5	20	2.5	M6	15	6.8	15	80**	30	20	11.5	M5
ML6025	60	25	25	37.5	20	3.5	M6	20	6.8	15	80	30	20	16.5	M5
ML6525	65	25	25	42.5	20	5	M6	25	6.8	15	80	30	20	21.5	M5
ML7025	70	25	25	47.5	20	6.5	M6	30	6.8	15	80	30	20	26.5	M5
ML7035	70	35	35	45	25	3	M8	21	9	20	100**	32	20	15.5	M6
ML8035	80	35	35	55	25	5	M8	31	9	20	100	32	20	25.5	M6
ML8040	80	40	40	50	30	3	M10	23	11	25	100**	32	20	16	M6
ML9040	90	40	40	60	30	5	M10	33	11	25	100	32	20	26	M6
ML9050	90	50	50	55	40	3	M12	24	13	30	100**	32	20	15.5	M6
ML10050	100	50	50	65	40	5	M12	34	13	30	100	32	20	25.5	M6

* These dimensions are dependent on the gib position, adjustment range ± 0.5
** ML5020 + ML5525 + ML7035 + ML8040 + ML9050: length (L) 100mm, hole distance (LA) = 50mm
The tolerance of the hole distances (LA) is in proportion to the length tolerance
*** L1 and L2 are the same size at both ends of the guideways and dependent on the guideway length without any specific requests being made
**** 3 hole types in the guideways for screw size T (according to the drawing below)



T15: Sinkhole for screws ISO 4762
Depending on left or right guideway
T03: Threaded hole, thread length “t”
Depending on left or right guideway
T13: Sinkhole as T15, but with insert nuts ESM
Depending on left or right guideway
A : Reference side





STANDARD LENGTHS (MM)

Dimensions	100	200	250	300	400	500	600	700	750	800	900	1000
ML5020	o	o		o								
ML5520					o	o	o					
ML5525	o	o	o									
ML6025				o	o	o						
ML6525							o	o	o			
ML7025										o	o	o
ML7035	o	o		o	o	o						
ML8035							o	o		o	o	o
ML8040	o	o		o	o	o						
ML9040							o	o		o	o	o
ML9050	o	o		o	o	o						
ML10050							o	o		o	o	o

o = ex stock, non-hardened, non-ground
Special lengths available on request

CAGE ALLOCATION

Guideways	Rolling elements	Plastic	Aluminium	Steel	Brass	Brass (with damping)
ML5020	Needle rollers	E-FFW2025	E-HW15	E-HW15 F	E-HW15 MS	E-HGW15
ML5520	Needle rollers	E-FFW2025	E-HW15	E-HW15 F	E-HW15 MS	E-HGW15
ML5525	Needle rollers	E-FFW2025	E-HW15 E-HW16	E-HW15 F	E-HW15 MS E-HW16 MS	E-HGW15
ML6025	Needle rollers	E-FFW2025	E-HW15 E-HW16	E-HW15 F	E-HW15 MS E-HW16 MS	E-HGW15
ML6525	Needle rollers	E-FFW2025	E-HW15 E-HW16	E-HW15 F	E-HW15 MS E-HW16 MS	E-HGW15
ML7025	Needle rollers	E-FFW2025	E-HW15 E-HW16	E-HW15 F	E-HW15 MS E-HW16 MS	E-HGW15
ML7035	Needle rollers	E-FFW2535	E-HW20	E-HW20 F	E-HW20 MS	E-HGW20
ML8035	Needle rollers	E-FFW2535	E-HW20	E-HW20 F	E-HW20 MS	E-HGW20
ML8040	Needle rollers	E-FFW3045	E-HW25	E-HW25 F	E-HW25 MS	E-HGW25
ML9040	Needle rollers	E-FFW3045	E-HW25	E-HW25 F	E-HW25 MS	E-HGW25
ML9050	Needle rollers	E-FFW3555	E-HW30	E-HW30 F	E-HW30 MS	E-HGW30
ML10050	Needle rollers	E-FFW3555	E-HW30	E-HW30 F	E-HW30 MS	E-HGW30

4

GUIDEWAYS WITH INTEGRATED TOOTHED RACK MVZ (M/V/ML) FOR POSITIVE CONTROL OF THE NEEDLE ROLLER FLAT CAGE ASSEMBLY

A MATERIAL

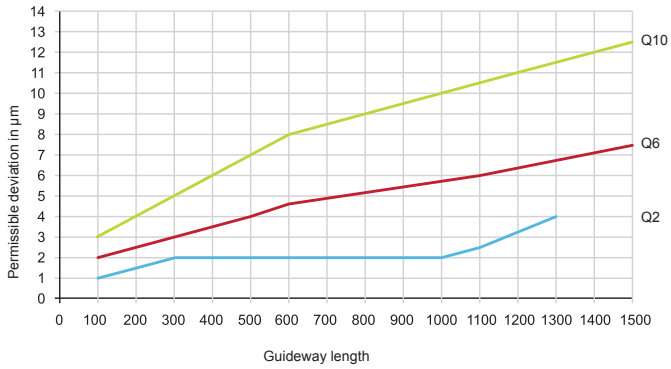
Hardened tool steel 1.2842 HRc 58 – 62.

B QUALITY

Raceways and locating faces are precision ground.

The guideways are available in 3 qualities (parallelism tolerance of the raceways on the reference sides of the guideway in relation to a defined length).

Q10: normal quality for general machine construction
Q6: precise quality for machine tool construction
Q2: particularly precise quality for exceptionally demanding structures



SPECIAL EXECUTIONS
SEE CHAPTER 10 ALTERNATIVE VERSIONS

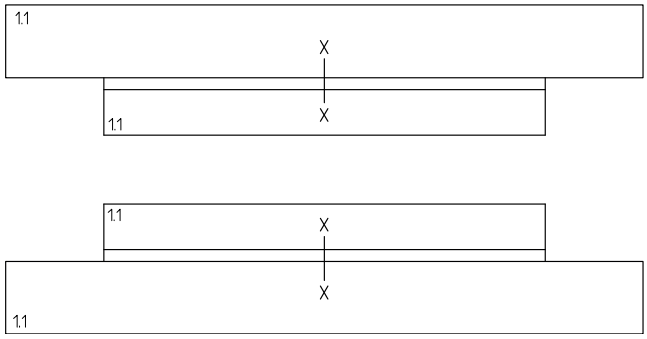
C MATCHING BY SETS

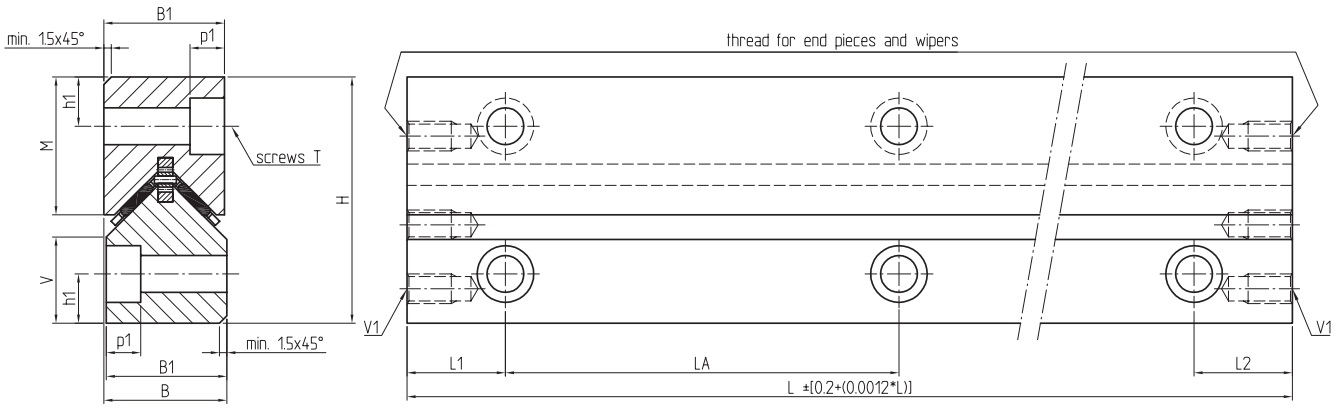
MVZ – guideways with integrated toothed rack are supplied in sets and consist of:

- M and/or ML guideways with integrated toothed rack.
- V guideways with integrated toothed rack.
- Flat cage assemblies: E-HW F or E-HW with integrated toothed wheel for positive control of the cage assemblies.
- The assembly dimensions have the same mounting dimensions as the M/ML and V guideways with flat cage assemblies.

IMPORTANT ASSEMBLY INFORMATION

- Set numbering must be respected.
- When the guideways are being positioned, it is important to take into account the “X-X” labelling which guarantees the correct positioning of the guideways and cage assemblies in the central stroke position.

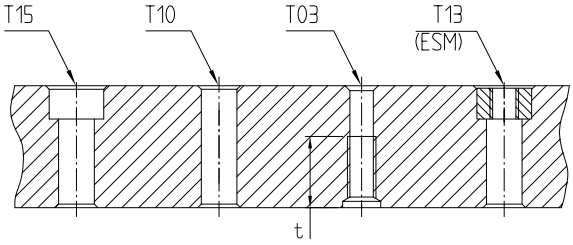




DIMENSIONS IN MM

Type		Dimensions					Fixing holes							Threads
		H 0/-0.2	B 0/-0.1	B1 0/-0.2	M	V	Screws T ****	h1	p1	t min.	LA***	L1** min.	L2** min.	V1
M3015		30	15	15	15.75	-	M4	5.5	4.6	15	40*	15	15	M3
	V3015	30	15	15	-	10.5	M4	5.5	4.6	15	40*	15	15	M3
M4020		40	20	20	22.5	-	M6	7.5	6.9	20	80*	15	15	M5
	V4020	40	20	20	-	13.5	M6	7.5	6.9	20	80*	15	15	M5
M5025		50	25	25	28	-	M6	10	6.9	15	80*	20	20	M6
	V5025	50	25	25	-	17	M6	10	6.9	15	80*	20	20	M6
M6035		60	35	35	35	-	M8	11	9.1	20	100	20	20	M6
	V6035	60	35	35	-	20	M8	11	9.1	20	100	20	20	M6
M7040		70	40	40	40	-	M10	13	11.1	25	100	20	20	M6
	V7040	70	40	40	-	24	M10	13	11.1	25	100	20	20	M6
M8050		80	50	50	45	-	M12	14	13.1	30	100	20	20	M6
	V8050	80	50	50	-	26	M12	14	13.1	30	100	20	20	M6

* M/V3015: length (L) 100mm, hole distances (LA) = 35mm
M/V4020: length (L) 100mm, hole distances (LA) = 50mm
M/V5025: length (L) 100mm, hole distances (LA) = 50mm
** L1 and L2 are the same size at both ends of the guideways and dependent on the guideway length without any specific requests being made
*** The tolerance of the hole distances (LA) is in proportion to the length tolerance
**** 4 hole types in the guideways for screw size T (according to the drawing below)



T15: Sinkhole for screws ISO 4762
T10: Clearance hole
T03: Threaded hole, thread length “t”
T13: Sinkhole as T15, but with insert nuts ESM

STANDARD LENGTHS (MM)

Dimensions		100	150	200	300	400	500	600	700	800	900	1000	Made-to-measure lengths up to L max.
M3015	V3015	o	o	o	o	o	o	o					600
M4020	V4020	o	o	o	o	o	o	o	o	o	o	o	1000
M5025	V5025	o		o	o	o	o	o	o	o	o	o	1300
M6035	V6035			o	o	o	o	o	o	o	o	o	1300
M7040	V7040			o	o	o	o	o	o	o	o	o	1300
M8050	V8050				o	o	o	o	o	o	o	o	1300

o = ex stock, non-hardened, non-ground
Special lengths available on request

5

M AND ML GUIDEWAYS WITH SLIDING LAYER
(TURCITE OR PERMAGLIDE)

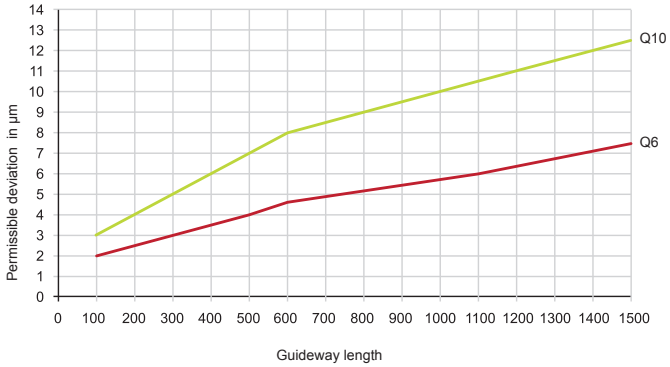
A MATERIAL

M and ML guideways: non-hardened tool steel 1.2842 with affixed Turcite (LB) or Permaglide (LP21)- sliding layer.

B QUALITY

The guideways with a sliding layer are available in 2 qualities (parallelism tolerance of the raceways on the reference sides of the guideways in relation to a defined length).

Q10: normal quality for general machine construction
Q6: precise quality for machine tool construction



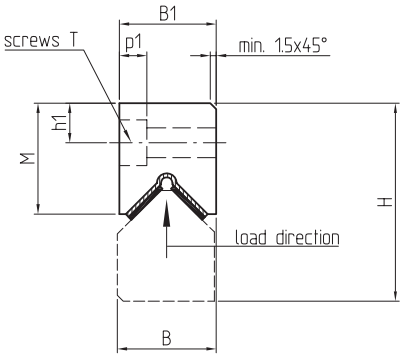
C CHOICE OF COATING

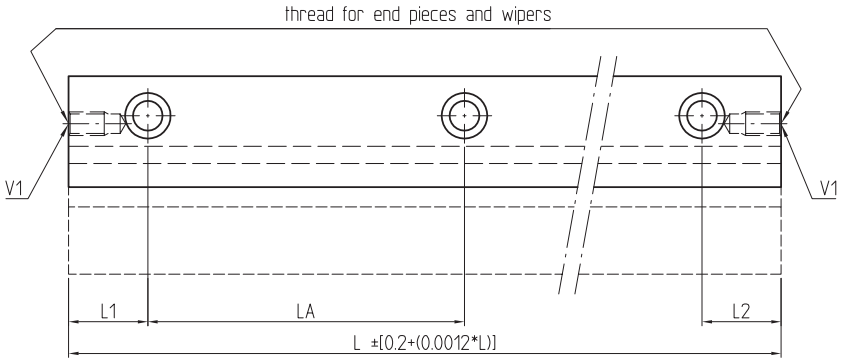
Reference values	Layer	
	Turcite LB	Permaglide LP21
Specific permissible load capacity Static p_{max} [N/mm²]	6	250
$p * v_{max}$ [N/mm² * m/s]	1	3
Permissible temperature [°C]	-40° bis +80°	-40° bis +110°
Friction coefficient (without lubricant)	0.15 – 0.26	Not usable
Friction coefficient (with lubricant)	0.04 – 0.08	0.02 – 0.2

IMPORTANT INFORMATION

The use of M and ML guideway sets with a sliding layer and V guideways (without clearance or preloaded) in a rigid environment can result in uncontrolled friction in the presence of thermal expansion.

SPECIAL EXECUTIONS
SEE CHAPTER 10 ALTERNATIVE VERSIONS

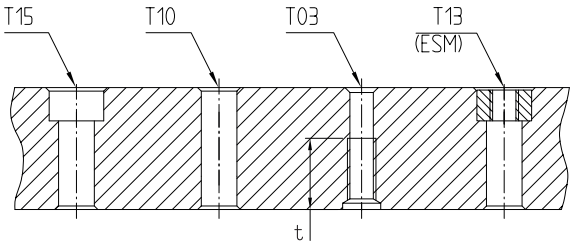




DIMENSIONS IN MM

Type	Dimensions					Fixing holes							Threads
	H 0/-0.2	B 0/-0.1	B1 0/-0.2	M	V	Screws T ****	h1	p1	t min.	LA***	L1** min.	L2** min.	V1
M3015	30	15	15	17.3	-	M4	5.5	4.6	15	40*	15	15	M3
M4020	40	20	20	23.6	-	M6	7.5	6.8	20	80*	15	15	M5
M5025	50	25	25	29.8	-	M6	10	6.8	15	80*	20	20	M6
M6035	60	35	35	36.3	-	M8	11	9.0	20	100	20	20	M6
M7040	70	40	40	41.3	-	M10	13	11.0	25	100	20	20	M6
M8050	80	50	50	46.3	-	M12	14	13.0	30	100	20	20	M6

* M3015: length (L) 100mm, hole distances (LA) = 35mm
M4020: length (L) 100mm, hole distances (LA) = 50mm
M5025: length (L) 100mm, hole distances (LA) = 50mm
** L1 and L2 are the same size at both ends of the guideways and dependent on the guideway length without any specific requests being made.
*** The tolerance of the hole distances (LA) is in proportion to the length tolerance
**** 4 hole types in the guideways for screw size T (according to the drawing below)



T15: Sinkhole for screws ISO 4762
T10: Clearance hole
T03: Threaded hole, thread length “t”
T13: Sinkhole as T15, but with insert nuts ESM

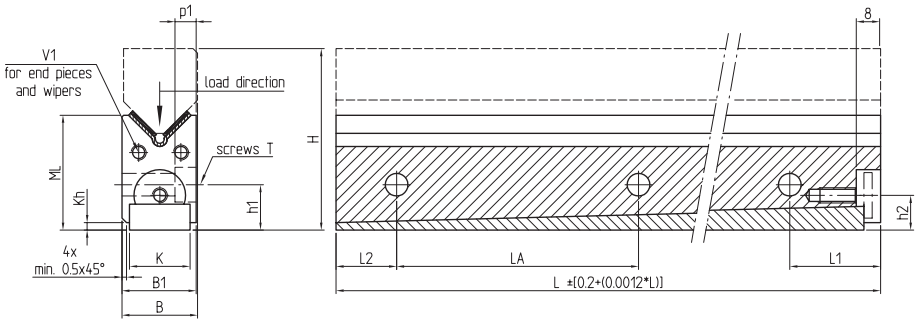
STANDARD LENGTHS (MM)

Dimensions	100	150	200	300	400	500	600	700	800	900	1000	Made-to-measure lengths up to L max.
M3015	o	o	o	o	o	o	o					600
M4020	o	o	o	o	o	o	o	o	o	o	o	1000
M5025	o		o	o	o	o	o	o	o	o	o	1300
M6035			o	o	o	o	o	o	o	o	o	1300
M7040			o	o	o	o	o	o	o	o	o	1300
M8050				o	o	o	o	o	o	o	o	1300

o = ex stock, non-hardened, non-ground
Special lengths available on request

Dimensions	Maximum permissible static load*	
	Turcite LB (N)	Permaglide LP21 (N)
M3015	3'600	150'000
M4020	6'600	275'000
M5025	8'400	350'000
M6035	12'000	500'000
M7040	13'800	575'000
M8050	16'200	675'000

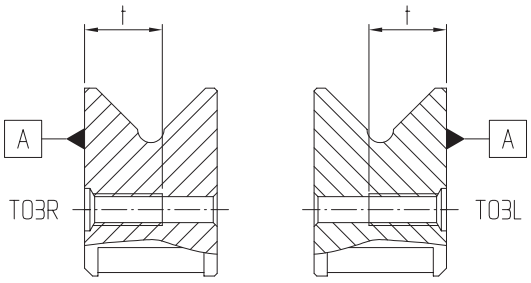
* For guideways with a length of 100 mm, load direction according to dimension diagram, see page 60



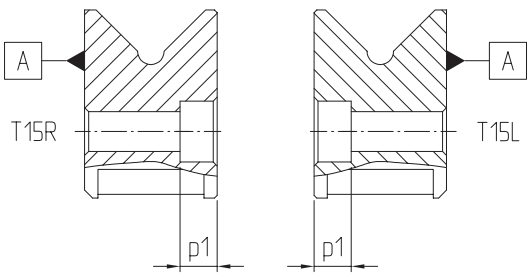
DIMENSIONS IN MM

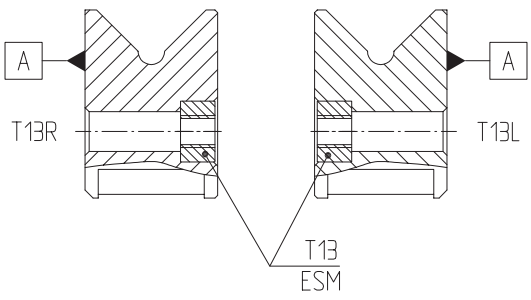
Type	Dimensions						Fixing holes							Gib screws	Threads
	H*	B 0/-0.1	B1 0/-0.2	ML*	K	Kh*	Screws T ****	h1*	p1	t	LA	L1*** min.	L2*** Min.	h2	V1
ML5020	50	20	20	33	15	5.5	M6	17.5	6.8	20	80**	30	15	15	M4
ML5520	55	20	20	38	15	6	M6	22.5	6.8	20	80	30	15	20	M4
ML5525	55	25	25	34	20	2.5	M6	15	6.8	15	80**	30	20	11.5	M5
ML6025	60	25	25	39	20	3.5	M6	20	6.8	15	80	30	20	16.5	M5
ML6525	65	25	25	44	20	5	M6	25	6.8	15	80	30	20	21.5	M5
ML7025	70	25	25	48	20	6.5	M6	30	6.8	15	80	30	20	26.5	M5
ML7035	70	35	35	45.5	25	3	M8	21	9	20	100**	32	20	15.5	M6
ML8035	80	35	35	55.5	25	5	M8	31	9	20	100	32	20	25.5	M6
ML8040	80	40	40	50.5	30	3	M10	23	11	25	100**	32	20	16	M6
ML9040	90	40	40	60.5	30	5	M10	33	11	25	100	32	20	26	M6
ML9050	90	50	50	56	40	3	M12	24	13	30	100**	32	20	15.5	M6
ML10050	100	50	50	66	40	5	M12	34	13	30	100	32	20	25.5	M6

* These dimensions are dependent on the gib position, adjustment range ± 0,5 mm
** ML5020 + ML5525 + ML7035 + ML8040 + ML9050: length (L) 100mm, hole distance (LA) = 50mm.
*** L1 and L2 are the same size at both ends of the guideways and dependent on the guideway length without any specific requests being made.
**** 3 hole types in the guideways for screw size T (according to the drawing below)



T15: Sinkhole for screws ISO 4762
Depending on left or right guideway
T03: Threaded hole, thread length “t”
Depending on left or right guideway
T13: Sinkhole as T15, but with insert nuts ESM
Depending on left or right guideway
A : Reference side





STANDARD LENGTHS (MM)

Dimensions	100	200	250	300	400	500	600	700	750	800	900	1000
ML5020	o	o		o								
ML5520					o	o	o					
ML5525	o	o	o									
ML6025				o	o	o						
ML6525							o	o	o			
ML7025										o	o	o
ML7035	o	o		o	o	o						
ML8035							o	o		o	o	o
ML8040	o	o		o	o	o						
ML9040							o	o		o	o	o
ML9050	o	o		o	o	o						
ML10050							o	o		o	o	o

o = ex stock, non-hardened, non-ground
Special lengths available on request

Dimensions	Maximum permissible static load*	
	Turcite LB (N)	Permaglide LP21 (N)
ML5020 ML5520	6'600	275'000
ML5525 ML6025 ML6525 ML7025	8'400	350'000
ML7035 ML8035	12'000	500'000
ML8040 ML9040	13'800	575'000
ML9050 ML10050	16'200	675'000

* For guideways with a length of 100mm, load direction according to dimension diagram, see page 62

6

S AND J GUIDEWAYS
WITH NEEDLE ROLLER FLAT CAGE ASSEMBLY

A MATERIAL

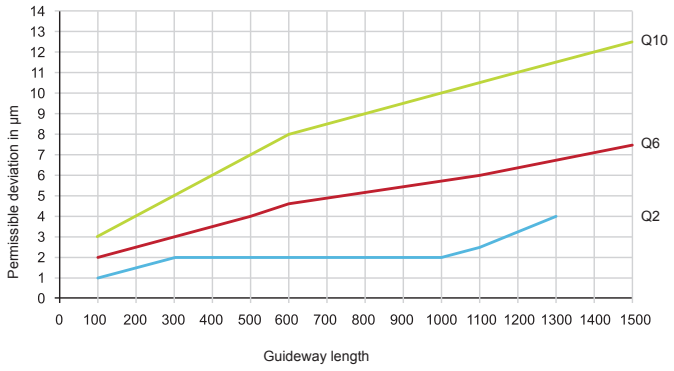
Hardened tool steel 1.2842 HRc 58 – 62.

B QUALITY

The raceways and locating faces are precision ground.

The guideways are available in 3 qualities (parallelism tolerance of the raceways on the reference sides of the guideway in relation to a defined length).

Q10: normal quality for general machine construction
Q6: precise quality for machine tool construction
Q2: particularly precise quality for exceptionally demanding structures

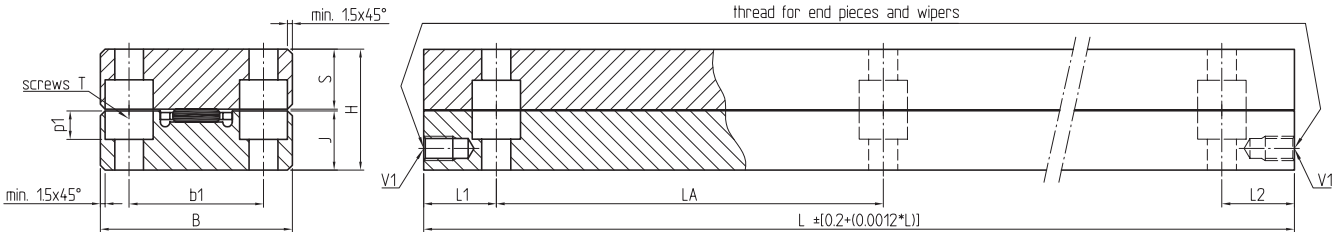


IMPORTANT INFORMATION

The correct functioning of the guideways is dependent above all on the precision of the locating faces.

MATCHING IN SETS

Matching in sets “M/V/S/J” (4SX) when an order is placed allows for installation without insert plate or ML guideway. The guideways are labelled by sets. The tolerance of the height difference must be maintained with the connecting parts in this case.



DIMENSIONS IN MM

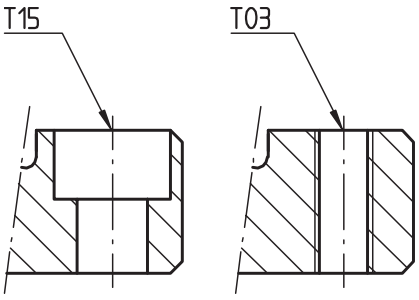
Type		Dimensions				Fixing holes							Threads
		H	B	S	J	Screws T****		b1	p1	LA***	L1***	L2**	V1
		0/-0.2	0/-0.2			T15	T03				min.	min.	
S3525		25	35	13	-	M5	M6	22	(5.7)	80*	15	15	-
	J3525	25	35	-	11.8	M5	M6	22	(5.7)	80*	15	15	M5
S4025		25	40	12.5	-	M5	M6	28	(5.7)	80*	15	15	-
	J4025	25	40	-	12.3	M5	M6	28	(5.7)	80*	15	15	M5
S5030		30	50	15	-	M6	M6	35	(6.8)	100*	15	15	-
	J5030	30	50	-	14.8	M6	M6	35	(6.8)	100*	15	15	M6
S5530		30	55	14.5	-	M6	M6	40	(6.8)	100*	15	15	-
	J5530	30	55	-	15.3	M6	M6	40	(6.8)	100*	15	15	M6

* S/J3525: length (L) 100mm, hole distances (LA) = 50mm
S/J4025: length (L) 100mm, hole distances (LA) = 50mm
S/J5030: length (L) 100mm, hole distances (LA) = 50mm
S/J5530: length (L) 100mm, hole distances (LA) = 50mm

** L1 and L2 are the same size at both ends of the guideway and dependent on the guideway length without any specific requests being made.

*** The tolerance of the hole distances (LA) is in proportion to the length tolerance

**** 2 hole types in the guideways for screw size T (according to the drawing below)



T15: Sinkhole for screws ISO 4762
T03: Threaded hole

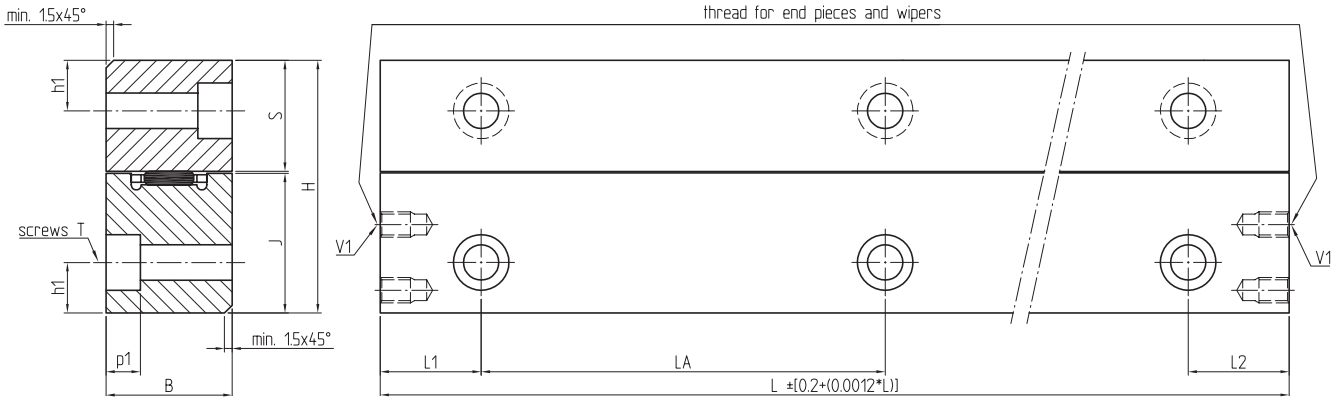
STANDARD LENGTHS (MM)

Dimensions		100	200	300	400	500	600	700	800	900	1000	Made-to-measure lengths up to L max.
S3525	**J3525**	O	O	O	O	O	O	O	O	O	O	1300
S4025	**J4025**	O	O	O	O	O	O	O	O	O	O	1300
S5030	**J5030**	O	O	O	O	O	O	O	O	O	O	1300
S5530	**J5530**	O	O	O	O	O	O	O	O	O	O	1300

O = ex stock, non-hardened, non-ground
Special lengths available on request

CAGE ALLOCATION

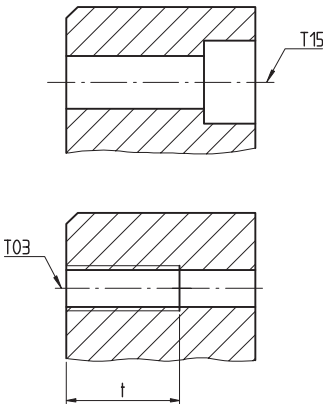
Guideways	Rolling elements	Plastic	Aluminium	Steel	Brass	Brass (with damping)
S/J3525	Needle rollers	E-FF2010	E-H10	E-H10 F	E-H10 MS	E-HG10
S/J4025	Needle rollers Cylindrical rollers	E-FF2515	E-H15 E-HB2515	E-H15 F	E-H15 MS	E-HG15
S/J5030	Needle rollers Cylindrical rollers	E-FF3020	E-H20 E-HB3020	E-H20 F E-BF3020	E-H20 MS	E-HG20
S/J5530	Needle rollers Cylindrical rollers	E-FF3525	E-H25 E-HB4025	E-H25 F	E-H25 MS	E-HG25



DIMENSIONS IN MM

Type		Dimensions				Fixing holes							Threads
		H 0/-0.2	B 0/-0.2	S	J	Screws T ****	h1	p1	t min.	LA***	L1** min.	L2** min.	V1
S5025		50	25	22	-	M6	10	(6.8)	15	80*	20	20	-
	J5025	50	25	-	27.7	M6	10	(6.8)	15	80*	20	20	M6
S6035		60	35	25	-	M8	11	(9)	20	100*	20	20	-
	J6035	60	35	-	34.7	M8	11	(9)	20	100*	20	20	M6
S7040		70	40	30	-	M10	13	(11)	25	100*	20	20	-
	J7040	70	40	-	39.7	M10	13	(11)	25	100*	20	20	M6
S8050		80	50	35	-	M12	14	(13)	30	100*	20	20	-
	J8050	80	50	-	44.7	M12	14	(13)	30	100*	20	20	M6

* S/J5025: length (L) 100mm, hole distances (LA) = 50mm
S/J6035: length (L) 100mm, hole distances (LA) = 50mm
S/J7040: length (L) 100mm, hole distances (LA) = 50mm
S/J8050: length (L) 100mm, hole distances (LA) = 50mm
** L1 and L2 are the same size at both ends of the guideway and dependent on the guideway length without any specific requests being made
*** The tolerance of the hole distances(LA) is in proportion to the length tolerance
**** 2 hole types in the guideways for screw size T (according to the drawing below)



T15: Sinkhole for screws ISO 4762
T03: Threaded hole, thread length “t”

STANDARD LENGTHS (MM)

Dimensions		100	200	300	400	500	600	700	800	900	1000	Made-to-measure lengths up to L max.
S5025	**J5025**	O	O	O	O	O	O	O	O	O	O	1000
S6035	**J6035**	O	O	O	O	O	O	O	O	O	O	1000
S7040	**J7040**	O	O	O	O	O	O	O	O	O	O	1300
S8050	**J8050**	O	O	O	O	O	O	O	O	O	O	1300

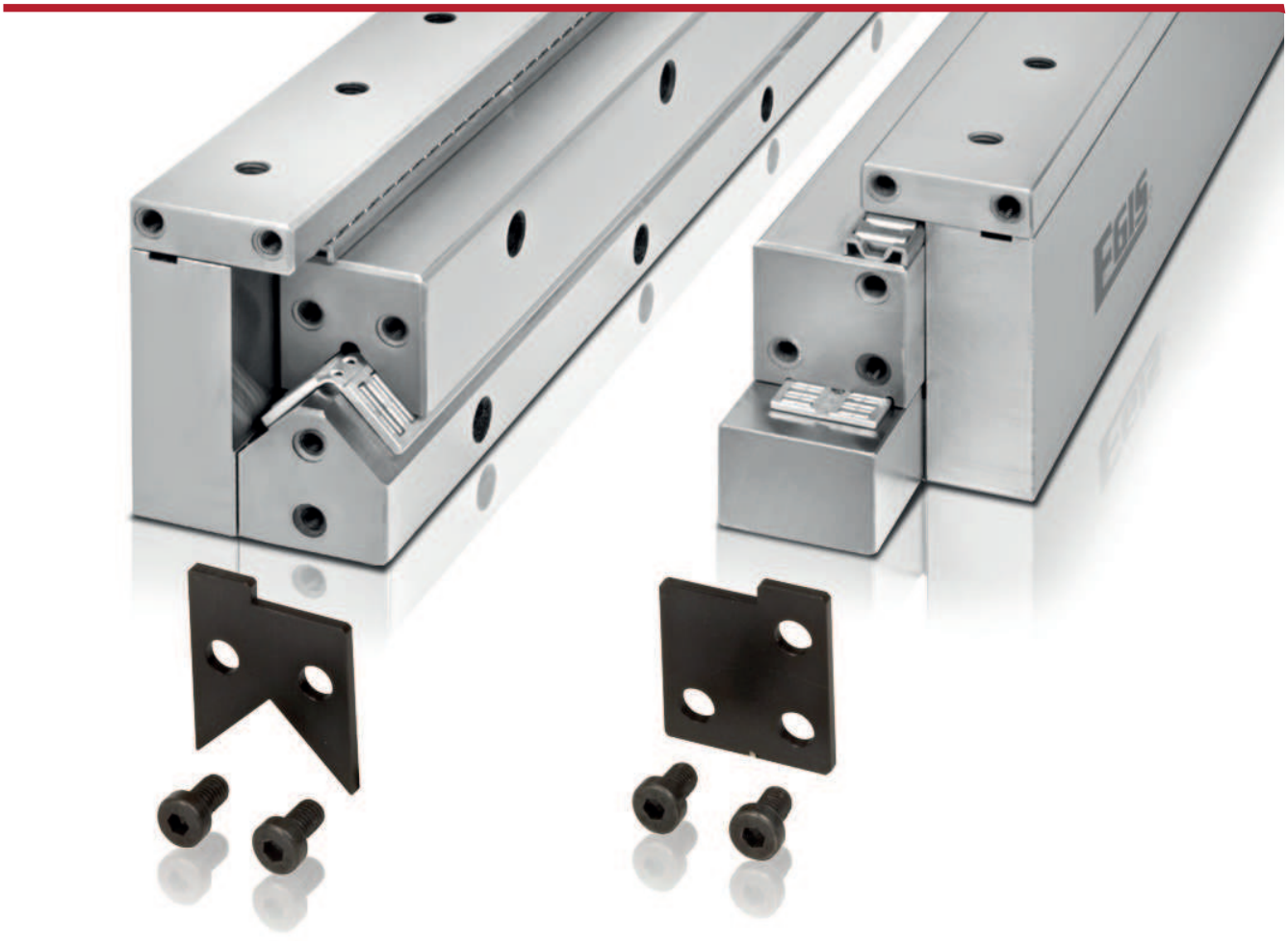
O = ex stock, non-hardened, non-ground
Special lengths available on request

CAGE ALLOCATION

Guideways	Rolling elements	Plastic	Aluminium	Steel	Brass	Brass (with damping)
S/J5025	Needle rollers	E-FF2515	E-H15	E-H15 F	E-HG15	E-HG15
S/J6035	Needle rollers	—	E-H24 ZW	E-H24 ZW F	E-H24 ZW MS	—
S/J7040	Needle rollers	—	E-H34 ZW	E-H34 ZW F	E-H34 ZW MS	—
S/J8050	Needle rollers	—	E-H44 ZW	E-H44 ZW F	E-H44 ZW MS	—

7

LUE – COUNTERSTAY SYSTEM WITH NEEDLE AND CYLINDRICAL ROLLER FLAT CAGE ASSEMBLIES



The LUE counterstay system is particularly suited to high-precision applications. This system provides the highest level of accuracy of all linear guidance systems with rolling elements.
It is the perfect solution when a high degree of accuracy and rigidity are required, particularly when the main load operates in a vertical or lateral direction. The separation between locating and non-locating bearings prevents the system from becoming distorted by thermal expansion.

The LUE counterstay system does not require any adjustment after assembly.

The system is preloaded by components which have been adjusted against one another in terms of dimensions. Preloading is established by observing the prescribed tightening torques during assembly without any adjustments being required.

A MATERIAL

M and V and S and J guideways: Hardened tool steel 1.2842 HRc 58 – 62

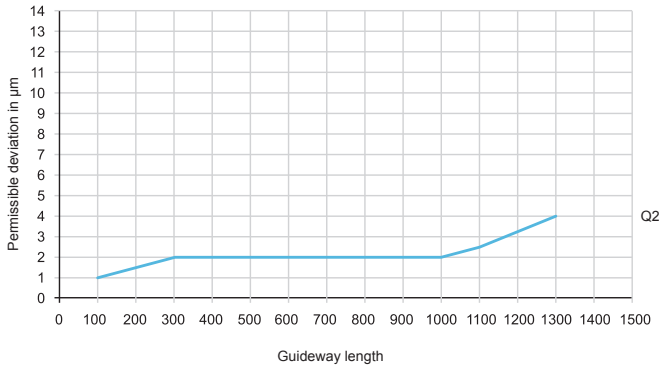
LU counterstays: counterstay bar (LUT) made from hardened tool steel 1.2842 HRc 58 – 62 and a distance bar (LUD) made from soft construction steel.

B QUALITY

The raceways and locating faces are precision ground.

The LUE counterstay system is only supplied in Q2 quality, which is the highest quality for standard guideways (parallelism tolerance of the raceways to the reference sides of the guideways in relation to a defined length).

Q2: particularly precise quality for exceptionally demanding structures



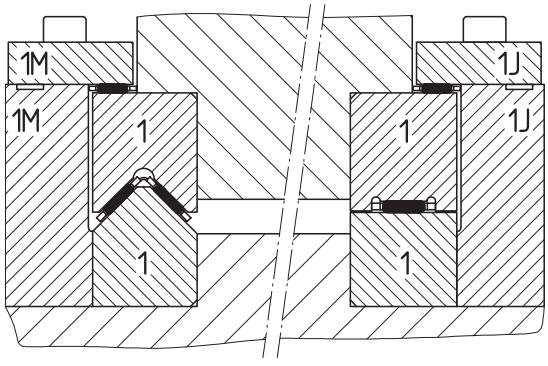
SPECIAL EXECUTIONS
SEE CHAPTER 10 ALTERNATIVE VERSIONS

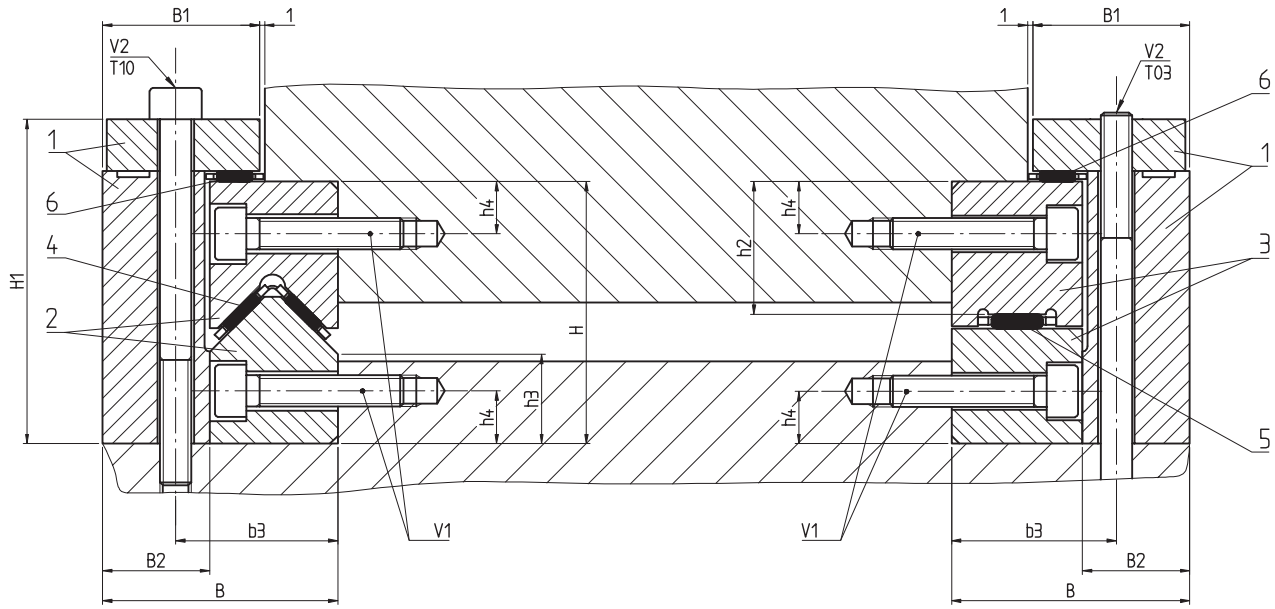
C MATCHING IN SETS

The guideways are manufactured, labelled and packaged by sets.

NB

Under no circumstances must the counterstay components be mixed up as matching and preloading could no longer be guaranteed in that case.



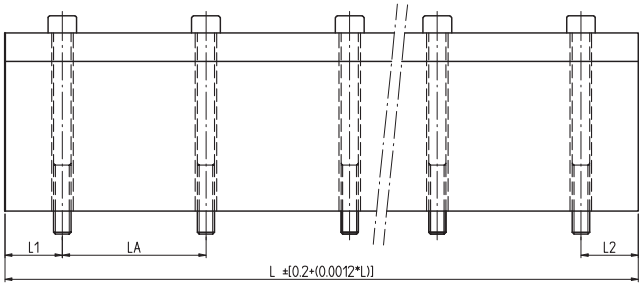


DIMENSIONS IN MM

Type	H 0/-0.2	H1	B	B1	B2	b3	V1	V2 T10 / T03	h2	h3	h4	L max.
LUE 5025	50	62	45	30	20	31	M6	M6	25.5	17	10	800
LUE 6035	60	77	60	40	25	42	M8	M8	33	20	11	1000
LUE 7040	70	89	65	40	25	47	M10	M8	37.5	24	13	1000
LUE 8050	80	100	86	51	36	61	M12	M12	42	26	14	1000

LUE COUNTERSTAY SYSTEM COMPONENTS:

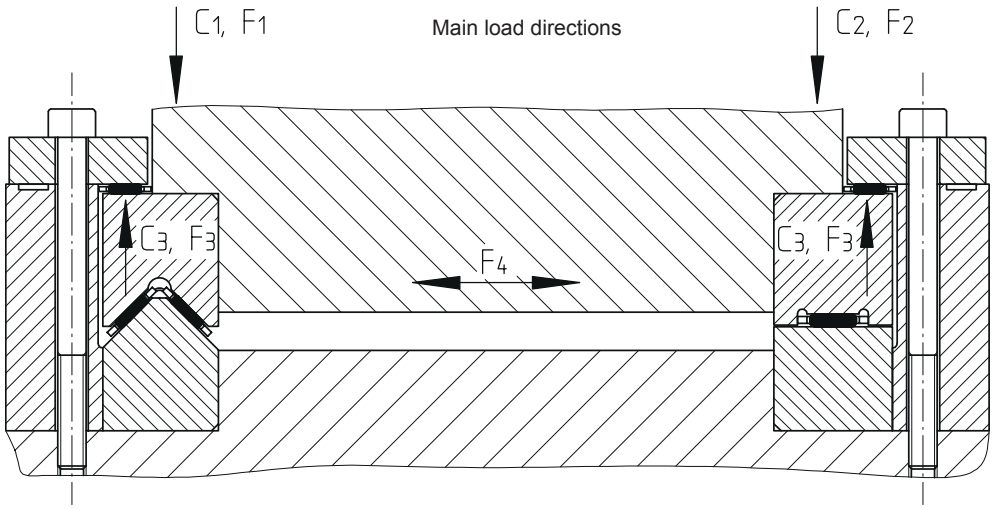
Type	L1* min.	LA**	L2* min.	L max.
LU 5025	20	50	20	800
LU 6035	20	50	20	1000
LU 7040	20	50	20	1000
LU 8050	20	50	20	1000



* L1 and L2 are the same size at both ends of the guideway and dependent on the guideway length without any specific requests being made.
** The tolerance of the hole distances (LA) is in proportion to the length tolerance

LUE COUNTERSTAY SYSTEM COMPONENTS:

Type	Counterstays	Guideways		Precision cages: G1		
	LU	M / V	J / S			
	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6
LUE 5025	LU5025	5025	5025	E-HW15	E-H15	E-H10
LUE 6035	LU6035	6035	6035	E-HW20	E-H24 ZW	E-BF5015
LUE 7040	LU7040	7040	7040	E-HW25	E-H34 ZW	E-BF5015
LUE 8050	LU8050	8050	8050	E-HW30	E-H44 ZW	E-BF5015



DIMENSIONS IN MM

Type	Load carrying capacity						
	Basic dynamic load ratings			Limiting loads*			
	C_1 (N)	C_2 (N)	C_3 (N)	F_1 (N)**	F_2 (N)**	F_3 (N)***	F_4 (N)***
LUE 5025	25'960	35'620	21'410	13'840	15'630	1'200	7'500
LUE 6035	40'200	36'710	70'410	38'690	58'620	1'500	10'000
LUE 7040	62'840	56'850	70'410	42'500	61'720	2'500	16'000
LUE 8050	82'980	88'860	70'410	43'150	69'540	4'000	23'000

* For a theoretical cage length of 100 mm in load direction according to table (see above)
Calculation of limiting loads for effective cage lengths:

$$F_{w1,2,3} = F_{1,2,3} \cdot \frac{L_k - 2e + t}{100} \text{ where } Z = \frac{L_k - 2e + 1}{100} = \text{whole number}$$

** limited by system preload
*** limited by load carrying capacity / friction locking effect of fixing screws

TIGHTENING TORQUE FOR FIXING SCREWS:

For V1 and V2 screws	Tightening torque
Strength category 10.9	**Nm**
M6	12
M8	29
M10	58
M12	101

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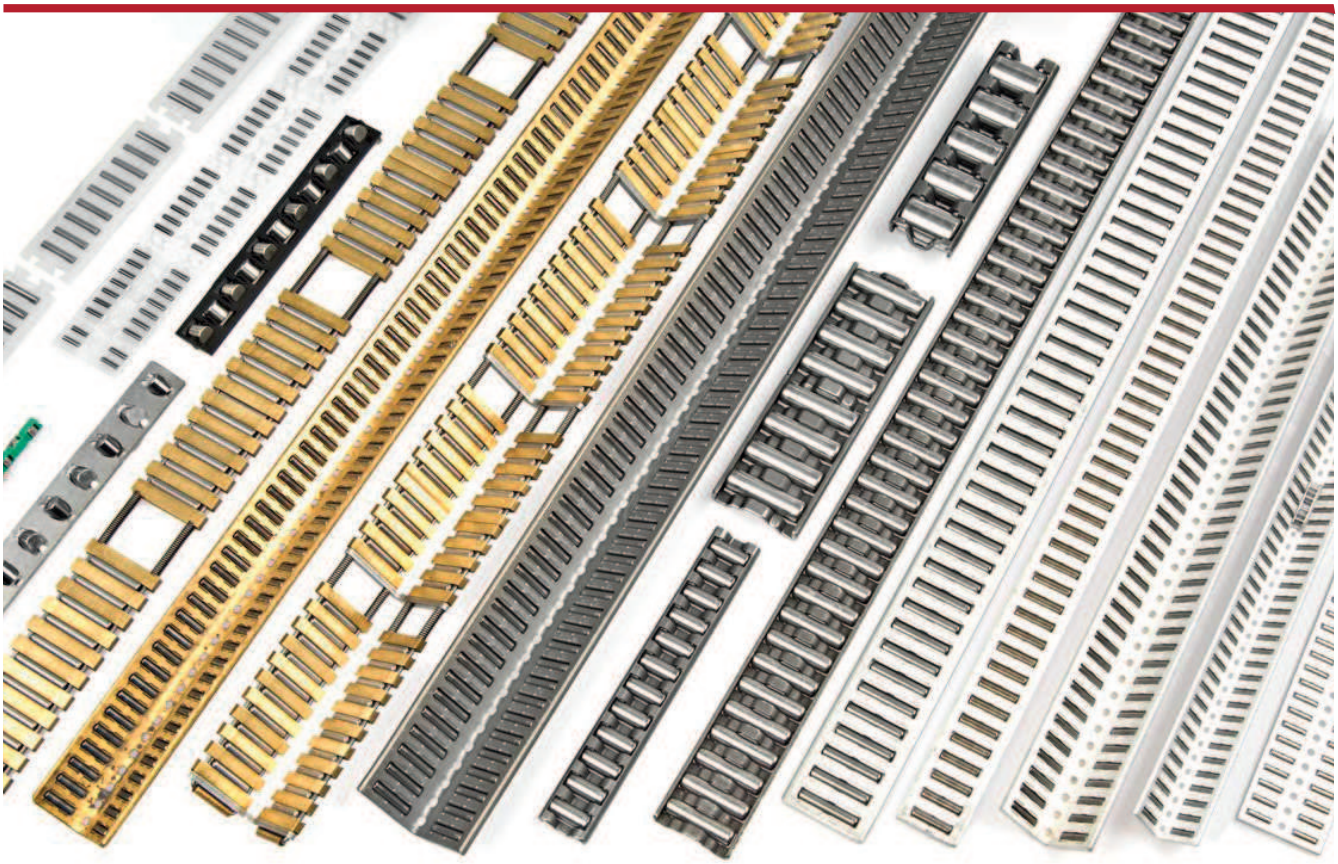
FLAT CAGE ASSEMBLIES



A GENERAL ASPECTS

Every cage type possesses specific technical characteristics and application features. The flat cage assemblies presented in the table below are intended for use with the guideways described in this catalogue. However, they can also run directly on raceways in connecting parts which fulfil the necessary characteristics.

The cage length can be adapted to the application in steps according to the spacing LA.

B RACEWAY CHARACTERISTICS

The raceways must fulfil the same conditions as the raceways on the guideways

- Surface roughness $R_a \leq 0.35 \mu m$
- Hardness min. 58 HRC / 670 HV

(with lower hardness levels, the hardness factors according to figure 10 page 25 should be taken into account)

C MATERIAL

4 materials for flat basic cages:

- Aluminium (standard) for normal operating conditions and high accelerations
- Steel for difficult operating conditions (suffix “F”)
- Plastic for easy operating conditions (series E-FF / E-FFW)
- Brass for special operating conditions (suffix “MS”) (Standard for cages with damping)

D ALTERNATIVE VERSIONS

- Higher precision of rolling elements (suffix G1)
- Corrosion-resistant cages (suffix BK)
- Friction-reducing coating (suffix BR)

DELIVERABLE CAGES

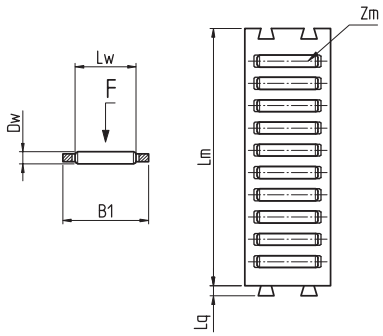
Flat cage material	Rolling elements			
	Type	Cage shape	Single row	Double row
Plastic	Needle rollers	Flat	E-FF	E-FF…ZW
		Angled		E-FFW
Aluminium	Needle rollers	Flat	E-H	E-H ZW
		Angled		E-HW
	Cylindrical rollers	Flat	E-HR	E-HR ZW
		Angled		E-HRW
	Balls	Flat	E-HB	
		Angled		E-HBW
Steel	Needle rollers	Flat	E-H F	E-H ZW F
		Angled		E-HW F
		Profiled sheet	E-BF	
Brass	Needle rollers	Flat	E-H MS	E-H ZW MS
		Angled		E-HW MS
	Needle rollers with damping	Flat	E-HG	
		Angled		E-HGW

ACCURACY OF THE ROLLING ELEMENTS

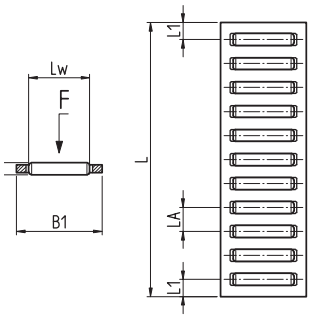
Rolling elements	According to DIN standard	Quality category	Roundness µm	Category tolerance µm
Needle rollers	DIN 5402-3	G2 (standard)	1	2
		G1	0.5	1
Cylindrical rollers	DIN 5402-1	GN	1	2
		G1	0.5	1
Balls	DIN 5401	G5	0.13	1

E SINGLE-ROW FLAT CAGE ASSEMBLIES

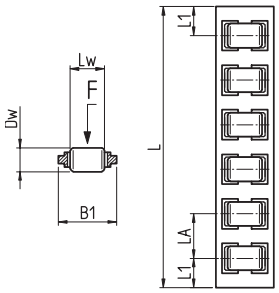
E-FF



E-H, E-BF, E-H F, E-H MS



E-HR



F = Load direction

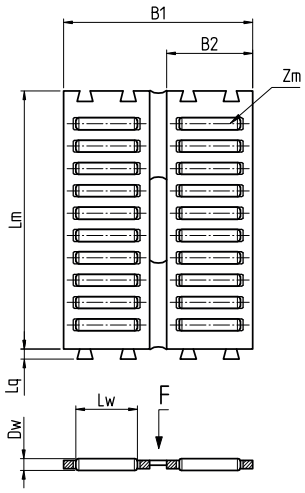
DIMENSIONS IN MM

Rolling element diameter	Type				Dimensions							Number of rolling elements per row	Basic load ratings***	
Dw	E-FF	E-H E-H F E-H MS	E-BF	E-HR	B1*	Lw	LA	L1	Lq	L** max.	Lm	Zm	C N	Co N
2	E-FF2010				10	6.8			2		32	7	21'160	61'900
		E-H10			10	6.8	4.5	3.5		2000			21'410	62'900
2.5	E-FF2515				15	9.8			2.5		45	8	32'600	92'300
		E-H15			15	9.8	5	3.5		2000			35'620	103'900
3	E-FF3020				20	13.8			3		60	9	47'880	133'300
		E-H20			20	13.8	6	4.5		2000			51'830	148'100
			E-BF3020		20	15.8	6	4.5		2000			57'750	170'200
3.5	E-FF3525				25	17.8			3		75	10	64'990	177'400
		E-H25			25	17.8	7	5		2000			68'450	190'100
5				E-HR50	10.5	5	10	6.5		2000			29'400	50'800
			E-BF5015		15	11.8	8	5.5		2000			70'410	154'700
			E-BF5023		23	19.8	8	5.5		2000			107'080	265'200
			E-BF5032		32	27.8	8	5.5		2000			140'400	375'700
7				E-HR70	17	10	13	8.5		2000			65'800	114'200
			E-BF7028		28	24	11	7.5		2000			153'000	331'900
			E-BF7035		35	30	11	7.5		2000			182'480	416'300
10				E-HR100	24	14	17	10		2000			109'900	174'200
12			E-BF12022		22	18	16	10		2000			183'000	288'400
			E-BF12040		40	36	16	10		2000			317'950	586'800

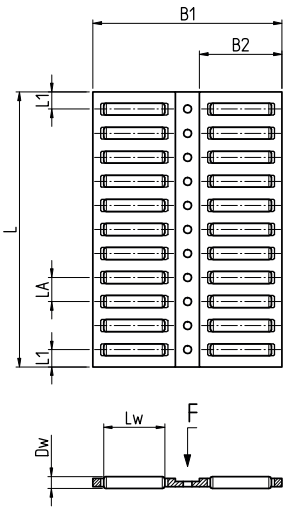
* Mounting dimensions: see table, page 82
** Length tolerance: 0/-1*LA
*** Basic load ratings for a theoretical cage length of 100mm in load direction “F”

F DOUBLE-ROW FLAT CAGE ASSEMBLIES

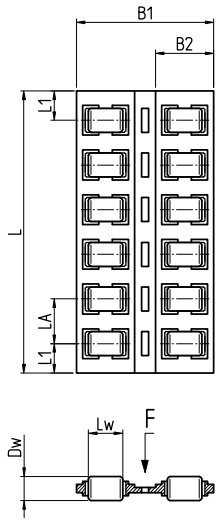
E-FF ZW



E-H ZW, E-H ZW F, E-H ZW MS



E-HR ZW



F = Load direction

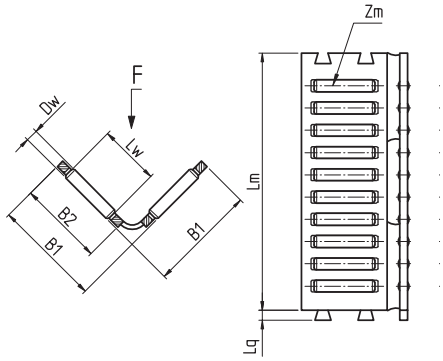
DIMENSIONS IN MM

Rolling element diameter	Type			Dimensions								Number of rolling elements per row	Basic load ratings***	
Dw	E-FF ZW	E-H ZW E-H ZW F E-H ZW MS	E-HR ZW	B1*	B2	Lw	LA	L1	Lq	L** max.	Lm	Zm	C N	Co N
2		E-H19 ZW F		19.2	8	4.8	4	3		1000			29'960	97'200
	E-FF2025 ZW			25	10	6.8			2		32	7	36'280	123'800
		E-H24 ZW		24	10.5	6.8	4.5	3.5		2000			36'710	125'700
2.5	E-FF2535 ZW			35	15	9.8			2.4		45	8	55'900	184'700
		E-H34 ZW		33.5	14.3	9.8	5.5	4		2000			56'850	188'900
3	E-FF3045 ZW			45	20	13.8			3		60	9	82'090	266'500
		E-H44 ZW		44	19	13.8	6	4.5		2000			88'860	296'100
3.5	E-FF3555 ZW			55	25	17.8			3.2		75	10	111'420	354'800
		E-H55 ZW		55	24	17.8	7	5		2000			117'360	380'100
5			E-HR50 ZW	24	10.5	5	10	6.5		2000			51'080	101'700
7			E-HR70 ZW	40	17	10	13	8.5		2000			114'900	228'500
10			E-HR100 ZW	55	24	14	17	10		2000			193'110	348'400

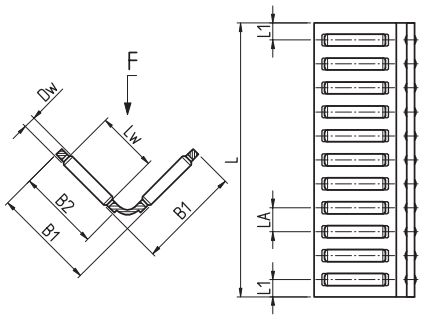
* Mounting dimensions: see table, page 83
** Length tolerance: 0/-1*LA
*** Basic load ratings for a theoretical cage length of 100mm in load direction “F”

G ANGLED FLAT CAGE ASSEMBLIES

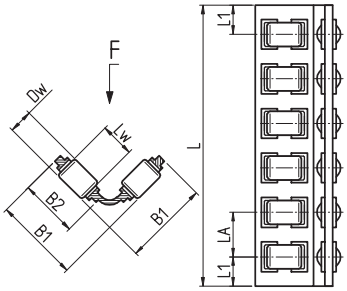
E-FFW



E-HW, E-HW F, E-HW MS



E-HRW



F = Load direction

DIMENSIONS IN MM

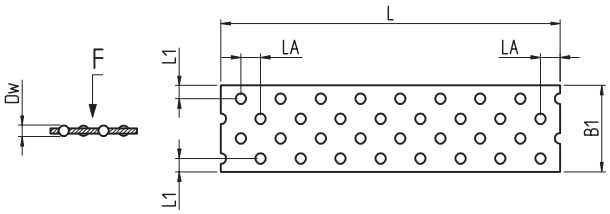
Rolling element diameter	Type			Dimensions								Number of rolling elements per row	Basic load ratings**	
Dw	E-FFW	E-HW E-HW F E-HW MS	E-HRW	B1	B2	Lw	LA	L1	Lq	L* max.	Lm	Zm	C N	Co N
2		E-HW10 F		10	8	4.8	4	3		1000			21'190	68'800
	E-FFW2025			15	10	6.8			2		32	7	25'650	87'500
		E-HW15		14	10.5	6.8	4.5	3.5		2000			25'960	88'900
		E-HW16		16	13.5	8.8	3.8	2.8		2000			36'410	138'200
2.5	E-FFW2535			20.5	15	9.8			2.4		45	8	39'530	130'600
		E-HW20		20	14.3	9.8	5.5	4		2000			40'200	133'500
3	E-FFW3045			26	20	13.8			3		60	9	58'050	188'500
		E-HW25		25	19	13.8	6	4.5		2000			62'840	209'400
3.5	E-FFW3555			31.5	25	17.8			3.2		75	10	78'790	250'900
		E-HW30		30	24	17.8	7	5		2000			82'980	268'800
5			E-HRW50	15.5	10.5	5	10	6.5		2000			36'120	71'900
7			E-HRW70	25	17	10	13	8.5		2000			81'240	161'600
10			E-HRW100	34	24	14	17	10		2000			136'550	246'400

* Length tolerance: 0/-1*LA

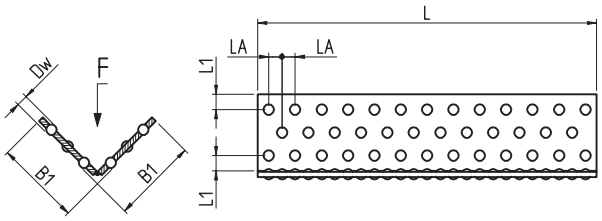
** Basic load ratings for a theoretical cage length of 100mm in load direction “F”

H BALL FLAT CAGE ASSEMBLIES

E-HB



E-HBW



F = Load direction

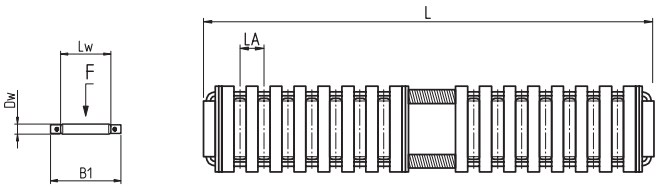
DIMENSIONS IN MM

Ball diameter	Type		Dimensions				Basic load ratings**	
Dw	E-HB	E-HBW	B1	LA	L1	L* max.	C N	Co N
2	E-HB2515		15	3	4.5	2000	3'180	3'040
3	E-HB3020		20	3.5	4	2000	5'140	5'000
		E-HBW3x18x18	17.75	3.5	3.5	1000	5'970	5'020
	E-HB3023		23	3.5	5.5	2000	5'140	5'000
		E-HBW3x23x23	22.75	3.5	4	1000	7'300	6'690
4	E-HB4025		25	5	5	2000	7'410	6'220

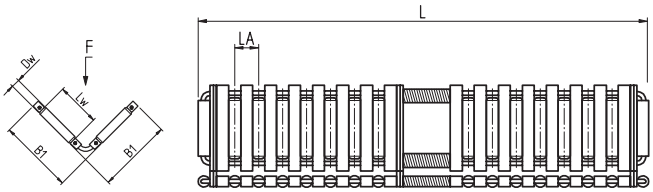
* Length tolerance: 0/-1*LA
** Basic load ratings for a theoretical cage length of 100mm in load direction “F”

FLAT CAGE ASSEMBLIES WITH DAMPING

E-HG



E-HGW



F = Load direction

DIMENSIONS IN MM

Needle roller diameter	Type		Dimensions				Basic load ratings**		Damping power
Dw	E-HG	E-HGW	B1*	Lw	LA	L max.	C N	Co N	RS*** N
2	E-HG10		10	6.3	4.5	2000	18'210	50'800	4.5
		E-HGW15	13.5	6.3	4.5	1500	21'760	70'500	9
2.5	E-HG15		15	9.8	5	2000	31'630	88'700	8
		E-HGW20	19.5	9.8	5	1500	37'970	123'800	16
3	E-HG20		20	13.8	6	2000	47'780	132'900	11
		E-HGW25	25	13.8	6	1500	57'370	185'500	22
3.5	E-HG25		25	17.8	7	2000	61'740	165'700	14
		E-HGW30	30.5	17.8	7	1500	74'320	232'100	28

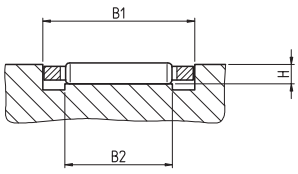
* Mounting dimensions: see table page 82

** Basic load ratings for a theoretical cage length of 100mm in load direction “F”

*** For a cage length of 100mm.
Calculation of the damping power for the effective cage length =>RSw=RS*$\frac{L}{100}$

J MOUNTING DIMENSIONS

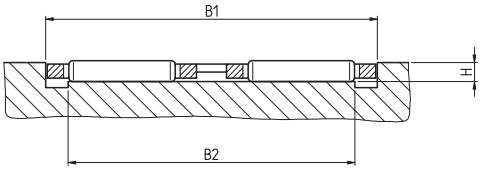
SINGLE-ROW FLAT CAGE ASSEMBLY



Cage type					Mounting dimensions in mm		
E-FF	E-H E-H F E-H MS	E-BF	E-HR	E-HG	B1	B2 min.	H
E-FF2010	E-H10			E-HG10	10.3 $^{+0.2/0}$	7	1.7
E-FF2515	E-H15			E-HG15	15.3 $^{+0.2/0}$	10	2.2
E-FF3020	E-H20			E-HG20	20.4 $^{+0.2/0}$	14	2.7
		E-BF3020			20.4 $^{+0.2/0}$	16	2.7
E-FF3525	E-H25			E-HG25	25.4 $^{+0.2/0}$	18	3.2
			E-HR50		10.9 $^{+0.2/0}$	5	3.4
		E-BF5015			15.3 $^{+0.2/0}$	12	4.6
		E-BF5023			23.4 $^{+0.2/0}$	20	4.6
		E-BF5032			32.5 $^{+0.3/0}$	28	4.6
			E-HR70		17.4 $^{+0.2/0}$	10	4.8
		E-BF7028			28.4 $^{+0.2/0}$	24	6.5
		E-BF7035			35.6 $^{+0.3/0}$	30	6.5
			E-HR100		24.4 $^{+0.2/0}$	14	6.5
		E-BF12022			22.4 $^{+0.2/0}$	18	11
		E-BF12040			40.5 $^{+0.3/0}$	36	11

J MOUNTING DIMENSIONS

DOUBLE-ROW FLAT CAGE ASSEMBLY



Cage type			Mounting dimensions in mm		
E-FF ZW	E-H E-H F E-H MS	E-BF	B1	B2 min.	H
	E-H19 ZW F		19.6 $^{+0.2/0}$	17	1.7
E-FF2025 ZW			25.4 $^{+0.2/0}$	22	1.7
	E-H24 ZW		24.4 $^{+0.2/0}$	21	1.7
E-FF2535 ZW			35.5 $^{+0.2/0}$	30	2.2
	E-H34 ZW		34.0 $^{+0.2/0}$	28.5	2.2
E-FF3045 ZW			45.5 $^{+0.2/0}$	39	2.7
	E-H44 ZW		44.5 $^{+0.2/0}$	38	2.7
E-FF3555 ZW	E-H55 ZW		55.5 $^{+0.2/0}$	48	3.2
		E-HR50 ZW	24.4 $^{+0.2/0}$	19.5	3.4
		E-HR70 ZW	40.5 $^{+0.2/0}$	34	4.8
		E-HR100 ZW	55.5 $^{+0.2/0}$	46	6.5

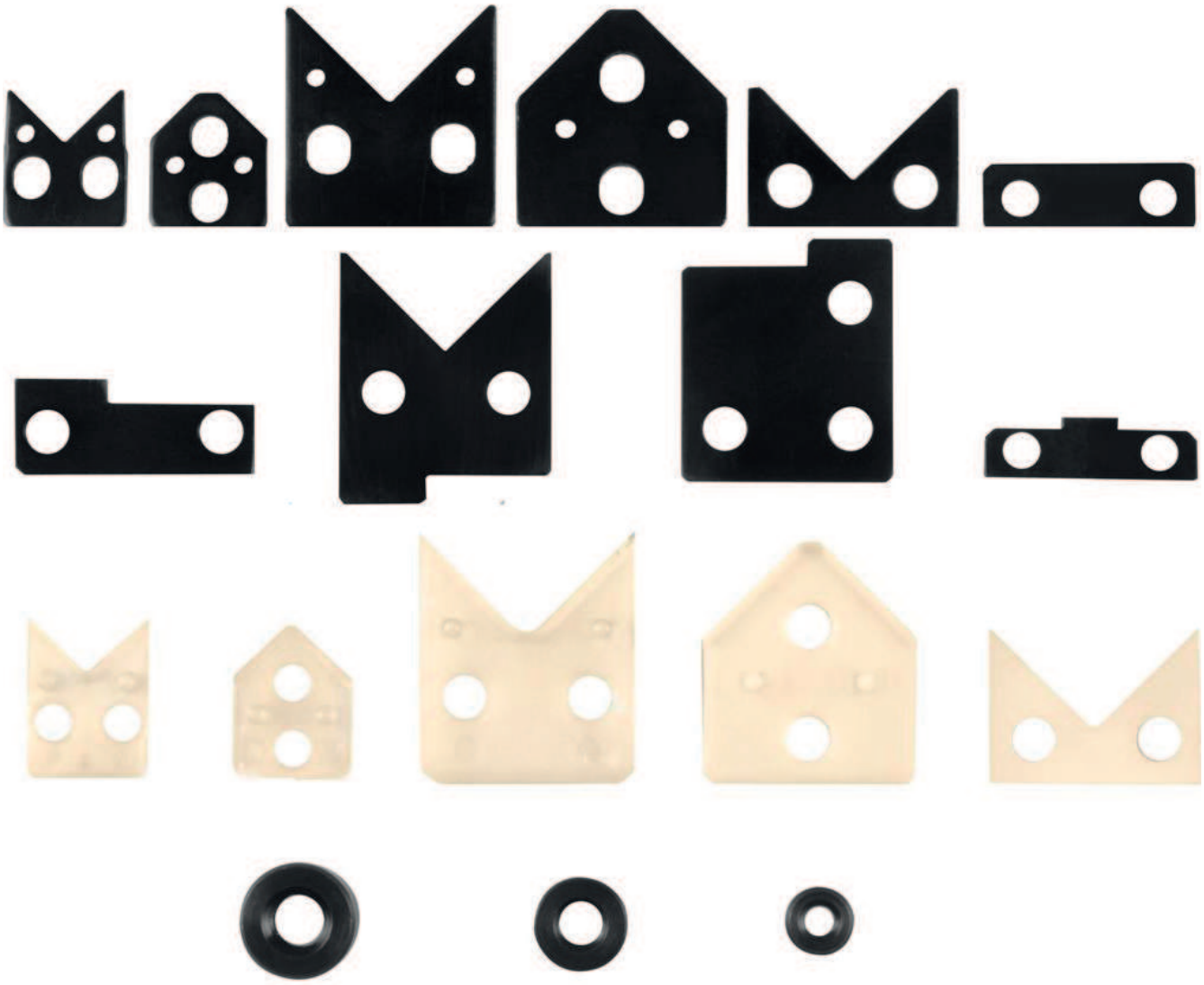
K DELIVERABLE CAGE ASSEMBLIES

Flat cage material	Rolling elements	Cage shape	Number of rows	Designation	Dimensions	Weight per metre (g)	Guideway allocation
Plastic	Needle rollers	Flat	1	E-FF	E-FF2010	46	S3525, J3525
					E-FF2515	84	S4025, J4025, S5025, J5025
					E-FF3020	148	S5030, J5030
					E-FF3525	221	S5530, J5530
		Flat	2	E-FF ZW	E-FF2025 ZW	94	Special guideways
					E-FF2535 ZW	182	Special guideways
					E-FF3045 ZW	315	Special guideways
					E-FF3555 ZW	464	Special guideways
		Angled	2	E-FFW	E-FFW2025	94	M4020, V4020, M5025, V5025, ML5020, ML5520, ML5525, ML6025, ML6525, ML7025
					E-FFW2535	182	M6035, V6035, ML7035, ML8035
					E-FFW3045	315	M7040, V7040, ML8040, ML9040
					E-FFW3555	464	M8050, V8050, ML9050, ML10050
Aluminium	Needle rollers	Flat	1	E-H	E-H10	63	S3525, J3525, LUE5025
					E-H15	120	S4025, J4025, S5025, J5025, LUE5025
					E-H20	202	S5030, J5030
					E-H25	294	S5530, J5530
		Flat	2	E-H ZW	E-H24 ZW	138	S6035, J6035, LUE6035
					E-H34 ZW	239	S7040, J7040, LUE7040
					E-H44 ZW	408	S8050, J8050, LUE8050
					E-H55 ZW	598	Special guideways
		Angled	2	E-HW	E-HW15	138	M4020, V4020, M5025, V5025, ML5020, ML5520, ML5525, ML6025, ML6525, ML7025, LUE5025
					E-HW16	190	M5025, V5025, ML5525, ML6025, ML6525, ML7025
					E-HW20	239	M6035, V6035, ML7035, ML8035, LUE6035
					E-HW25	408	M7040, V7040, ML8040, ML9040, LUE7040
					E-HW30	598	M8050, V8050, ML9050, ML10050, LUE8050
	Cylindrical rollers	Flat	1	E-HR	E-HR50	105	Special guideways
					E-HR70	295	Special guideways
					E-HR100	598	Special guideways
		Flat	2	E-HR ZW	E-HR50 ZW	215	Special guideways
					E-HR70 ZW	602	Special guideways
					E-HR100 ZW	1233	Special guideways
		Angled	2	E-HRW	E-HRW50	215	M4525, V4525
					E-HRW70	602	M6535, V6535
					E-HRW100	1233	M8550, V8550
	Balls	Flat	1	E-HB	E-HB2515	95	S4025, J4025, S5025, J5025
					E-HB3020	167	S5030, J5030
					E-HB3023	187	Special guideways
					E-HB4025	250	S5530, J5530
		Angled	2	E-HBW	E-HBW3x18x18	300	Special guideways
					E-HBW3x23x23	480	Special guideways

Flat cage material	Rolling elements	Cage shape	Number of rows	Designation	Dimensions	Weight per metre (g)	Guideway allocation
Steel	Needle rollers	Flat	1	E-H F	E-H10 F	127	S3525, J3525, LUE5025
					E-H15 F	224	S4025, J4025, S5025, J5025, LUE5025
					E-H20 F	369	S5030, J5030
					E-H25 F	546	S5530, J5530
		Profiled sheet	1	E-BF	E-BF3020	342	S5030, J5030
					E-BF5015	375	LUE6035, LUE7040, LUE8050
					E-BF5023	530	Special guideways
					E-BF5032	722	Special guideways
					E-BF7028	875	Special guideways
					E-BF7035	1080	Special guideways
					E-BF12022	1220	Special guideways
					E-BF12040	1970	Special guideways
		Flat	2	E-H ZW F	E-H19 ZW F	219	Special guideways
					E-H24 ZW F	289	S6035, J6035, LUE6035
					E-H34 ZW F	471	S7040, J7040, LUE7040
					E-H44 ZW F	756	S8050, J8050, LUE8050
					E-H55 ZW F	1117	Special guideways
		Angled	2	E-HW F	E-HW10 F	219	M3015, V3015
					E-HW15 F	289	M4020, V4020, M5025, V5025, ML5020, ML5520, ML5525, ML6025, ML6525, ML7025, LUE5025
					E-HW20 F	471	M6035, V6035, ML7035, ML8035, LUE6035
					E-HW25 F	756	M7040, V7040, ML8040, ML9040, LUE7040
					E-HW30 F	1117	M8050, V8050, ML9050, ML10050, LUE8050
Brass	Needle rollers	Flat	1	E-H MS	E-H15 MS	234	S4025, J4025, S5025, J5025, LUE5025
					E-H20 MS	389	S5030, J5030
					E-H25 MS	575	S5530, J5530
		Flat	2	E-H ZW MS	E-H19 ZW MS	230	Special guideways
					E-H24 ZW MS	306	S6035, J6035, LUE6035
					E-H34 ZW MS	499	S7040, J7040, LUE7040
					E-H44 ZW MS	798	S8050, J8050, LUE8050
					E-H55 ZW MS	1178	Special guideways
		Angled	2	E-HW MS	E-HW10 MS	230	M3015, V3015
					E-HW15 MS	306	M4020, V4020, M5025, V5025, ML5020, ML5520, ML5525, ML6025, ML6525, ML7025, LUE5025
					E-HW16 MS	390	M5025, V5025, ML5525, ML6025, ML6525, ML7025
					E-HW20 MS	499	M6035, V6035, ML7035, ML8035, LUE6035
					E-HW25 MS	798	M7040, V7040, ML8040, ML9040, LUE7040
					E-HW30 MS	1178	M8050, V8050, ML9050, ML10050, LUE8050
	Needle rollers with damping	Flat	1	E-HG	E-HG10	130	S3525, J3525, LUE5025
					E-HG15	230	S4025, J4025, J5025, LUE5025
					E-HG20	375	S5030, J5030
					E-HG25	560	S5530, J5530
		Angled	2	E-HGW	E-HGW15	265	M4020, V4020, M5025, V5025, ML5020, ML5520, ML5525, ML6025, ML6525, ML7025, LUE5025
					E-HGW20	470	M6035, V6035, ML7035, ML8035, LUE6035
					E-HGW25	760	M7040, V7040, ML8040, ML9040, LUE7040
					E-HGW30	1150	M8050, V8050, ML9050, ML10050, LUE8050

9

ACCESSORIES
END PIECES / WIPERS FOR GUIDEWAYS / ESM INSERT NUTS FOR GUIDEWAYS



END PIECES

Conditioning: end piece with fixing screws

- MATERIAL

Blackened construction steel St 37-2
Fixing screws ISO 7984

IMPORTANT INFORMATION: the end pieces must not be used to limit the stroke.

WIPERS

Conditioning: end piece with assembled wiper plate and fixing screws

- MATERIAL

Blackened construction steel St 37-2
Polyester elastomer
Fixing screws ISO 7984

Longitudinal seals may also be applied in order to reduce the risk of soiling on the raceways.

ESM INSERT NUTS

Standard guideways are delivered with sinkholes (T15). These guideways can be attached as with a threaded hole (T03) by using ESM insert nuts. The insert nuts must be glued into the hole (T13).

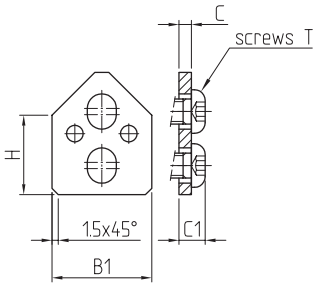
The ESM insert nuts should be ordered separately and are delivered loose.

- MATERIAL

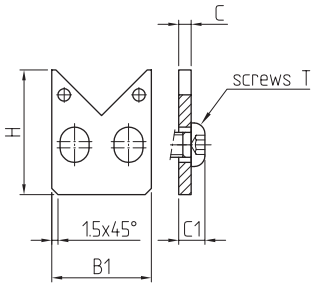
Heat-treatable steel CK 45 (1.1191)

END PIECES

EV TYPE



EM TYPE



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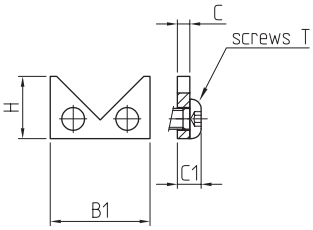
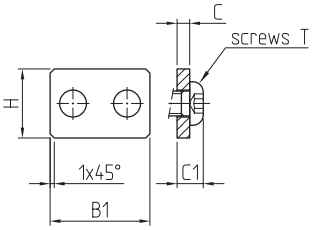


EJ TYPE

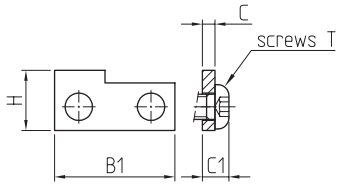


DIMENSIONS IN MM

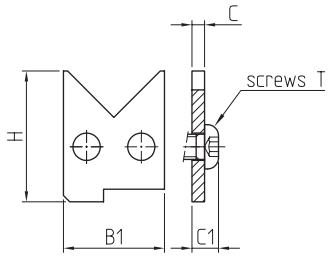
Guideways	Designation				Dimensions				T screws
	EV	EM	EML	EJ	B1	H	C	C1 max.	DIN 7984
V 3015	EV3015				14	12.6	2	5	M3x6
V 4020	EV4020				19	14.9	3	7	M5x10
V 4525	EV4525				24	18.5	3	7.5	M6x10
V 5025	EV5025				24	17.8	3	7.5	M6x10
V 6035	EV6035				34	21.5	3	7.5	M6x10
V 6535	EV6535				34	27.5	3	7.5	M6x10
V 7040	EV7040				39	26.2	3	7.5	M6x10
V 8050	EV8050				49	29	3	7.5	M6x10
V 8550	EV8550				49	37.5	3	7.5	M6x10
M 3015		EM3015			14	16.7	2	5	M3x6
M 4020		EM4020			19	23	3	7	M5x10
M 4525		EM4525			24	26.5	3	7.5	M6x10
M 5025		EM5025			24	29	3	7.5	M6x10
M 6035		EM6035			34	36	3	7.5	M6x10
M 6535		EM6535			34	40.5	3	7.5	M6x10
M 7040		EM7040			39	42	3	7.5	M6x10
M 8050		EM8050			49	49	3	7.5	M6x10
M 8550		EM8550			49	54.5	3	7.5	M6x10
ML5020, ML 5520			EML 20		19	12	3	6.5	M4x10
ML 5525 to ML 7025			EML 25		24	15	3	7	M5x10
ML 7035, ML 8035			EML 35		34	23	3	7.5	M6x10
ML 8040, ML 9040			EML 40		39	28.5	3	7.5	M6x10
ML 9050, ML 10050			EML 50		49	35	3	7.5	M6x10
J 3525				EJ 35	34	11	3	7	M5x10
J 4025				EJ 40	39	12	3	7	M5x10
J 5030				EJ 50	49	14	3	7.5	M6x10
J 5530				EJ 55	54	15	3	7.5	M6x10
J 5025				EJ 5025	24	16.6	3	7.5	M6x10
J 6035				EJ 6035	34	17	3	7.5	M6x10
J 7040				EJ 7040	39	16.8	3	7.5	M6x10
J 8050				EJ 8050	49	18.2	3	7.5	M6x10

END PIECES

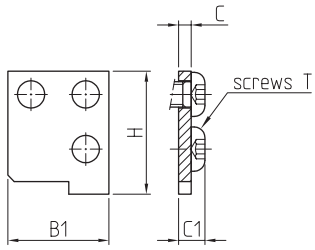
ELU TYPE



EMLU TYPE



EJLU TYPE

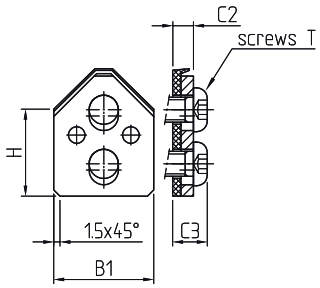


DIMENSIONS IN MM

Guideways	Designation			Dimensions				T screws
	ELU	EMLU	EJLU	B1	H	C	C1 max.	DIN 7984
LUE 5025	ELU 5025			28.6	11.3	3	7.5	M6x10
		EMLU5025		24	31.1	3	7.5	M6x10
			EJLU 5025	24	29.2	3	7.5	M6x10
LUE 6035	ELU 6035			38.6	13.8	3	7.5	M6x10
		EMLU6035		34	40.5	3	7.5	M6x10
			EJLU 6035	34	39	3	7.5	M6x10
LUE 7040	ELU 7040			38.6	15.8	3	7.5	M6x10
		EMLU7040		39	46.5	3	7.5	M6x10
			EJLU 7040	39	44	3	7.5	M6x10
LUE 8050	ELU 8050			49.6	18.8	3	7.5	M6x10
		EMLU8050		49	53.5	3	7.5	M6x10
			EJLU 8050	49	49	3	7.5	M6x10

WIPERS

EAV TYPE



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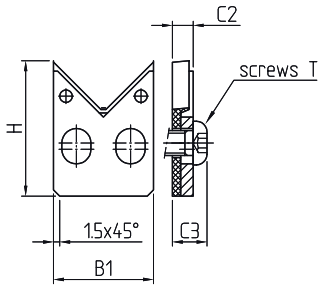

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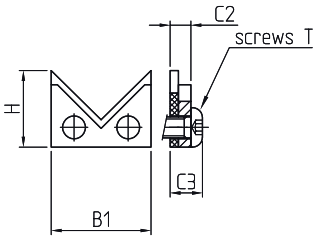
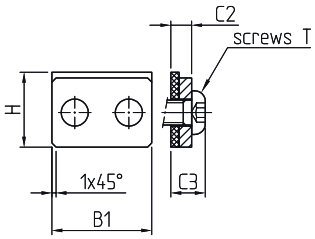


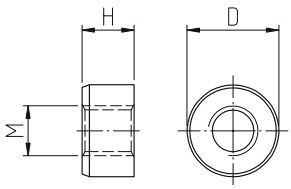
EAJ TYPE



AFFILIATION TABLE

Guideways	End pieces with assembled wipers	Dimensions				T screws
		B1	H	C2	C3	DIN 7984
V 3015	EAV3015	14	13.4	4	7	M3x8
V 4020	EAV4020	19	16.7	5	9	M5x12
V 4525	EAV4525	24	21.2	5	9.5	M6x12
V 5025	EAV5025	24	19.9	5	9.5	M6x12
V 6035	EAV6035	34	23.7	5	9.5	M6x12
V 6535	EAV6535	34	30.2	5	9.5	M6x12
V 7040	EAV7040	39	28.4	5	9.5	M6x12
V 8050	EAV8050	49	31.2	5	9.5	M6x12
V 8550	EAV8550	49	40.2	5	9.5	M6x12
M 3015	EAM3015	14	18.6	4	7	M3x8
M 4020	EAM4020	19	25.7	5	9	M5x12
M 4525	EAM4525	24	30.2	5	9.5	M6x12
M 5025	EAM5025	24	32.2	5	9.5	M6x12
M 6035	EAM6035	34	39.2	5	9.5	M6x12
M 6535	EAM6535	34	44.2	5	9.5	M6x12
M 7040	EAM7040	39	45.2	5	9.5	M6x12
M 8050	EAM8050	49	53.2	5	9.5	M6x12
M 8550	EAM8550	49	58.2	5	9.5	M6x12
ML5020, ML 5520	EAML 20	19	14	5	8.5	M4x12
ML 5525 to ML 7025	EAML 25	24	18.4	5	9.0	M5x12
ML 7035 - ML 8035	EAML 35	34	25.7	5	9.5	M6x12
ML 8040, ML 9040	EAML 40	39	31.2	5	9.5	M6x12
ML 9050, ML 10050	EAML 50	49	39.6	5	9.5	M6x12
J 3525	EAJ 35	34	11.6	5	9	M5x12
J 4025	EAJ 40	39	12.3	5	9	M5x12
J 5030	EAJ 50	49	14.3	5	9.5	M6x12
J 5530	EAJ 55	54	14.8	5	9.5	M6x12
J 5025	EAJ 5025	24	16.9	5	9.5	M6x12
J 6035	EAJ 6035	34	17.3	5	9.5	M6x12
J 7040	EAJ 7040	39	17.1	5	9.5	M6x12
J 8050	EAJ 8050	49	18.7	5	9.5	M6x12

ESM INSERT NUTS



DIMENSIONS IN MM

Guideways	Designation	Dimensions		
	ESM	D -0.05/-0.10	H	M
M/V 3015	ESM M4	8.5	4.3	M4
S/J 3525 **S/J 4025**	ESM M5	10	5.5	M5
M/V 4020 - M/V 4525 - M/V 5025 **S/J 5025** **ML 5020 - ML 5520** **ML 5525 - ML 6025** **ML 6525 - ML 7025**	ESM M6	11.5	6.5	M6
S/J 5030 - S/J 5530	ESM M6	11.0	6.5	M6
M/V 6035 - M/V 6535 **S/J 6035** **ML 7035 - ML 8035**	ESM M8	15	8.5	M8
M/V 7040 **S/J 7040** **ML 8040 - ML 9040**	ESM M10	18.5	10.5	M10
M/V 8050 - M/V 8550 **S/J 8050** **ML 9050 - ML 10050**	ESM M12	20	12.5	M12

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ALTERNATIVE VERSIONS

GROUP	DETAILS	CODE
No threaded holes on front side	No threaded holes on both ends	E1
	No threaded holes at beginning of the guideway (distance L1)	E1L
	No threaded holes at end of the guideway	E1R
Raceway lead areas at end of guideways	Raceway lead areas at both ends of the guideway	E2
	Raceway lead area at beginning of the guideway (distance L1)	E2L
	Raceway lead area at end of the guideway (distance L2)	E2R
Position of fixing holes different from dimension table	Distance between the first hole and the start of the guideway	L1
	Hole distance	LA
	Distance between the last hole and the end of the guideway	L2
Layout with longitudinal seal 	Layout sealed with sealing strips made from plastic	PP
	Layout sealed with sealing strips made from a steel band	ZZ
Raceways with sliding layer	With Turcite sliding layer	LB
	With Permaglide sliding layer	LP21
Layout with integrated toothed rack	For positive control of flat cage assemblies	MVZ

GROUP	DETAILS	CODE
Special treatments	Corrosion protection – thin layer chromium plating (layer thickness 2-5µm)	DSV
	Galvanising – nickel coating – blackening – sandblasting – trovalisation procedures, etc.	AVAILABLE ON REQUEST
Special tolerances	Pre-ground raceways	VQ10
	Special height dimension (H)	TH
	Restricted width tolerance	TB
	Restricted hole distance tolerance (LA)	P
	Lubrication holes or additional holes	TG
	Ground joints for multi-part guideways	E5
	Guideways with joints ground on both sides	E6
Different guideway materials	Stainless or other steel	AVAILABLE ON REQUEST

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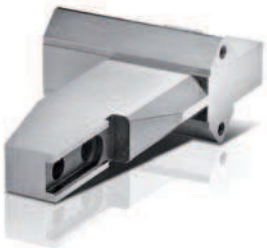
SPECIAL DESIGNS

GUIDEWAYS FOR CROSSED ROLLER AND BALL FLAT CAGE ASSEMBLIES R3/R6/R9...

GUIDEWAYS FOR HYDROSTATIC GUIDANCE SYSTEMS

GUIDEWAYS FOR AIR BEARINGS

SPECIFIC SHAPES AND DIMENSIONS



LINEAR RECIRCULATING ROLLER BEARINGS (RUSW + U-100)

SPECIAL MATERIALS

Stainless or other steel available on request

NOTES

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