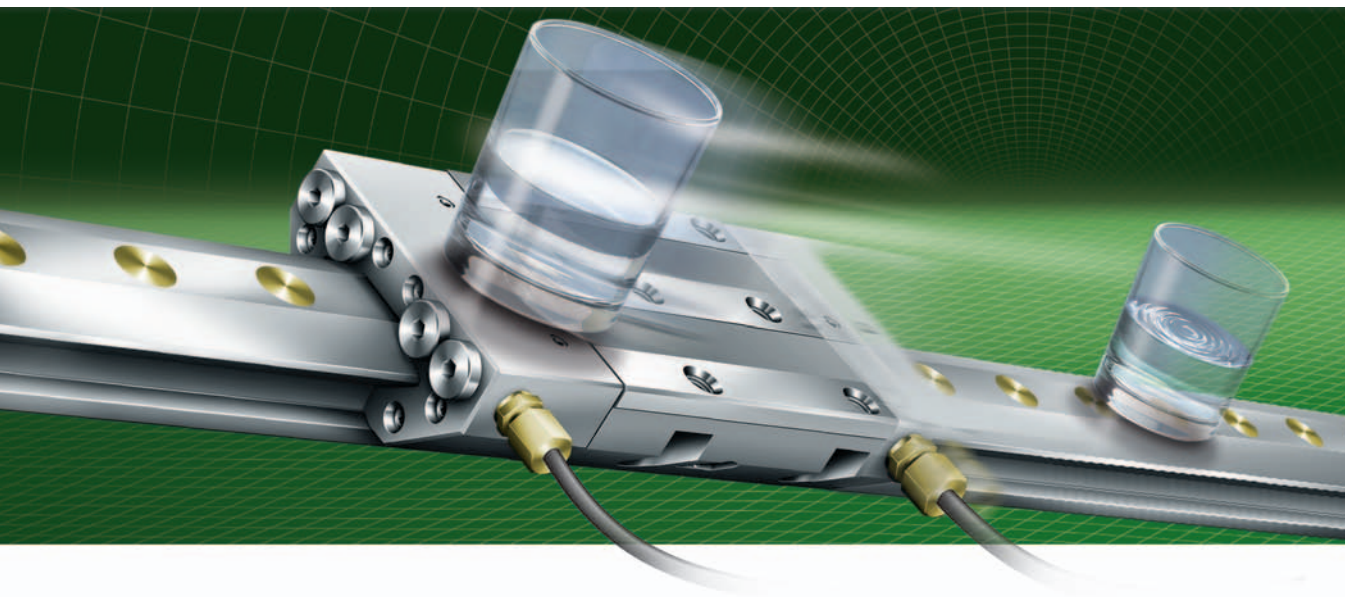




Hydrostatic compact guidance system

HLE45

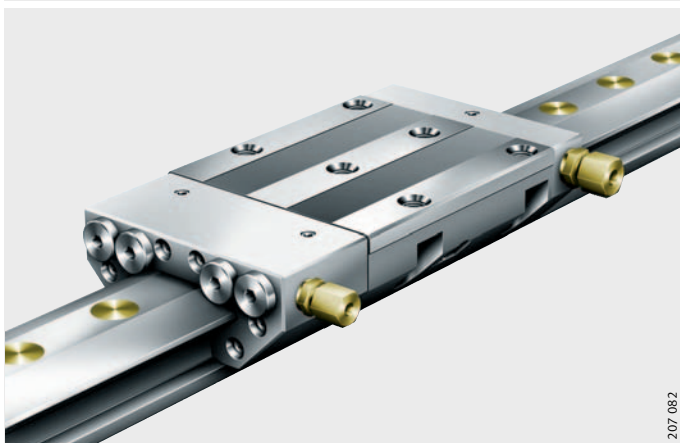
Hydrostatic compact guidance system

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Product overview Hydrostatic compact guidance system

Hydrostatic compact guidance system

HLE45



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Hydrostatic compact guidance system

Features

The carriages in monorail guidance systems cannot accommodate vibration damping. In order to allow appropriate damping of vibrations from the adjacent construction, additional elements such as the passive damping carriage RUDS for the RUE series are required, which is positioned between the carriages. However, in order to have the greatest effect when bending vibrations occur, the damping carriage must be positioned at the point of the largest deflection. Good knowledge of the vibration patterns is therefore required.

Hydrostatic vibration damping by means of oil cushion

For applications with very high demands on damping, dynamic rigidity and load capacity, a hydrostatic compact guidance system based on our proven range of linear recirculating roller bearing and guideway assemblies RUE...-E now exists for size 45.

This preloaded guidance system is a complete unit. It has been designed specifically for damping and does not need to be retrofitted with special damping components.

Function

A chamber system in the carriage is charged with hydraulic oil. The oil is fed to the pressure side under constant pressure, *Figure 1*. The integrated chokes are set so that the carriage is positioned optimally on the guideway and lifts off uniformly to a gap height of 0,015 mm under pressure. Pressure pockets in the carriage ensure that the carriage is flushed with oil.

The unpressured oil is extracted from the compact guidance system on the suction side and fed back to the oil circuit.

- ① Pressure side
- ② Integrated choke
- ③ Pressure pockets
- ④ Suction side (unpressurised area)

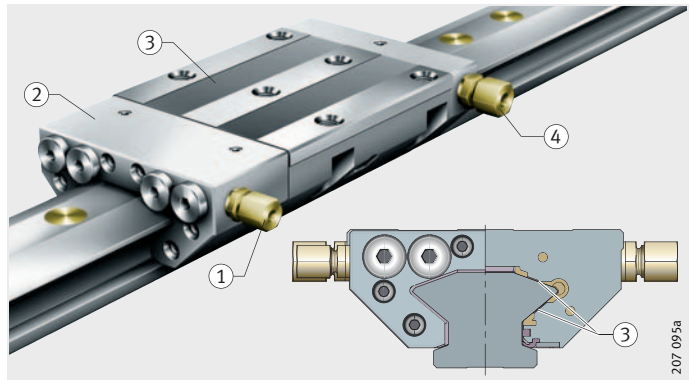


Figure 1

Functional parts

Hydrostatic compact guidance system

Advantages of this solution

Due to an integral hydraulic control system, the hydrostatic guidance system is ready to fit and can be integrated into the standard design envelope of a linear recirculating roller bearing and guideway assembly.

Only one machine concept required

Due to compliance with the DIN design envelope and DIN mounting dimensions for monorail guidance systems (identical geometrical mounting dimensions and identical outline profile) several performance classes are possible within one machine concept. As a result, just one concept can cover various machining requirements.

For example, the following is possible depending on the key issue:

- perfect surface quality and accuracy in standard machining
- an increased cutting rate and cutting depth with high machining quality and accuracy in high performance machining.

Performance characteristics

There is approximately zero friction between the guideway and the carriage, see Friction, page 5. The pressure rigidity conforms to the standard linear recirculating roller bearing and guideway assembly RUE-E.

The operating load in machine tools is similar to the standard monorail guidance system. This guidance system can support loads from all directions – apart from the direction of motion – and moments about all axes.

It is suitable for accelerations of 100 m/s^2 and speeds of up to 120 m/min.

Design of the units

A hydrostatic system comprises a minimum of two guideways TSH, two carriages HLW per guideway and brass closing plugs to seal the fixing holes in the guideways.

The guideways are supplied as single pieces only, to a maximum length of 5 900 mm; guideways composed of joined sections are not permissible.

Seals

Elastic double lip seals on the end faces and sealing strips on the undersides of the carriages protect the system from contamination and keep the hydraulic oil in the carriage.

Operating temperature

The compact guidance system is designed for use at room temperature.

Cannot be used in any other combinations

Carriages and guideways are matched to each other and therefore cannot be freely combined with other guideways and carriages.

The chokes in the carriage are set to the respective gap.

Corrosion-resistant design

A corrosion-resistant version is not available.

Preload	The guidance system HLE is preloaded hydraulically at a pressure of approx. 5 Mpa. The preload class is determined by the valve setting.
Influence of preload on the linear guidance system	Increasing the preload increases the rigidity. However, preload does not influence the displacement force or operating life of the linear guidance system.
Friction	Friction is independent of load until the load limit is reached. Due to all-round sealing, the constant displacement distance is only approx. 20 N per carriage.
Rigidity	Rigidity is as follows: ■ compressive direction = 1 300 N/μm ■ tensile direction = 1 200 N/μm ■ lateral direction = 950 N/μm. These values have been calculated from a system (HLE45) comprising two guideways (TSH45) and four carriages (HLW45) which were screwed to a plate. They cover the deformation of the hydrostatic guidance system HLE, including the screw connection to the adjacent construction.
Caution!	The rigidity values only apply where there is a sixfold screw connection and a corresponding oil supply; see Hydraulic Unit, page 14.

Hydrostatic compact guidance system

Hole pattern of guideway

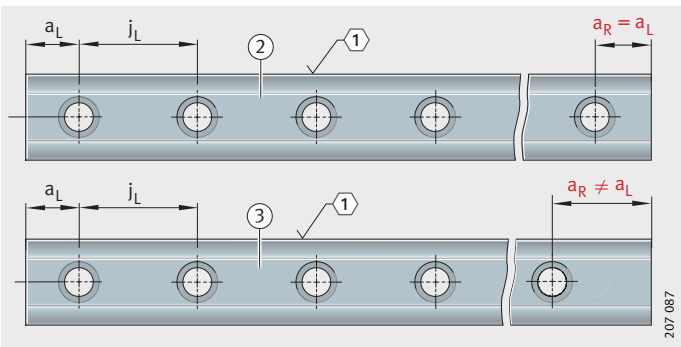
Unless specified otherwise, the guideways have a symmetrical hole pattern, *Figure 2*.

An asymmetrical hole pattern may also be available on request. In this instance the following must be adhered to:
 $a_L \geq a_{L \min}$ and $a_R \geq a_{R \min}$, *Figure 2*.

- ① Locating face
- ② Symmetrical hole pattern
- ③ Asymmetrical hole pattern

Figure 2

Hole pattern for guideways with one row of holes



Maximum number of pitches between holes

The number of pitches between holes is the rounded whole number equivalent to:

$$n = \frac{l - 2 \cdot a_{L \min}}{j_L}$$

The distances a_L and a_R are generally determined by:

$$a_L + a_R = l - n \cdot j_L$$

For guideways with a symmetrical hole pattern:

$$a_L = a_R = \frac{1}{2} \cdot (l - n \cdot j_L)$$

Number of holes:

$$x = n + 1$$

a_L, a_R	mm
Distance between start or end of guideway and nearest hole	
$a_{L \min}, a_{R \min}$	mm
Minimum values for a_L, a_R according to dimension table	
l	mm
Guideway length	
n	—
Maximum possible number of hole pitches	
j_L	mm
Distance between holes	
x	—
Number of holes.	

Caution! If the minimum values for a_L and a_R are not observed, the counterbores may be intersected by the end of the guideway!

Multi-piece guideways

Multi-piece guideways cannot be used.

Demands

The straightness of the system is only achieved when the guideway is pressed against the datum surface.

If high demands are to be made on the running accuracy and/or if soft substructures and/or movable guideways are used, please contact us.

Geometrical

The higher the requirements for accuracy and smooth running of the guidance system, the more attention must be paid to the geometrical and positional accuracy of the mounting surfaces.

Caution!

The tolerances in *Figure 3*, page 8 must be adhered to.
Surfaces should be ground or precision milled with the aim of achieving a mean roughness value of $R_a 1,6$.
Deviations from the specified tolerances will impair the overall accuracy of the guidance system, affect the preload and may result in the system being inoperable.

Height difference ΔH

The permissible values for ΔH are given by the formula below. If larger deviations are present, please contact us.

$$\Delta H = a \cdot b$$

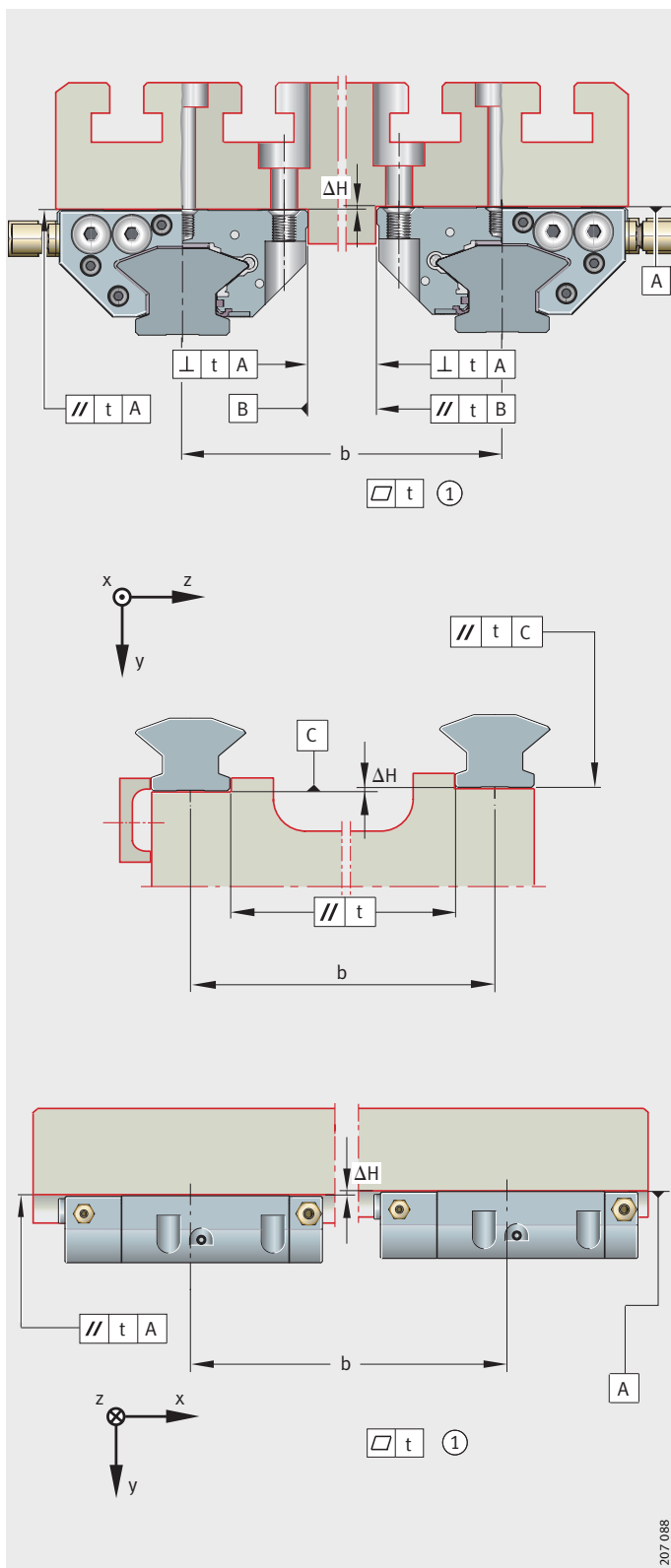
ΔH μm
Maximum permissible deviation from the theoretically precise position,
Figure 3, page 8

a – Factor dependent on preload class, in this instance: 0,075
b mm Centre distance between guidance elements.

Hydrostatic compact guidance system

① Not convex
(for all machined surfaces)

Figure 3
Tolerances of mounting surfaces
and parallelism
of mounted guideways



Accuracy Locating heights and corner radii

Locating heights and corner radii

Locating heights and corner radii should be in accordance with the table and *Figure 4*.

Compact guidance system	h_1	h_2 mm	r_1 mm	r_2 mm
Designation		max.	max.	max.
HLE45	10	8	1	0,8

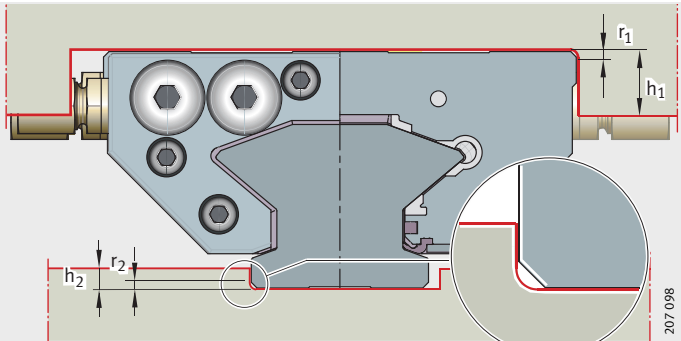
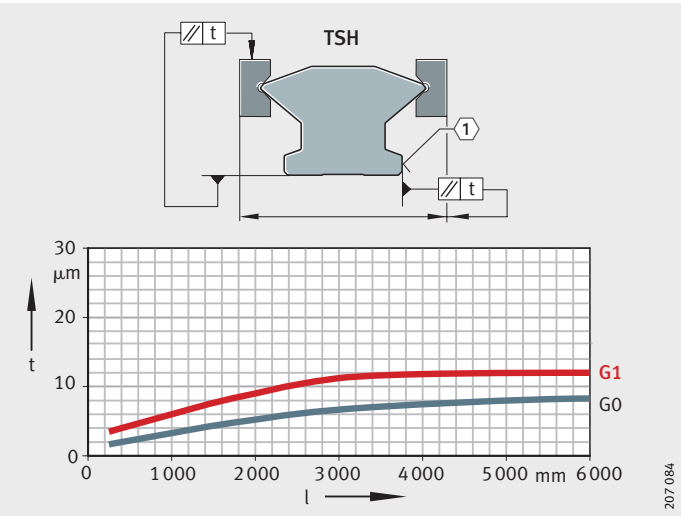


Figure 4
Locating heights
and corner radii

Accuracy classes

The compact guidance system HLE is available in accuracy classes G0 to G1, *Figure 5*. Class G1 is used as standard.



t = Parallelism tolerance
for differential measurement
 l = Total guideway length
① Locating face

Figure 5
Accuracy classes
and parallelism tolerances
of guideways

Hydrostatic compact guidance system

Parallelism of raceways to locating surfaces

The parallelism tolerances of the guideways are shown in *Figure 5*, page 9.

Tolerances

The tolerances are arithmetic mean values. They relate to the centre point of the screw mounting surfaces or locating surfaces of the carriage.

The dimensions H and A₁ (see table of accuracy class tolerances) should always remain within the tolerance irrespective of the position of the carriage on the guideway.

For reference dimensions H and A₁ see *Figure 6*.

Running accuracy

The running accuracy is influenced by the accuracy of the adjacent construction.

Accuracy class tolerances

Tolerance		Accuracy	
		G0 μm	G1 ¹⁾ μm
Height tolerance	H ³⁾	±5	±10
Height difference ²⁾	ΔH	3	5
Spacing tolerance	A ₁ ³⁾	±5	±10
Distance difference ²⁾	ΔA ₁	3	7

- 1) Standard accuracy class.
- 2) Dimensional difference between several carriages on one guideway, measured at the same point on the guideway.
- 3) Theoretical value from production.

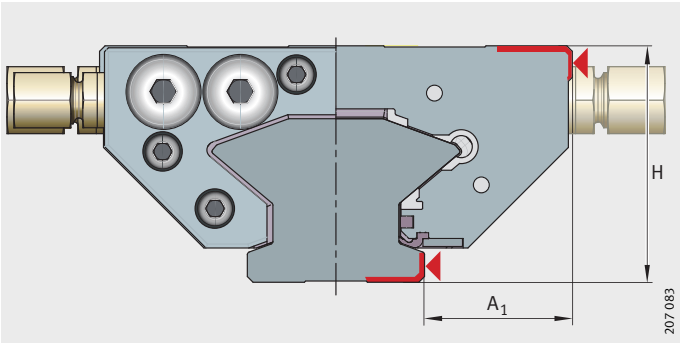


Figure 6
Reference dimensions for accuracy

Positional and length tolerances of guideways

The positional and length tolerances are shown in *Figure 7* and in the table of length tolerances for guideways.
 The hole pattern conforms to DIN ISO 1101.

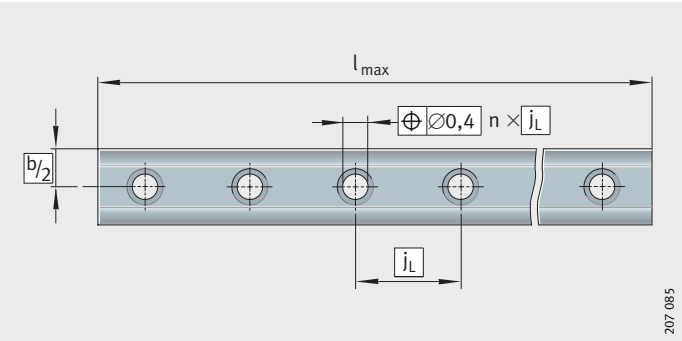


Figure 7
 Positional and length tolerances
 of guideways

Length tolerances of guideways

Guideway	Tolerances of guideways, as a function of the length $l_{\max}$ ¹⁾		
Designation	≤1 000 mm	>1 000 mm <3 000 mm	>3 000 mm
TSH45	−1 mm	−1,5 mm	±0,1% of guideway length

¹⁾ Length $l_{\max}$ see dimension table.

Hydrostatic compact guidance system

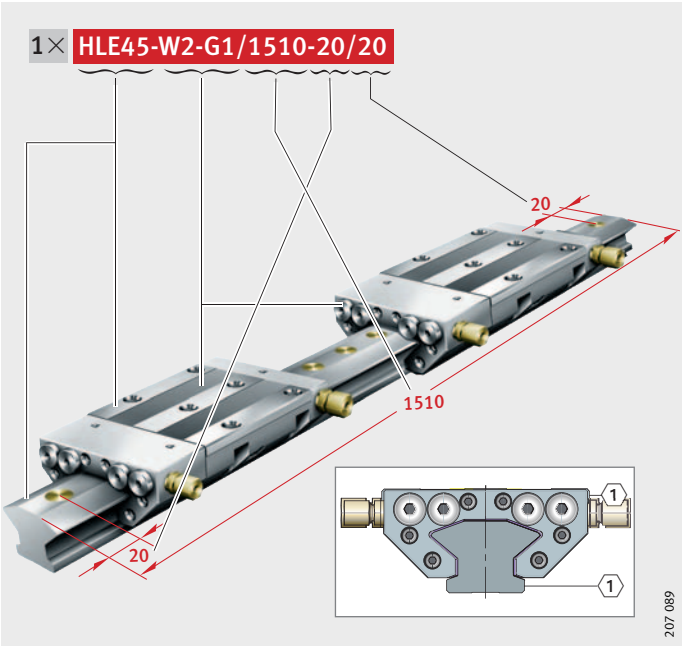
Ordering example,
ordering designation
Symmetrical hole pattern

Hydrostatic compact guidance system	HLE
Size	45
Number of carriages per unit	W2
Accuracy class	G1
Length of guideway	1510 mm
a _L	20 mm
a _R	20 mm

Ordering designation 1×HLE45-W2-G1/1510-20/20, Figure 8.

① Locating face

Figure 8
Ordering example,
ordering designation



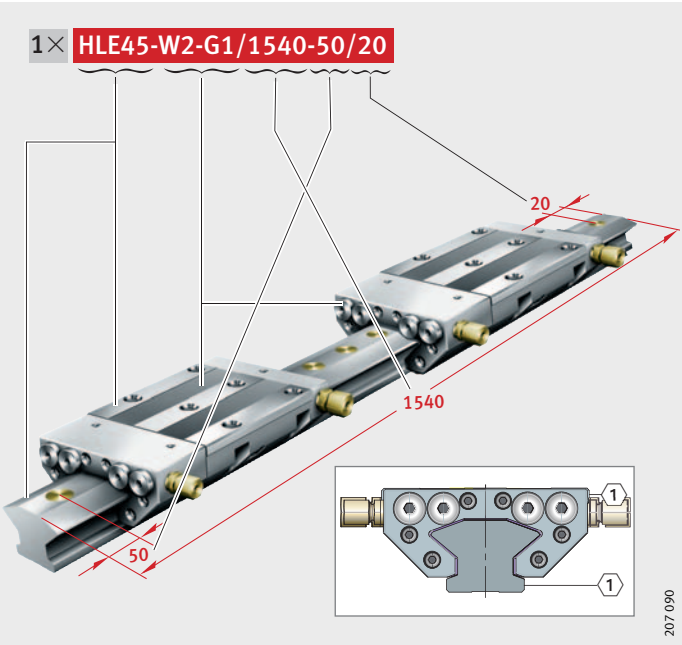
Asymmetrical hole pattern

Hydrostatic compact guidance system	HLE
Size	45
Number of carriages per unit	W2
Accuracy class	G1
Length of guideway	1540 mm
a_L	50 mm
a_R	20 mm

Ordering designation **1×HLE45-W2-G1/1540-50/20, Figure 9.**

① Locating face

Figure 9
Ordering example,
ordering designation



Hydrostatic compact guidance system

Hydraulic unit

Demands on the hydraulic unit

Each carriage requires two litres of oil per minute.

Example

The following example shows the selection of a hydraulic unit for a guidance system comprising two guideways, each with two carriages:

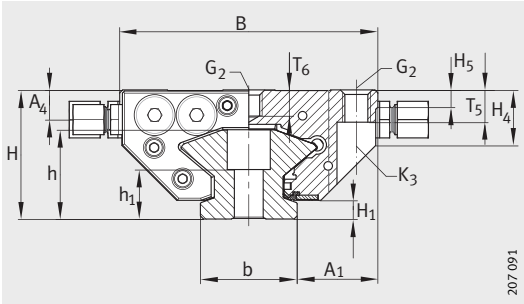
- pressure circuit driven by electric motor V1, output 2,2 kW, $n = 1\,500\text{ 1/min}$ 400 V, external gear wheel pump $Q = 8\text{ l/min}$ where $p = \text{approx. } 150\text{ bar}$
- oil container NG100 with filling filter and ventilation filter, fill level control, electrical temperature switch, drain cock
- filter cooling circuit (extraction pump) driven by electric motor V1, output 0,55 kW, $n = 1\,500\text{ 1/min}$ 400 V, external gear wheel pump $Q = 10\text{ l/min}$ where $p = \text{approx. } 25\text{ bar}$
- oil container NG100 with filling filter and ventilation filter, fill level control, electrical temperature switch, drain cock
- oil cooler plate heat exchanger (HEX 615-30(C71,C71))
- compressor cooling unit.
Cooling capacity must correspond to at least the total pump output.

Cooler design

The oil cooler must be sized so that the temperature of the oil leaving the hydraulic unit is 6° lower than the required ambient temperature for the hydrostatic guidance system.

Feed pipe and return pipe	Large pipe diameters should always be selected where possible.
Feed pipe	The feed pipe should have an inside diameter of 16 mm, which should only be reduced to 4 mm immediately before the carriage where possible. The pressure port in the carriage is L6.
Return pipe	In the return pipe, the pipe resistance through to the extraction pump must be uniform and as low as possible for all connected carriages. The pressure port in the carriage is L8. Once the oil has left the carriage, the inside diameter of the extraction pipe should be expanded to 16 mm after a maximum of 300 mm. If the return pipe is longer than 3 m, an extraction pump should be fitted directly at the axis where possible. The dynamic pressure in the extraction pipe must be below 0,2 bar.
Caution!	The pipe resistances for the extraction and pressure pipe must always be calculated. The hydraulic unit must be fitted with a pressure switch which will only enable the movement of the hydrostatic axis in the control system once there is sufficient pressure. All movements in the machine may only be made while the hydrostatic guidance system is active.
Assembly	
Caution!	The carriage should never be pushed onto the guideway in an unoiled state. The guideways must be aligned, screwed down tightly and the holes closed off using brass plugs. Where the hydrostatic guidance system is to be used, both guideways and one side of the carriage must have a fixed end stop.
Fitting	The following steps must be observed during fitting: ■ Push the oiled carriage onto the guideway and slide into the assembly position without exerting any load ■ Connect the carriage hydraulically ■ Supply the system with operating pressure ■ Place the counterpart on the carriages ■ Screw the carriage screw in from the back of the carriage (from above) ■ Tighten the four outer screws first, then the centre screws, observing the screw length. The guidance system is now operational.

Hydrostatic compact guidance system



HLE45

Dimension table · Dimensions in mm

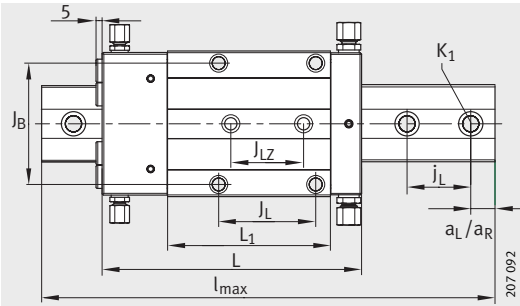
Designation	Carriage		Guideway			Dimensions				Mounting dimensions			
	Designation	Mass m ≈ kg	Designation	Mass m ≈ kg	Closing plug	$l_{\max}^{1)}$	H	B	L	A_1	J_B	b -0,005 -0,035	L_1
HLE45	HLW45	6	TSH45	12,6	KA20-M	5 900	60	120	213,9	37,5	100	45	134,2

1) Supplied as single pieces only, to a maximum length of 5 900 mm.
Guideways composed of joined sections are not permissible.

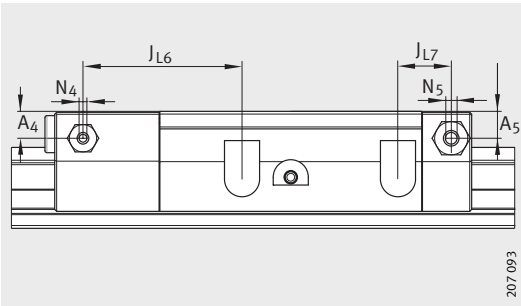
2) a_L and a_R are dependent on the guideway length.

Dimension table (continued) · Dimensions in mm

Designation	Fixing screws						Dimensioning of lubricant connections					
	G ₂		K ₁		K ₃		A ₄	N ₄	J _{L6}	A ₅	N ₅	J _{L7}
	DIN ISO 4 762-12.9											
		M _A Nm		M _A Nm		M _A Nm						
HLE45	M12	140	M12	140	M10	83	13,8	4	81,6	13,8	6	27,3



HLE45 · View rotated 90°



Lateral pressure oil connection

												Load carrying capacity at 10 Mpa in		
J _L	J _{LZ}	j _L	a _L /a _R ²⁾		H ₁	H ₅	H ₄	T ₅	T ₆	h	h ₁	Compressive direction	Tensile direction	Lateral direction
			min.	max.										
80	60	52,5	20	41	8,7	8	25,8	15	10	41,5	23	20 300	17 400	11 000

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