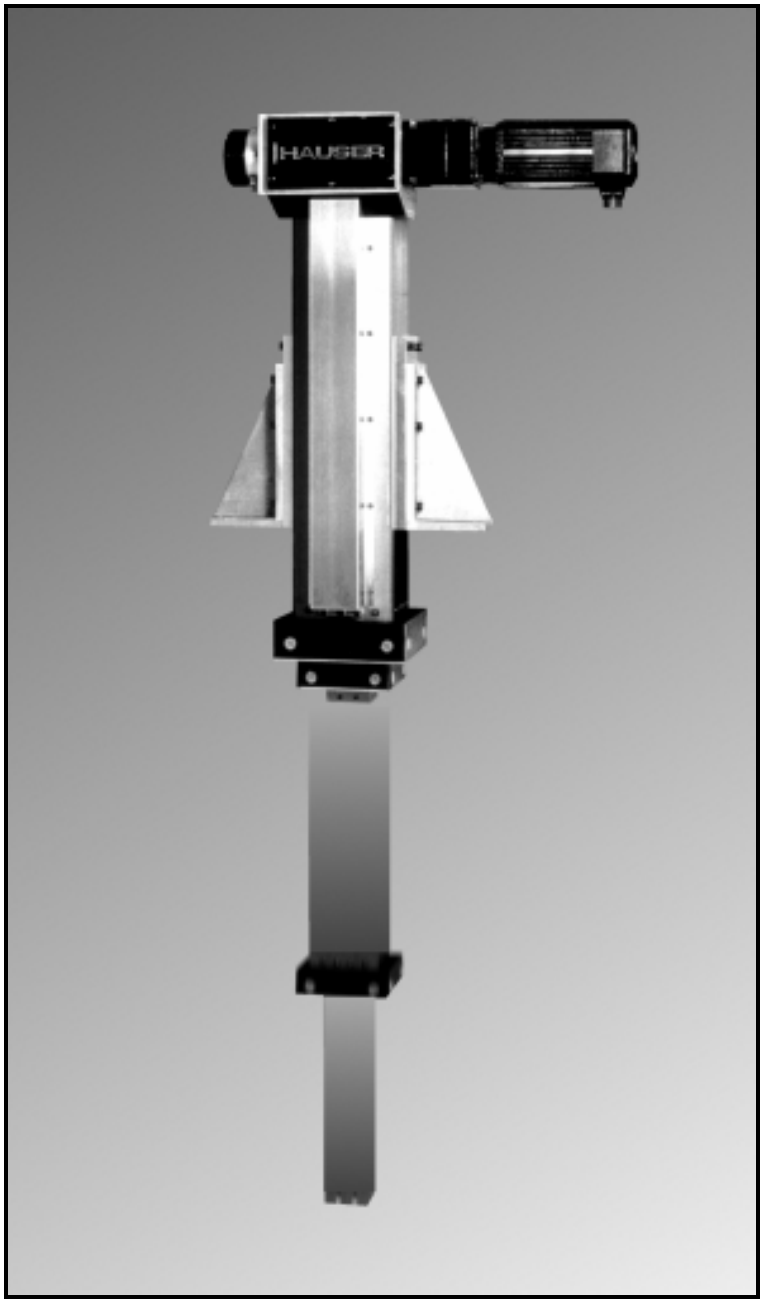
HTR - Product manual

Project planning, assembly, commissioning, maintenance, repairs



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We automate motion

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Technische Änderungen vorbehalten. Daten entsprechen dem technischen Stand zum Zeitpunkt der Drucklegung. 7/98 Art. Nr.: 192-530813N3

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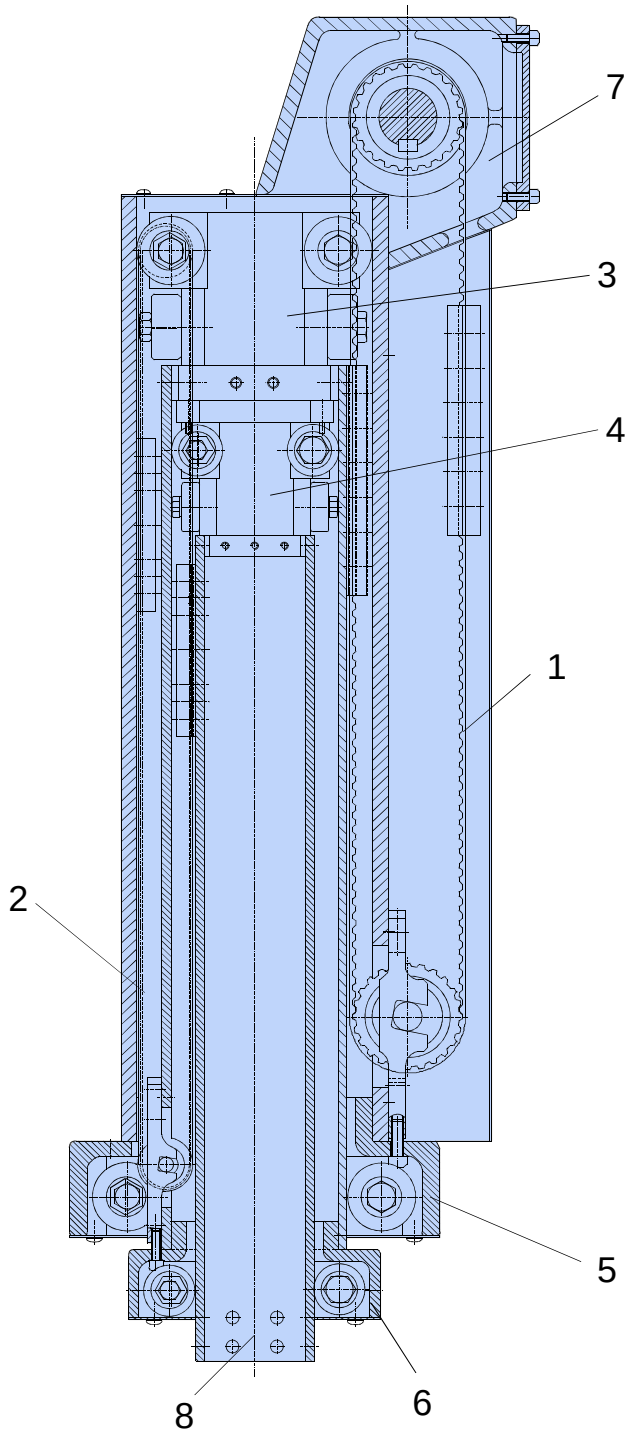


Great lifting power with small construction height

Specially designed for applications that require a large vertical lifting path in limited space, the telescopic axle has been developed by HAUSER.

With the wear-proof, high strength toothed belt, the main drive **(1)** and transmission drive **(2)** provide optimal power transfer to the load attachment **(8)**.

Maintenance free, plastic rollers mounted on roller bearings combined with surface treated aluminium extruded sections guarantees minimum wear with optimal running smoothness.

A newly developed guiding principle, consisting of the 3 guide profiles and the relevant rotor stations **(3)**, **(4)**, **(5)** and **(6)**, provides self-stabilising properties.

The hollow shafts and flange design of the drive station **(7)** are identical to the flange dimensions of HAUSER servo drives, offering optimal combinations with HAUSER drive technology.

HTR connection possibilities are compatible with the HAUSER modular system so that modular application specific handling technology can be provided in combination with linear units.

These proven HAUSER construction principles give the user many advantages which are also applicable to the telescopic axle.

1 Main drive
2 Transmission drive
3 Rotor station, upper central section
4 Rotor station, upper inner section
5 Rotor station, lower outer section
6 Rotor station, lower central section
7 Drive station
8 Connection for outer load (e.g. Gripper)

Product description

2 Technical data

HTR	Units	HTR50	HTR80
Cross-section outer profile	mm x mm x mm	125 x 125 x 6	180 x 180 x 10
Cross-section central profile	mm x mm x mm	80 x 80 x 6	125 x 125 x 6
Cross-section inner profile	mm x mm x mm	50 x 50 x 5	80 x 80 x 6
Moment of inertia about the outer profile	cm^4	674	3261
Moment of inertia about the central profile	cm^4	163	674
Moment of inertia about the inner profile	cm^4	31	163
Travel speed, maximum	m/s	5.0	5.0
Travel path, maximum	mm	2500	2500
Maximum permissible acceleration	m/s^2	5	5
Path travelled per rotation 1)	mm/U	340	480
Tooth lock washer diameter 1)	mm	108.2	152.8
Driving torque, maximum	Nm	40	108
Belt tensile force, maximum at retract speed	N	→ Diagram 2-4	→ Diagram 2-4
Roller load, maximum	N	→ Table 2- 2	→ Table 2- 2
Pos. repeat accuracy in one direction (DIN EN 29283)	mm	±0.2	±0.2
Mass base unit, no lifting	kg	12.8	35.3
Mass additional length	kg/m	8.6	16.2
Moving mass, without lifting	kg	2.8	7.4
Moving mass, additional length	kg/m	2.4	4.5
Basic mass moment of inertia, based on the drive shaft, without lifting	$kgcm^2$	52.4	302.8
Additional mass moment of inertia, based on the drive shaft	$\frac{kgcm^2}{m}$	49.2	202.3

Table 2-1: Technical data of HTR axle

2.1 Permissible loading of the rollers for vertical axle construction

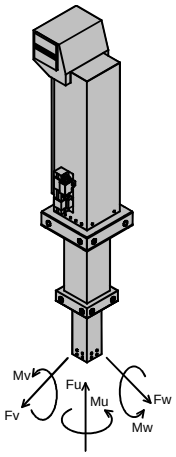
Approach/retract speed (V_u) [m/s]	0 - 2	2-3	3-4	4-5
Maximum permissible roller load [N]				
HTR50	210	170	145	125
HTR80	388	316	268	232

Table 2- 2: Maximum permissible roller load in relation to HTR speed

An additional safety factor of 1.5 must be taken into account with the given values! If it is unavoidable that this safety factor may be undershot, please contact HAUSER.

Technical data, as of 10/98, safety based on S=1, different technical data on request. The data applies for a temperature range from -10°C to + 40°C.

1) calculated value, take into account telescope ratio 1:2



The total load on a single roller is calculated using the superposition principle from the sum of all resultant forces (F_{Roller}, → see Diagrams 2-1 to 2-3). I.e. the sum of all resultant forces ($F_{TotalRoller}$) must be smaller that the maximum permissible roller load (→ Table 2- 2). Meaning:

$$F_{TotalRoller} = F_{Roller}\,(F_{av}) + F_{Roller}\,(F_v) + F_{Roller}\,(M_w) + F_{Roller}\,(M_u)$$

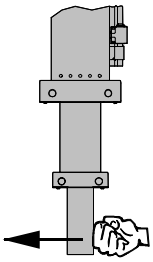
Equation 2-1a: Composition of the total roller load (direction 1)

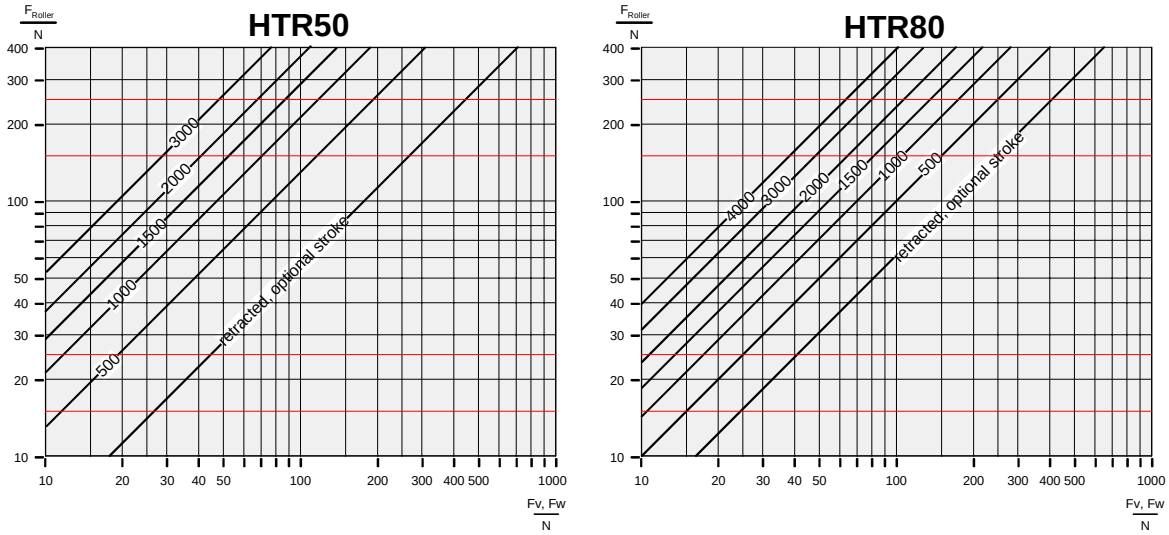
$$F_{TotalRoller} = F_{Roller}\,(F_{aw}) + F_{Roller}\,(F_w) + F_{Roller}\,(M_v) + F_{Roller}\,(M_u)$$

Equation 2-1b: Composition of the total roller load (direction 2)

Dimensioning is based on the higher value from equation 2-1a or 2-1b!

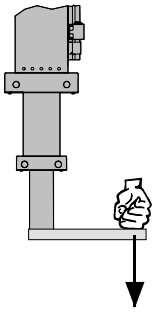
2.1.1 Roller load based on static side load (F_v; F_w)

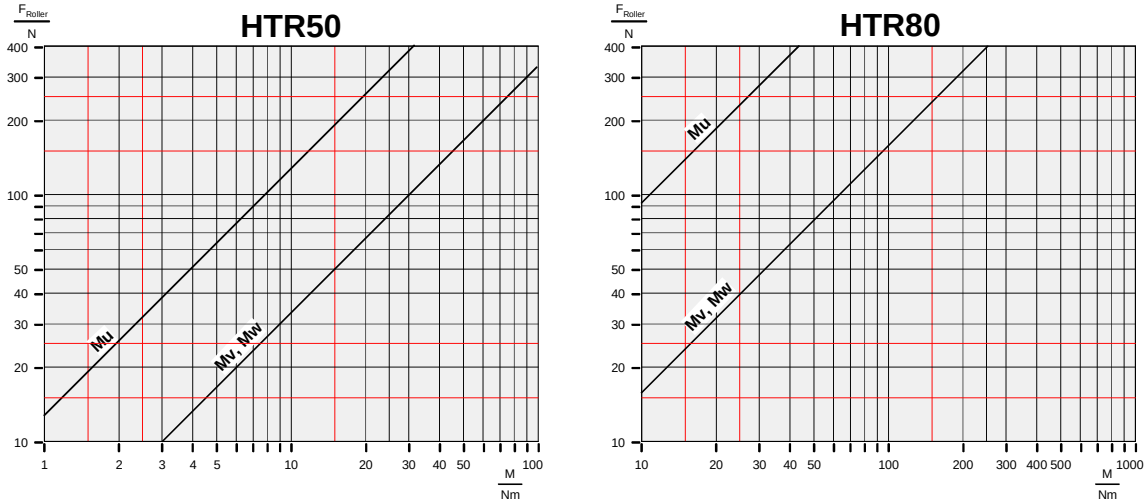




Dia. 2-1: Resultant force F_{Roller} based on F_v or F_w. Vertical installation position. Each of the curves 500 - 4000 denotes a telescope with that stroke [mm], fully extended. Safety taken into consideration S=1.

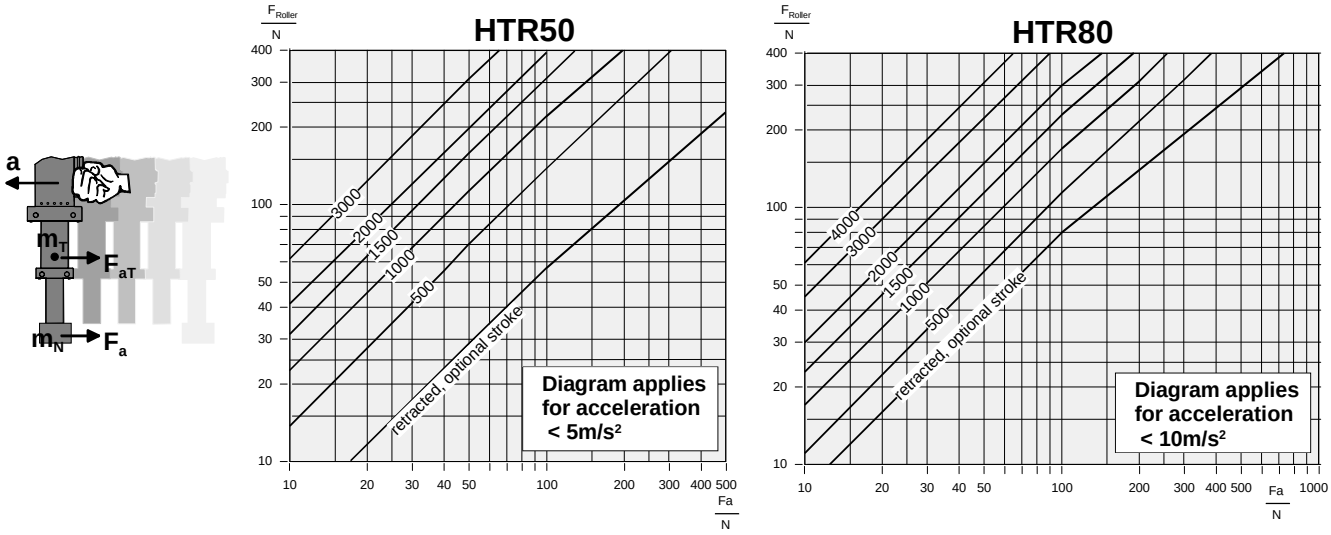
2.1.2 Roller load based on existing torque (M_u; M_v; M_w)





Dia. 2-2: Resultant force F_{Roller} based on M_u or M_v or M_w. Vertical installation position. Safety-factor taken into consideration S=1.

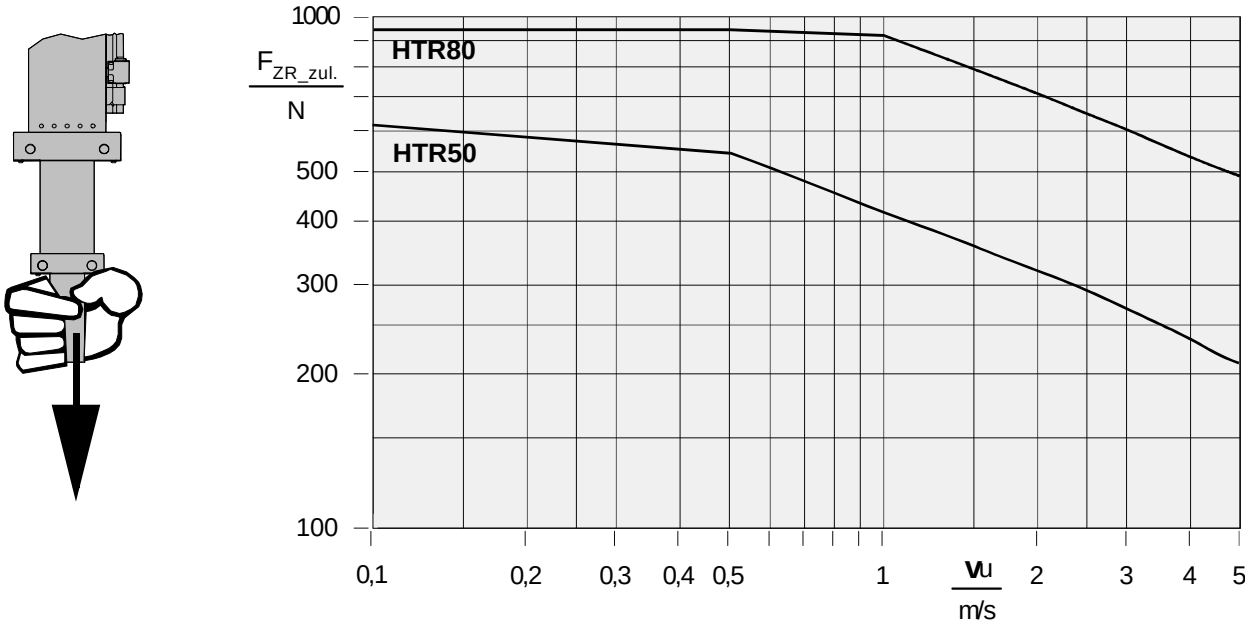
2.1.3 Roller load based on dynamic side load (Fa)



Dia. 2-3: Resultant force F_{Roller} based on dynamic side loads. The diagram already takes into account the own mass of the moving telescope sections (m_T). Each of the curves 500 - 4000 is based on a telescope with this stroke [mm], fully extended. Safety taken into consideration S=1.

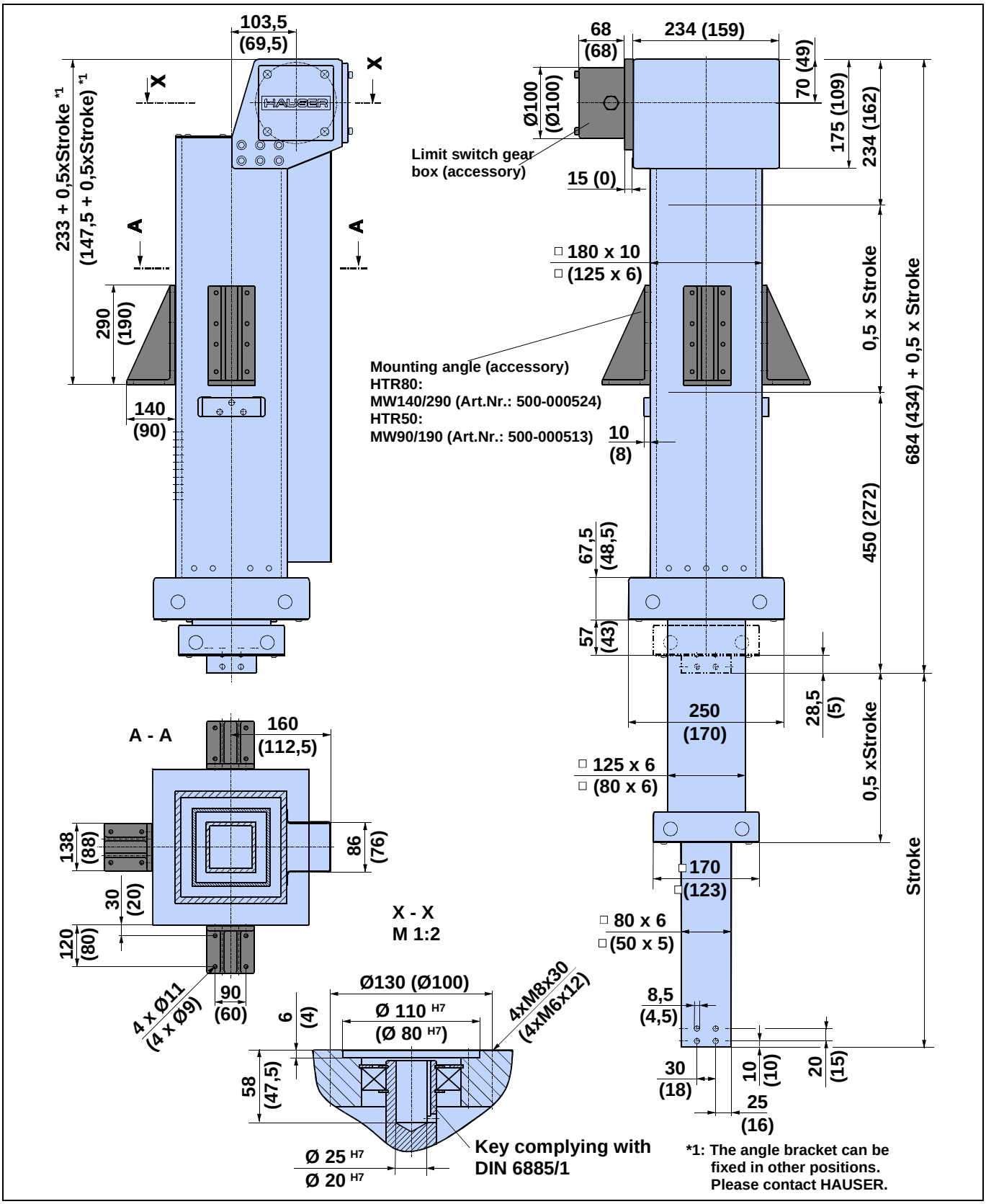
$F_a = m_N \bullet a$ (m_N = Mass of the working load moved in kg; a = Horizontal acceleration of the HTR with working load in m/s^2)

2.2 Permissible toothed belt load



Dia. 2-4: Maximum permissible belt tensile force dependent on the traversing speed of the HTR. Installation position vertical, stroke as required between 0 - 4000 mm, acceleration < 5 m/s^2.

2.3 Construction dimensions HTR80 (HTR50)

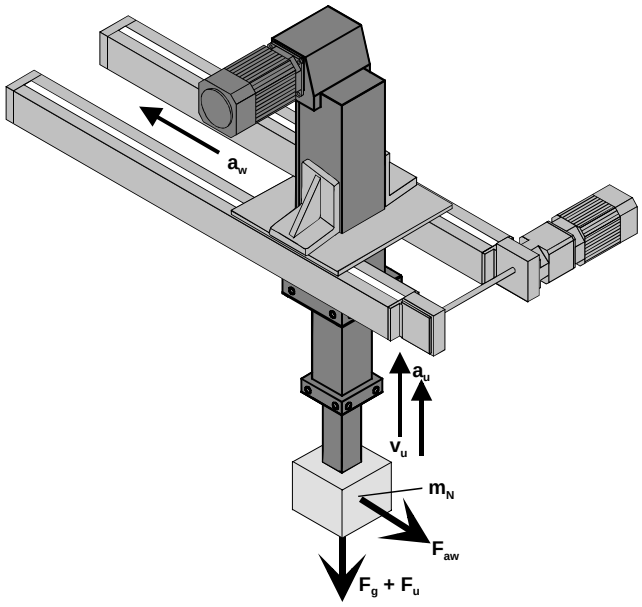


Dimensions in ( ): HTR50

2.4 Application examples for the diagrams

2.4.1 Application example 1. Working load centred below the HTR80

This shows the moment that occurs during the greatest axle loading: HTR fully extended, acceleration of working load upwards and simultaneous acceleration of the HTR in the horizontal direction.



Equation symbols used:

- m_N = Mass of working load [kg]
- v_u = Approach speed of the HTR [m/s]
- a_u = Maximum acceleration while HTR is approaching [m/s^2]
- F_u = Inertia force on the HTR produced by acceleration and mass [N]. $F_u = m_N \bullet a_u$
- F_g = Gravity based loading of the HTR [N]
- a_w = Maximum acceleration while HTR is travelling [m/s^2]
- F_{aw} = Inertia force on the HTR produced by acceleration and mass [N]. $F_w = m_N \bullet a_w$
- g = Acceleration due to gravity (9.81 m/s^2)

Required results:

Mass of working load on the HTR:	m_N = 36.5 kg
Maximum stroke of the HTR:	Stroke = 1000 mm
Approach speed of the HTR:	v_u = 3 m/s
Acceleration during approach of HTR:	a_u = 3 m/s^2
Horizontal acceleration of the total system (HTR + working load):	a_w = 4.5 m/s^2

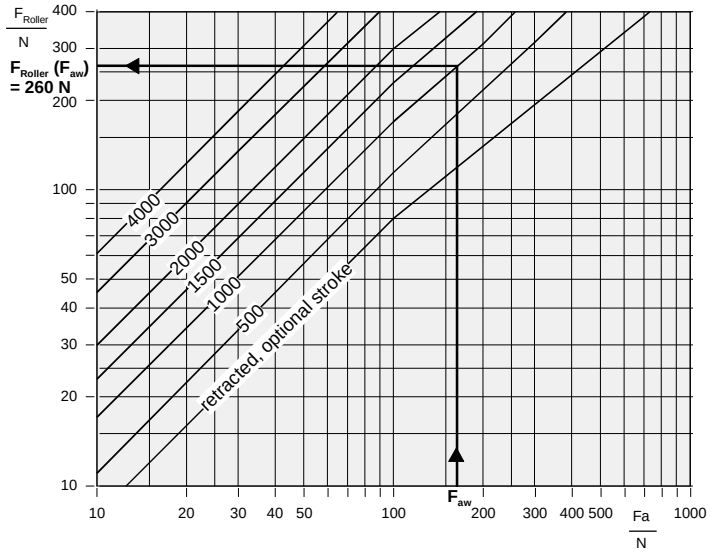
2.4.1.1 Determine roller loading:

Step 1: Calculate resulting forces:

$F_{aw} = m_N \bullet a_w = 36.5\ kg \bullet 4.5\ m/s^2 = 164\ N$

$F_v, F_{av}, F_w, M_u, M_v, M_w = 0$

Step 2: Determine resultant forces with the help of the diagrams:



From diagram 2-3:

F_{Roller} (F_{aw}) = 260N

From equation 2-1b:

$F_{TotalRoller} = F_{Roller}$ (F_{aw}) = 260N

From Table 2- 2:

$F_{RollerPerm.}$ (v_u = 3 m/s) = 316N

Safety factor:

$F_{RollerPerm.} / F_{TotalRoller}$

= 316N / 260 N = 1.2.

Step 3: Back-calculate to permissible output value

The safety factor obtained is too low at 1.2! It should be at least 1.5. To achieve this, there are three possibilities:

a) Reduce acceleration a_w;

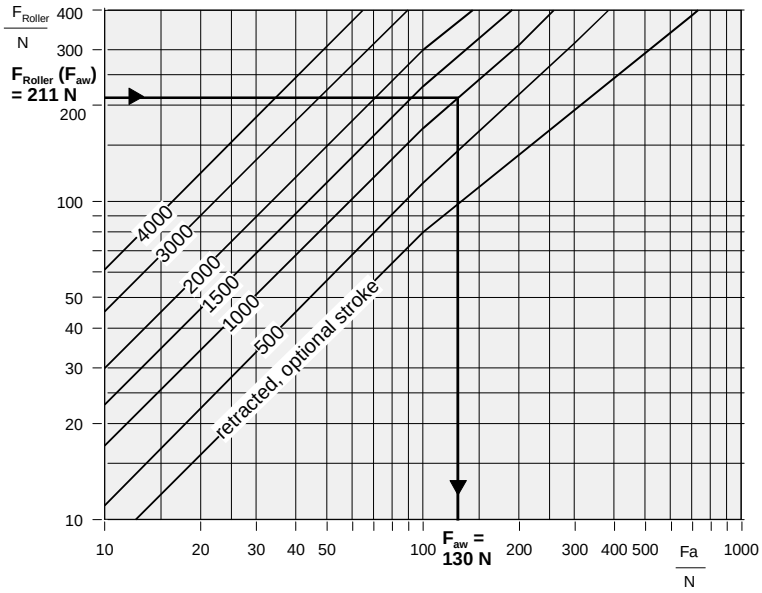
b) Reduce working load

c) First fully approach the HTR and then accelerate horizontally.

The following is calculated using possibility a) to determine how large a_w maximum can be:

From $F_{RollerPerm.} / F_{TotalRoller} = 1.5$:

$F_{TotalRoller} = F_{RollerPerm.} / 1.5 = 316\ N / 1.5 = 211\ N$



From diagram 2-3:

$F_{aw} = 130N$

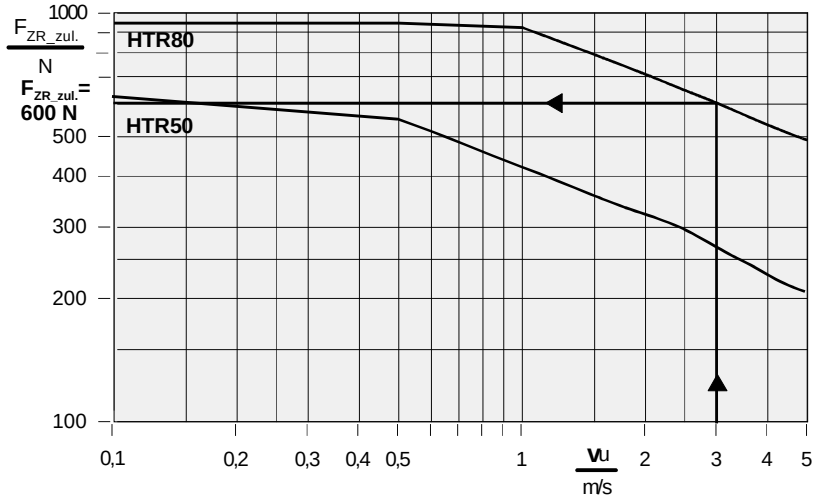
From $F_{aw} = m_N \bullet a_w$:

$a_w = F_{aw} / m_N$

$a_w = 130\ N / 36.5\ kg = 3.6\ m/s^2$

2.4.1.2 Determine toothed belt load:

Step 1: Determine maximum permissible toothed belt load at the required approach speed:



From diagram 2-4:

$F_{TB\_per} = 600\ N$

The safety factor of minimum 1.5 must also be taken into account here:

$F_{TB\_max.} = F_{TB\_per} / S$

$F_{TB\_max} = 600N / 1.5 = 400N$

Step 2: Determine maximum possible vertical acceleration:

The toothed belt load is composed of:

$F_g + F_u = m_N \bullet g + m_N \bullet a_u$

From $F_g + F_u = F_{TB\_max}$:

$a_u = (F_{TB\_max} - m_N \bullet g) / m_N$

$a_u = (400N - 36.5\ kg \bullet 9.81\ m/s^2) / 36.5\ kg$

$a_u = 1.1\ m/s^2$

The maximum possible vertical acceleration is less than required (required: $a_u = 3\ m/s^2$). To increase this value, there are two possibilities:

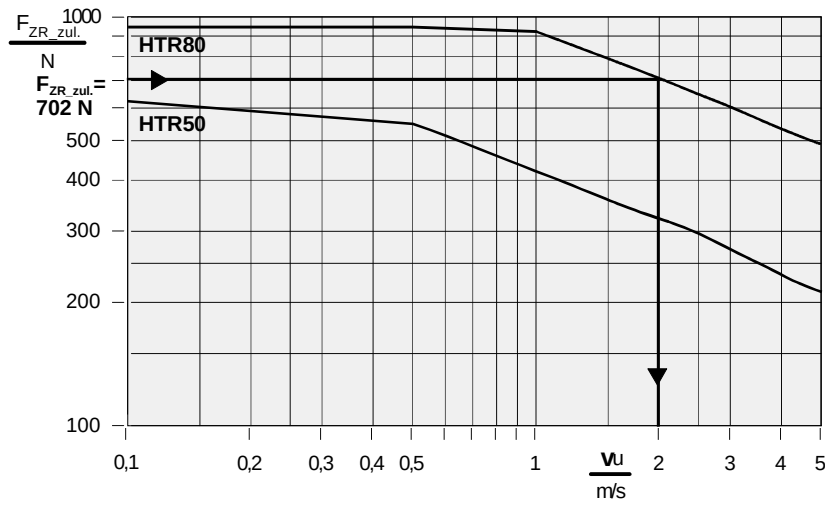
a) Reduce approach speed;

b) Reduce working load

The following is calculated using possibility a) to determine how large v_u maximum can be:

$F_{TB\_max} = m_N \bullet g + m_N \bullet a_u = 36.5\ kg \bullet 9.81\ m/s^2 + 36.5\ kg \bullet 3\ m/s^2 = 468\ N$

$F_{TB\_per} = F_{TB\_max} \bullet S = 468\ N \bullet 1.5 = 702\ N$



From diagram 2-4:

v_{u_max} = 2 m/s

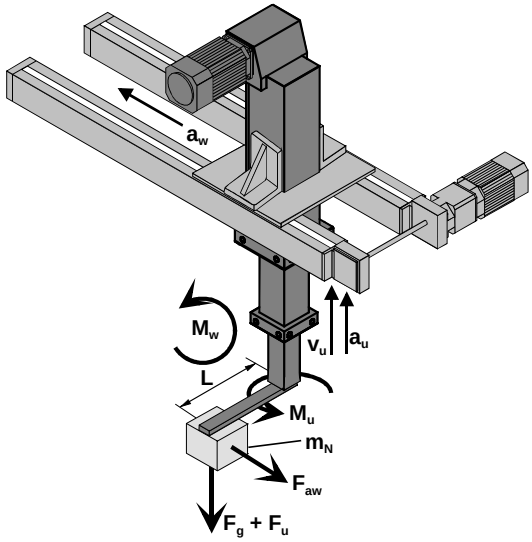
When v_u is reduced to 2 m/s, the permissible roller loading increases from 316 N to 388 N (→ Table 2- 2) - the original required horizontal acceleration of $a_w = 4.5\ m/s^2$ is then permissible.

Total result, Example 1:

The required performance ratings are achievable if the approach speed of the telescope (v_u) is reduced from 3 m/s to 2 m/s!

2.4.2 Application example 2. Working load eccentric below the HTR80

This shows the moment that occurs during the greatest axle loading: HTR fully extended, acceleration of working load upwards and simultaneous acceleration of the HTR in the horizontal direction.



Equation symbols used:

- m_N = Mass of working load [kg]
- v_u = Approach speed of the HTR [m/s]
- a_u = Maximum acceleration while HTR is approaching [m/s^2]
- F_u = Inertia force on the HTR produced by acceleration and mass [N]. $F_u = m_N \bullet a_u$
- F_g = Gravity based loading of the HTR [N]
- a_w = Maximum acceleration while HTR is travelling [m/s^2]
- F_{aw} = Inertia force on the HTR produced by acceleration and mass [N]. $F_w = m_N \bullet a_w$
- g = Acceleration due to gravity (9.81 m/s^2)
- L = Lever arm for centre of mass of outer load

Required results:

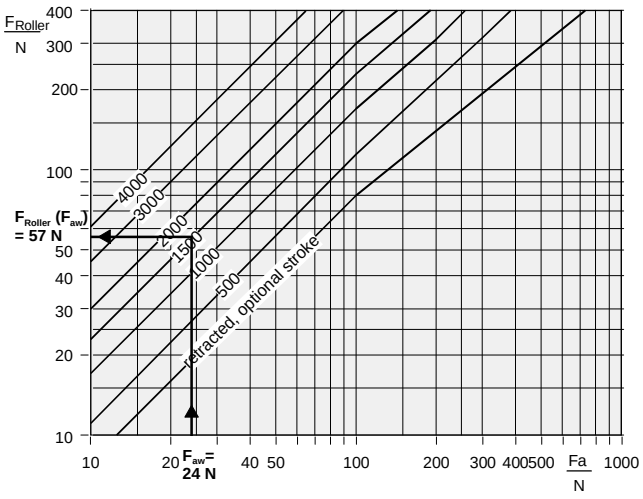
Mass of working load on HTR:	m_N = 12 kg
Maximum stroke of HTR:	Stroke = 1500 mm
Approach speed of HTR:	v_u = 3.5 m/s
Acceleration during approach of HTR:	a_u = 3 m/s^2
Horizontal acceleration of the total system (HTR + working load):	a_w = 2 m/s^2
Lever arm for centre of mass of outer load:	L = 0.4 m

2.4.2.1 Determine roller loading:

Step 1: Calculate resulting forces:

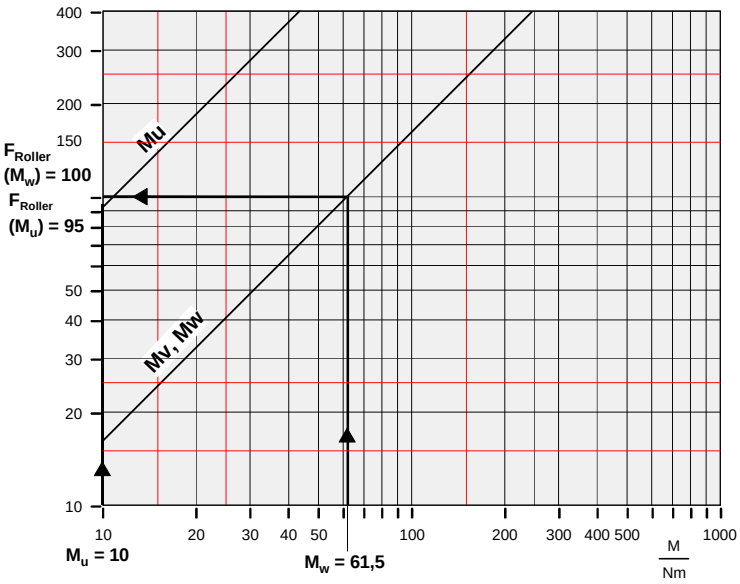
$F_{aw} = m_N \bullet a_w = 12\ kg \bullet 2\ m/s^2 = 24\ N$
$F_g + F_u = m_N \bullet g + m_N \bullet a_u = 12\ kg \bullet 9.81\ m/s^2 + 12\ kg \bullet 3\ m/s^2 = 153.7\ N$
$M_u = F_{aw} \bullet L = 24\ N \bullet 0.4\ m = 10\ Nm$
$M_w = (F_g + F_u) \bullet L = 153.7\ N \bullet 0.4\ m = 61.5\ Nm$
$F_v, F_{av}, F_w, M_v = 0$

Step 2: Determine resultant forces with the help of the diagrams:



From diagram 2-3:

F_{Roller} (F_{aw}) = 57N



From diagram 2-2:

F_{Roller} (M_u) = 95 N

F_{Roller} (M_w) = 100 N

From equation 2-1a: $F_{TotalRollera} = F_{Roller}$ (F_{av}) + F_{Roller} (F_v) + F_{Roller} (M_w) + F_{Roller} (M_u):

$F_{TotalRollera}$ = 0 N + 0 N + 100 N + 95 N = 195 N

From equation 2-1b: $F_{TotalRollerb} = F_{Roller}$ (F_{aw}) + F_{Roller} (F_w) + F_{Roller} (M_v) + F_{Roller} (M_u):

$F_{TotalRollerb}$ = 57 N + 0 N + 0 N + 95 N = 152 N

The higher roller total load results from equation 2-1a.

From Table 2- 2:

$F_{RollerPerm.}$ (v_u = 3.5 m/s) = 268N

Safety factor:

$F_{RollerPerm.}$ / $F_{TotalRollera}$ = 268N / 195 N = 1.37.

Step 3: Back-calculate to permissible output value

The safety factor obtained is too low at 1.37! It should be at least 1.5. To achieve this, there are four possibilities:

a) Reduce acceleration a_w and/or acceleration a_u.

b) Reduce working load

c) Reduce lever arm

d) First fully approach the HTR and then accelerate horizontally.

The following is calculated using possibility a) to determine how large a_w maximum can be:

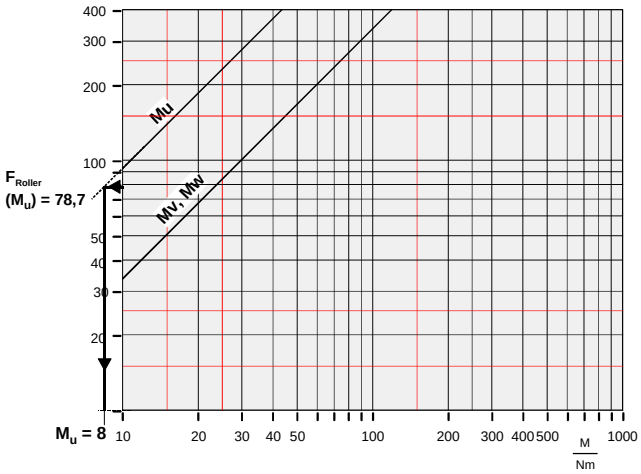
From $F_{RollerPerm.}$ / $F_{TotalRoller}$ = 1.5:

$F_{TotalRollera}$ = $F_{RollerPerm.}$ / 1.5 = 268 N / 1.5 = 178.7 N

From equation 2-1a: $F_{TotalRollera} = F_{Roller}$ (F_{av}) + F_{Roller} (F_v) + F_{Roller} (M_w) + F_{Roller} (M_u):

F_{Roller} (M_u) = $F_{TotalRollera}$ - F_{Roller} (F_{av}) - F_{Roller} (F_v) - F_{Roller} (M_w)

F_{Roller} (M_u) = 178.7 N - 0 N - 0 N - 100 N = 78.7 N



From diagram 2-2:

M_u (F_{Roller}) = 8 Nm

From M_u = F_{aw} • L:

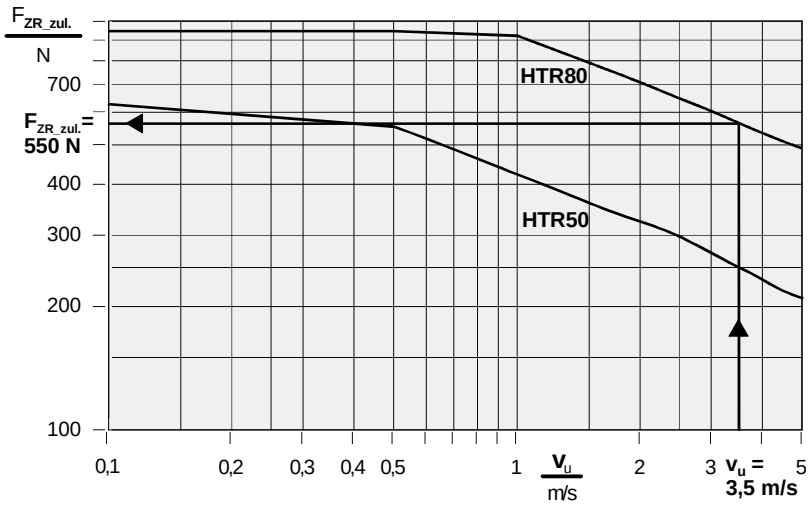
$F_{aw} = M_u / L = 8 Nm / 0.4 m = 20 N$

From $F_{aw} = m_N • a_w$:

$\underline{a_w} = F_{aw} / m_N = 20 N / 12 kg = \underline{1.7 m/s^2}$

2.4.2.2 Determine toothed belt load:

Step 1: Determine maximum permissible toothed belt load at the required approach speed:



From diagram 2-4:

F_{TB_per} = 550 N

The safety factor of minimum 1.5 must also be taken into account here:

$F_{TB\_max.} = F_{TB\_per} / S$

F_{TB_max} = 550N / 1.5 = 367N

Step 2: Determine maximum possible vertical acceleration:

The toothed belt load is composed of:

$F_g + F_u = m_N • g + m_N • a_u$

From $F_g + F_u = F_{TB\_max}$:

$a_u = (F_{TB\_max} - m_N • g) / m_N$

$a_u = (367N - 12 kg • 9.81 m/s^2) / 12 kg$

$a_u = 20.8 m/s^2$

The maximum possible vertical acceleration for the toothed belt is theoretically 20.8 m/s^2. It must be noted however that diagram 2-4 only applies up to an acceleration of 10 m/s^2. Based on the resulting roller loading, a_u must not exceed 3 m/s^2.

Total result, Example 2:

The required performance ratings are achievable if the horizontal acceleration (a_w) is reduced from 2 m/s^2 to 1.7 m/s^2!

3 Safety

3.1 Correct use

The HTR is used for many purposes, including:

positioning, transporting, feeding, removing, palletting, loading, unloading, handling and manipulating workpieces or tools.

As it can be used in the most widely differing areas, the responsibility for use in specific purposes is handed over to the user.

The user must ensure that when mounting workpieces or tools on the load attachment of the HTR, that personnel and/or property cannot be injured or damaged.

The HTR may only be used in areas which are not accessible by personnel during operation.

Where the HTR is used in areas accessible to personnel, it must be installed in such a way that personnel are not endangered during operation.

The HTR must not be driven against the limit damper (Block). For prevention, our safety limit switches or limit switch gears can be installed.

Note that for vertical installation, the rotors can fall downwards if the belt breaks.

If the HTR has been driven up to the block, the axle must not be operated. Notify our Service Department immediately:

Parker Hannifin GmbH
EMD-Hauser, Germany
Service Department
☎ +49-(0)781 / 509-381

3.2 Identification of other dangers and danger areas

If other dangers still exist for personnel or property despite the structurally secure application of the HTR, the user must indicate these other dangers by means of signs and written behaviour regulations.

The safety instructions given in these operating instructions are summarised in Table 3.1.

	**Danger;** means that death, serious physical injury or damage to property may occur unless prevented by corresponding safety measures.
	**Caution;** means that physical injury or damage to property may occur unless prevented by corresponding safety measures.
	**Note;** important information which must be observed regarding the product, the operation of the product or the relevant section of the manual.

Table 3.1: Safety symbols and their significance

3.3 General dangers in the event of non-observance of the safety notices

The machine components are built according to the state of the art and is safe in use. Dangers may, however, be generated by the machine if it is used by personnel who are not trained or at least instructed, or is used incorrectly or for purposes other than those intended.
As a consequence, there may be a risk of:

- ☞ Danger to life and limb of the user or a third party
- ☞ Damage to the machine and the user's other property

When installing the HTR in a machine plant, the safety instructions given in these operating instructions must be sensibly integrated with those in the machine plant operating instructions.

3.4 Safe working practices

3.4.1 Observe the notes

The notes in these operating instructions and shutdown procedures must be observed in all work relating to the installation, start-up, setting up, operation, modifications to conditions of use and methods of operation, maintenance, inspections and repair.

3.4.2 Operating personnel

The following work should only be carried out by trained and authorised personnel.

- ☞ Assembly and calibration work on the HTR
- ☞ Installation of safety limit switches
- ☞ Installation of the drives and testing the direction of rotation

3.5 Safety instructions for the user company

Management must be familiar with the whole of Chapter "Safety" and the necessary operations on the HTR.

Management must ensure that the Chapter "Safety" and the descriptionsof the appropriate operations are read, understood and complied with by the assembly and operating personnel.

The HTR must only be operated when in faultless condition.

3.6 Safety instructions for the operating personnel

Refrain from any method of working which is prejudicial to the safety of the HTR.

The operating or supervisory personnel are obliged to inspect the HTR or the machine plant at least once per shift for outerly detectable damage and defects, any changes detected (including the operating performance) which could affect safety must be reported immediately.

Components and accessories have been specially designed for the product. Only use our original parts when purchasing replacement parts and wearing parts. We would like to make you expressly aware that genuine parts and accessories not supplied by us have also not been checked and released by us. The installation and/or use of such products can therefore, under certain circumstances, have a negative effect on the constructional characteristics of the machine and thus affect active and/or passive operating safety.

We accept no liability as manufacturers for damages arising through the use of non-genuine parts and accessories.

On no account may any safety fixtures be removed or put out of operation.

Protective fixtures may not be made ineffective or circumvented.

The relevant requirements and national accident-prevention regulations are always to be complied with when installing and operating our mechanical linear units.

3.7 Note regarding special dangers

The HTR must be fixed or supported in accordance with the indications in these operating instructions with the prescribed minimum distances.

Ensure that the movement of the HTR does not result in any danger.

If the HTR moves in danger areas, these areas can be secured with safety limit switches.

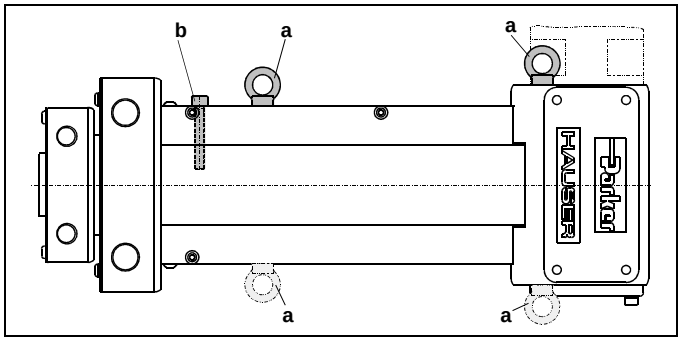
3.8 Unauthorised conversions or modifications are forbidden

The HTR may not be altered structurally or safety-wise without our express authorisation. Any unauthorised alteration of this sort excludes any liability on our part.

3.9 Transport

STOP **Danger**	When transporting components, never move under the suspended load. This can be fatal!

Before transportation, secure axle against independent extension. Block the axle with a bolt (b).
Only use transport equipment with adequate lifting capacity. When using ropes, ensure that these are not twisted or knotted. If several ropes are used, all should be under equal tension.
The HTR housing is fitted with eyebolts or threaded holes suitable for eyebolts for attaching transportation ropes (HTR80: M10; HTR50: M6).



Key:

a: Threaded hole transportation eyebolts

b: Axle extension safety bolt

Fig. 3-1: Transporting the HTR

Safety instructions

4 Assembly

4.1 General remarks

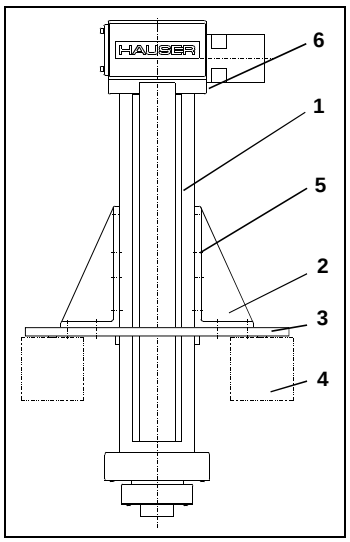
The HTR standard axle is always fully assembled and delivered mechanically operational.

If no HAUSER drive is provided, fit your motor-gear combination according to the applicable manufacturer's instructions.

The installation position of the HTR is always vertical, unless specially designed otherwise.

Attention! The HTR may only be fitted / removed by specialists.

4.2 Assembly on the flange plate



Key:

1. HTR
2. Assembly angle bracket
3. Flange plate
4. Robot system (for example, two HAUSER linear units)
5. Threaded holes (HTR80: M10; HTR50: M6)
6. Threaded holes (for eyebolts to „suspend" the axle HTR80: M10; HTR50: M6)

The HTR is fixed by at least 2 assembly angle brackets (2) and a flange plate suitable for the current application purposes.

The HTR standard axle is fitted for this purpose on three sides respectively with 8 (HTR50) or 10 (HTR80) threaded holes M10x10 (HTR80) or M6x6 (HTR50). Pos. 5

Fig. 4-1: Flange plate assembly

☞ Fix the flange plate where present in your robot system - the flange plate must be fitted so that the axle can be inserted without having to remove the lower rotor stations!.

4.2.1 Removal of the rotor station, lower central section

(Pos-Nos. see Figure 4-2, Page 4-3)

only necessary, if the axle with rotor station attached cannot pass through flange plate opening!

☞ Remove outer attachments (Gripper, etc.).

☞ Extend linear axle (min. 50 mm).

☞ Remove the cover plate (295)/[375] of the lower central section of the rotor station by removing the fixing screws (296)/[376].

☞ Mark the position of the tensioning station (44)/[44] against the guide profile of the central section (40)/[40].

The marking ensures that at a later date the toothed belt tension can be reset to the correct level - if it is accidentally changed. (Adjustment, see Chapter 7.3.3)

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50

- ☞ Set screws (61)/[45] must be firmly tightened so that the toothed belt tension does not change.
- ☞ Completely unscrew set screw (58)/[63].
- ☞ Completely unscrew fixing screws (60)/[55].
- ☞ Pull rotor station out of the guide profile central section (40)/[40].

4.2.2 Removal of the rotor station, lower outer section

(Pos-Nos. see Figure 4-2, Page 4-3)

only necessary, if the axle with rotor station attached cannot pass through flange plate opening!

- ☞ Remove the toothed belt cover (14)/[31] from the main drive by unscrewing the fixing screws (23)/[32].
- ☞ Remove the cover plate (215)/[295] of the lower central section of the rotor station by removing the fixing screws (216)/[296].
- ☞ Mark the position of the tensioning station (4)/[600] against the guide profile of the outer section (1)/[1].

The marking ensures that at a later date the toothed belt tension can be reset to the correct level - if it is accidentally changed. (Adjustment, see Chapter 7.3.2)

- ☞ Set screws (26)/[8] must be firmly tightened so that the toothed belt tension does not change.
- ☞ Completely unscrew set screws (27)/[10].
- ☞ Remove fixing screws (25+21)/[4].
- ☞ Pull rotor station out of the guide profile outer section (1)/[1].

4.2.3 Installation of the HTR in the flange plate

- ☞ Attach the assembly angle brackets to the HTR, loosely tighten the screws so that the brackets can still be adjusted.
- ☞ Block the HTR rotors against independent extension using the transportation bolts (see Figure 3-1).
- ☞ Feed the HTR from above into the flange plate and loosely screw on the assembly angle brackets.

STOP Keep the HTR suspended until all fixing screws are firmly tightened!

- ☞ Align the HTR at right angles to the flange plate.
- ☞ Firmly tighten the screws between the HTR <> assembly angle brackets and assembly angle bracket <> flange plate.

4.2.4 Installation of the rotor station, lower outer section

(Pos-Nos. see Figure 4-2, Page 4-3)

- ☞ Carefully insert lower outer section of rotor station over the central section guide profile (40)/[40] into the outer section guide profile (1)/[1].

Insert the rotor station so that the holes for the toothed belt tensioning screws (27)/[10] are on the side of the main drive.

- ☞ Fix the rotor station with fixing screws (21)/[28], e.g. attach to the tension station of the main drive at Pos. (25)/[8] inc. screw locking devices.
- ☞ Fit the set screws (27)/[10] of the main drive.
- ☞ Fit the cover plate (215)/[295].

4.2.5 Intallation of the rotor station, lower central section

(Pos-Nos. see Figure 4-2, Page 4-3)

☞ Carefully insert lower central section of rotor station over the inner section guide profile (80)/[80] into the central section guide profile (40)/[40].

Insert the rotor station so that the holes for the toothed belt tensioning screws (58)/[63] are on the side of the main drive.

☞ Fix rotor station with fixing screws (60)/[55], inc. screw locking devices.

☞ Fit the set screws (58)/[63] of the transmission drive.

☞ Fit the cover plate (295)/[375].

☞ Remove the extension block.

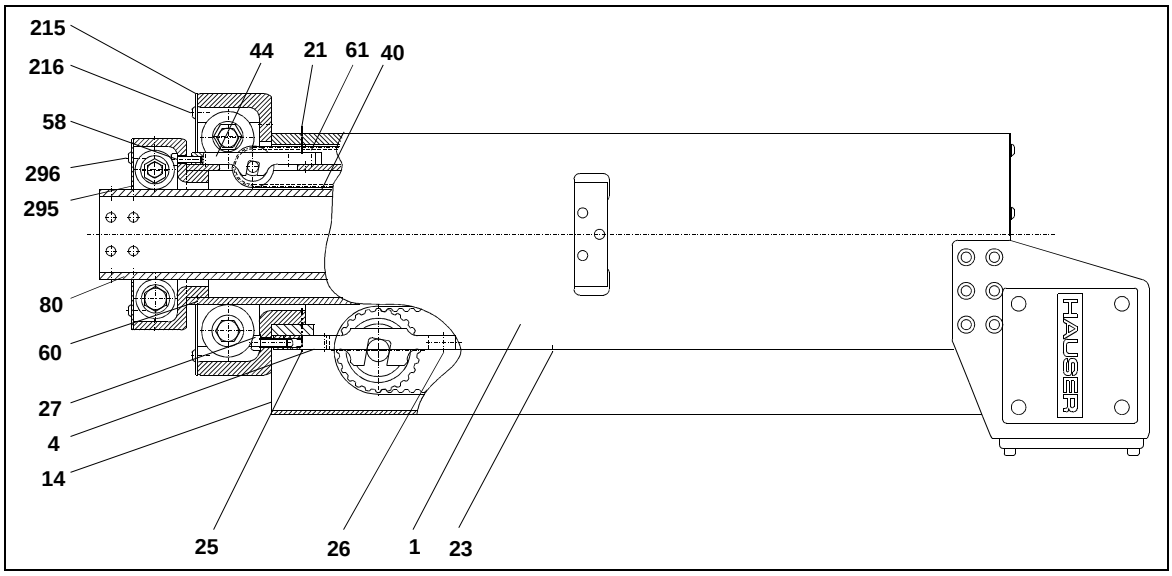


Fig. 4-2: Removal and installation of the rotor station lower central section and outer section. (Pos-Nos. for HTR80)

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50

Assembly

5 Commissioning

5.1 General remarks

The HTR standard axle is always fully assembled and delivered mechanically operational.

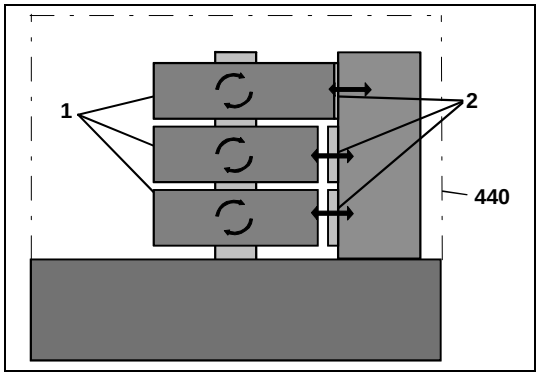
If no HAUSER drive is provided, fit your motor-gear combination according to the applicable manufacturer's instructions.

The installation position of the HTR is always vertical, unless specially designed otherwise.

If, following commissioning, it is noted that the travel range selected is too big or that there are problem edges lying in the regular safety path, Chapter 5.2 shows how to adjust the equipment.

5.2 Setting limit stops

The following working steps are best carried out with the drive switched on. They should therefore only be carried out by trained and authorised personnel. Only move at creep speed (< 2m/min) and - if possible - limit the driving torque. Check that there are no unauthorised people in the danger area



Key:

1: Rotatable control cam
2: Limit switch
440: Housing cover

Fig. 5-1: Principle of the limit switch mechanism

Setting the positive limit stop (Retracted condition)

- ☞ Check that the travel path of the axle is free.
- ☞ Remove the cover from the limit switch mechanism (440)
- ☞ Set linear axle to machine datum.
- ☞ In manual mode, carefully travel up against the positive limit stop (fully retracted).
- ☞ If the linear axle is in contact with the mechanical limit stop and the positive limit stop is not recognised: Rotate the control cam against the limit switch for the positive limit stop until this is activated.
- ☞ If the linear axle recognises the positive limit stop too early, rotate the control cam away from the limit switch and repeat the process described above until the required end position is reached.

Setting the negative limit stop (Extended condition)

- ☞ In manual mode, carefully travel up against the negative limit stop (fully extended).
- ☞ If the linear axle is in contact with the mechanical limit stop and the negative limit stop has not been recognised, rotate the control cam against the limit switch for the negative limit stop until this is activated.
- ☞ If the linear axle recognises the negative limit stop too early, rotate the control cam **away** from the limit switch and repeat the process described above until the required end position is reached.

- ☞ Fit the cover of the limit switch mechanism (440)
- ☞ Set linear axle to machine datum.
- ☞ Where possible, set the software limit stops (see commissioning instructions for the installed position controller).

6 Maintenance

- ☞ After commissioning as well as every 6 months, check the rotor play, toothed belt tension, positioning and wear. (see maintenance schedule, below)
- ☞ In addition, depending on the level of contamination, all relevant components (guides, rotors, tension station, drive station) should be cleaned in rotation.
- ☞ With high levels of contamination (e.g. drilling chips, etc.) the HTR must be fitted with a cover (e.g.: concertina walls, protective plate between gripper/tool and HTR).

Maintenance schedule:

What	Action	Description
Rotors / Rollers	**Check rotor play**: Rock the lower and central HTR profile sections manually - there should not be any play.	**Chapter 7.4** Setting and adjusting rollers.
Toothed belt	**Check positioning (alignment):** The toothed belt must always run to the opposite flanged wheel when travel is reversed, i.e. it must always travel from right to left.	**Chapter 7.3.3.4 and 7.3.4.3** Align toothed belts on the main and transmission drives.
	Check pre-tension: Press the toothed belt in the centre. The belt must be tautly tensioned when loaded and unloaded.	**Chapter 7.3.3.3 and 7.3.4.2** Tensioning toothed belts of the main and transmission drives.
	Check wear: Evaluate wear of the toothed belt by a visual check.	**Chapter 7.3.3.2 and 7.3.4.1** Replace the toothed belts of the main and transmission drives if there is abnormal wear.

Causes of abnormal toothed belt wear

Certain wear appearances can have various causes, so a clear cause is often difficult to determine. The following table shows possible causes in typical faults:

Error type	Cause	Removal
Abnormal wear on the loaded tooth profiles of the belt	Incorrect belt tension Overload	Adjust pre-tension correctly Check whether the load is within the permitted range.
Abnormal wear in the tooth gullet of the belt	Pre-tension too great Drive torque too high	Reduce pre-tension Check the drive dimensioning
Abnormal wear on the side profiles of the belt	Incorrect toothed belt orientation Edge of the roller/tooth lock washer deformed	Align toothed belt Change the roller/tooth lock washer
Belt teeth sheared off	Pre-tension too low Overload (by collision)	Adjust pre-tension

Error type	Cause	Removal
Cracks on the belt teeth	Incorrect belt tension	Adjust pre-tension correctly
	Overload	Check whether the load is within the permitted range.
	Ageing of the belt material	Replace belt
Toothed belt break	Incorrect belt tension	Adjust pre-tension correctly
	Overload	Check whether the load is within the permitted range.
Toothed belt material softening	Operating temperature too high	Lower operating temperature
	Contact with solvents	Do not clean the belt using solvents
Gearing jumping, loss of machine datum point	Pre-tension too low	Adjust pre-tension correctly

7 Repairs

Help with problems

Parker Hannifin GmbH
EMD-Hauser, Germany
Mechanical Division
Service Department
☎ +49 (0)781 / 509-381

7.1 Safety instructions

Switch main switch to '0' and secure against re-start by means of a padlock before maintenance and repair work.
Particular caution is advised if the machine must be ready for operation during certain repair tasks: Make sure that there is no possibility of persons staying in the danger area; if necessary, secure against unauthorized persons by additional barriers or fences.

Repairs may only be carried out by engineers or by HAUSER personnel.

Work on the electrical equipment must only be carried out by engineers qualified for this task; the relevant requirements shall be observed (IEC..., EN..., national accident prevention regulations)

Where it is necessary to dismantle safety devices during set up, repair and maintenance work, the safety devices must be refitted immediately on conclusion of the work. The machine must be disabled before disassembly.

7.2 General remarks

☞ For optimal working conditions (easier access) and for personal safety, it is recommended that the HTR is completely removed, i.e. removal of all attachments and dismount the telescopic axle from the robot system!

Incorrect repairs will invalidate any claim against HAUSER under the guarantee. Screw locking devices must be used for all screw connections. Old safety plates must be replaced after several applications. If safety plates are not available use a suitable adhesive (e.g. Loctite 243).

7.3 Toothed belts

7.3.1 General remarks regarding toothed belts

☞ Unpack new toothed belts immediately. They must be stored, laid out in a circle, at room temperature in dry rooms.

☞ Toothed belts must not be kinked.

☞ The distribution of toothed belts and synchronizing disks must coincide.

☞ Long-term temperatures of a maximum of 80° C are permitted. In the short term, the temperature can reach 120° C.

☞ The drives must be protected from dust, dirt, hot water and steam as well as acids and lyes.

☞ The pre-tension must be adapted to the operating loads, but must not exceed the maximum permissible tensile force (→ Table 7-1).

7.3.2 Tensioning toothed belts, guidelines

Note:	The toothed belt tension must be adapted to the operating loads, but must not exceed the maximum permissible tension values given in Table 7-1.

The toothed belt tension is based on the force being transmitted by the toothed belt Fu ($Fu = F_{static} + F_{dynamic}$).

To avoid the toothed belt coming off, the toothed belt tension (operating tension) must lie approx. 10% above the force Fu being transmitted.

In the case of new or old slackened toothed belts, the pre-tension will reduce by about 20% a short time after first being tensioned. Therefore, on tensioning the belt, a tension must be set which is 1.25 times greater than the operating tension. This tension is defined in Table 7-1 as the tension to be set.

If the tension of a toothed belt, in operation for over a week, is less than 0.9 x operating tension, then the toothed belt tension must be increased to 1.1 x operating tension.

HTR	Toothed belt pre-tension for		Default values all in [N]			
			Fu_{max}	Tension to be set		Operating tension
			max. force transmitted by toothed belt	new/ old slackened belts	After tensioning	adjusts with time
80	**Main drive**	**unloaded**	---	1500	1320	1200
		loaded	---	500	440	400
	Transmission drive	**unloaded**	---	656	578	525
		loaded	700	219	193	175
50	**Main drive**	**unloaded**	---	731	644	585
		loaded	---	244	215	195
	Transmission drive	**unloaded**	---	310	273	248
		loaded	330	104	91,3	83

Table 7-1: Toothed belt tension of the HTR with vertical installation

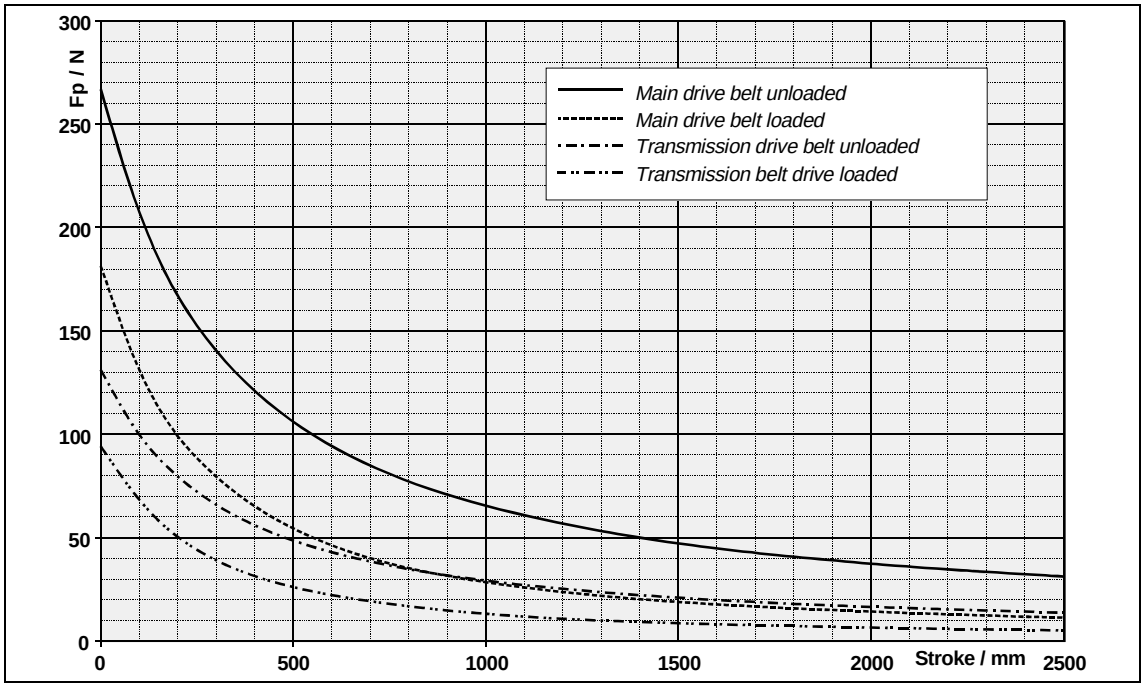


Diagram 7-1: Test force for vertically installed HTR80 toothed belt tension, fully extended for 10 mm depth of impression

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50

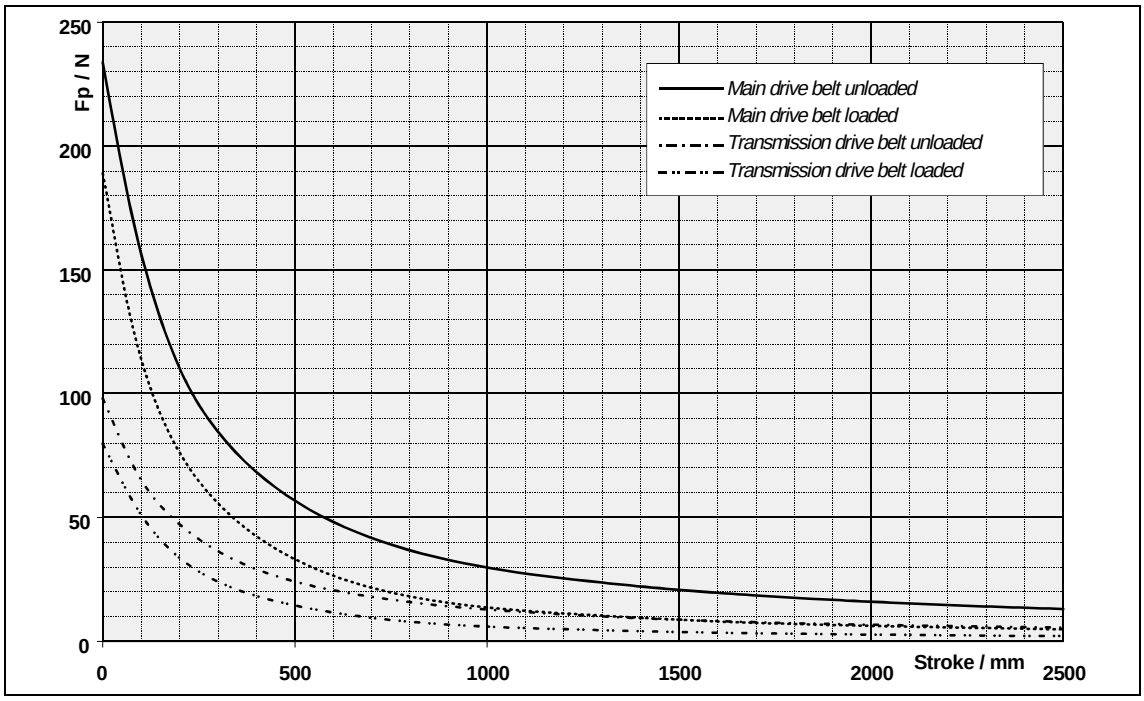


Diagram 7-2: Test force for vertically installed HTR50 toothed belt tension, fully extended for 8 mm depth of impression

7.3.2.1 Toothed belt tension, measurement

The following measuring procedure is currently the only way to measure the toothed belt tension at the required tolerance of +/- 5% .

Belt tension measuring device RSM

The belt tension measuring device RSM determines, with known data (specifically belt mass, free running belt length) and belt oscillation frequency, the current belt tension .
The belt tension measuring device can be obtained through HAUSER (Art. No. 037- 000200).

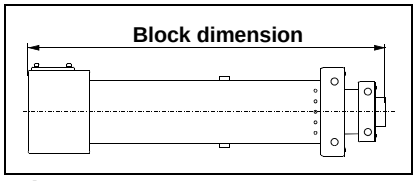
( ): Position numbers for HTR80; [ ]: Position numbers for HTR50

7.3.3 Replacing, tensioning and aligning the main drive toothed belt

7.3.3.1 Determine axle stroke

Many HTR parameters, such as toothed belt length, dimensions and weights, are dependent on the stroke. These parameters will recur frequently in the following equations.

The stroke of a axle can be measured from its block dimension. To do this, fully retract the axle carefully and slowly (up to the inner limit stops).



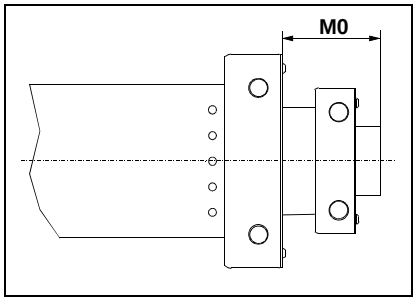
The block dimension is the total length of the retracted telescope.

Fig. 7-1: Determine HTR block dimension

HTR80: Stroke = 2•Block dim. [mm] - 1368 mm / **HTR50:** Stroke = 2•Block dim. [mm] - 870 mm

Equation 7-1: Calculate HTR stroke

7.3.3.2 Replace main drive toothed belts

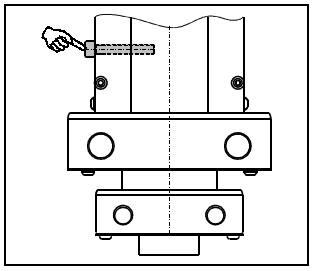


- ☞ Remove outer attachments (Gripper, etc.).
- ☞ If possible; position linear axle on the machine datum and record this point by marking or measuring the distance from the lower outer section of the M0 rotor station to the gripper / lower end of the inner section guide profile.

Marking or recording the machine datum point facilitates subsequent commissioning.

Figure 7-2: Mark machine datum

- ☞ If possible; extend linear axle (min. 50 mm)
- ☞ If present; switch off drive and secure against accidental start-up.
- ☞ Remove outer attachments (Gripper, etc.).

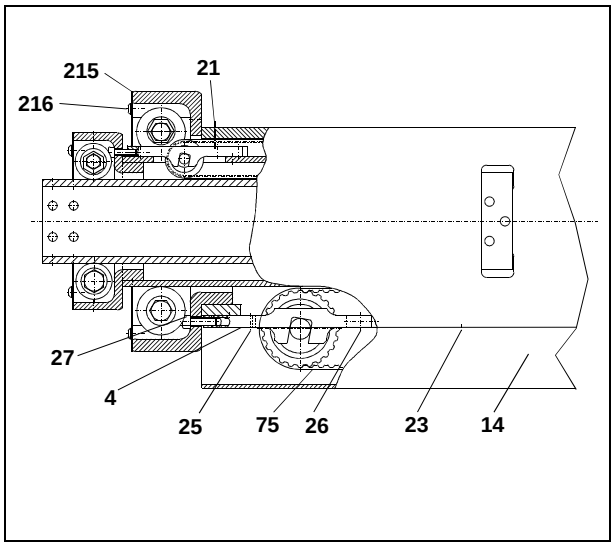


- ☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP

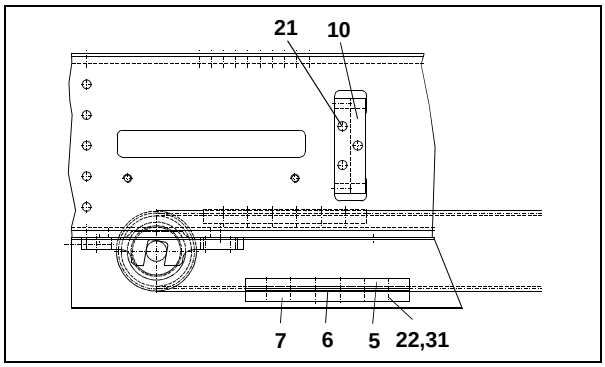
Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

Figure 7-3: Block telescope



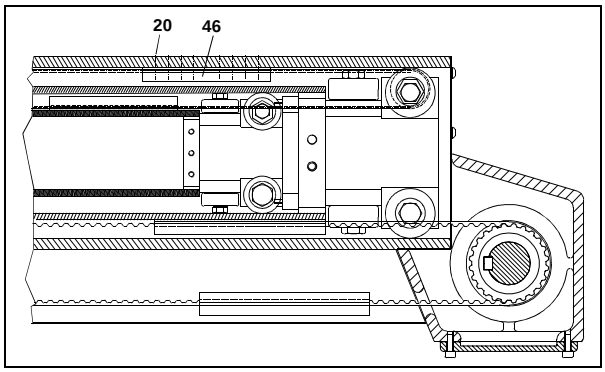
- ☞ Remove the toothed belt covers (14)/[31] from the main drive by unscrewing the fixing screws (23)/[32].
- ☞ Remove the cover plate (215)/[295] of the lower central section of the rotor station by removing the fixing screws (216)/[296].
- ☞ Unscrew set screws (25+26)/[8] on the belt tensioner outer section (4)/[600].
- ☞ Slacken off main drive toothed belt (75)/[65] by rotating the set screw (27)/[10] anticlockwise, ( ).
- ☞ Unscrew fixing screws (25)/[4] and let down the lower rotor station outer section until it reaches the lower rotor station central section.

Figure 7-4: Slacken the main drive toothed belt (Pos. No. for HTR80)



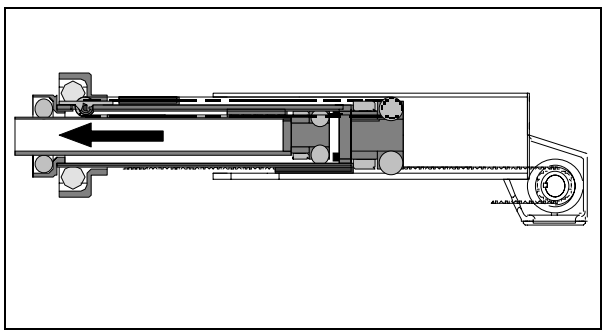
- ☞ Open sealing piece (5-7)/[16-18] on the main drive toothed belt (75)/[65] by removing the set screws (22)/[19].
- ☞ Remove the mechanical limit stop (10)/[26] by removing the fixing screws (21)/[28].
- ☞ Remove set screws (25+26-Fig. 7-4)/[8] and belt tensioner outer section.

Figure 7-5: Remove toothed belt sealing piece and mechanical limit stop (Pos. No. for HTR80)



- ☞ Undo adjustment device (46)/[58] (sealing piece for transmission drive) of the guide profile inner section by removing the fixing screws (20)/[4].

Figure 7-6: Undo transmission drive - outer housing section connection. (Pos-Nos. for HTR80)



- ☞ Carefully remove auxilliary structure and slowly remove the complete central section telescope from the outer section guide profile.
- The mass of the part removed is: (General equation) (Determine stroke: Chapter 7.3.3.1)

HTR80: m~15 *kg + 9 *kg/per metre stroke
HTR50: m~7 *kg + 3 *kg/per metre stroke

Equation 7-2: Complete central section mass

Figure 7-7: Remove telescope central section and inner section

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50

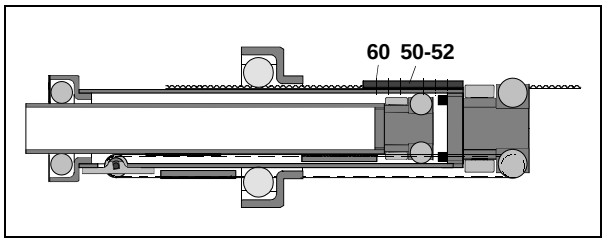


Figure 7-8: Remove old toothed belt (Pos. Nos. for HTR80)

- ☞ Place complete telescope central section - with the main drive upwards - on suitable, level blocks.
- ☞ Open the clamping piece of the main drive (50-52)/[68-70] by removing the set screws (60)/[71].
- ☞ Remove old gear belt.

☞ Cut new toothed belt to the correct length.

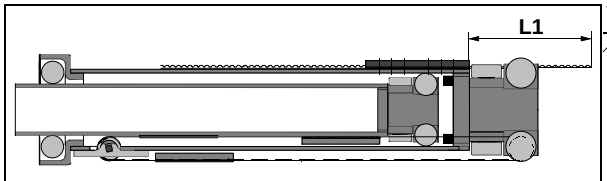
Find the correct length l from the piece list. General equation:

HTR80: l = 980 + stroke; **HTR50:** l = 620 + stroke

Equation 7-3: Toothed belt length

(Determine stroke: Chapter 7.3.3.1)

Simple method:
Lay old and new toothed belt together and use the length to cut the new belt. If the old belt is torn or stretched, count the number of teeth and use this number to cut the new belt.



HTR80: L1 = 500 + 0.5 * stroke
HTR50: L1 = 326 + 0.5 * stroke

Equation 7-4: Toothed belt excess length L1 (Determine stroke: Chapter 7.3.3.1)

Figure 7-9: Toothed belt installation

The toothed belt must be mounted with the excess length L1 for correct installation.
If the toothed belt is incorrectly mounted, the sealing piece may knock against the drive housing or belt tensioner and damage important functional parts of the HTR.

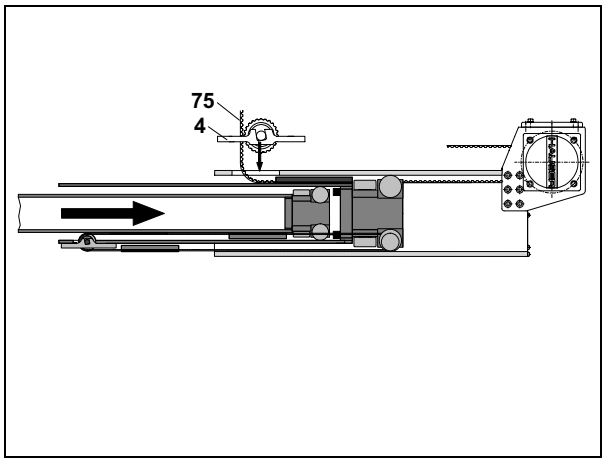


Figure 7-10: Insert telescope central section into the housing (Pos. Nos. for HTR80)

- ☞ Position the guide profile outer section opening for the belt tensioner of the main drive belt facing upwards on level blocks.
- ☞ Insert the telescope central section and transmission drive belt from below into the guide profile outer section. Feed the main drive belt (75)/[65] up out through the guide profile outer section or through the opening for the belt tensioner (4)/[600].
- ☞ Loosely tighten the belt tensioner outer section (4)/[600] with set screws (25+26 - Figure 7-4)[8]

- ☞ Replace lower rotor station outer section on the profile outer section and screw tight.
- ☞ Prevent linear axle from extending (→ Figure 7-3).
- ☞ Close sealing piece of the main drive belt (5-7)/[16-18] using screws (22)/[19] (Pos. Nos. Fig. 7-5).
- ☞ Fit mechanical limit stop (10)/[26]
- ☞ Insert set screws (27)/[10] of the main drive and pre-tension toothed belt by rotating the set screws clockwise (↻), as described in the operating instructions (→ Page 7-7: Tension main drive toothed belt).

The pre-tension must be adapted to the loading.
General guideline: **Toothed belt tension >= maximum operating force**
Unnecessarily high pre-tension only puts pressure on the bearings and other components. Too high pre-tension can cause damage to the mechanics!

- ☞ Fit cover plate (215)/[295] (→ Figure 7-4).
- ☞ Fit the toothed belt cover (14)/[31] of the main drive using screws (23)/[32].
- ☞ Fit gears (→ Page 7-30)
- ☞ Fit motor (→ Page 7-31)
- ☞ Remove auxilliary structures.
- ☞ Fit attachments
- ☞ Set machine datum (see operating manual of the controller being used)

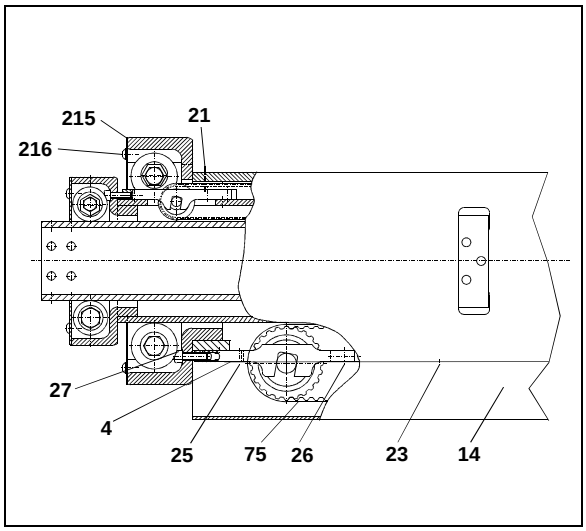
7.3.3.3 Tension main drive toothed belt

The diagrams 7-1 and 7-2, Page 7-2 are only applicable for vertical hoist positions. The toothed belts can be lightly pre-tensioned during assembly of the axle in the horizontal position. If the axle is then positioned vertically: readjust tension!

- ☞ Move linear axle up to 50 mm in the upper end position.
- ☞ Remove cover plate (14)/[31] (→ Figure 7-4) by undoing the fixing screws.
- ☞ Press centre of toothed belt using the test force (→ Diagram 7-1 or 7-2) and determine depth of impression. The tension is correct, when the depth of impression is 10 mm for the HTR80 or 8 mm for the HTR50.
- ☞ When the depth of impression or tension is not correct:
- ☞ Unscrew cover plate (215)/[295] (→ Figure 7-4) and displace until the screw, Pos. (27)/[10], can be reached.
- ☞ Undo the fixing screws (25+26)/[8] (→ Figure 7-4) until the belt tensioner (4)/[600] can be straightened out.
- ☞ Depth of impression too big ==> tension too low: Tension toothed belt by tightening the set screw (27)/[10].
- ☞ Depth of impression too low ==> tension too high: Slacken toothed belt by releasing the set screw (27)/[10].
- ☞ Checking the pre-tension or depth of impression
- ☞ Tighten or slacken tension until the tension or depth of impression (→ Table 7-1, Diagram 7-1 or 7-2) is correct.
- ☞ Clamp down belt tensioner by tightening the fixing screws (25+26)/[8].

7.3.3.4 Aligning main drive toothed belts

Precise alignment is only possible while the telescopic axle is travelling. The toothed belt must always run to the opposite flanged wheel when travel is reversed, i.e. when correctly adjusted it must always travel from left to right.

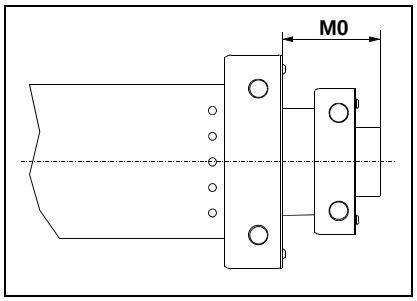


- ☞ Remove the toothed belt covers (14)/[31] by unscrewing the fixing screws (23)/[32].
- ☞ Remove the cover plate (215)/[295] by removing the fixing screws (216)/[296].
- ☞ Undo the fixing screws (25 + 26)/[8] until the belt tensioner (4)/[600] can be moved in a straight line.
- ☞ Carefully undo set screw (27)/[10] on the side that the toothed belt continually contacts and rotate anticlockwise ( ) until the toothed belt runs in according to the above definition.
- ☞ Tighten fixing screws (25+26)/[8].
- ☞ Refit cover plate (215)/[295]
- ☞ Refit toothed belt cover (14)/[31]

Figure 7-11: Align the toothed belt of the main drive (Pos. Nos. for HTR80)

7.3.4 Replacing, tensioning and aligning the transmission drive toothed belt

7.3.4.1 Replace transmission drive toothed belt

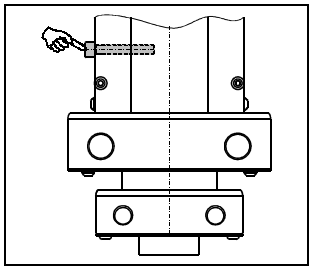


- ☞ Remove outer attachments (Gripper, etc.).
- ☞ If possible; position linear axle on the machine datum and record this point by marking or measuring the distance from the lower outer section of the M0 rotor station to the gripper / lower end of the inner section guide profile.

Marking or recording the machine datum point facilitates subsequent commissioning.

Fig. 7-12: Mark machine datum

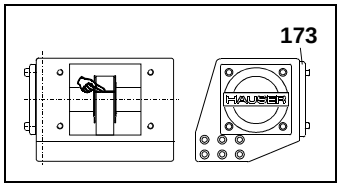
- ☞ If possible; extend linear axle (min. 50 mm)
- ☞ if present; switch off servo drive
- ☞ Remove outer attachments (Gripper, etc.).



- ☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

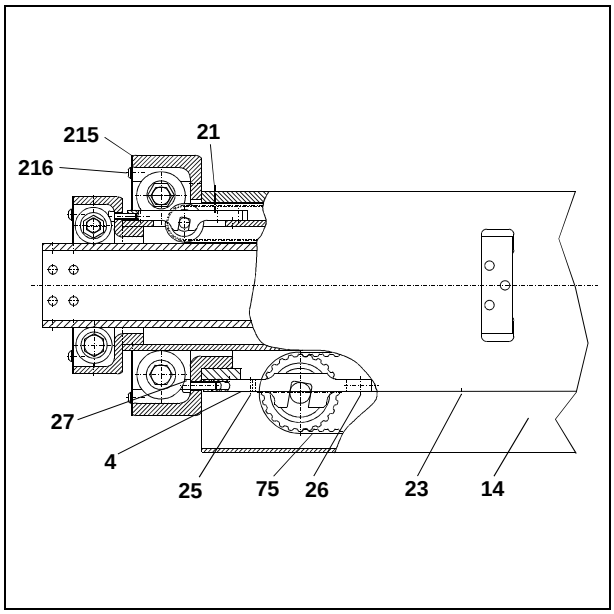
Fig. 7-13: Block telescope



- ☞ Open housing cover (173)/[177] of the drive station

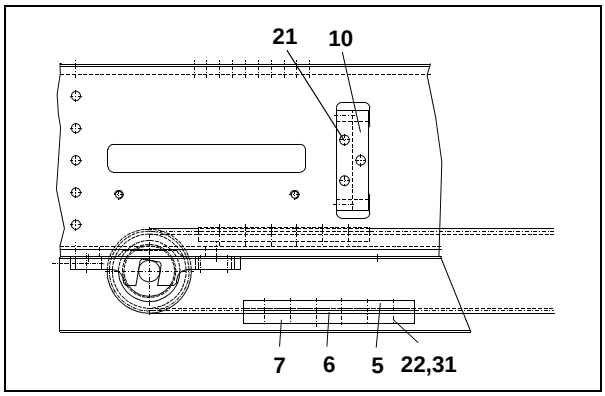
Mark the belt position on the drive plate so that the belt can be correctly re-installed at a later date - this retains the previous settings.

Figure 7-14: Mark toothed belt position on the drive plate (Pos. Nos. for HTR80)



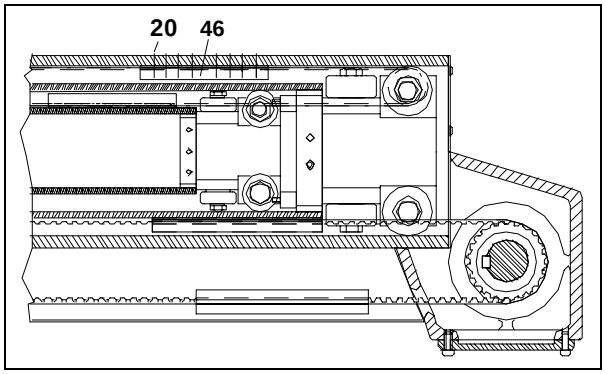
- ☞ Remove the toothed belt covers (14)/[31] by unscrewing the fixing screws (23)/[32].
- ☞ Remove the cover plate (215)/[295] by removing the fixing screws (216)/[296].
- ☞ Mark the position of the belt tensioner (4)/[600] against the guide profile. The marking ensures that at a later date the toothed belt tension can be reset to the correct level.
- ☞ Unscrew set screws (25+26)/[8] on the belt tensioner (4)/[600].
- ☞ Slacken off main drive toothed belt (75)/[65] by rotating the set screw (27)/[10] anticlockwise, ( ).
- ☞ Unscrew fixing screws (25)/[4] and let down the lower rotor station outer section.

Figure 7-15: Slacken the main drive toothed belt (Pos. No. for HTR80)



- ☞ Mark the toothed belt position in the clamping plate
- ☞ Open sealing piece (5-7)/[16-18] on the main drive toothed belt (75)/[65] by removing the set screws (22)/[19].
- ☞ Remove the mechanical limit stop (10)/[26] by removing the fixing screws (21)/[28].
- ☞ Remove set screws (25+26 - see Figure 7-15)/[8] and belt tensioner outer section.

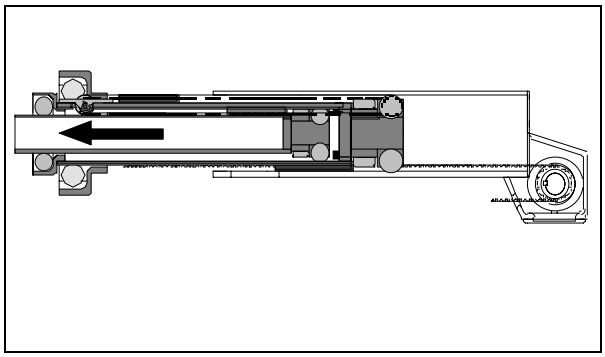
Figure 7-16: Remove toothed belt sealing piece and mechanical limit stop (Pos. No. for HTR80)



- ☞ Undo adjustment device (46)/[58] (sealing piece for transmission drive) of the guide profile inner section by removing the fixing screws (20)/[61].

Figure 7-17: Undo transmission drive - outer housing section connection. (Pos. Nos. for HTR80)

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50



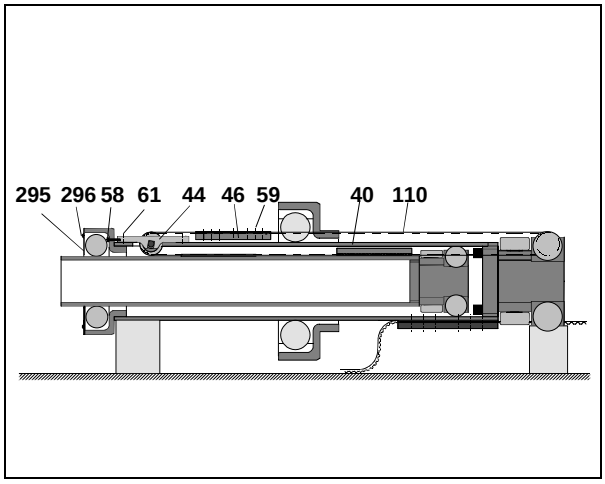
- ☞ Carefully remove auxilliary structure and slowly remove the complete central section telescope from the central section guide profile.

The mass of the part removed is: (General equation) (Determine stroke: Chapter 7.3.3.1)

HTR80: m ≈ 15 *kg + 9 *kg / per metre stroke **HTR50:** m ≈ 7 *kg + 3 *kg / per metre stroke

Equation 7-5: Complete central section mass

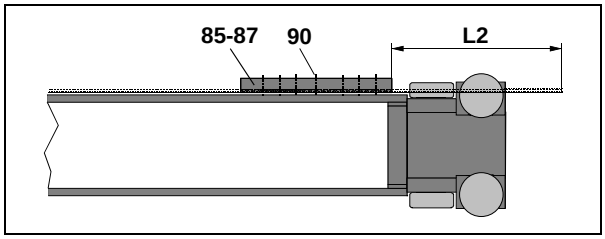
Figure 7-18: Remove telescope central section and inner section



- ☞ Place complete telescope central section on level blocks.
- ☞ Remove the cover plate (295)/[375] by removing the fixing screws (376)/[296].
- ☞ Undo the set screws (61)/[45] until the belt tensioner (44)/[640] can be moved in a straight line.
- ☞ Slacken off transmission drive toothed belt (110)/ [93] by rotating the set screw (58)/[63] anticlockwise, ( ).
- ☞ Open sealing piece (46)/[58] by removing the set screws (59)/[61].
- ☞ Remove belt tensioner (44)/[640] by undoing the set screws (61)/[45]

Figure 7-19: Remove telescope inner section (Pos. Nos. for HTR80)

- ☞ Carefully remove telescope "complete inner section" from the guide profile central section.



- ☞ Place complete telescope inner section on level blocks.
- ☞ Open the clamping piece of the main drive (85-87)/[87-89] by removing the set screws (90)/[90].
- ☞ Remove old gear belt.

Figure 7-20: Remove transmission drive toothed belt (Pos. Nos. for HTR80)

- ☞ Cut new toothed belt to the correct length.

Find the correct length l from the piece list. General equation:

HTR80: l = 865 + stroke; **HTR50:** l = 560 + stroke

Equation 7-6: Transmission drive toothed belt length

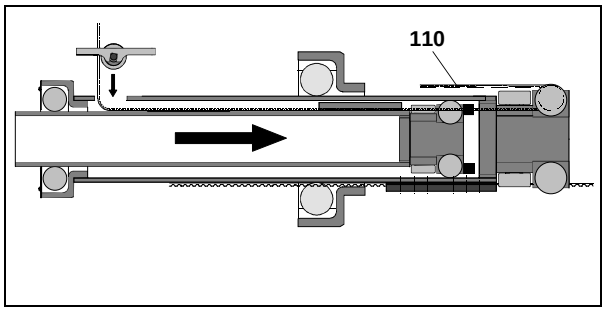
(Determine stroke: Chapter 7.3.3.1)

Simple method:
Lay old and new toothed belt together and use the length to cut the new belt. If the old belt is torn or stretched, count the number of teeth and use this number to cut the new belt (applies to belts with same gauge).

The toothed belt must be mounted with the excess length L2 for correct installation (→ Figure 7-20). If the toothed belt is incorrectly mounted, the sealing piece may knock against the drive housing or belt tensioner and damage important functional parts of the HTR. **General equation:**

HTR80: L2 = 450 + 0.5 * stroke / **HTR50:** L2 = 355 + 0.5 * stroke

Equation 7-7: Excess length L2 for transmission drive toothed belts (Determine stroke: Chapter 7.3.3.1)



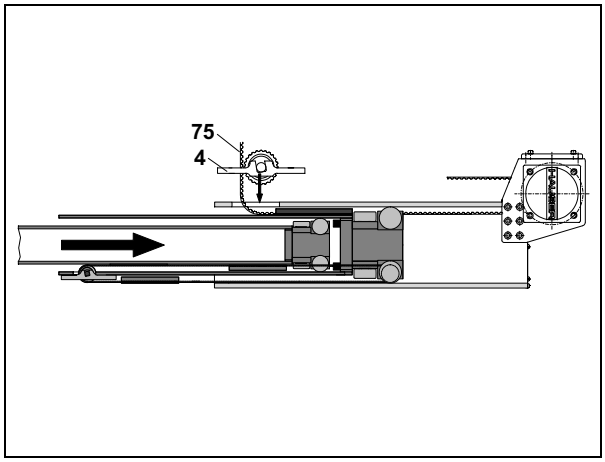
- ☞ Insert complete telescope inner section in the guide profile central section.
- ☞ Feed the toothed belt (110)/[93] up out through the guide profile inner section or through the opening for the belt tensioner.
- ☞ Loosely tighten belt tensioner central section with set screws (61 - Figure 7-19)/[45]

Figure 7-21: Thread in transmission drive toothed belt (Pos. Nos. for HTR80)

- ☞ Close the sealing piece (46)/[58] for the transmission drive belt with screws (59)/[61] (Pos. Nos.: Figure 7-19).
- ☞ Insert set screws (58)/[63] (→ Figure 7-19), of the transmission drive and pre-tension toothed belts by rotating the set screws clockwise ( ), following the marking (see above) or operating instructions (→ Page 7-12).

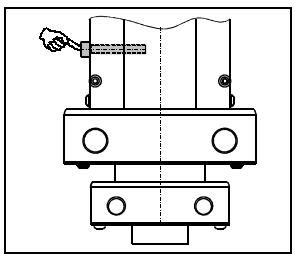
The pre-tension must be adapted to the loading.
General guideline: **Toothed belt tension >= maximum operating force**
Unnecessarily high pre-tension only puts pressure on the bearings and components. Too high pre-tension can cause damage to the mechanics!

- ☞ Fit cover plate (295)/[375] (→ Figure 7-19).



- ☞ Position the guide profile outer section opening for the belt tensioner of the main drive belt facing upwards on level blocks.
- ☞ Insert the telescope central section and transmission drive belt from below into the guide profile outer section. Feed the main drive belt (75)/[65] up out through the guide profile outer section or through the opening for the belt tensioner (4)/[600].
- ☞ Loosely tighten belt tensioner outer section (4)/[600] with set screws (25+26 - Figure 7-15, Page 7-9)/[8]

Figure 7-22: Insert telescope central section into the housing (Pos. Nos. for HTR80)



- ☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP

Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

Figure 7-23: Block telescope

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50

- ☞ Close sealing piece of the main drive belt (5-7)/[16-18] using screws (22)/[19] (Pos. Nos. Figure 716).
- ☞ Refit mechanical limit stop (10)/[26].
- ☞ Insert set screws (27)/[10] (→ Figure 7-15) of the main drive and pre-tension toothed belt by rotating the set screws clockwise ( ) following the marking or operating instructions (see Page 7-7: Tension main drive toothed belt).

The pre-tension must be adapted to the loading.
General guideline: **Toothed belt tension >= maximum operating force**
Unnecessarily high pre-tension only puts pressure on the bearings and othe components. Too high pre-tension can cause damage to the mechanics!

- ☞ Fit cover plate (215)/[295] (→ Figure 7-15).
- ☞ Fit the toothed belt cover (14)/[31] using screws (23)/[32].
- ☞ Close drive station with housing cover (173 - see Figure 7-14)/[177]
- ☞ Fit gears (→ Page 7-31)
- ☞ Fit motor (→ Page 7-31)
- ☞ Remove the extension block.
- ☞ Fit attachments
- ☞ Set machine datum (see operating manual of the controller)

7.3.4.2 Tensioning toothed belts of the transmission drive

The diagrams 7-1 and 7-2, Page 7-2 are only applicable for vertical hoist positions. Th toothed belts can be lightly pre-tensioned during assembly of the axle in the horizonta position. If the axle is then positioned vertically: readjust tension!

- ☞ Move the linear axle to the lower end position (extend).
- ☞ Press toothed belt with the test force (→ Diagram 7-1 or 7-2, Page 7-2) and determine depth of impression. The depth of impression must be 10 mm for the HTR80 or 8 mm for the HTR50.
- ☞ If the depth of impression, and therefore the tension, is incorrect:
- ☞ Remove cover plate (295)/[375] (→ Figure 7-19) or displace until the screw, Pos. (58)/[63], can be reached.
- ☞ Loosen or tighten the fixing screws (61)/[45] (→ Figure 7-19) until the belt tensioner can just be moved.
- ☞ Depth of impression too big ==> tension too low: Tension toothed belt by tightening the set screw (58)/[63].
- ☞ Depth of impression too low ==>tension too high: Tension toothed belt by loosening the set screw (58)/[63].
- ☞ Checking the pre-tension or depth of impression
- ☞ Tighten or slacken tension until the tension or depth of impression is correct.
- ☞ Clamp down belt tensioner by tightening the fixing screws (61)/[45].
- ☞ Fit cover plate (295)/[375].

7.3.4.3 Aligning the transmission drive toothed belts

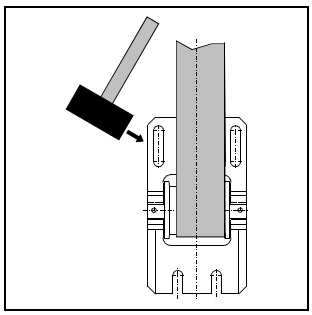
The transmission drive belt is only possible in specific conditions.

Precise alignment is only possible while the telescopic axle is travellin toothed belt must always run to the opposite flanged wheel when travel versed, i.e. when correctly adjusted it must always travel from left to right.

- ☞ Move the linear axle to the lower end position.

☞ Remove the cover plate (295)/[375] of the lower central section of the rotor station by removing the fixing screws (296)/[376].→ Figure 7-19).

☞ Loosen fixing screws (61)/[45].



☞ Carefully move belt tensioner by displacing it from the front side using the bore tolerance (e.g. by lightly tapping with a rubber hammer), always on the opposite side to where the toothed belt touches. Repeat process until the toothed belt runs as defined above.

Fig. 7-24: Aligning toothed belts

☞ Tighten fixing screws (61)/[45].

☞ Fit the cover plate (295)/[375] of the lower central section of the rotor station with the fixing screws (296)/[376].

7.4 Setting and aligning rollers.

7.4.1 Adjusting rollers of the rotor station lower outer section

☞ Extend linear axle (min. 100 mm).

☞ **Check roller action:**

☞ To check the roller action of the rotor station lower outer section from below, unscrew the cover plate (215)/[295] (→ Figure 7-11).

The roller action can only be checked while the telescopic axle is travelling.

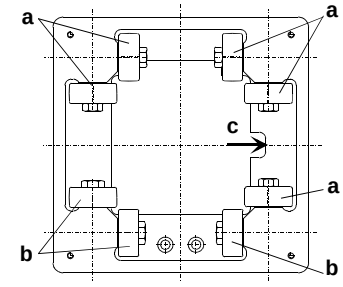
Danger of injury - special care must be taken here! If possible, move the shaft manually (if necessary, remove motor and gears first and position shaft horizontally). If not, then move the shaft in the creep mode using the jog button (Speed < 2m/min).

☞ All rollers must rotate during the movement.

☞ To check the pressure acting against it, prevent the wheels from turning using your index finger; the wheels should be able to be stopped with minimal force.

Jockey wheels which are adjusted too tightly develop pressure marks which lead to running noise. Replace defective rollers (→ Chapter 7.5)

☞ **Adjusting the rollers**



a: Eccentric rollers; **b:** Fixed rollers; **c:** Opening (HTR80)

☞ First adjust the eccentric rollers opposite the two fixed rollers. Do not exceed the maximum permissible screw tightening torque:

Fixed rollers: **HTR80:** 42.3 Nm / **HTR50:** 40.0 Nm
Eccentric rollers: **HTR80:** 26.5 Nm / **HTR50:** 23.1 Nm

☞ Adjust the jockey wheels using the hexagon of the eccentric bush in small steps so that the guide profile / rotors can be easily moved without any play. Lock in position using an Allen key - ensure that the adjusted setting is not changed!

☞ Fit the cover plate (215)/[295].

Fig. 7-25: Rollers of the rotor station lower outer section

7.4.2 Adjusting rollers of the rotor station upper outer section

The central section of the rotor station cannot be adjusted when fitted. Adjustments can only be carried out when the linear shaft is removed and partially disassembled.

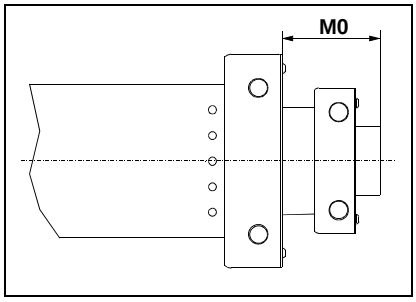


Figure 7-26: Mark machine datum

- ☞ Remove outer attachments (Gripper, etc.).
- ☞ If possible; position linear axle on the machine datum and record this point by marking or measuring the distance from the lower outer section of the M0 rotor station to the gripper / lower end of the inner section guide profile.

Marking or recording the machine datum point facilitates subsequent commissioning.

- ☞ If possible; extend linear axle (min. 50 mm)
- ☞ if present; switch off servo drive
- ☞ Remove outer attachments (Gripper, etc.).

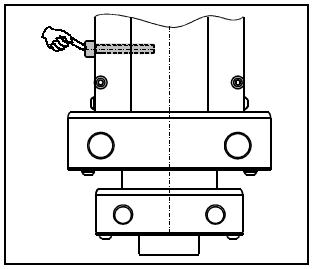


Figure 7-27: Block telescope

- ☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

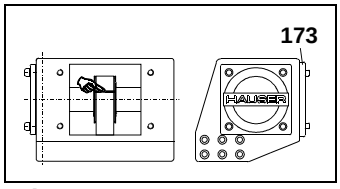
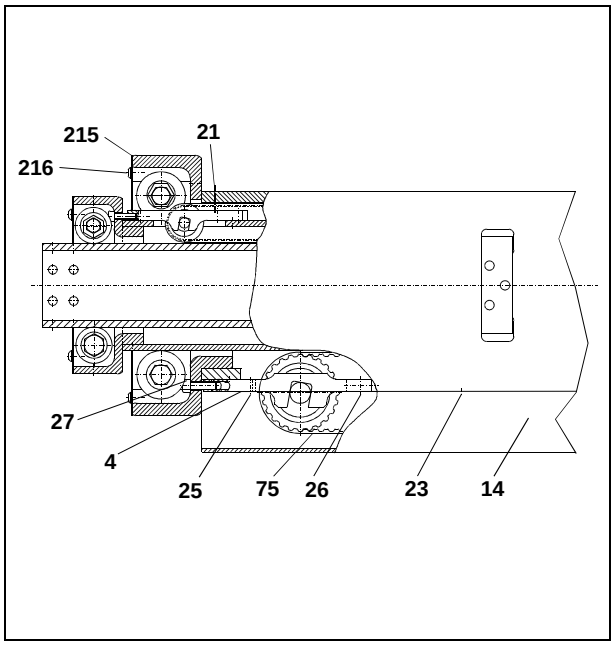


Figure 7-28: Mark toothed belt position on the drive plate (Pos. Nos. for HTR80)

- ☞ Open housing cover (173)/[177] of the drive station

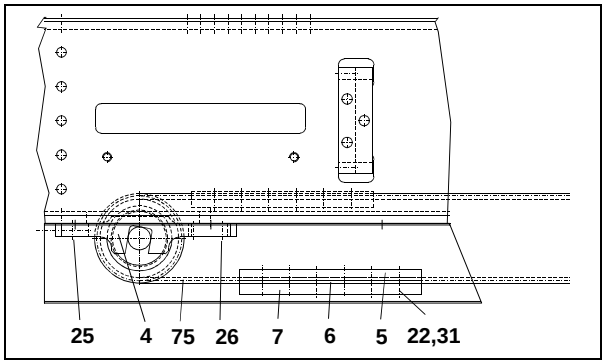
Mark the belt position on the drive plate so that the belt can be correctly re-installed at a later date - this retains the previous settings.

- ☞ Remove motor (→ Page 7-31).
- ☞ Remove the HTR from the robot system
- ☞ Place the HTR on level blocks ensuring that it is accessible from all sides.



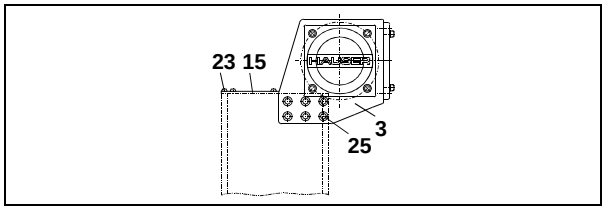
- ☞ Remove the toothed belt cover (14)/[31] from the main drive by unscrewing the fixing screws (23)/[32].
- ☞ Remove the cover plate (215)/[295] of the lower outer section of the rotor station by removing the fixing screws (216)/[296].
- ☞ Mark the toothed belt position in the clamping plate
- ☞ Mark the position of the belt tensioner (4)/[600] against the guide profile. The marking ensures that at a later date the toothed belt tension can be reset to the correct level.
- ☞ Unscrew set screws (25+26)/[8] on the main drive belt tensioner (4)/[600].
- ☞ Slacken off main toothed belt (75)/[65] by rotating the set screws (27)/[10] anticlockwise ( ).

Figure 7-29: Slacken the main drive toothed belt. (Pos. Nos. for HTR80)



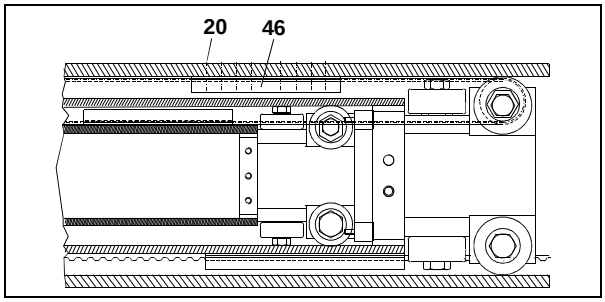
- ☞ Open sealing piece (5-7)/[16-18] on the main drive toothed belt (75)/[65] by removing the set screws (22)/[19].

Figure 7-30: Remove main drive toothed belt and belt tensioner (Pos. Nos. for HTR80)



- ☞ Remove the drive housing (3)/[160] by unscrewing the fixing screws (25)/[4].
- ☞ Remove the cover plate (15)/[22] by unscrewing the screws (23)/[23].

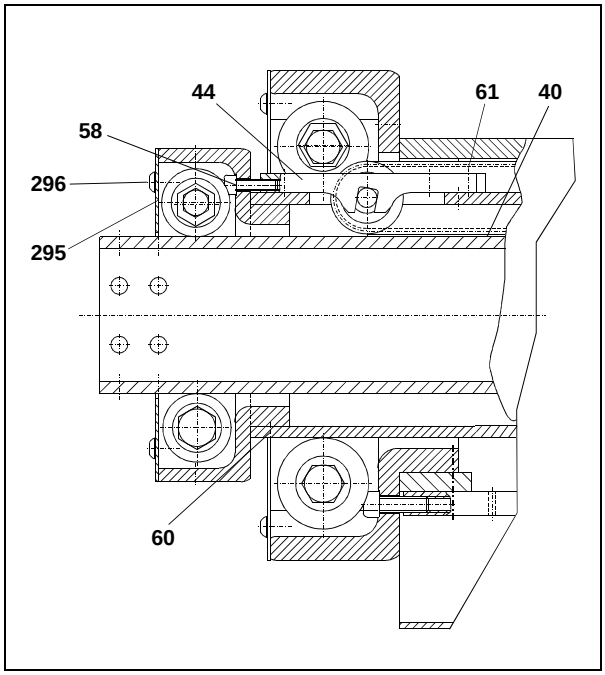
Figure 7-31: Remove drive housing (Pos. Nos. for HTR80)



- ☞ Undo adjustment device (46)/[58] (sealing piece for transmission drive) of the guide profile inner section by removing the screws (20)/[61].

Figure 7-32: Undo transmission drive - outer housing section connection (Pos. Nos. for HTR80)

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50



- ☞ Remove the cover plate (295)/[375] of the lower central section of the rotor station by removing the screws (296)/[376].
- ☞ Mark the position of the belt tensioner (44)/[640] against the guide profile of the central section (40)/[40].

The marking ensures that at a later date the toothed belt tension can be reset to the correct level - if it is accidentally changed. (Adjustment: Chapter 7.3.4, Page 7-8)

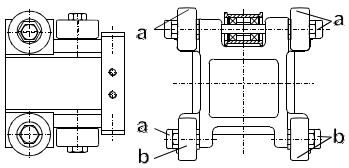
- ☞ Set screws (61)/[45] must be firmly tightened so that the toothed belt tension does not change.
- ☞ Remove set screws (58)/[63].
- ☞ Remove fixing screws (60)/[55].
- ☞ Pull rotor station out of the guide profile central section (40)/[40].

Figure 7-33: Remove rotor station lower central section (Pos. Nos. for HTR80)

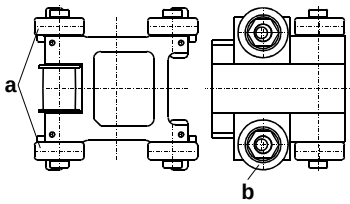
- ☞ To check the roller action of the rotor station upper central section from the drive side, move the complete telescope central section backwards and forwards manually in the guide profile outer section.
- ☞ All rollers must rotate during the movement.
- ☞ To check the pressure acting against it, prevent the wheels from turning using your index finger; the wheels should be able to be stopped with minimal force.

Jockey wheels which are adjusted too tightly develop pressure marks which lead to running noise. Replace defective rollers (→ Chapter 7.5)

☞ **Adjusting the rollers**



HTR80:
a: Eccentric rollers; **b:**Fixed rollers:



HTR50:
a: Eccentric rollers at minimum position; **b:** Eccentric rollers at central position

- ☞ Remove complete telescope central section from the guide profile outer section on the drive side.
- ☞ **HTR80:** First adjust the eccentric rollers opposite the two fixed rollers. **HTR50:** First set the two eccentric rollers a to the minimum position, then the roller b to the central position and leave them as they are. Do not exceed the maximum permissible screw tightening torque:

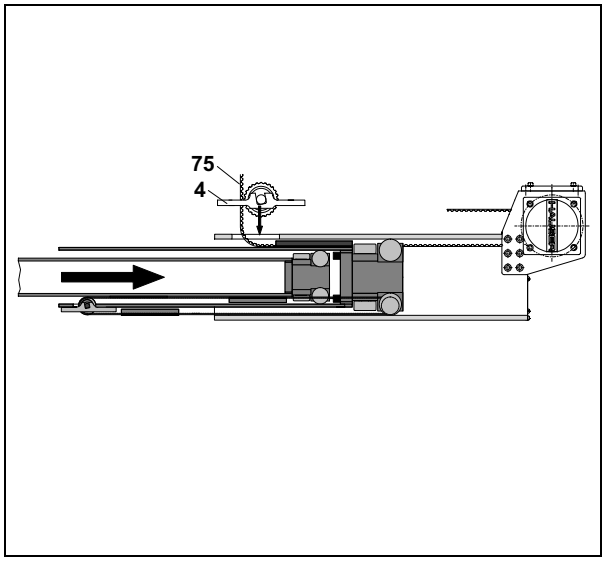
  Fixed rollers: **HTR80:** 42.3 Nm / **HTR50:** 40.0 Nm
  Eccentric rollers: **HTR80:** 26.5 Nm / **HTR50:** 23.1 Nm
- ☞ Adjust the remaining jockey wheels using the hexagon of the eccentric bush in small steps so that the guide profile / rotors can be easily moved without any play. Lock in position using an Allen key - ensure that the adjusted setting is not changed!

Figure 7-34: Adjust the rollers of the rotor station upper central section

- ☞ Carefully insert complete telescope central section in the guide profile outer section and check the correct settings of the rollers.

Carelessness during insertion can damage the rollers on the rotor station.

☞ Repeat process described above until all eccentric rollers are adjusted.



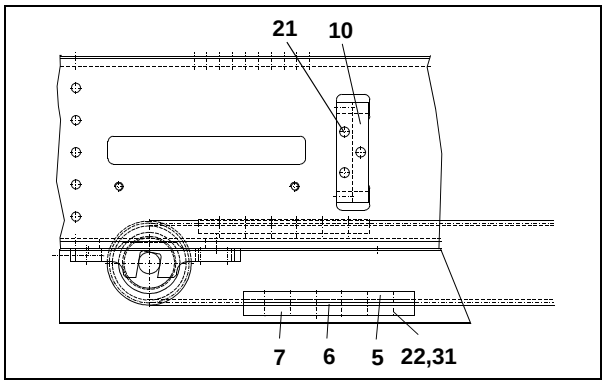
☞ Position the guide profile outer section opening for the tension station of the main drive belt (4)/[600] facing upwards on level blocks.

☞ Insert the pre-assembled telescope central section (Rotor station lower central section), with the transmission drive belt facing downwards, into the guide profile outer section. Feed the main drive belt (75)/b [65] up out through the guide profile outer section or through the opening for the tension station.

☞ Fit the cover (15)/[22] using screws (23)/[32].

☞ Fit the drive housing (3)/[160] using screws (25)/[4].

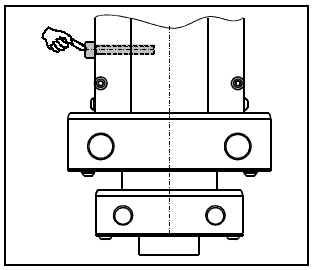
Figure 7-35: Insert telescope central section into the housing (Pos. Nos. for HTR80)



☞ Close sealing piece of the main drive belt (5-7)/[16-18] using screws.

Figure 7-36: Fit main drive belt (Pos. Nos. for HTR80)

☞ Block HTR rotors against undesired movement.

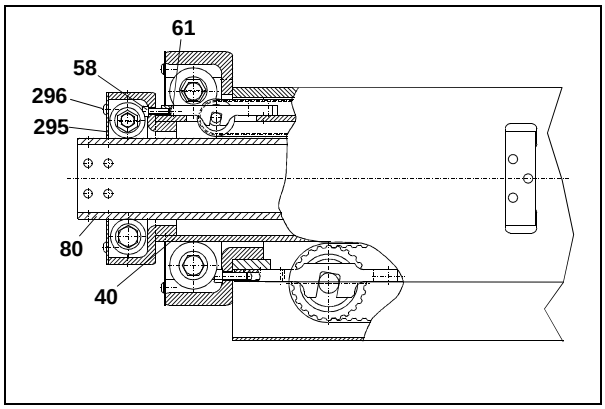


☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP

Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

Figure 7-37: Block telescope



- ☞ Carefully insert lower central section of rotor station over the inner section guide profile (80)/[80] into the central section guide profile (40)/[40].

Insert the rotor station so that the holes for the toothed belt tensioning screws (58)/[63] are on the side of the main drive.

- ☞ Fix rotor station with two fixing screws, inc. screw locking devices (61)/[45] on each side.

Figure 7-38: Fit rotor station lower central section (Pos. Nos. for HTR80)

- ☞ Insert set screws (58)/[63] of the transmission drive and pre-tension toothed belts by rotating the set screws clockwise ( ), following the marking (see above) or operating instructions (→ Page 7-12).

The pre-tension must be adapted to the loading.
General guideline: **Toothed belt tension >= maximum operating force**
Unnecessarily high pre-tension only puts pressure on the bearings and other components. Too high pre-tension can cause damage to the mechanics!

- ☞ Fit the toothed belt cover (14)/[31] of the main drive using screws (23)/[32].
- ☞ If necessary, refit HTR in the robot system.
- ☞ Fit gears (→ Page 7-30)
- ☞ Fit motor (→ Page 7-31)
- ☞ Tension the toothed belts of the main and transmission drives (→ Page 7-7 and Page 7-12)
- ☞ Screw on housing cover (173 - see Figure 7-28)/[177]
- ☞ Fit the cover plate (295)/[375].

7.4.3 Adjusting rollers of the rotor station lower outer section

- ☞ To check the roller action of the rotor station lower outer section from below, unscrew the cover plate (295)/[375] (→ Figure 7-38).

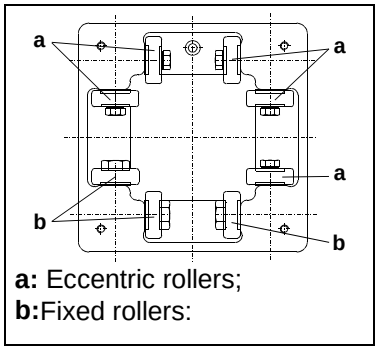
The roller action can only be checked while the telescopic axle is travelling.

Danger of injury - special care must be taken here! If possible, move the shaft manually (if necessary, remove motor and gears first and position shaft horizontally). If not, then move the shaft in the creep mode using the jog button (Speed = 2m/min).

- ☞ All rollers must rotate during the movement.
- ☞ To check the pressure acting against it, prevent the wheels from turning using your index finger; the wheels should be able to be stopped with minimal force.

Jockey wheels which are adjusted too tightly develop pressure marks which lead to running noise. Replace defective rollers (→ Chapter 7.5)

☞ **Adjusting the rollers**



a: Eccentric rollers;
b:Fixed rollers:

☞ First adjust the eccentric rollers opposite the two fixed rollers. Do not exceed the maximum permissible screw tightening torque:

Fixed rollers: **HTR80:** 40.0 Nm / **HTR50:** 13.1 Nm
Eccentric rollers: **HTR80:** 22.0 Nm / **HTR50:** 10.2 Nm

☞ Adjust the jockey wheels using the hexagon of the eccentric bush in small steps so that the guide profile / rotors can be easily moved without any play. Lock in position using an Allen key - ensure that the adjusted setting is not changed!

☞ Fit the cover plate (295)/[375].

Figure 7-39: Adjust the rollers of the rotor station lower central section

7.4.4 Adjusting rollers of the rotor station upper inner section

The inner section of the rotor station cannot be adjusted when fitted. Adjustments can only be carried out when the linear shaft is removed and partially disassembled.

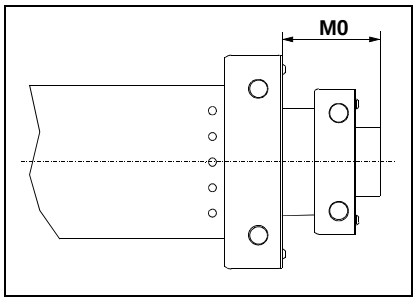


Figure 7-40: Mark machine datum

☞ Remove outer attachments (Gripper, etc.).

☞ If possible; position linear axle on the machine datum and record this point by marking or measuring the distance from the lower outer section of the M0 rotor station to the gripper / lower end of the inner section guide profile.

Marking or recording the machine datum point facilitates subsequent commissioning.

☞ Where possible: Extend linear axle (min. 50 mm).

☞ If present: switch off drive and secure against accidental start-up.

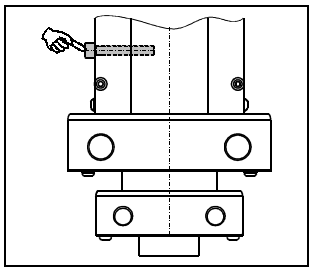


Figure 7-41: Block telescope

☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

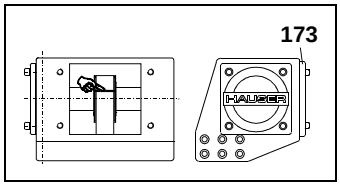
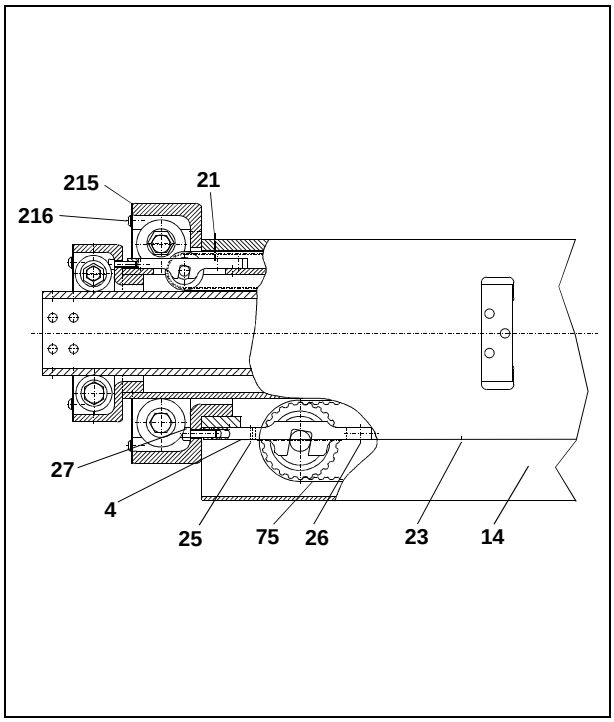


Figure 7-42: Mark toothed belt position on the drive plate (Pos. Nos. for HTR80)

☞ Open housing cover (173)/[177] of the drive station

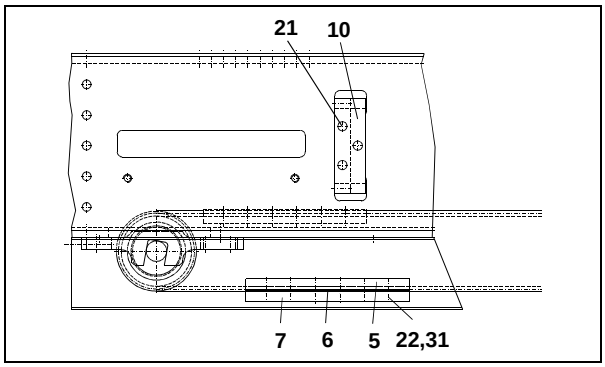
Mark the belt position on the drive plate so that the belt can be correctly re-installed at a later date - this retains the previous settings.

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50



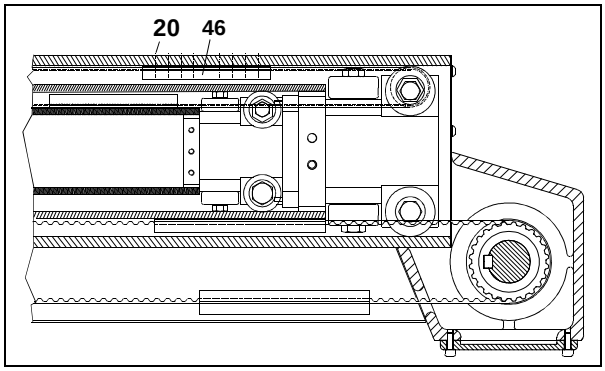
- ☞ Remove the toothed belt cover (14)/[31] from the main drive by unscrewing the fixing screws (23)/[32].
- ☞ Remove the cover plate (215)/[295] of the lower outer section of the rotor station by removing the fixing screws (216)/[296].
- ☞ Mark the toothed belt position in the clamping plate
- ☞ Mark the position of the belt tensioner (4)/[600] against the guide profile. The marking ensures that at a later date the toothed belt tension can be reset to the correct level.
- ☞ Loosen set screws (25+26)/[8] on the main drive belt tensioner (4)/[600].
- ☞ Slacken off main drive toothed belt (75)/ [65] by rotating the set screw (27)/[10] anticlockwise ( ).
- ☞ Remove fixing screws (25)/[4] and take off the lower rotor station outer section.

Figure 7-43: Slacken the main drive toothed belt (Pos. No. for HTR80)



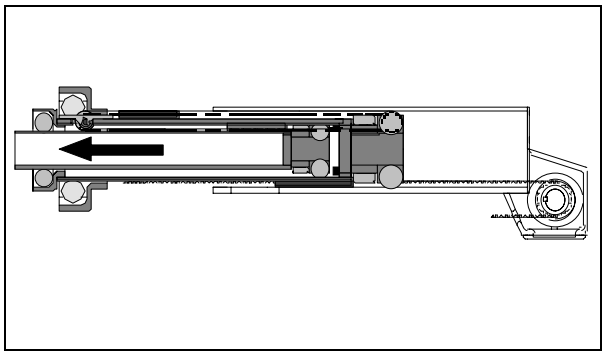
- ☞ Open sealing piece (5-7)/[16-18] on the main drive toothed belt (75)/[65] by removing the set screws (22)/[19].
- ☞ Remove the mechanical limit stop (10)/[26] by removing the fixing screws (21)/[4].
- ☞ Remove the belt tensioner of the main drive (4)/ [600] by undoing the set screws (25+26 - see Figure 7-43)/[8].

Figure 7-44: Remove toothed belt sealing piece and mechanical limit stop (Pos. No. for HTR80)



- ☞ Undo adjustment device (46)/[58] (sealing piece for transmission drive) of the guide profile inner section by removing the fixing screws (20)/[61].

Figure 7-45: Undo transmission drive - outer housing section connection. Pos. Nos. for HTR80)



☞ Carefully remove auxilliary structure and slowly remove the complete central section telescope from the outer section guide profile.

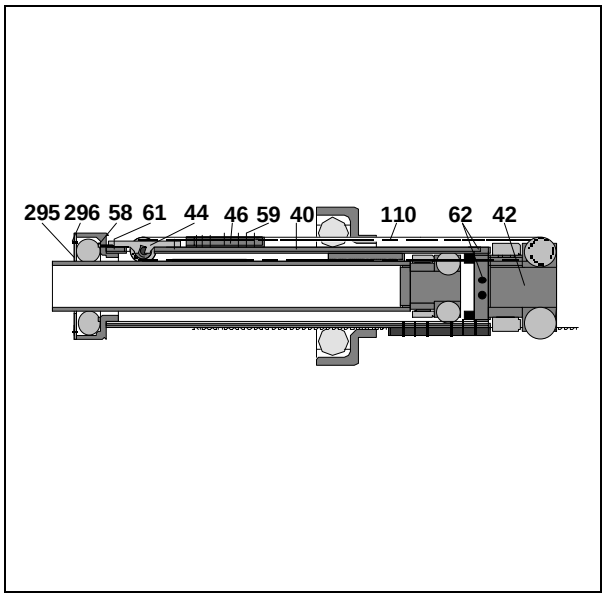
The mass of the part removed is: (General equation) (Determine stroke: Chapter 7.3.3.1)

HTR80: m~15 *kg + 9 *kg / per metre stroke
HTR50: m~7 *kg + 3 *kg / per metre stroke

Equation 7-8: Complete central section mass

Figure 7-46: Remove telescope central section and inner section

☞ Place complete telescope central section on suitable, level blocks.



☞ Remove the cover plate (295)/[375] of the lower central section of the rotor station by removing the fixing screws (296)/[376].
☞ Mark the position of the belt tensioner (44)/[640] against the guide profile of the central section (40)/[40]. The marking ensures that at a later date the toothed belt tension can be reset to the correct level.
☞ Loosen set screws (61)/[45] on the transmission drive belt tensioner (44)/[640].
☞ Slacken off transmission drive toothed belt (110)/ [93] by rotating the set screw (58)/[63] anticlockwise, ( ).
☞ Open sealing piece (46)/[58] on the transmission drive toothed belt by removing the set screws (59)/ [61].

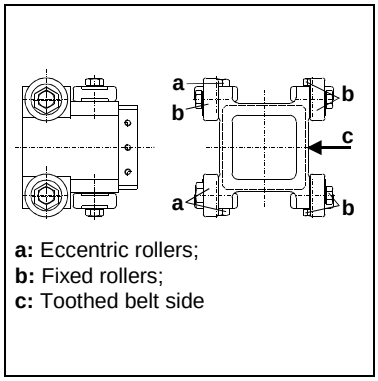
Figure 7-47: Remove old toothed belt (Pos. Nos. for HTR80)

☞ Undo rotor station upper central section (42)/[48] by removing the fixing screws (62)/[49] and remove from the guide profile central section.
☞ To check the roller action of the rotor station upper inner section from the right→ Fig.7-47, move the complete telescope inner section backwards and forwards manually in the guide profile central section. .
☞ All rollers must rotate during the movement.
☞ To check the pressure acting against it, prevent the wheels from turning using your index finger; the wheels should be able to be stopped with minimal force.

Jockey wheels which are adjusted too tightly develop pressure marks which lead to running noise. Replace defective rollers (→ Chapter 7.5)

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50

☞ **Adjusting the rollers**



a: Eccentric rollers;
b: Fixed rollers;
c: Toothed belt side

☞ Remove complete telescope inner section upwards out of the guide profile central section.

☞ First adjust the eccentric rollers opposite the two fixed rollers. Do not exceed the maximum permissible screw tightening torque:

Fixed rollers: HTR80: 40.0 Nm / **HTR50:** 13.1 Nm
Eccentric rollers: HTR80: 22.0 Nm / **HTR50:** 10.2 Nm

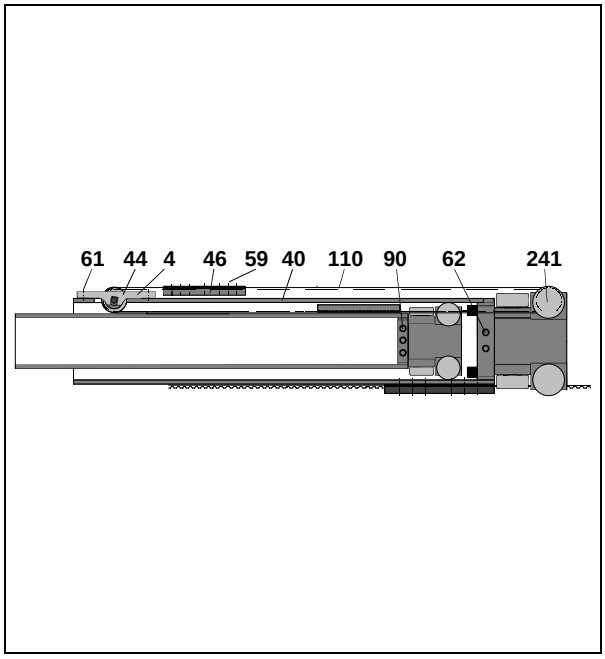
☞ Adjust the jockey wheels using the hexagon of the eccentric bush in small steps so that the guide profile / rotors can be easily moved without any play. Lock in position using an Allen key - ensure that the adjusted setting is not changed!

Figure 7-48: Adjust the rollers of the rotor station upper inner section

☞ Carefully insert complete telescope inner section into the guide profile complete.

⚠ Carelessness during insertion can damage the rollers on the rotor station.

☞ Repeat process until all eccentric rollers are adjusted.



☞ Place guide profile central section, with the transmission drive belt (110)/[93] facing upwards, on level blocks so that it is accessible from all sides.

Use suitable blocks (spacers) to provide optimal support.

☞ Fit the rotor station upper central section, with the deflection roller for the toothed belt (241)/[350] facing upwards, on the guide profile central section and secure with the screws (62)/[49].

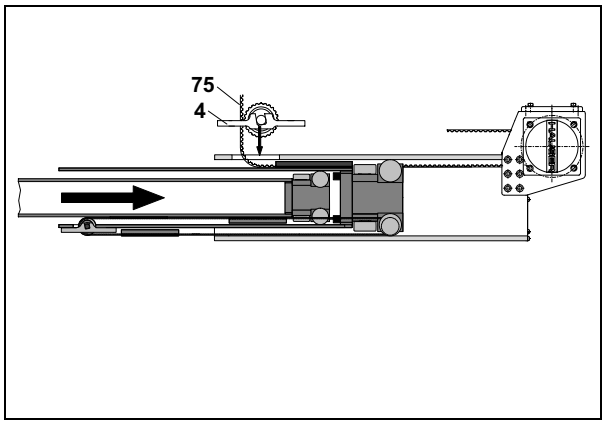
☞ Close the sealing piece (46)/[58] for the transmission drive belt with screws (59)/[61] as indicated by the markings.

☞ Lightly pre-tension the transmission drive belt by manually operating the belt tensioner (4)/[600]. (if necessary loosen the screws (61)/[45] until the belt tensioner can just be moved manually)

Figure 7-49: Prepare telescope central section for assembly (Pos. Nos. for HTR80)

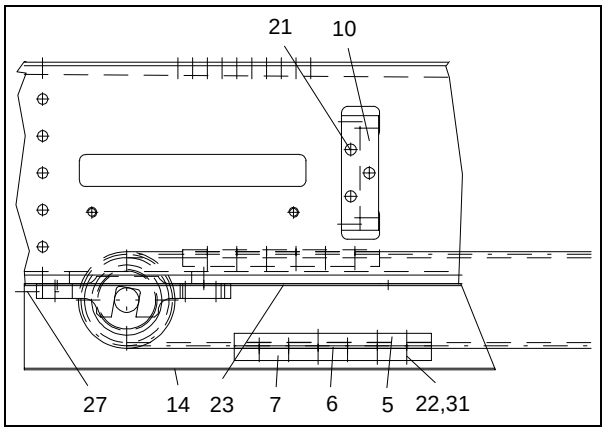
☞ Pre-tension toothed belt by rotating the set screw (58)/[63] clockwise (↻) following the marking (→ Page 7-20) or operating instructions (→ Page 7-12).

⚠ The pre-tension must be adapted to the loading.
General guideline: **Toothed belt tension >= maximum operating force**
Unnecessarily high pre-tension only puts pressure on the bearings and othe components. Too high pre-tension can cause damage to the mechanics!



- ☞ Position the guide profile outer section opening for the tension station of the main drive belt (4)/[600] facing upwards on level blocks.
- ☞ Insert the pre-assembled telescope central section (without the rotor station lower central section), with the transmission drive belt facing downwards, into the guide profile outer section. Feed the main drive belt (75)/ [65] up out through the guide profile outer section or through the opening for the tension station.

Figure 7-50: Insert telescope central section (Pos. Nos. for HTR80)



- ☞ Close sealing piece of the main toothed belt (5-7)/[16-18] using screws (22)/[19].
- ☞ Pre-tension toothed belt by rotating the set screw (27)/[10] clockwise ( ), following the marking (→ Page 7-20) or operating instructions (→ Page 7-7).

Figure 7-51: Fit limit stop and tension main toothed belt (Pos. Nos. for HTR80)

The pre-tension must be adapted to the loading.
General guideline: **Toothed belt tension >= maximum operating force**
Unnecessarily high pre-tension only puts pressure on the bearings and othe components. Too high pre-tension can cause damage to the mechanics!

- ☞ Screw on cover plate (215)/[295] (→ Figure 7-43).
- ☞ Fit the toothed belt cover (14)/[31] of the main drive using screws (23)/[32].

7.5 Replace rollers

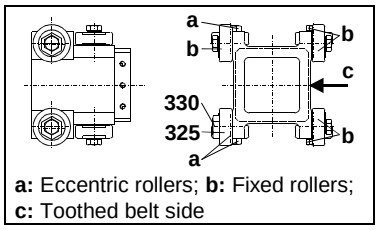
7.5.1 General remarks

- ☞ The HAUSER telescopic axle rollers are ball-bearing rollers with a synthetic coating.
- ☞ With long downtimes, the rollers become slightly flattened, however this mainly disappears during subsequent continuous operation.
- ☞ The ball-bearings used conform to the normal roller-bearing standards and have recieved a lifetime lubrication. The seals used are Z-seals.

The rollers should where possible be replaced only by HAUSER personnel.

7.5.2 Replace fixed rollers

Each rotor station has 3 fixed rollers. The rollers are always replaced in accordance with the same procedure. In some cases where the removal of the rotor station is unavoidable, follow the relevant recommendations. The example given is based on the rotor station upper inner section.



a: Eccentric rollers; **b:** Fixed rollers;
c: Toothed belt side

- ☞ Remove fixing screws (330)/[410].
- ☞ Replace the rollers (325)/[405]

Figure 7-52: Replace fixed rollers following the example of the rotor station upper inner section (Pos. Nos. for HTR80)

The roller must be screwed with the collar (smaller inner diameter) against the rotor station. Locking rings must always be fitted between screw and bearing, and there should also be the appropriate number of plain washers between bearing and rotor station. Safety plates must always be replaced to maintain safety functions.

- ☞ Tighten screw (330)/[410] with the correct tightness torque Ma (→ Table 7-2).
- ☞ Adjust rotor station according to the relevant setting instructions.

Adjusting/Aligning the rotor station:

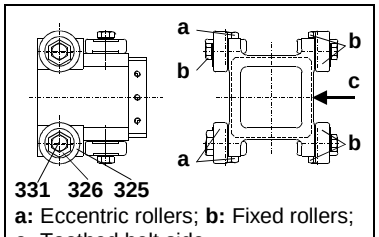
Lower outer section:	Chapter 7.4.1
Upper central section:	Chapter 7.4.2
Lower central section:	Chapter 7.4.3
Upper inner section:	Chapter 7.4.4

Rotor station	Tightness torque [Nm] HTR80	HTR50
Lower outer section:	42.3	40.0
Upper central section	42.3	40.0
Lower central section	40.0	13.1
Upper inner section	40.0	13.1

Table 7-2: Tightness torque for fixed rollers

7.5.3 Replace eccentric rollers

Each rotor station has 5 eccentric rollers. The rollers are always replaced in accordance with the same procedure. In some cases where dismantling of the linear axle is unavoidable, follow the relevant recommendations. The example given is based on the rotor station upper inner section.



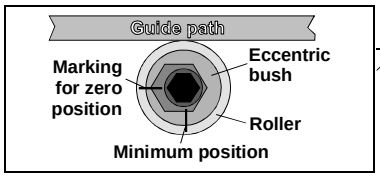
a: Eccentric rollers; **b:** Fixed rollers;
c: Toothed belt side

- ☞ Remove the fixing screws, (331)/[411] including the eccentric bushes
- ☞ Replace the rollers (325)/[405]

Fig. 7-53: Replace fixed rollers following the example of the rotor station upper inner section (Pos. Nos. for HTR80)

The roller must be screwed with the collar (smaller inner diameter) against the rotor station. Locking rings must always be fitted between screw and eccentric bush, and there should also be the appropriate number of plain washers between bearing and rotor station. Safety plates must always be replaced to maintain safety functions. If locking rings are not used, suitable screw locking devices (e.g. Loctite 243) must be used.

☞ Tighten screw (331)/[441] with the correct tightness torque Ma (→ Table 7-3).



The eccentric bushes of the roller must be aligned so that the roller distance decreases when rotating clockwise ( ). The ideal position for the nominal size in this case is a horizontal alignment, i.e. zero-position of the cam.

Figure 7-54: Adjusting the eccentric rollers

☞ Adjust rotor station according to the relevant setting instructions.

Adjusting/Aligning the rotor station:

Lower outer section: Chapter 7.4.1
Upper central section: Chapter 7.4.2
Lower central section: Chapter 7.4.3
Upper inner section: Chapter 7.4.4

Rotor station	Tightness torque [Nm] HTR80	HTR50
Lower outer section:	26.5	23.1
Upper central section	26.5	23.1
Lower central section	22.0	10.2
Upper inner section	22.0	10.2

Table 7-3: Tightness torque for eccentric rollers

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50

7.6 Replace belt tensioner

7.6.1 Replace main drive belt tensioner

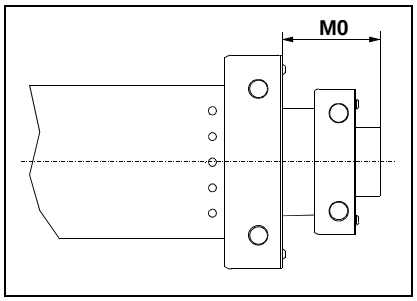


Figure 7-55: Mark machine datum

- ☞ Remove outer attachments (Gripper, etc.).
- ☞ If possible; position linear axle on the machine datum and record this point by marking or measuring the distance from the lower outer section of the M0 rotor station to the gripper / lower end of the inner section guide profile.

Marking or recording the machine datum point facilitates subsequent commissioning.

- ☞ Where possible: Extend linear axle (min. 50 mm).
- ☞ If present: switch off drive and secure against accidental start-up.

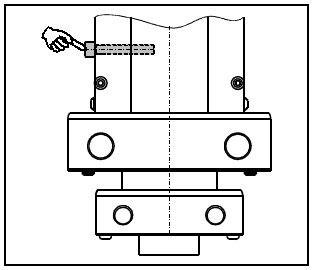


Figure 7-56: Block telescope

- ☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP

Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

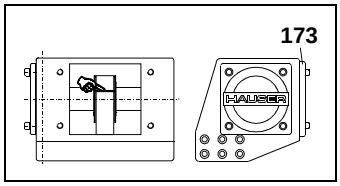


Figure 7-57: Mark toothed belt position on the drive plate (Pos. Nos. for HTR80)

- ☞ Open housing cover (173)/[177] of the drive station

Mark the belt position on the drive plate so that the belt can be correctly re-installed at a later date - this retains the previous settings.

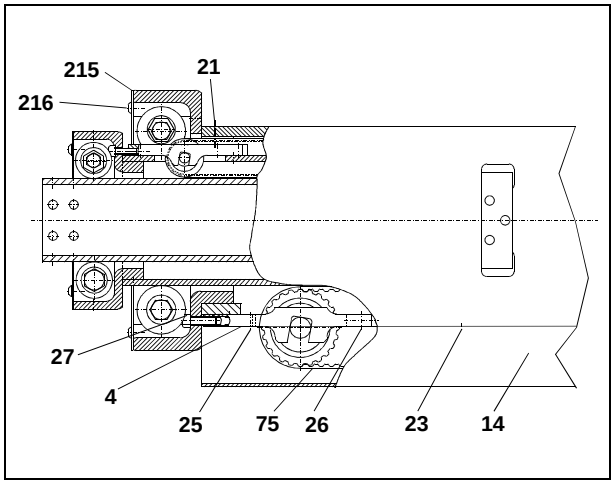


Figure 7-58: Slacken the main drive toothed belt (Pos. No. for HTR80)

- ☞ Remove the toothed belt cover (14)/[31] from the main drive by unscrewing the screws (23)/[32].
- ☞ Remove the cover plate (215)/[295] of the lower central section of the rotor station by removing the screws (216)/[296].
- ☞ Mark the toothed belt position in the clamping plate
- ☞ Loosen set screws (25+26)/[8] on the main drive belt tensioner (4)/[600].
- ☞ Slacken off main drive toothed belt (75)/ [65] by rotating the set screw (27)/[10] anticlockwise ( ).

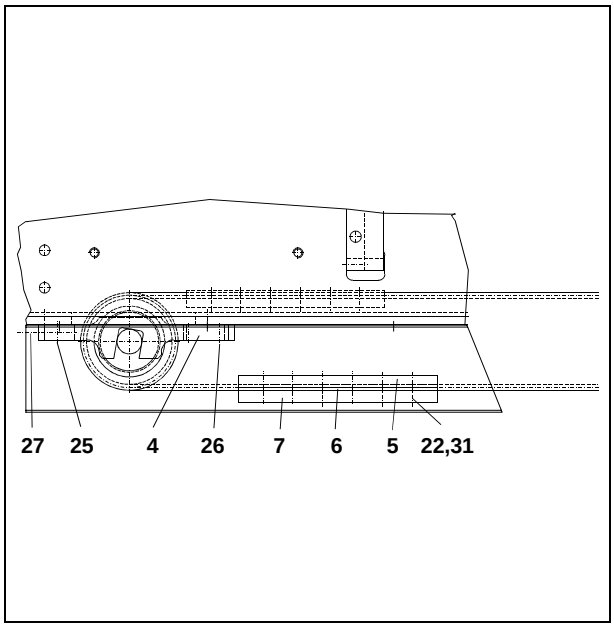


Fig. 7-59: Replace belt tensioner (Pos. Nos. for HTR80)

- ☞ Open sealing piece (5-7)/[16-18] on the main drive toothed belt by removing the set screws (22)/[19].
- ☞ Unscrew set screws (27)/[10] on the main drive belt tensioner (4)/[600].
- ☞ Remove set screws (25+26)/[8] on the main drive belt tensioner (4)/[600].
- ☞ Replace main drive belt tensioner (4)/ [600].
- ☞ Insert and lightly tighten set screws (25+26)/[8] on the main drive belt tensioner (4)/ [600].
- ☞ Close sealing piece of the main drive belt (5-7)/[16-18] using screws (22)/ [19].
- ☞ Insert set screws (27)/[10] of the main drive and pre-tension toothed belt by rotating the set screws clockwise (↻), following the marking or operating instructions (→ Page 7-7).

⚠ The pre-tension must be adapted to the loading.
General guideline: **Toothed belt tension >= maximum operating force**
Unnecessarily high pre-tension only puts pressure on the bearings and other components. Too high pre-tension can cause damage to the mechanics!

- ☞ Remove auxilliary structures.
- ☞ Fit the toothed belt cover (14)/[31] of the main drive using screws (23)/[32] (Pos. Nos.: Figure 7-58).
- ☞ Fit the cover plate (215)/[295] of the rotor station lower outer section using screws (216)/[296] (Pos. Nos.: Figure 7-58).
- ☞ Set machine datum (see operating manual of the controller being used)

7.6.2 Replace transmission drive belt tensioner

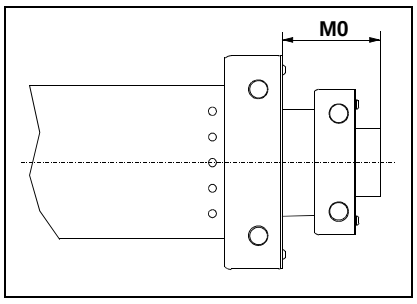
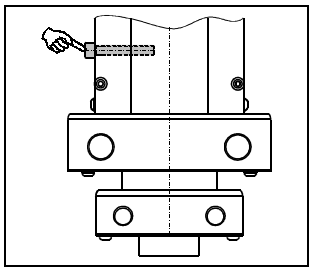


Figure 7-60: Mark machine datum

- ☞ Remove outer attachments (Gripper, etc.).
- ☞ If possible; position linear axle on the machine datum and record this point by marking or measuring the distance from the lower outer section of the M0 rotor station to the gripper / lower end of the inner section guide profile.

Marking or recording the machine datum point facilitates subsequent commissioning.

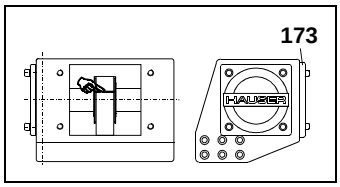
- ☞ Where possible: Extend linear axle (min. 50 mm).
- ☞ If present: switch off drive and secure against accidental start-up.



☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

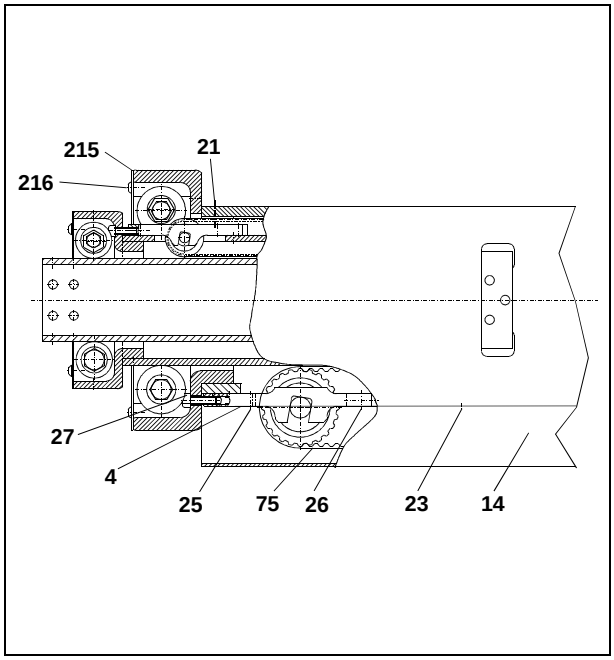
Figure 7-61: Block telescope



☞ Open housing cover (173)/[177] of the drive station

Mark the belt position on the drive plate so that the belt can be correctly re-installed at a later date - this retains the previous settings.

Figure 7-62: Mark toothed belt position on the drive plate (Pos. Nos. for HTR80)



☞ Remove the toothed belt cover (14)/[31] from the main drive by unscrewing the fixing screws (23)/[32].

☞ Remove the cover plate (215)/[295] of the lower outer section of the rotor station by removing the fixing screws (216)/[296].

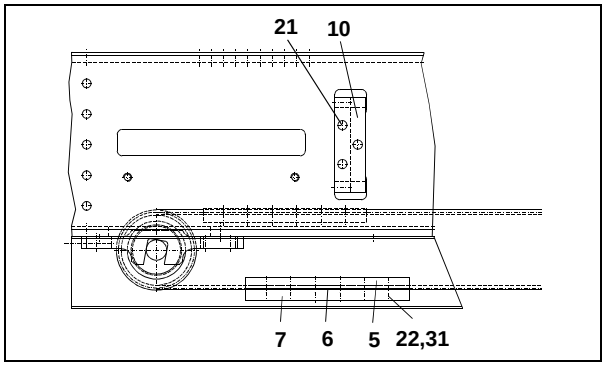
☞ Mark the toothed belt position in the clamping plate

☞ Mark the position of the belt tensioner (4)/[600] against the guide profile. The marking ensures that at a later date the toothed belt tension can be reset to the correct level.

☞ Loosen set screws (25+26)/[8] on the main drive belt tensioner (4)/[600].

☞ Slacken off main drive toothed belt (75)/ [65] by rotating the set screw (27)/[10] anticlockwise ( ).

Figure 7-63: Slacken the main drive toothed belt (Pos. No. for HTR80)

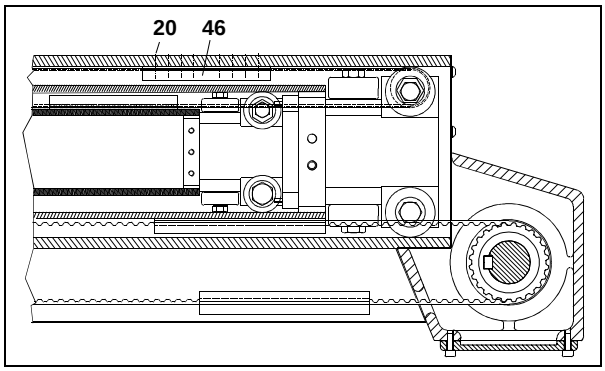


☞ Open sealing piece (5-7)/[16-18] on the main drive toothed belt (75)/[65] by removing the set screws (22)/[19].

☞ Remove the mechanical limit stop (10)/[26] by removing the fixing screws (21)/[28].

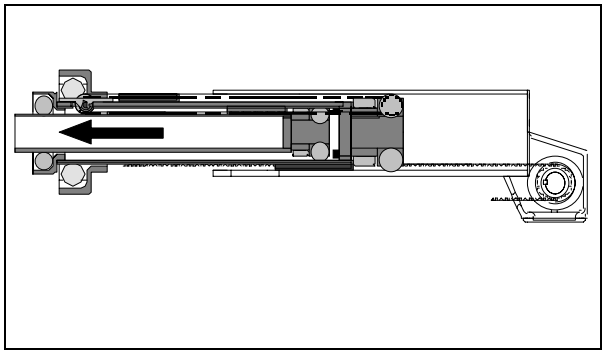
☞ Remove set screws (25+26 - see Figure 7-63)/[8] and belt tensioner outer section.

Figure 7-64: Remove toothed belt sealing piece and mechanical limit stop (Pos. No. for HTR80)



☞ Undo adjustment device (46)/[58] (sealing piece for transmission drive) of the guide profile inner section by removing the fixing screws (20)/[61].

Figure 7-65: Undo transmission drive - outer housing section connection. Pos. Nos. for HTR80)



☞ Carefully remove auxilliary structure and slowly remove the complete central section telescope from the outer section guide profile.

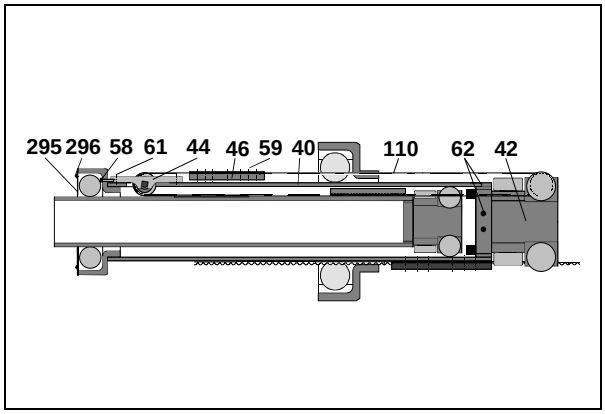
The mass of the part removed is: (General equation) (Determine stroke: Chapter 7.3.3.1)

HTR80: m~15 *kg + 9 *kg / per metre stroke
HTR50: m~15 *kg + 9 *kg / per metre stroke

Equation 7-9: Complete central section mass

Figure 7-66: Remove telescope central section and inner section

☞ Place complete telescope central section on suitable, level blocks.



☞ Remove the cover plate (295)/[375] of the lower central section of the rotor station by removing the fixing screws (296)/[376].

☞ Loosen set screws (61)/[45] on the transmission drive belt tensioner (44)/ [640].

☞ Slacken off transmission drive toothed belt (110)/ [93] by rotating the set screw (58)/[63] anticlockwise, ( ).

☞ Open sealing piece (46)/[58] on the transmission drive toothed belt by removing the set screws (59)/ [61].

Figure 7-67: Remove old toothed belt (Pos. Nos. for HTR80)

☞ Remove set and locking screws (58+61)/[63+45] of the transmission drive belt tensioner (44)/[640].

☞ Replace transmission drive belt tensioner (44)/ [640].

☞ Close sealing piece (46)/[58] on the transmission drive toothed belt using the set screws (59)/[61].

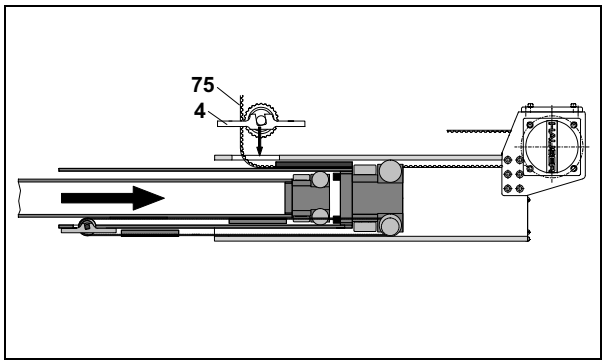
☞ Insert and lightly tighten the set screws (61)/[45] of the transmission drive belt tensioner (44)/[640].

☞ Insert set screws (58)/[63] of the transmission drive and pre-tension toothed belts by rotating the set screws clockwise ( ), following the marking (see above) or operating instructions (→ Page 7-12).

⚠ The pre-tension must be adapted to the loading.
General guideline: **Toothed belt tension >= maximum operating force**
Unnecessarily high pre-tension only puts pressure on the bearings and other components. Too high pre-tension can cause damage to the mechanics!

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50

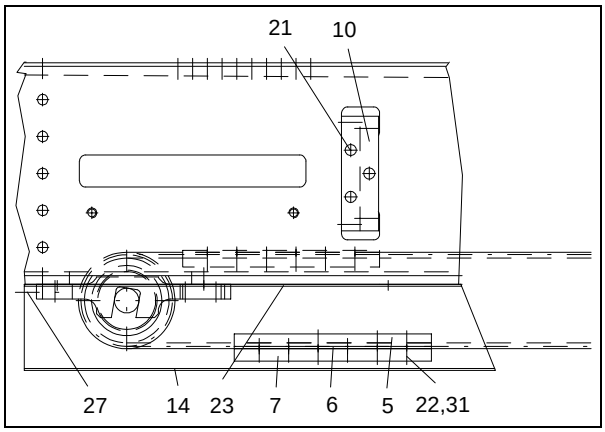
☞ Fit the cover plate (295)/[375].



☞ Position the guide profile outer section opening for the belt tensioner of the main drive belt facing upwards on level blocks.

☞ Insert the telescope central section and transmission drive belt from below into the guide profile outer section. Feed the main drive belt (75)/ [65] up out through the guide profile outer section or through the opening for the belt tensioner.

Figure 7-68: Insert telescope central section into the housing (Pos. Nos. for HTR80)



☞ Close sealing piece of the main toothed belt (5-7)/[16-18] using screws (22)/[19].

☞ Pre-tension toothed belt by rotating the set screw (27)/[10] clockwise ( ), following the marking (→ Page 7-20) or operating instructions (→ Page 7-7).

Figure 7-69: Fit limit stop and tension main toothed belt (Pos. Nos. for HTR80)

The pre-tension must be adapted to the loading.
General guideline: **Toothed belt tension >= maximum operating force**
Unnecessarily high pre-tension only puts pressure on the bearings and other components. Too high pre-tension can cause damage to the mechanics!

☞ Screw on cover plate (215)/[295] (→ Figure 7-63).

☞ Fit the toothed belt cover (14)/[31] of the main drive using screws (23)/[32].

☞ Block HTR rotors against undesired movement.

☞ Fit gears (→ Page 7-30)

☞ Fit motor (→ Page 7-31)

☞ Attach grippers if required.

☞ Set machine datum (see operating manual of the controller being used)

7.7 Replace gears

The gears can be fitted at any time on the side opposite to the drive station on the HTR80 - the drive shaft is symmetric.
In the HTR50, the drive shaft must first be removed and rotated by 180°!

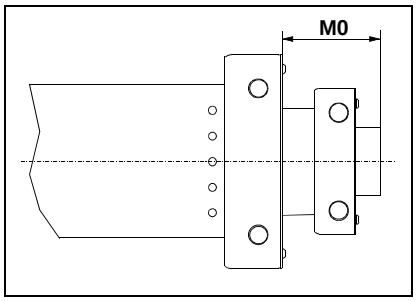


Figure 7-70: Mark machine datum

- ☞ Remove outer attachments (Gripper, etc.).
- ☞ If possible; position linear axle on the machine datum and record this point by marking or measuring the distance from the lower outer section of the M0 rotor station to the gripper / lower end of the inner section guide profile.

Marking or recording the machine datum point facilitates subsequent commissioning.

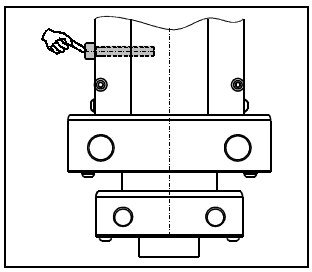


Figure 7-71: Block telescope

- ☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

- ☞ Remove motor.
- ☞ Undo gear attachements.
- ☞ Remove gears.

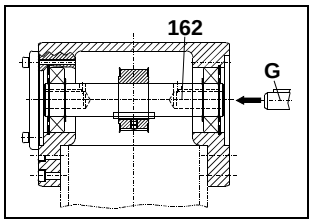


Figure 7-72: Insert gears in drive housing (Pos. Nos. for HTR80)

- ☞ Insert new gears in the drive shaft (162)/[163] (If necessary sand down transmission shaft (G) with sandpaper - 360 grade) and secure.
- ☞ Fit motor.

7.8 Change motor

⚠ The gears can be fitted at any time on the side opposite to the drive station on the HTR80 - the drive shaft is symmetric.
In the HTR50, the drive shaft must first be removed and rotated by 180°!

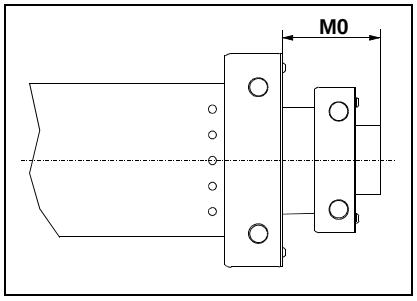


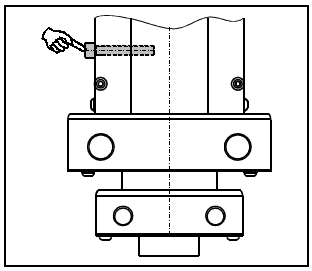
Figure 7-73: Mark machine datum

- ☞ Remove outer attachments (Gripper, etc.).
- ☞ If possible; position linear axle on the machine datum and record this point by marking or measuring the distance from the lower outer section of the M0 rotor station to the gripper / lower end of the inner section guide profile.

Marking or recording the machine datum point facilitates subsequent commissioning.

- ☞ Where possible, move axle to real zero and mark the zero point.
- ☞ Switch off the axle.

( ): Position numbers for HTR80; [ ]: Position numbers for HTR50



☞ Secure the linear axle with safety bolts against falling out when the axle is vertically positioned.

STOP Gravity can cause the linear axle to fall down if not secured. This may harm personnel or property

Figure 7-74: Block telescope

☞ Remove the motor and resolver cable.

☞ Remove motor - the process is dependent on the motor-gear combination used - comply with appropriate manufacturer information!

☞ Fit new motor.

☞ Connect the motor and resolver cable.

☞ Switch on the axle.

☞ Move to real zero of the axle and correct until agreement with marking is reached (correct using controller or resolver).

8 HTR wearing parts, replacement parts and parts lists

8.1 HTR80

8.1.1 HTR80 wearing parts

☞ Position numbers and component designations, see Table 8-1.

Toothed belts

Pos.	Name	Location	Fig. No.	Part No.
75	Toothed belt 32AT10 HPF, length = 980 + stroke [mm]	Main drive	Fig. 8-1 Fig. 8-2	420-000031
110	Toothed belt 32 AT5 HPF, length = 855 + stroke [mm]	Transmission drive	Fig. 8-3	420-000005

Rollers

Pos.	Name	Location	Fig. No.	Part No.
285	Roller R4 OL 0027 Fixed + Eccentric rollers	Rotor station, lower central section	Fig. 8-7	416-201030
325		Rotor station, upper inner section	Fig. 8-8	
205	Roller R4 OL 0025 Fixed roller	Rotor station, lower outer section	Fig. 8-5	416-201020
245		Rotor station, upper central section	Fig. 8-6	
206	Roller R4 OL 0026 Eccentric roller	Rotor station, lower outer section	Fig. 8-5	416-201010
246		Rotor station, upper central section	Fig. 8-6	

8.1.2 HTR80 replacement parts

Tooth lock washers

Pos.	Name	Location	Fig. No.	Part No.
164	Tooth lock washer Z4 AS 3246 for shafts ∅ 40^{H7}	Drive station	Fig. 8-4	420-100718
361	Tooth lock washer Z4 AS 3247 for shafts ∅ 40^{K7}	Main drive belt tensioner	Fig. 8-9	420-100737

Deflection rollers

Pos.	Name	Location	Fig. No.	Part No.
241	Deflection roller	Rotor station, upper central section	Fig. 8-6	128-000050
401		Transmission drive belt tensioner	Fig. 8-10	

Safety plates (Warning! generally always use new safety plates)

Pos.	Name	Location	Fig. No.	Part No.
31	Safety plate 6(M6)	Telescope, outer section	Fig. 8-1	135-201052
70		Telescope, central section	Fig. 8-2	
91		Telescope, inner section	Fig. 8-3	
181		Drive station	Fig. 8-4	
297		Rotor station, lower central section	Fig. 8-7	
30	Safety plate 8(M8)	Telescope, outer section	Fig. 8-1	135-201053
71		Telescope, central section	Fig. 8-2	
180		Drive station	Fig. 8-4	
293		Rotor station, lower central section	Fig. 8-7	
333		Rotor station, upper inner section	Fig. 8-8	
213	Safety plate 10 (M10)	Rotor station, lower outer section	Fig. 8-5	135-201054
253		Rotor station, upper central section	Fig. 8-6	
212	Safety plate 12 (M12)	Rotor station, lower outer section	Fig. 8-5	135-201055
252		Rotor station, upper central section	Fig. 8-6	
292		Rotor station, lower central section	Fig. 8-7	

8.1.3 Component overview with position numbers

Name	Position number range HTR80	
Complete telescope	1	39
Complete telescope central section	40	79
Complete telescope inner section	80	119
Drive station	160	199
Rotor station, lower outer section	200	239
Rotor station, upper central section	240	279
Rotor station, lower central section	280	319
Rotor station, upper inner section	320	359
Main drive belt tensioner	520	559
Transmission drive belt tensioner	560	599

Table 8-1: Overview components / position numbers

8.1.4 Component diagrams with position numbers for HTR80

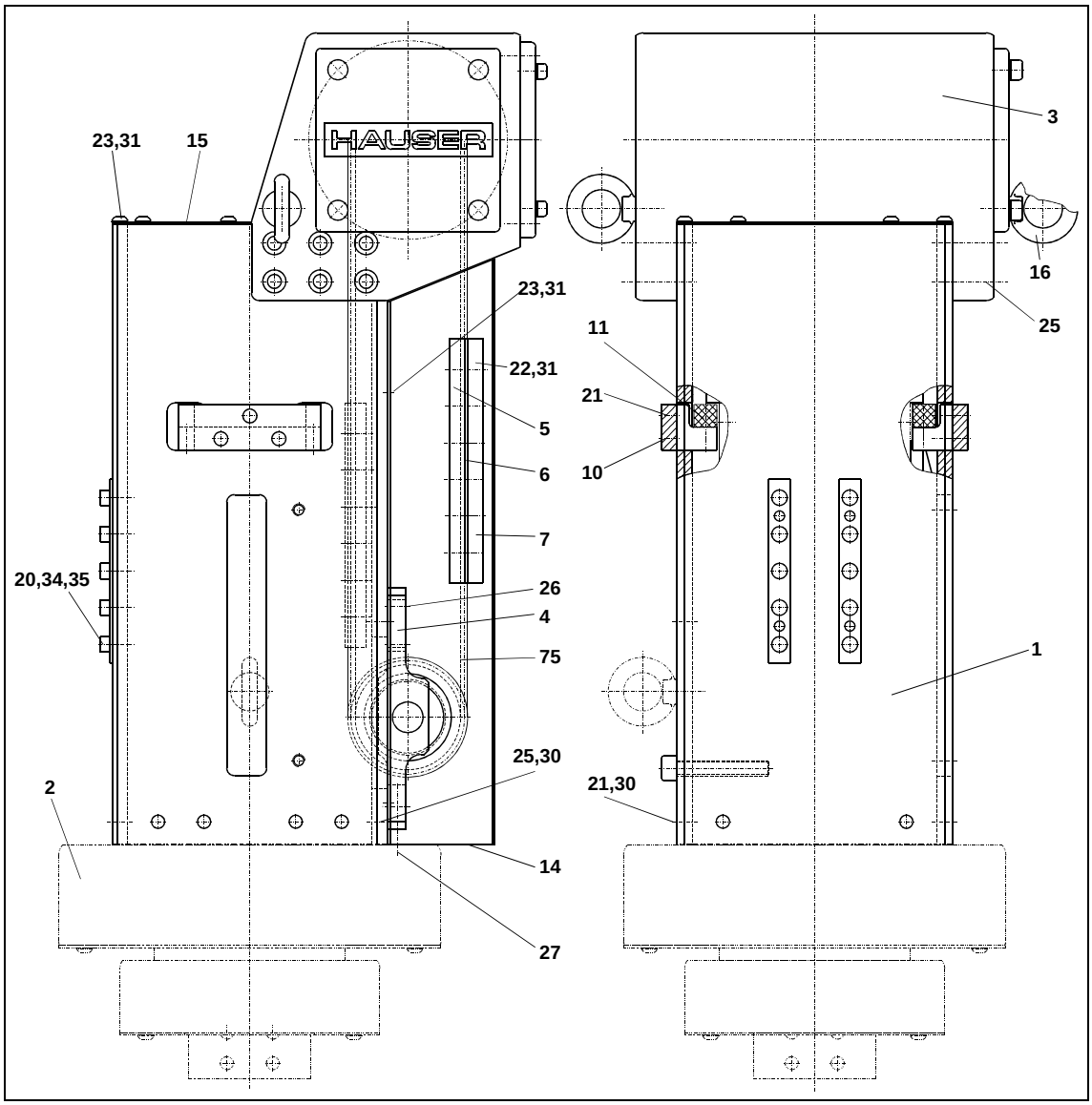


Fig. 8-1: HTR80: Complete telescope

Pos	Pcs.	Name	Part No.
1	1	Telescope component 1 profile H4TR8037	400-204030
2	1	Telescope component 2 H4TR8016	→ Fig. 8-2
3	1	Drive station H4TR8008 (→ Fig. 8-4)	510-000800
4	1	Belt tensioner component 1 H4TR8027 (→ Fig. 8-9)	510-000810
5	1	Clamping plate Z4RL0052	500-000552
6	2	Distance plate B4LE0624	500-000554
7	1	Clamping plate P4LA6121	500-000560
10	2	Limit stop component 1 H4TR8031	128-000072
11	4	Rubber buffer	400-302138
14	1	Toothed belt cover B4LE0631	128-000070
15	1	Housing cover B4LE0630	500-000562
16	2	Eyebolt DIN 580 M10	--
20	10	Pan head screw DIN 912 M6x25	130-302346

Pos	Pcs.	Name	Part No.
21	23	Oval head screw M8x20	130-501560
22	12	Pan head screw DIN 912 M6x20	130-302344
23	X	Oval head screw M6x10	130-501541
25	15	Pan head screw DIN 912 M8x30	130-302376
26	2	M8x25	130-302375
27	2	M8x40	130-302378
30	42	Safety plate 8(M8)	135-201053
31	X	6(M6)	135-201052
34	2	Distance plate B4LE0612	500-000544
35	10	Spring lock washer A6(M6)	135-201002
37	5	Plain washer DIN 125 B8,4(M8)	135-000400
39	1	Safety bolt (pan head screw) DIN 912 M10x60	130-302411

Parts list for Fig. 8-1. [X = 10 +(14/m)•stroke]

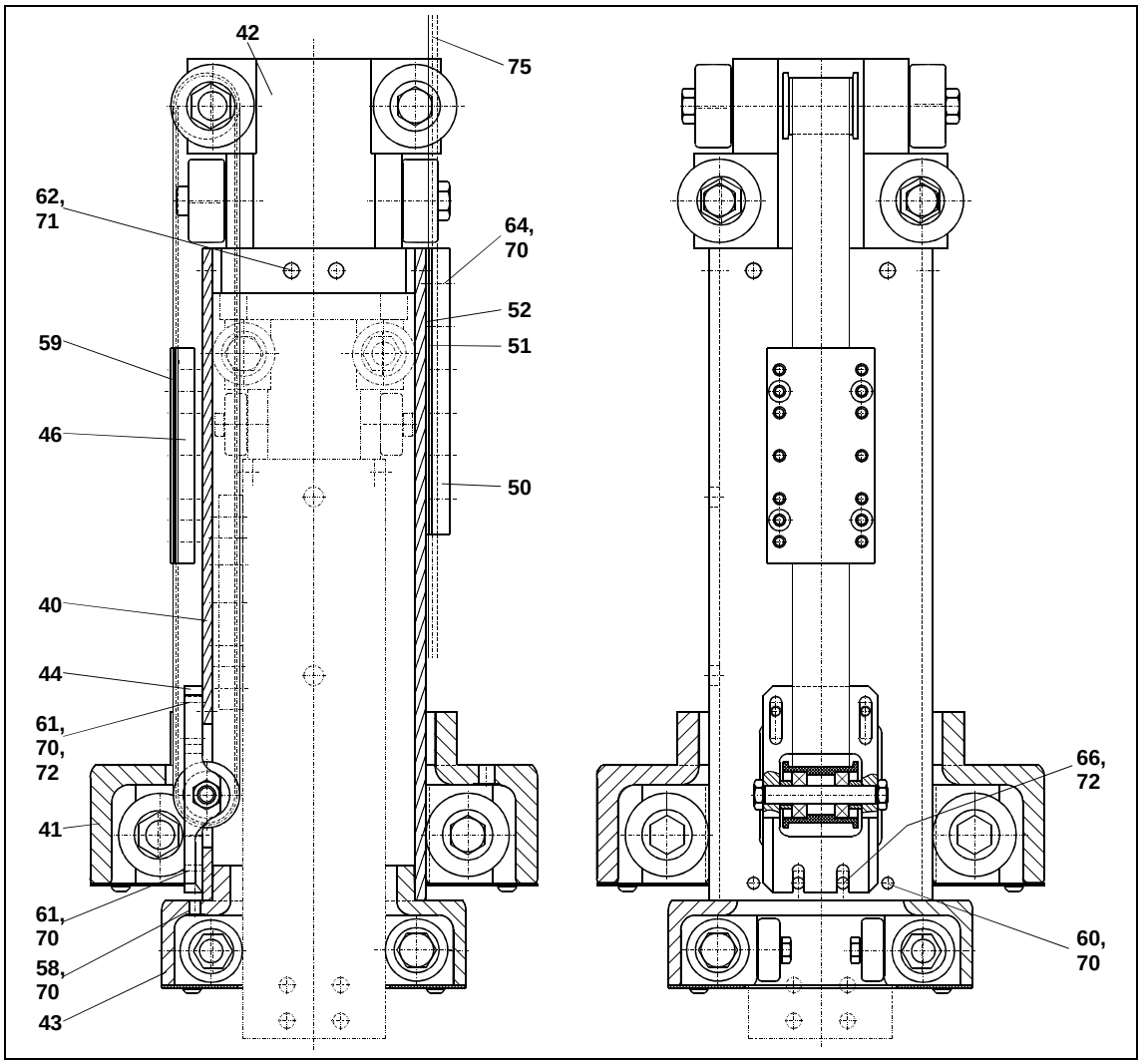


Fig. 8-2: HTR80: Complete telescope central section

Pos	Pcs.	Name	Part No.
40	1	Telescope component 2 profile H4TR8036	400-204025
41	1	Rotor station component 1 lower H4TR8012 (→ Fig. 8-5)	510-000802
42	1	Rotor station component 2 upper H4TR8015 (→ Fig. 8-6)	510-000804
43	1	Rotor station component 2 lower H4TR8021 (→ Fig. 8-7)	510-000806
44	1	Belt tensioner component 2 H4TR8026 (→ Fig. 8-10)	510-000812
45	1	Telescope component 3 H4TR8018	→ Fig. 8-3
46	1	Belt clamping component 1 M4ON1517	
47	1	Clamping plate, belt clamping Z4RL0050	500-000546
48	2	Distance plate B4LE0612	500-000544
49	1	B4LE0611	500-000542
50	1	Clamping plate, belt clamping Z4RL0052	500-000552
51	2	Distance plate B4LE0624	500-000554

Pos	Pcs.	Name	Part No.
52	1	Distance plate B4LE0625	500-000556
58	1	Pan head screw DIN 912 M6x30	135-721046
59	4	Countersunk screw DIN7991 M6x12	130-106537
60	12	Oval head screw M6x16	130-501544
61	4	M6x20	130-501546
62	8	M8x20	130-501560
64	12	Pan head screw DIN 912 M6x16	130-302342
66	2	Oval head screw M6x20	130-501546
70	30	Safety plate 6(M6)	135-201052
71	8	8(M8)	135-201053
72	4	Plain washer DIN 125 B6,4(M6)	135-000300
75	1	Toothed belt length = 980 + stroke [mm]	420-000031

Parts list for Fig. 8-2.

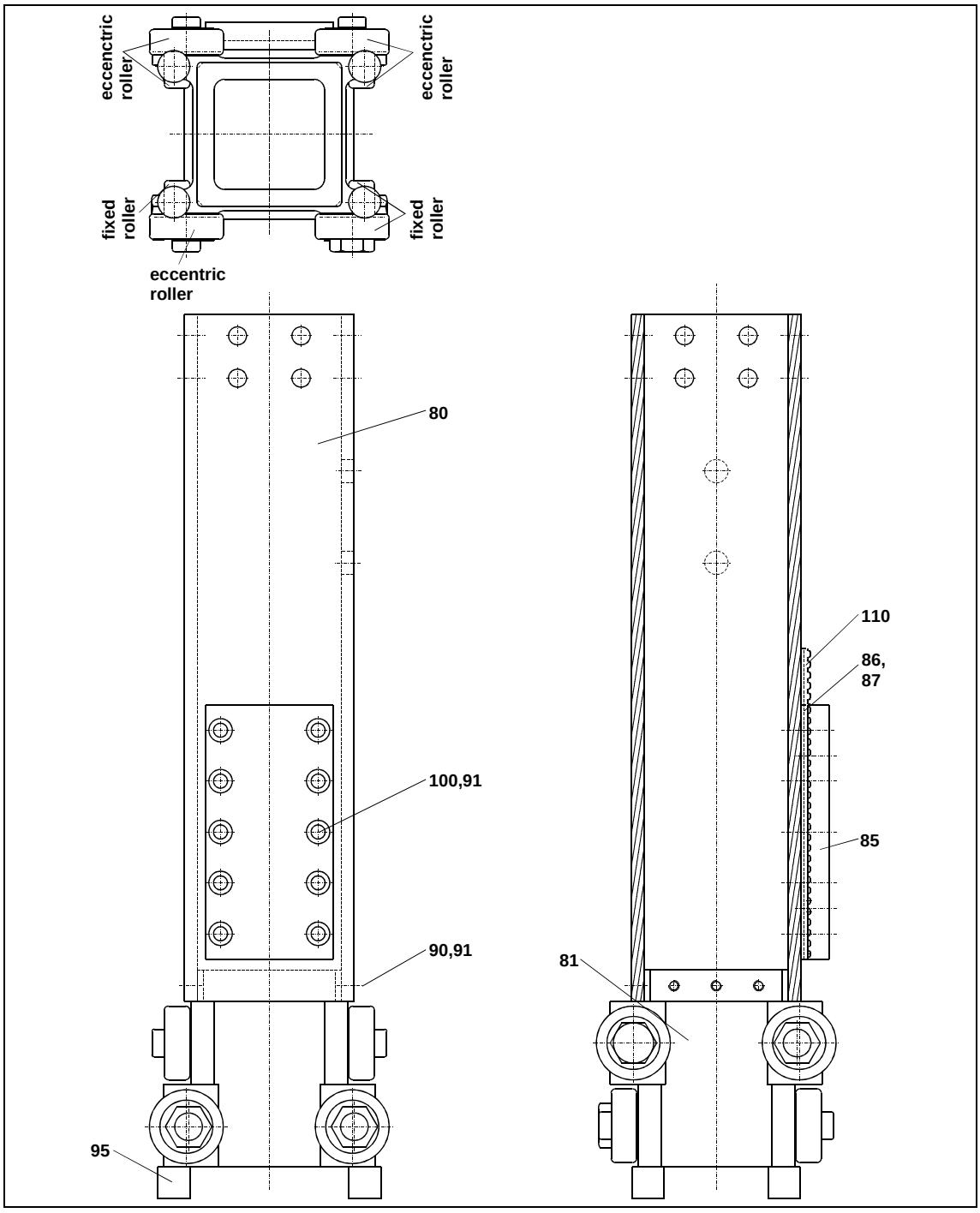


Fig. 8-3: HTR80: Complete telescope inner section

Pos	Pcs.	Name	Part No.
80	1	Telescope component 3 profile H4TR8035	400-204020
81	1	Rotor station component 3 upper H4TR8020 (→ Fig. 8-8)	510-000808
85	1	Clamping plate Z4RL0051	500-000540
86	1	Distance plate B4LE0611	500-000542
87	2	B4LE0612	500-000544

Pos	Pcs.	Name	Part No.
90	11	Oval head screw NB601 M6x14	130-501543
91	21	Safety plate 6(M6)	135-201052
95	4	Rubber buffer	400-302138
100	10	Pan head screw DIN 912 M6x16	130-302342
110	1	Toothed belt length = 855 + stroke	420-000005

Parts list for Fig. 8-3.

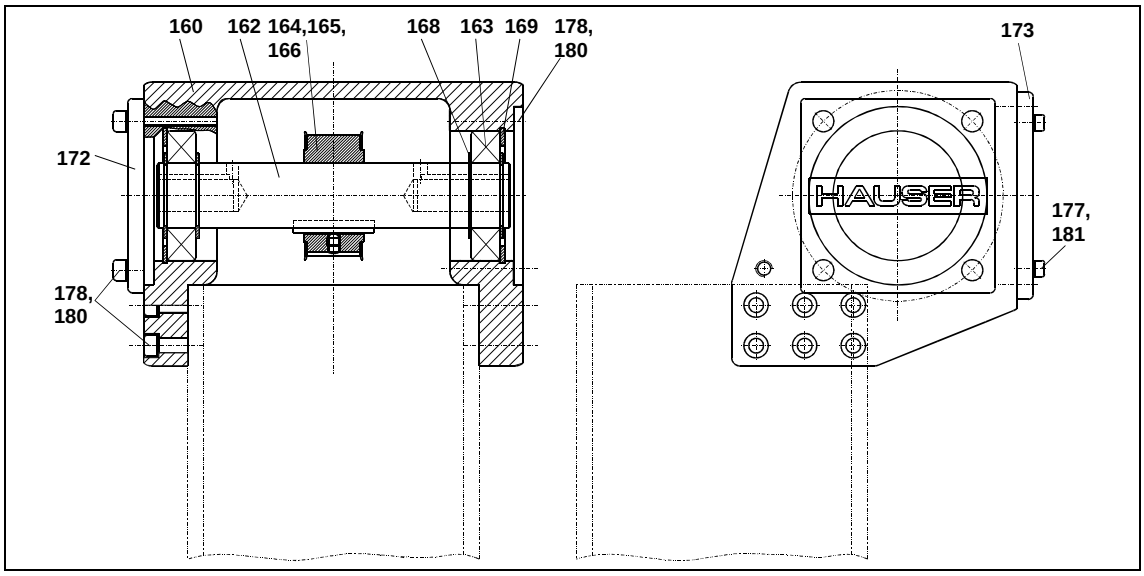


Fig. 8-4: HTR80: Drive station

Pos	Pcs.	Name	Part No.
160	1	Drive housing H4TR8000	424-300100
162	1	Drive shaft W4EL4004	125-068550
163	2	Deep groove ball bearing DIN 652 6208-2Z	146-001340
164	1	Tooth lock washer Z4AS3246	420-100718
165	1	Spline DIN 6885 A12x8x50	131-600133
166	1	Set screw DIN 914 M8x8	130-902043
168	4	Locking ring DIN 471 40x1.75	135-600228

Pos	Pcs.	Name		Part No.
169	2	Locking ring DIN 472 80x2.5		135-600251
172	1	Flange	F4LA0057	424-600621
173	1		F4LA0139	424-300532
177	6	Pan head screw DIN 912	M6x20	130-302344
178	16		M8x30	130-302376
180	16	Safety plate	8(M8)	135-201053
181	6		6(M6)	135-201052

Parts list for Fig. 8-4

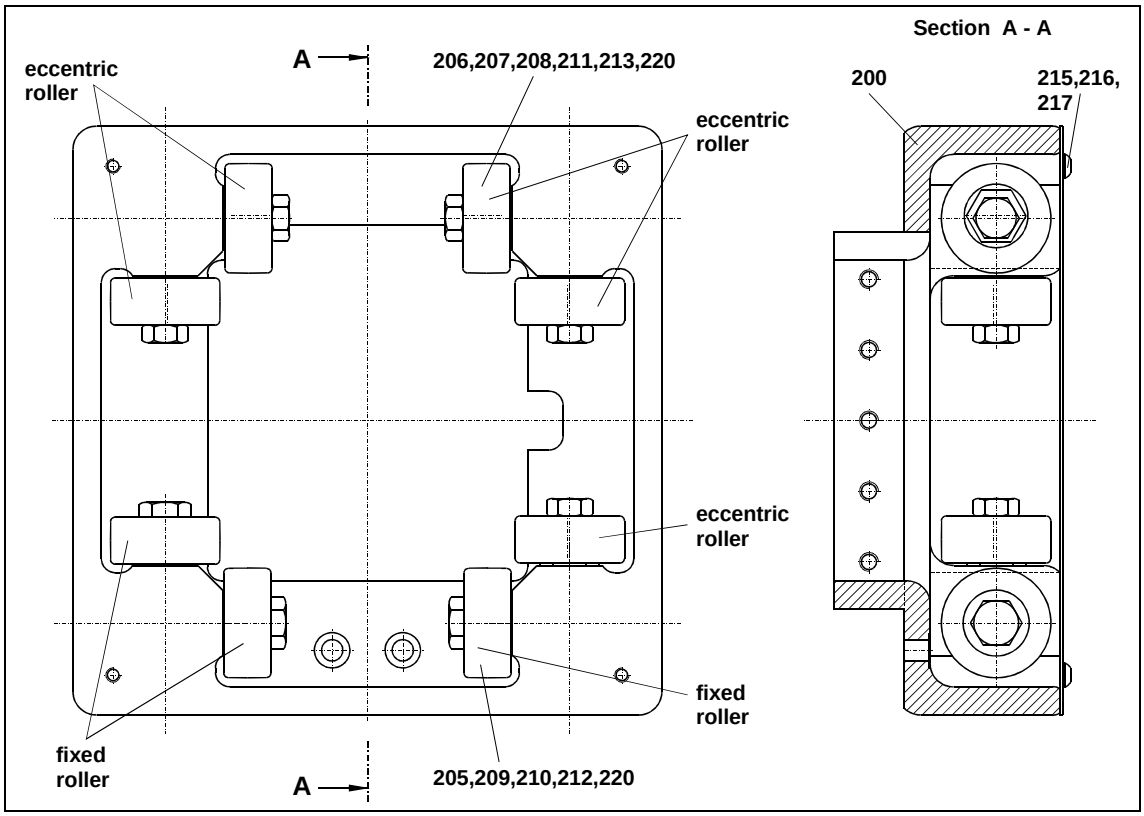


Fig. 8-5: HTR80: Rotor station, lower outer section

Pos	Pcs.	Name	Part No.
200	1	Roller housing component 1 lower H4TR8009	424-300102
205	3	Roller HLE150 R4OL0025	416-201020
206	5	R4OL0026	416-201010
207	5	Eccentric bush E4XZ0001	125-071100
208	20	Plain washer DIN 125 B10,5(M10)	135-000500
209	9	Ring HLE100 R4NG0004	125-070300
210	3	Hexagon screw DIN 933 M12x40	130-213304

Pos	Pcs.	Name	Part No.
211	5	Pan head screw DIN 6912 M10x40	130-302800
212	3	Safety plate 12(M12)	135-201055
213	5	10(M10)	135-201054
215	1	Cover plate B4LE0623	125-080800
216	4	Oval head screw M6x10	130-501541
217	4	Safety plate 6(M6)	135-201052
220	8	Sealing plug	400-303100

Parts list for Fig. 8-5

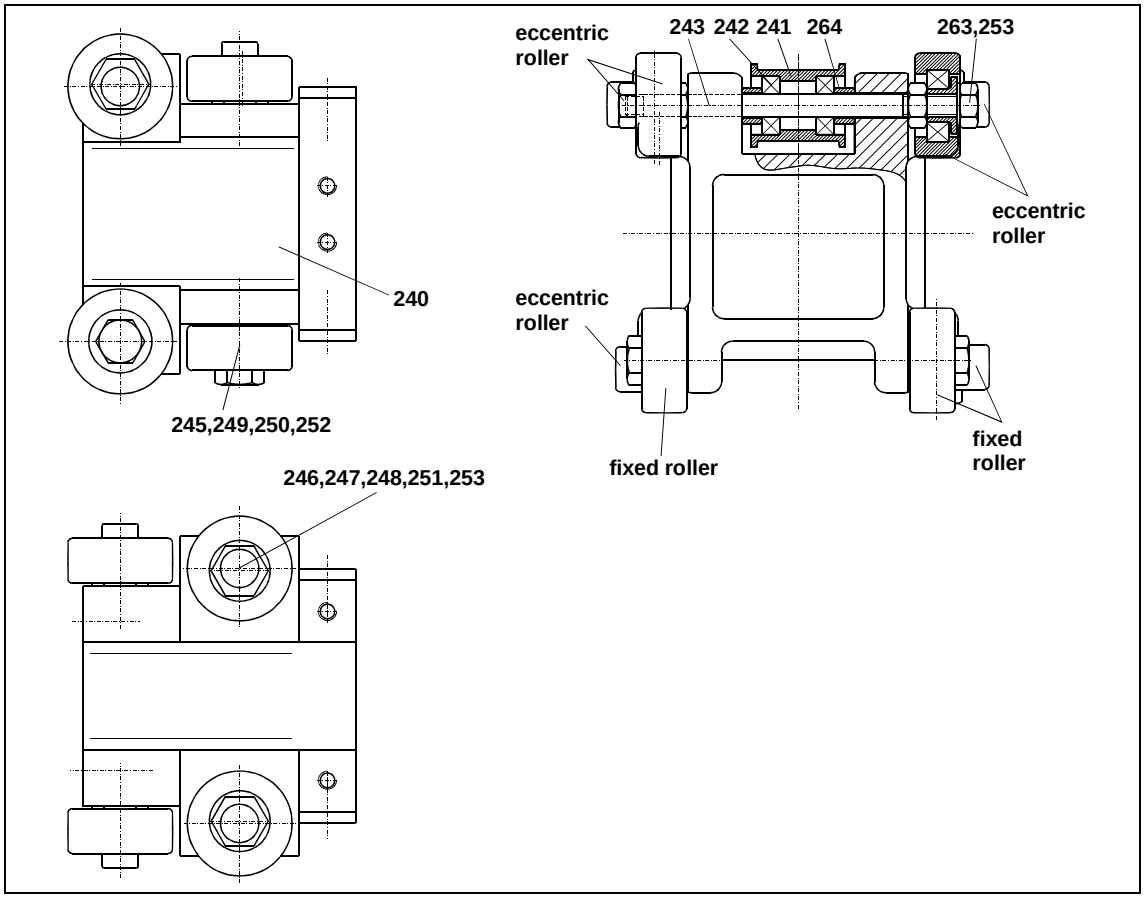


Fig. 8-6: HTR80: Rotor station, upper central section

Pos	Pcs.	Name	Part No.
240	1	Roller housing component 2 upper H4TR8006	424-300114
241	1	Deflection roller R4OL0087	128-000050
242	2	Deep groove ball bearing 6000.2RSR	416-000005
243	1	Axis for deflection roller W4EL0176	128-000058
245	3	Roller HLE150 R4OL0025	416-201020
246	5	R4OL0026	416-201010
247	5	Eccentric bush HLE150 E4XZ0001	125-071100
248	12	Plain washer DIN 125 B10,5(M10)	135-000500

Pos	Pcs.	Name	Part No.
249	9	Ring HLE100 R4NG0004	125-070300
250	3	Hexagon screw DIN 933 M12x40	130-213304
251	3	Pan head screw DIN 6912 M10x40	130-302800
252	3	Safety plate 12(M12)	135-201055
253	5	10(M10)	135-201054
262	2	Hexagon nut DIN936 M10	135-702031
263	2	Hexagon nut DIN934 M10	135-702004
264	2	Distance bush B4UC0107	128-000062

Parts list for Fig. 8-6

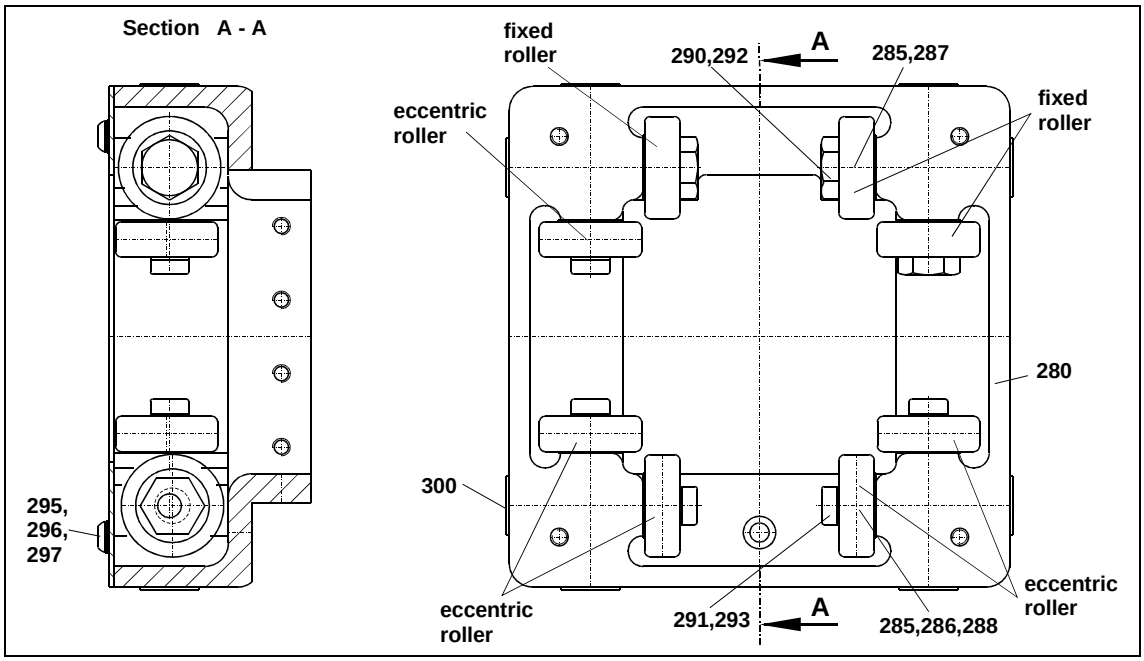


Fig. 8-7: HTR80: Rotor station, lower central section

Pos	Pcs.	Name	Part No.
280	1	Roller housing component 2 lower H4TR8004	424-300116
285	8	Roller HLE100 R4OL0027	416-201030
286	5	Eccentric bush E4XZ0003	125-070100
287	3	Ring HLE100 R4NG0004	125-070300
288	10	Plain washer DIN 125 B8,4(M8)	135-000400
290	3	Hexagon screw DIN 933 M12x20	130-213297
291	5	Pan head screw DIN 6912 M8x30	130-302750

Pos	Pcs.	Name	Part No.
292	3	Safety plate 12(M12)	135-201055
293	5	No110 8(M8)	135-201053
295	1	Cover plate B4LE0622	125-080805
296	4	Oval head screw NB601 M6x10	130-501541
297	4	Safety plate No. 110 6(M6)	135-201052
300	8	Sealing plugs	400-303100

Parts list for Fig. 8-7

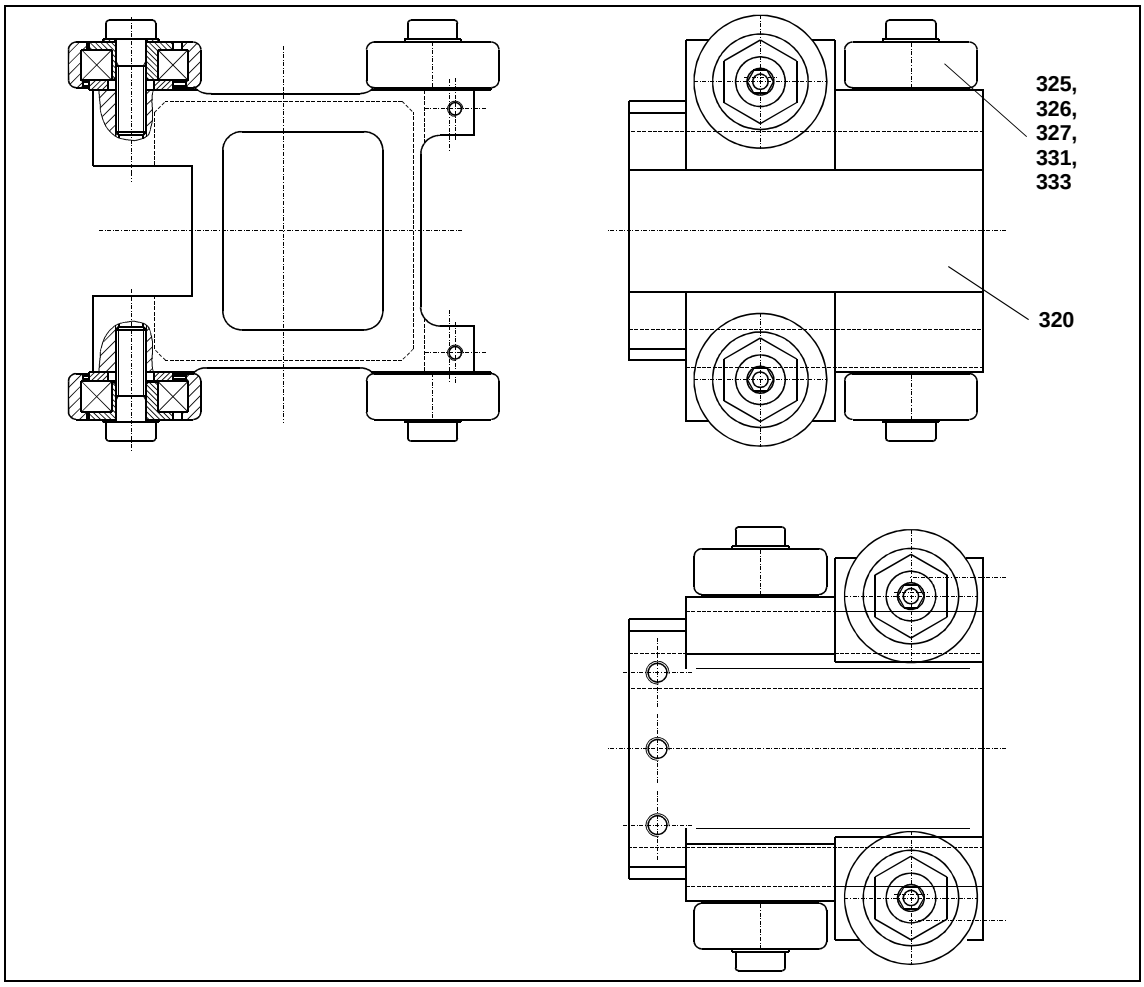


Fig. 8-8: HTR80: Rotor station, upper inner section

Pos	Pcs.	Name	Part No.
320	1	Roller housing component 3 upper H4TR8001	424-300101
325	8	Roller HLE100 R4OL0027	416-201030
326	8	Eccentric bush E4XZ0003	125-070100

Pos	Pcs.	Name	Part No.
327	8	Ring HLE100 S4EI0009	125-068160
331	8	Pan head screw DIN 6912 M8x25	130-302745
333	8	Safety plate No. 110 8(M8)	135-201053

Parts list for Fig. 8-8

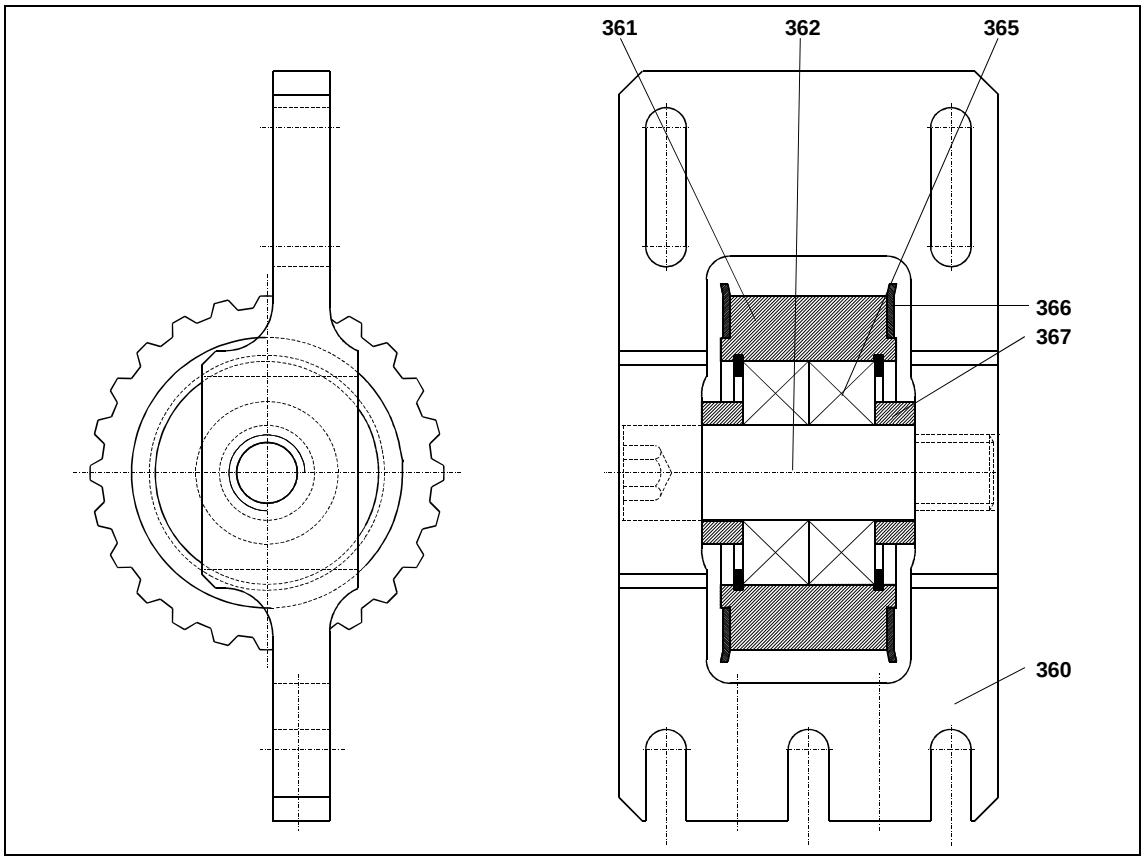


Fig. 8-9: HTR80: Main drive belt tensioner

Pos	Pcs.	Name	Part No.
360	1	Belt tensioner component 1 H4TR8023	424-300108
361	1	Tooth lock washer Z4AS3247	420-100737
362	1	Axis for tooth lock washer B4OL0279	128-000046

Pos	Pcs.	Name	Part No.
365	2	Deep groove ball bearing DIN 625 6204.RSR	416-001330
366	2	Locking ring DIN 472 47x1,75	135-600231
367	2	Distance bush B4UC0111	400-200025

Parts list for Fig. 8-9

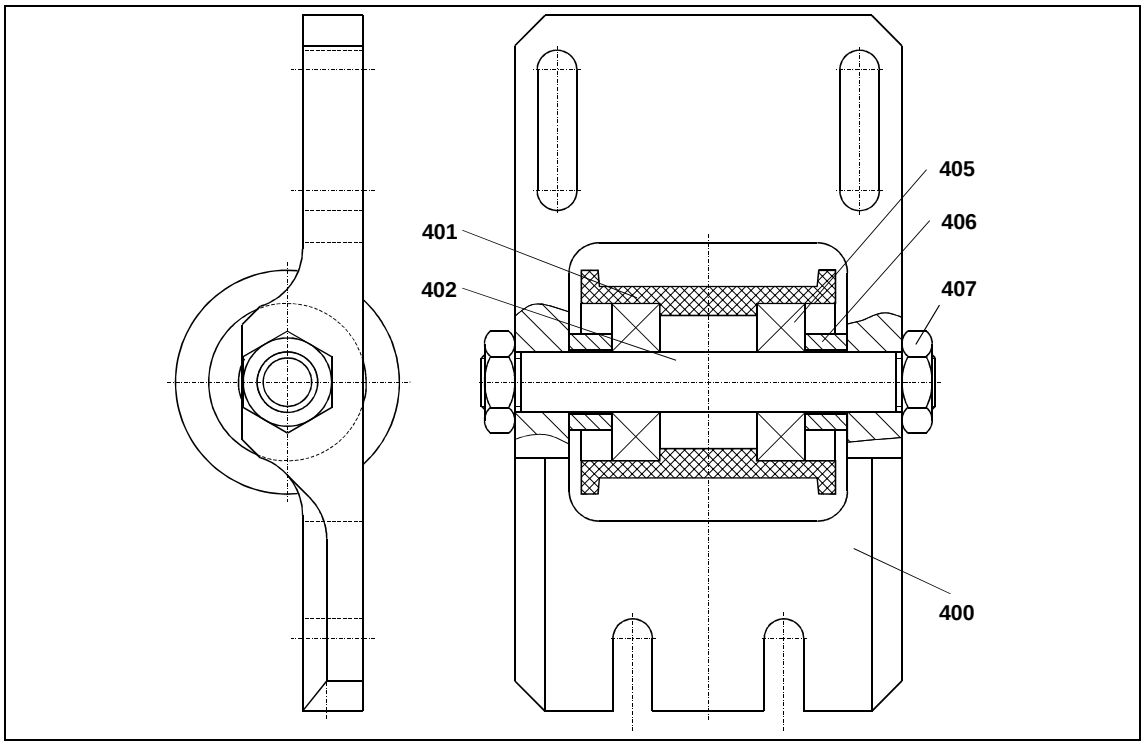


Fig. 8-10: HTR80: Transmission drive belt tensioner

Pos	Pcs.	Name	Part No.
400	1	Belt tensioner component 2 H4TR8025	424-300124
401	1	Deflection roller R4OL0087	128-000050
402	1	Shaft for deflection roller W4EL0179	128-000052

Pos	Pcs.	Name	Part No.
405	2	Deep groove ball bearing DIN 625 6000.2RSR	416-000005
406	2	Distance bush B4UC0108	128-000060
407	2	Nut DIN 936 M10	135-702031

Parts list for Fig. 8-10

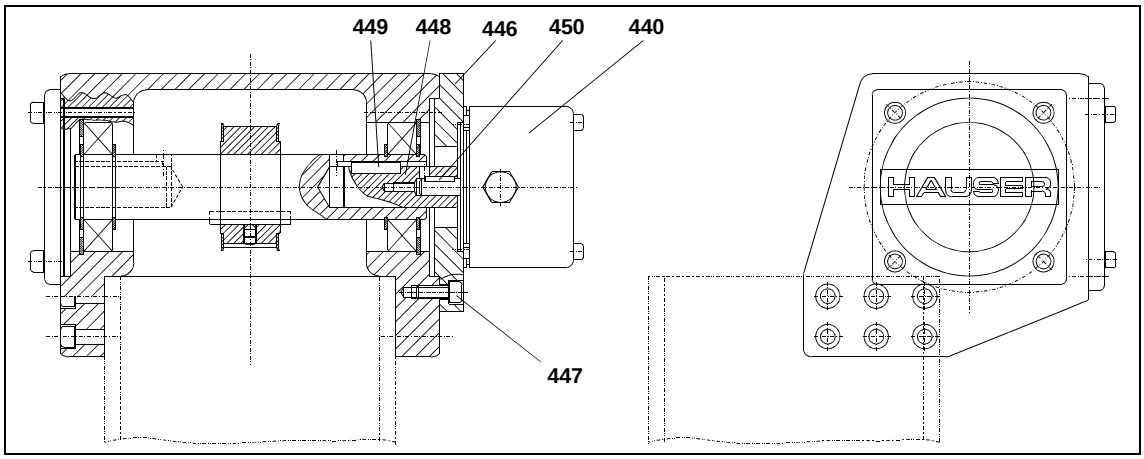


Fig. 8-11: HTR80: Limit switch gear

Pos	Pcs.	Name	Part No.
440	1	Limit switch i=8:1	
Variant 1		3 PNP-opener (COMPAX compliant)	029-180000
Variant 2		1 PNP-opener, 2 PNP-closer	029-180001
Variant 3		1 PNP-opener, 2 mech. limit switch	029-180002
Variant 4		1 PNP-closer, 2 mech. limit switch	029-180003

Pos	Pcs.	Name	Part No.
446	1	Gear flange F4LA0262	
447	4	Pan head screw DIN 912 M8x20	135-721063
448	1	Shaft W4KL0154	400-102013
449	1	Spline DIN 6885 8x7x30	131-600117
450	1	3x3x18	

Parts list for Fig. 8-11

8.2 HTR50

8.2.1 HTR50 wearing parts

☞ Position numbers and component designations, see Table 8-2.

Toothed belts

Pos	Name	Location	Figure No.	Part No.
65	Toothed belt 25AT10 HPF, length = 620 + stroke [mm]	Main drive	Fig. 8-13	420-000016
93	Toothed belt 25 AT5 HPF, length = 560 + stroke [mm]	Transmission drive	Fig. 8-14	420-000006

Rollers

Pos	Name	Location	Figure No.	Part No.
285	Roller R4 OL 0027 Fixed + Eccentric rollers	Rotor station, lower outer section	Fig. 8-16	416-201030
365		Rotor station, lower central section	Fig. 8-18	
325		Rotor station, upper central section	Fig. 8-17	
405	Roller R4 OL 0028 Fixed + Eccentric rollers	Rotor station, upper inner section	Fig. 8-19	416-201072

8.2.2 HTR50 replacement parts

Tooth lock washers

Pos	Name	Location	Figure No.	Part No.
164	Tooth lock washer Z4 AS 2504 for shafts ∅ 25	Drive station	Fig. 8-15	420-100105
601	Tooth lock washer Z4 AS 2500 for shafts ∅ 32	Main drive belt tensioner	Fig. 8-20	420-100112

Deflection rollers

Pos	Name	Location	Figure No.	Part No.
350	Deflection roller	Rotor station, upper central section	Fig. 8-17	128-000110
641		Transmission drive belt tensioner	Fig. 8-21	

Safety plates (Warning! generally always use new safety plates)

Pos	Name	Location	Figure No.	Part No.
372,377	Safety plate 5(M5)	Rotor station, lower central section	Fig. 8-18	135-201080
413		Rotor station, upper central section	Fig. 8-19	
5,14,20, 24,29	Safety plate 6(M6)	Complete telescope	Fig. 8-12	135-201052
72,56, 50		Telescope, central section	Fig. 8-13	
84		Telescope, inner section	Fig. 8-14	
175,179		Drive station	Fig. 8-15	
293	Safety plate 8 (M8)	Rotor station, lower outer section	Fig. 8-16	135-201053
331		Rotor station, upper central section	Fig. 8-17	
373		Rotor station, lower central section	Fig. 8-18	
413		Rotor station, upper inner section	Fig. 8-19	

8.2.3 Component overview with HTR50 position numbers

Name	Position number range HTR50	
Complete telescope	1	39
Complete telescope central section	40	79
Complete telescope inner section	80	119
Drive station	160	199
Rotor station, lower outer section	280	319
Rotor station, upper central section	320	359
Rotor station, lower central section	360	399
Rotor station, upper inner section	400	439
Main drive belt tensioner	600	639
Transmission drive belt tensioner	640	679
Limit switch mechanism	440	479

Table 8-2: Overview components / position numbers

8.2.4 Component diagrams with HTR50 position numbers

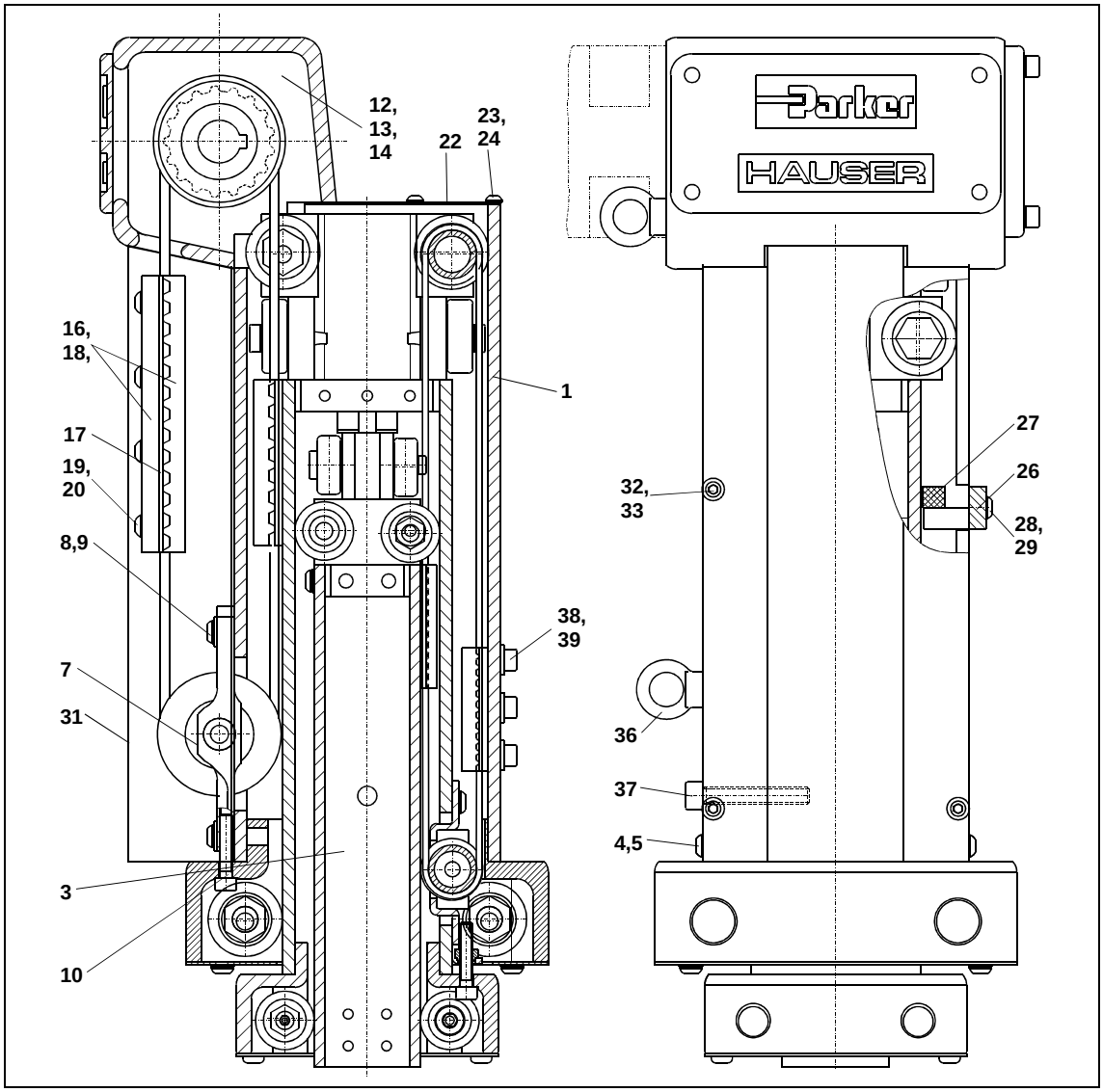


Fig. 8-12: HTR50: Complete telescope (HTR50)

Pos	Pcs.	Name	Part No.
1	1	Telescope component 2 profile H4TR5022	400-204025
3	1	Telescope component 3 H4TR5013	→ Fig. 8-13
4	8	Oval head screw NB601 M6x16	130-501544
5	8	Safety plate No. 110 6(M6)	135-201052
7	1	Belt tensioner component 2a H4TR5027 (→ Fig. 8-20)	510-000828
8	4	Oval head screw NB601 M6x16	130-501544
9	4	Plain washer DIN 125 B6,4(M6)	135-000300
10	1	Pan head screw DIN 912 M6x30	130-302347
12	1	Drive station H4TR5001 (→Fig. 8-15)	510-000820
13	6	Pan head screw DIN 912 M6x20	130-302344
14	6	Safety plate No. 110 6(M6)	135-201052
16	1	Clamping plate Z4RL8308	500-000586
17	2	Distance plate B4LE1057	128-000140
18	1	Clamping plate P4LA5195	128-000142
19	8	Oval head screw NB601 M6x16	130-501544

Pos	Pcs.	Name	Part No.
20	8	Safety plate No. 110 6(M6)	135-201052
22	1	Cover plate B4LE1058	128-000144
23	4	Oval head screw NB601 M4x10	130-501513
24	8	Safety plate No. 110 6(M6)	135-201052
26	2	End position damper component 2 H4TR5026	128-000146
27	4	Rubber buffer	400-302140
28	6	Oval head screw NB601 M6x16	130-501544
29	8	Safety plate No. 110 6(M6)	135-201052
31	1	Toothed belt cover B4LE1056	128-000148
32	X	Oval head screw NB601 M6x10	130-501541
33	X	Plain washer DIN 125 B6,4(M6)	135-000300
36	2	Eyebolt DIN 580 M6	130-501701
37	1	Pan head screw DIN 912 M6x25	130-302346
38	6	M6x20	130-302344
39	6	Plain washer DIN 125 B6,4(M6)	135-000300

Parts list for Fig. 8-12. [X = 4 + (14/m)•stroke]

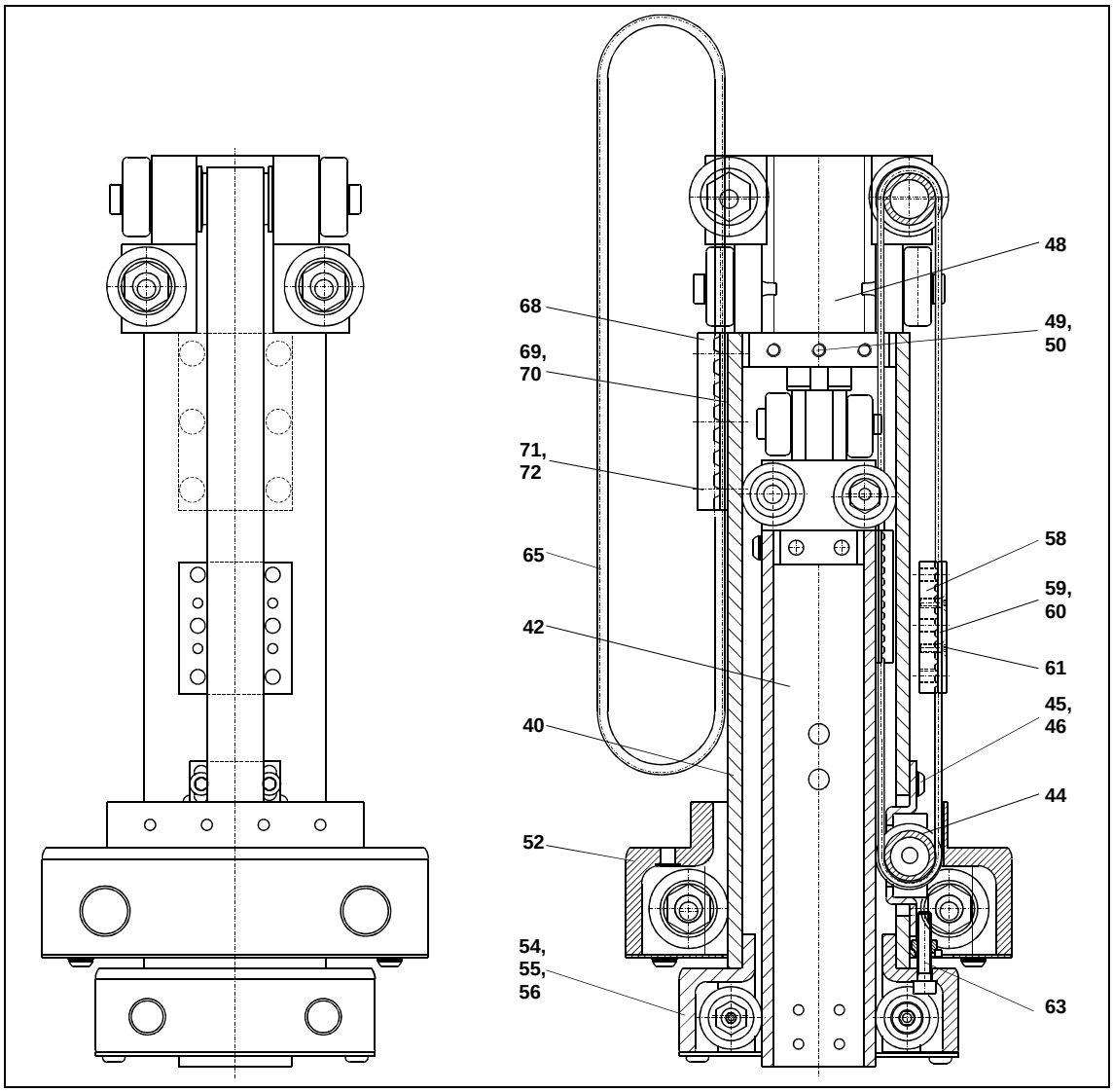


Fig. 8-13: HTR50: Complete telescope central section

Pos	Pcs.	Name	Part No.
40	1	Telescope component 3 profile H4TR5021	400-204020
42	1	Telescope component 4 profile H4TR5012	→ Fig. 8-14
44	1	Belt tensioner component 3 H4TR5014 (→ Fig. 8-21)	510-000830
45	4	Oval head screw NB601 M6x10	130-501541
46	4	Plain washer DIN125 B6,4 (M6)	135-000300
48	1	Rotor station component 3 upper H4TR5019 (→ Fig. 8-17)	510-000822
49	6	Oval head screw NB601 M6x12	130-501542
50	6	Safety plate No. 110 6(M6)	135-201052
52	1	Rotor station component 2 lower (H4TR8021) (→ Fig. 8-16)	510-000806
54	1	Rotor station component 3 lower H4TR5005 (→ Fig. 8-18)	510-000824
55	6	Oval head screw NB601 M6x12	130-501542
56	6	Safety plate No. 110 6(M6)	135-201052

Pos	Pcs.	Name	Part No.
58	1	Clamping plate, belt clamping Z4RL8306	500-000582
59	2	Distance plate B4LE1049	128-000120
60	1	B4LE1061	128-000134
61	4	Countersunk screw DIN 7991 M4x12	130-106513
63	1	Pan head screw DIN 912 M6x30	135-721046
65	1	Toothed belt 25AT10HPF	420-000016
68	1	Clamping plate, belt clamping Z4RL8307	500-000584
69	2	Distance plate B4LE1054	128-000136
70	1	B4LE1055	128-000138
71	6	Oval head screw NB601 M6x14	130-501543
72	6	Safety plate No. 110 6(M6)	135-201052

Parts list for Fig. 8-13.

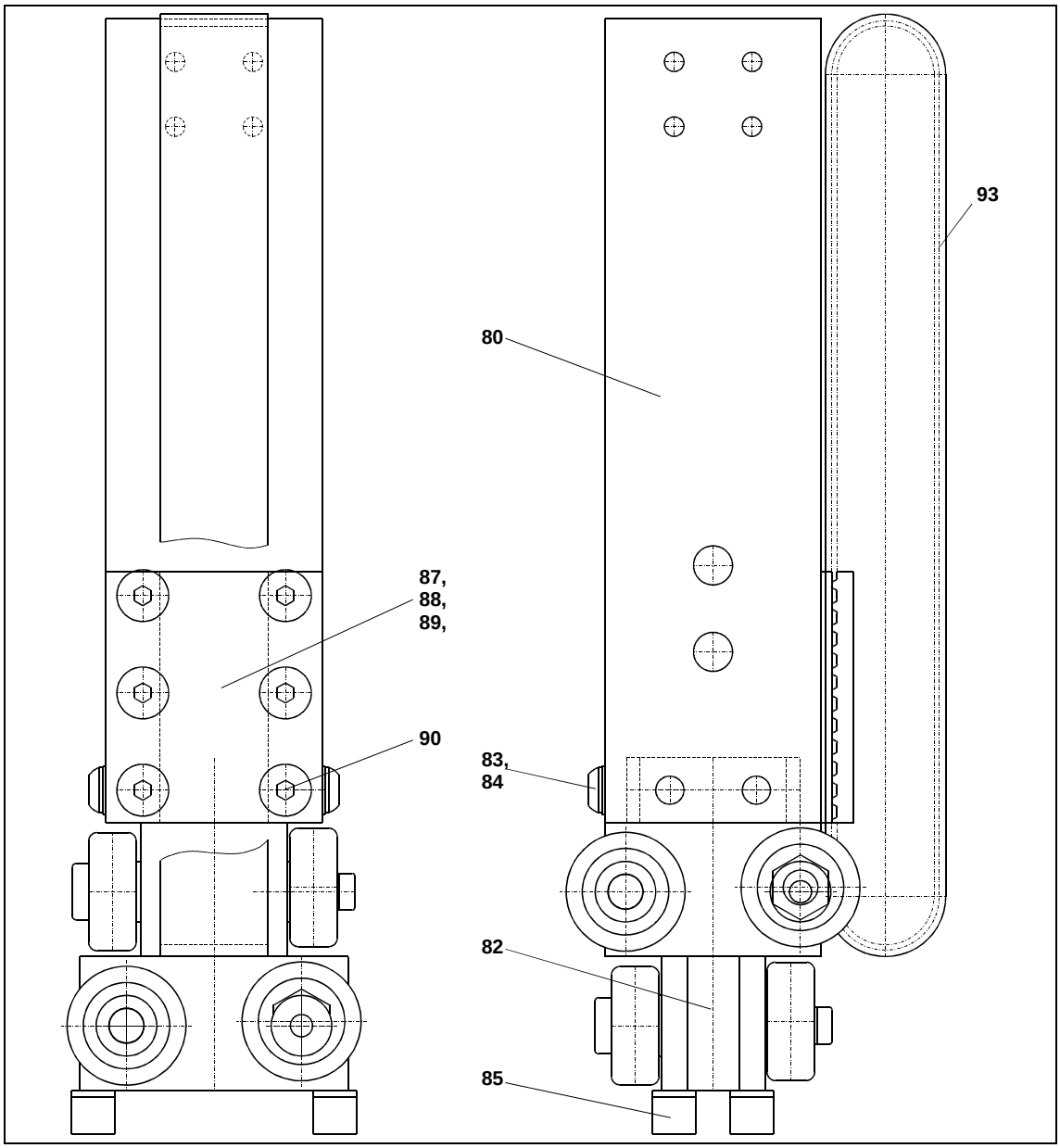


Fig. 8-14: HTR50: Complete telescope inner section

Pos	Pcs.	Name	Part No.
80	1	Telescope component 4 profile H4TR5017	400-204015
82	1	Rotor station component 4 upper H4TR5003 (→ Fig. 8-19)	510-000826
83	6	Oval head screw NB601 M6x12	130-501542
84	6	Safety plate 6(M6)	135-201052
85	4	Rubber buffer	400-302140

Pos	Pcs.	Name	Part No.
87	1	Clamping plate Z4RL8305	500-000580
88	1	Distance plate B4LE1048	128-000122
89	2	B4LE1049	128-000120
90	6	Countersunk screw DIN 7991 M6x12	130-106537
93	1	Toothed belt 25AT5HPF	420-000006

Parts list for Fig. 8-14.

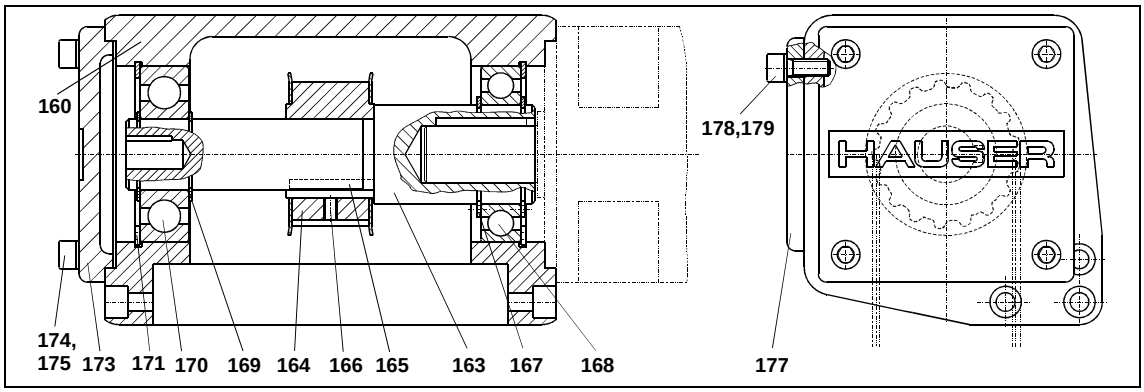


Fig. 8-15: HTR50: Drive station (Part No.: 510-000820)

Pos	Pcs.	Name	Part No.
160	1	Drive housing H4TR5002	424-300090
163	1	Drive shaft W4EL3116	128-000130
164	1	Tooth lock washer Z4AS2504	420-100103
165	1	Spline DIN 6885-A8x7x32	
166	1	Set screw DIN 916 M5x6	130-902148
167	2	Locking ring DIN 471 Ø35x1.5	135-600150
168	1	Deep groove ball bearing DIN 625 6007.2RSR	416-001325
169	2	Locking ring DIN 471 Ø25x1.2	135-600120

Pos	Pcs.	Name	Part No.
170	1	Deep groove ball bearing DIN 625 6305.2RSR	416-001307
171	2	Locking ring DIN 472 Ø62x2	135-600240
173	1	Flange F4LA0054	424-400010
174	4	Pan head screw DIN 912 M6x20	130-302344
175	4	Safety plate No. 110 6(M6)	135-201052
177	1	Flange F4LA0345	424-300054
178	4	Pan head screw DIN 912 M6x25	130-302346
179	4	Safety plate No. 110 6(M6)	135-201052

Parts list for Fig. 8-15.

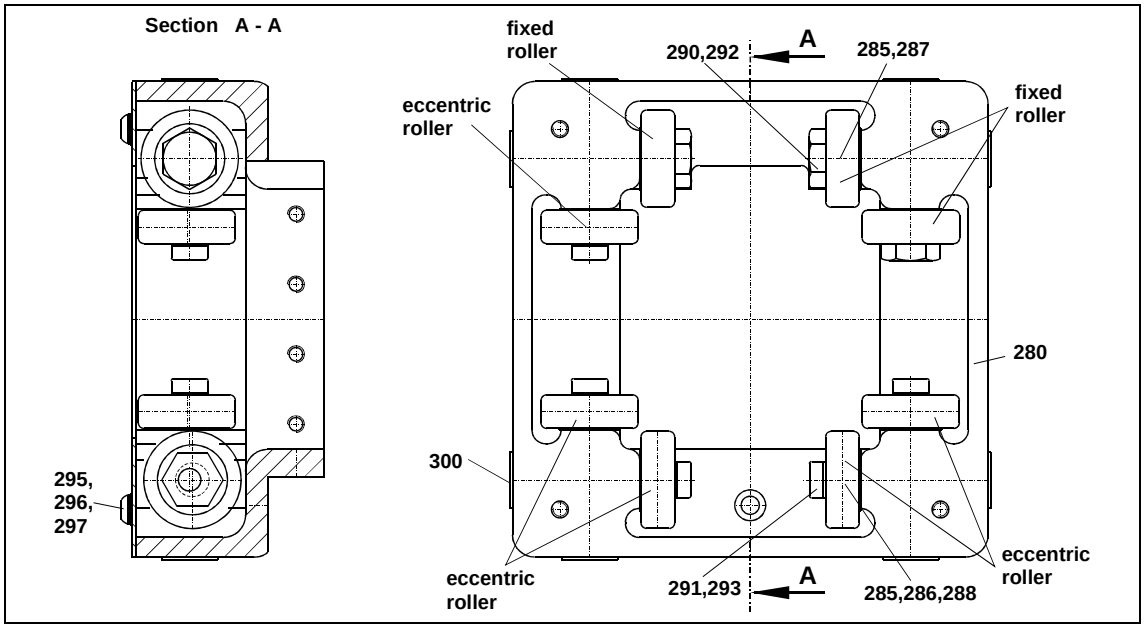


Fig. 8-16: HTR50: Rotor station, lower outer section

Pos	Pcs.	Name	Part No.
280	1	Roller housing component 2 lower H4TR8004	424-300116
285	8	Roller HLE100 R4OL0027	416-201030
286	5	Eccentric bush E4XZ0003	125-070100
287	3	Ring HLE100 R4NG0004	125-070300
288	10	Plain washer DIN 125 B8,4(M8)	135-000400
290	3	Hexagon screw DIN 933 M12x20	130-213297
291	5	Pan head screw DIN 6912 M8x30	130-302750

Pos	Pcs.	Name	Part No.
292	3	Safety plate 12(M12)	135-201055
293	5	No110 8(M8)	135-201053
295	1	Cover plate B4LE0622	125-080805
296	4	Oval head screw NB601 M6x10	130-501541
297	4	Safety plate No. 110 6(M6)	135-201052
300	8	Sealing plugs	400-303100

Parts list for Fig. 8-16.

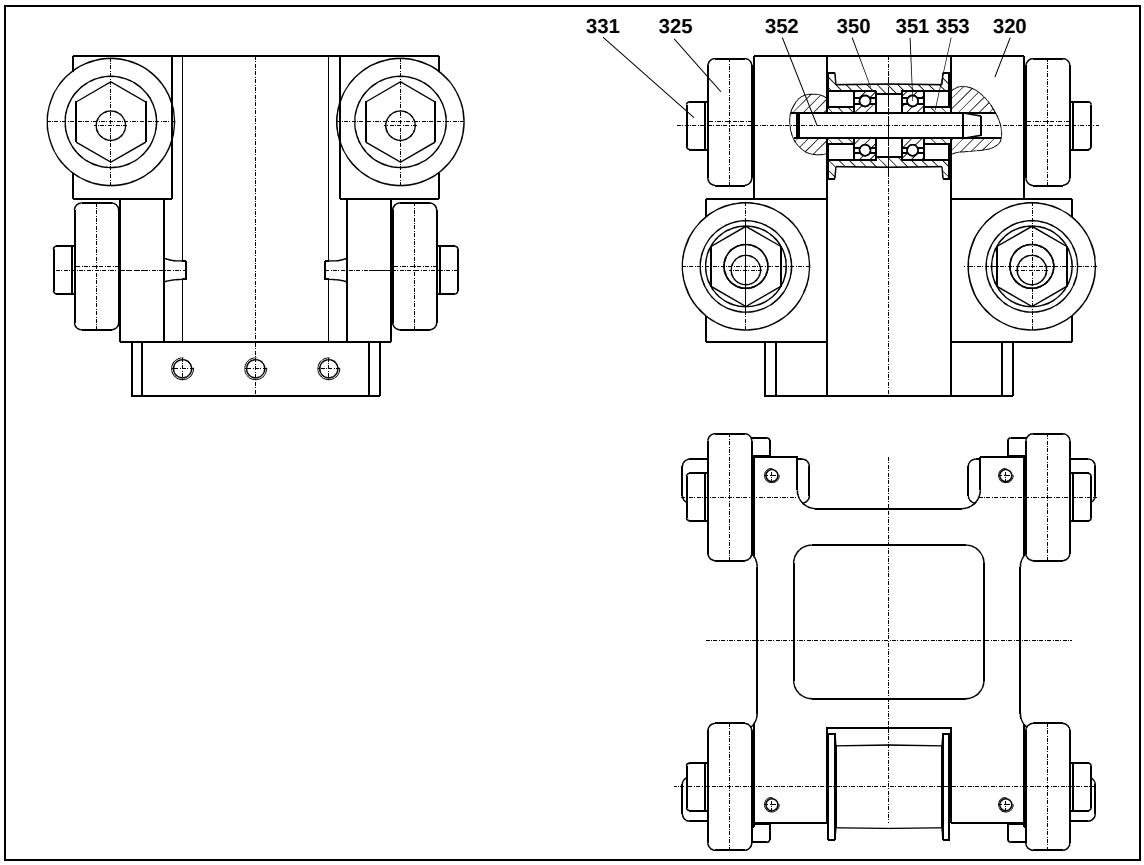


Fig. 8-17: HTR50: Rotor station, upper central section

Pos	Pcs.	Name	Part No.
320	1	Rotor station component 3 upper H4TR8020	510-000808
350	1	Deflection roller R4OL0094	128-000110
351	2	Deep groove ball bearing 607.2RSR	416-001290

Pos	Pcs.	Name	Part No.
352	1	Axis for deflection roller W4EL0211	128-000114
353	2	Distance bush B4UC0121	128-000116

Parts list for Fig. 8-17.

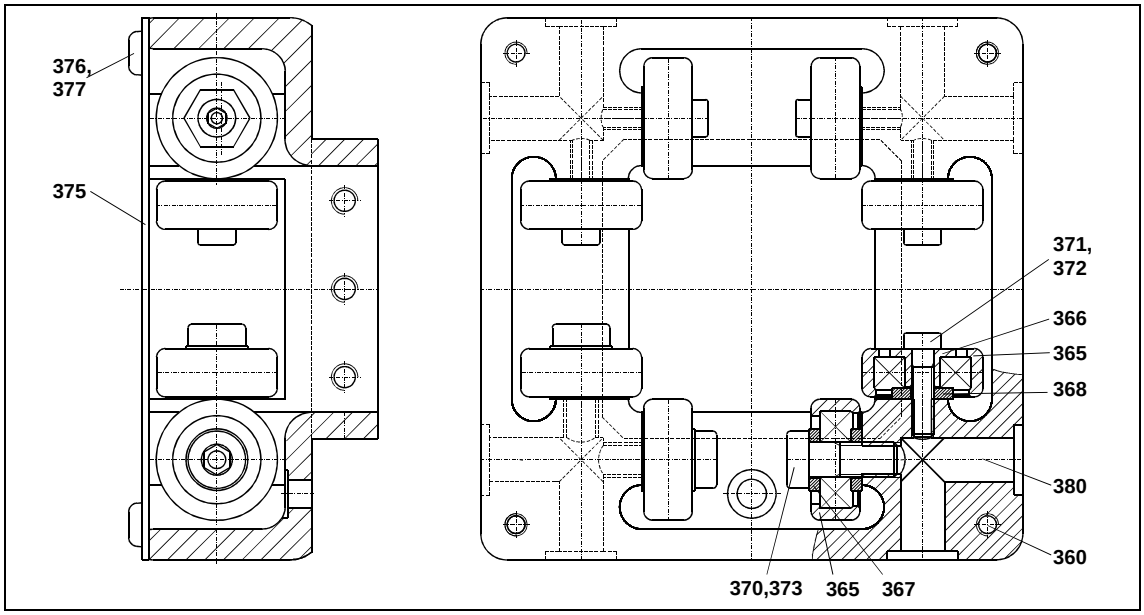


Fig. 8-18: HTR50: Rotor station, lower central section

Pos	Pcs.	Name		Part No.
360	1	Roller housing component 3 lower H4TR5006		424-300050
365	8	Roller HLE80 R4OL0028		416-201070
366	5	Eccentric bush E4XZ0004		125-068100
367	3	Washer	S4EI0009	125-068160
368	5		S4EI0008	125-068150
370	3	Pan head screw DIN	M8x20	130-302373
371	5	6912	M5x20	130-302680

Pos	Pcs.	Name		Part No.
372	5	Safety plate No. 110	5(M5)	135-201080
373	3		8(M8)	135-201053
375	1	Cover plate B4LE1052		128-000128
376	4	Oval head screw NB601 M5x10		130-501526
377	4	Safety plate No. 110	5(M5)	135-201080
380	8	Sealing plug		400-303110

Parts list for Fig. 8-18.

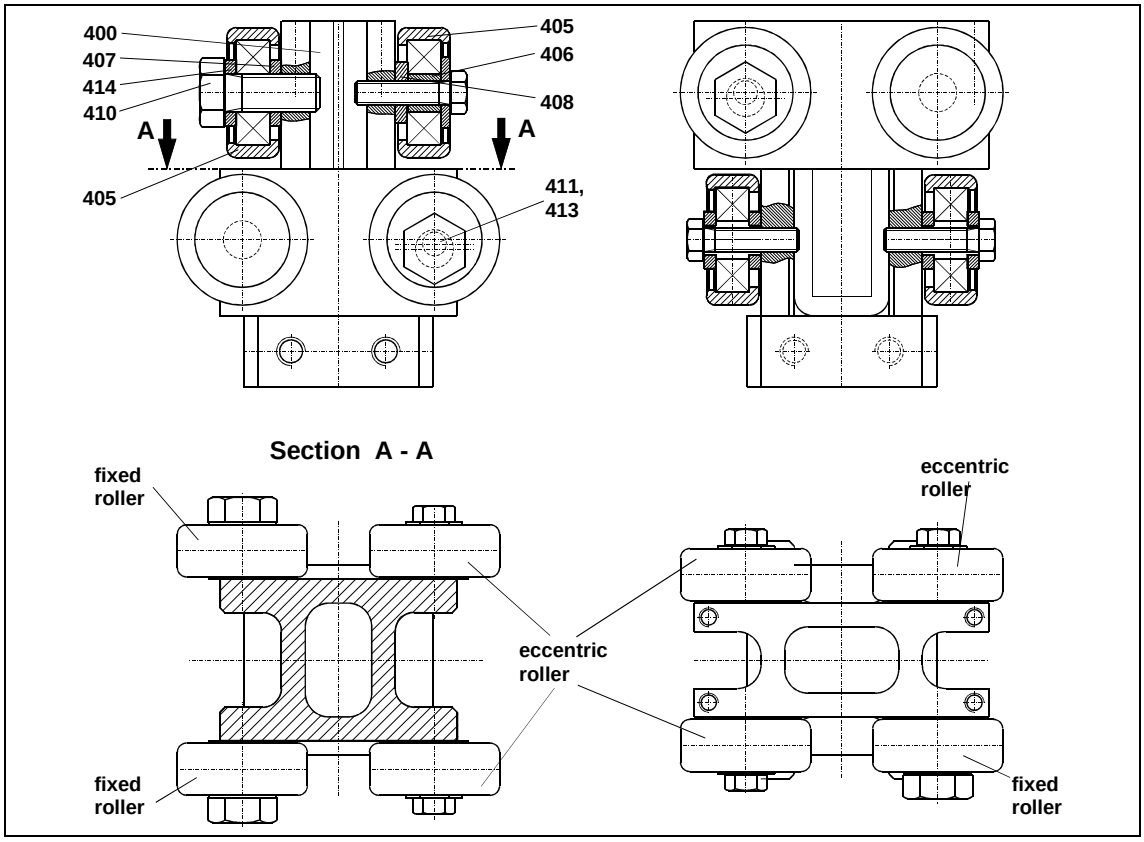


Fig. 8-19: HTR50: Rotor station, upper inner section

Pos	Pcs.	Name		Part No.
400	1	Roller housing component 4 upper H4TR5004		424-300052
405	8	Roller HLE80 R4OL0028		416-201070
406	5	Eccentric bush E4XZ0004		125-068100
407	3	Washer	S4EI0009	125-068160
408	5		S4EI0008	125-068150

Pos	Pcs.	Name		Part No.
410	3	Pan head screw DIN6912	M8x20	130-302372
411	5		M5x20	130-302680
413	5	Safety plate	5(M5)	135-201080
414	3		8(M8)	135-201053

Parts list for Fig. 8-19.

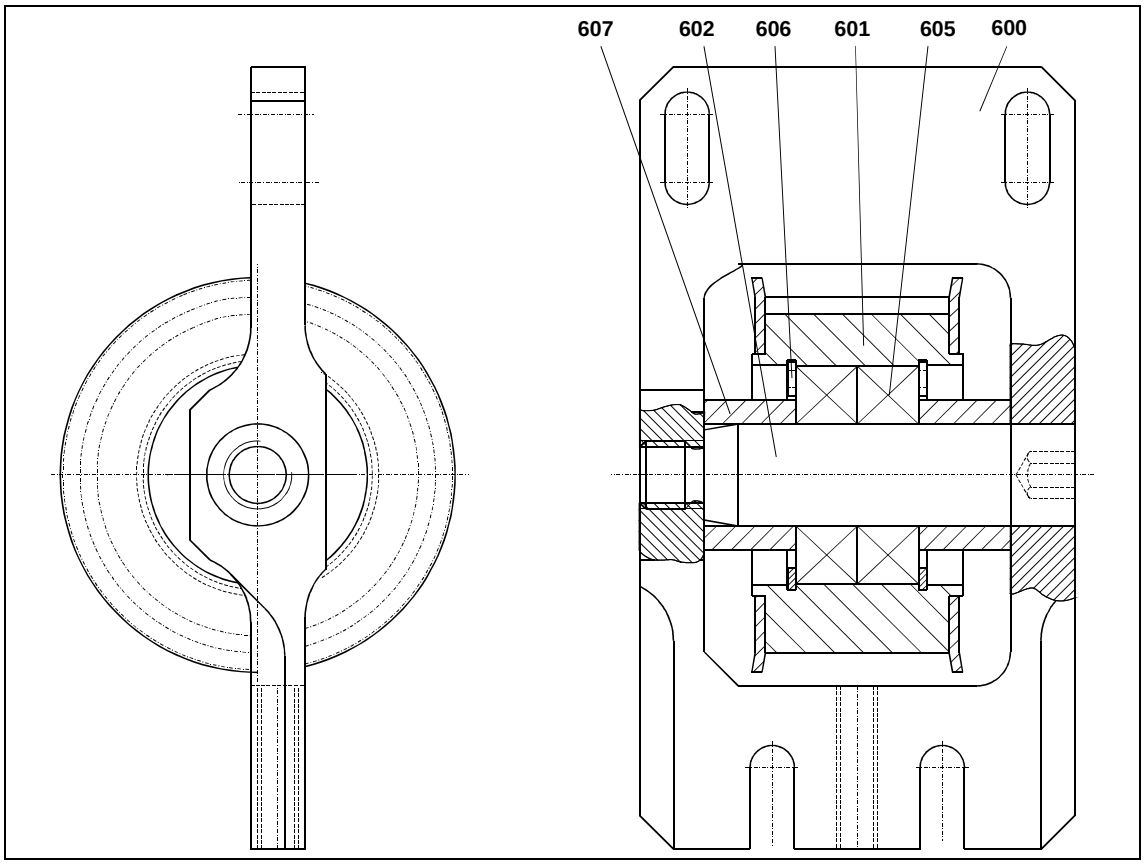


Fig. 8-20: HTR50: Main drive belt tensioner

Pos	Pcs.	Name	Part No.
600	1	Belt tensioner component 2a H4TR5025	424-300060
601	1	Tooth lock washer Z4AS2500	420-100112
602	1	Axis for tooth lock washer B4OL0424	128-000124

Pos	Pcs.	Name	Part No.
605	2	Deep groove ball bearing 60022RS	416-001320
606	2	Locking ring DIN 472 Ø32x1.2	135-600222
607	2	Distance bush B4UC0123	128-000126

Parts list for Fig. 8-20.

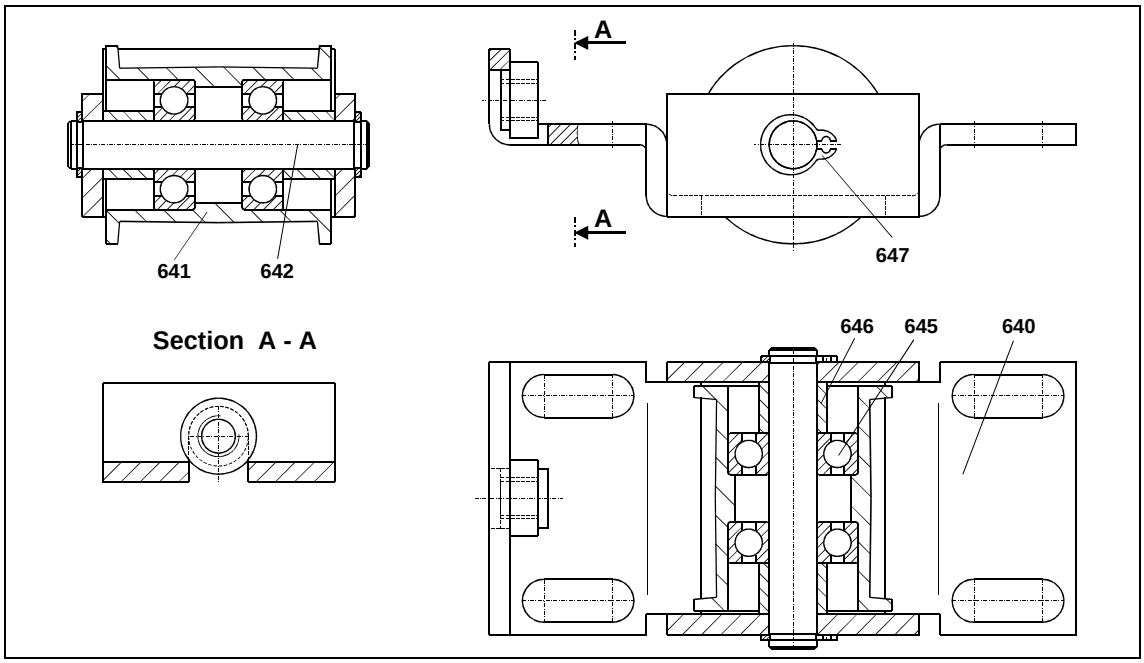


Fig. 8-21: HTR50: Transmission drive belt tensioner

Pos	Pcs.	Name	Part No.
640	1	Belt tensioner component 3 H4TR5015	128-000118
641	1	Deflection roller R4OL0094	128-000110
642	1	Axis for deflection roller W4EL4042	128-000132

Pos	Pcs.	Name	Part No.
645	2	Deep groove ball bearing DIN 625 607.2RS	416-001290
646	2	Distance bush B4UC0121	128-000116
647	2	Locking ring DIN 471 Ø7x0.8	135-600104

Parts list for Fig. 8-21.

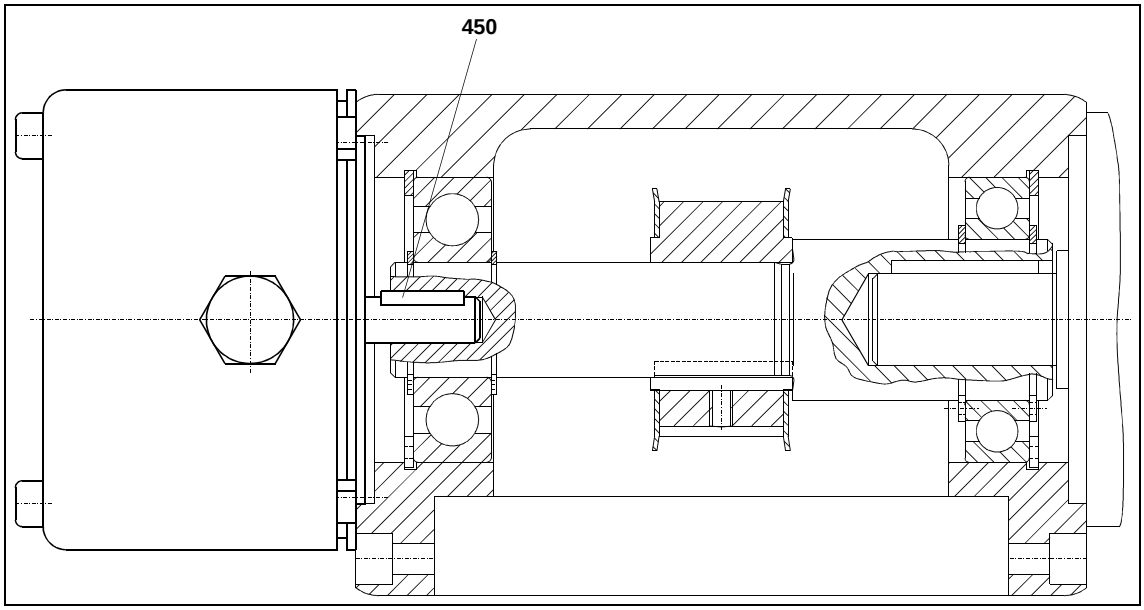


Fig. 8-22: HTR50: Limit switch gear

Pos	Pcs.	Name	Part No.
440	1	Limit switch mechanism i = 8:1	
Variant 1		3 PNP-opener (COMPAX compliant)	029-180000
Variant 2		1 PNP-opener, 2 PNP-closer	029-180001
Variant 3		1 PNP-opener, 2 mech. limit switch	029-180002
Variant 4		1 PNP-closer, 2 mech. limit switch	029-180003

Pos	Pcs.	Name	Part No.
445	4	Pan head screw DIN 912 M4x10	130-302296
446	1	Spline DIN 6885 A3x3x18	

Parts list for Fig. 8-22.

Keyword index

Keyword index