



FEDERATION EUROPEENNE DE LA MANUTENTION  
SECTION I  
HEAVY LIFTING APPLIANCES

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# **RULES FOR THE DESIGN OF HOISTING APPLIANCES**

BOOKLET 8

TEST LOADS AND TOLERANCES

The total 3rd Edition comprises booklets 1 to 8

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This booklet is part of the "Rules for the design of hoisting appliances" consisting of 8 booklets :

- Booklet 1 - Object and scope
- Booklet 2 - Classification and loading on structures and mechanisms
- Booklet 3 - Calculating the stresses in structures
- Booklet 4 - Checking for fatigue and choice of mechanism components
- Booklet 5 - Electrical equipment
- Booklet 6 - Stability and safety against movement by the wind
- Booklet 7 - Safety rules
- Booklet 8 - Test loads and tolerances

and must not be used separately.

## BOOKLET 8

### TEST LOADS AND TOLERANCES

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8.1.

## TESTS

Prior to being placed in service, appliances must be tested under overload conditions, as follows :

8.1.1.

### DYNAMIC TEST

The dynamic test shall be carried out with an overload coefficient  $\rho_1 = 1,2$ , i.e. with a load equal to 120 % of the safe working load. All motions shall be carefully operated in turn, without checking speeds of temperature rises in the motors (see clause 2.3.3.c).

8.1.2.

### STATIC TEST

The static test shall be carried out with an overload coefficient  $\rho_2 = 1,4$ , i.e. with a load equal to 140 % of the safe working load. This test must be carried out under still conditions and consists in hoisting the safe working load to a small distance above the ground and then adding the required surplus without shock (see clause 2.3.3.c.).

8.1.3.

### NOTE 1

The figures given for these test loads represent minimum requirements. Where national legislation or rules call for higher values, these must be complied with insofar as appliances destined for such countries are concerned.

The test to be used in certain countries are given in appendix A-8.1.3. for information.

### NOTE 2

When making these tests, it is customary to measure the deflection of the structure of an appliance.

The present rules impose no obligation as to the allowable deflections.

Should the user wish to impose a deflection limit, he must specify this in his call for tenders (1).

(1)

The custom of regarding small deflection under load as a measure of the strength of an appliance should be discontinued.

Although an unduly large deflection can adversely affect lattice girders because of the danger of movement at the joints, no untoward effects are to be feared in the case of solid-web or box girders.

In practice, the magnitude of the deflection should be limited only from the standpoint of convenience of operation, since vertical oscillations of the load can be troublesome in some cases.

## 8.2.

## TOLERANCES OF CRANES AND TRACKS

## GENERAL

The use of the Design Rules presupposes that the tolerances specified hereafter for cranes and tracks shall be maintained. These tolerances apply unless other conditions have been agreed with the user, and take no account of elastic deformations during the operation. The elastic deformations have to be taken into consideration if required.

The specified tolerances are valid for overhead travelling cranes, gantry cranes and jib cranes, but not for railway cranes. For cranes which have been erected for temporary use only, e.g. building cranes, these rules are only partially valid, in other cases they are to be used judiciously.

## 8.2.1.

## MEASURING PROCEDURE

When using measuring tapes, calibrated steel measuring tapes are to be used. The rules for the use of these measuring tapes are to be observed. The readings obtained are to be corrected for the sag of the tape measure as well as for the divergence of the ambient temperature from the standard temperature. All measurements on one and the same crane have to be made with the same tape and the same tension force.

## 8.2.2.

## MANUFACTURING TOLERANCES FOR CRANES

## 8.2.2.1.

The greatest divergence  $\Delta s$  of the crane span  $s$  from the drawing dimension must not exceed the following values :

for  $s \leq 15$  m :  $\Delta s = \pm 2$  mm

for  $s > 15$  m :  $\Delta s = \pm [2 + 0,15 \cdot (s-15)]$  mm (max.  $\pm 15$  mm)

( $s$  is to be expressed in m)

(see figure 8.2.2.1.)

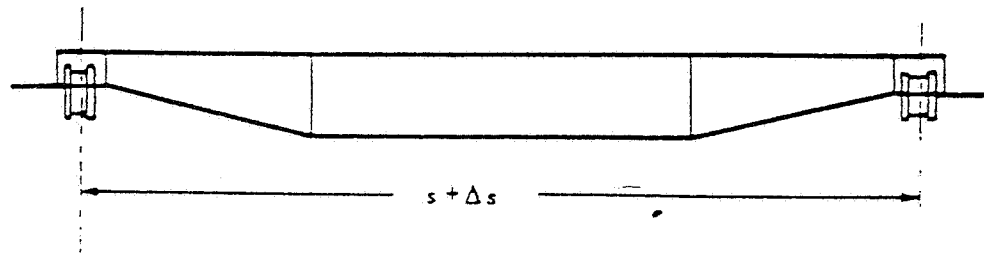


Figure 8.2.2.1.

## 8.2.2.2.

Crane girders, freely supported at their ends, must have no sag, even if the drawing does not prescribe a camber. This means that the track of the trolley with unloaded crane (without trolley) must have no deviation downward from the horizontal. This requirement only applies to cranes with a span longer than 20 m.

- 8.2.2.3. In cases where the top of the rail is flat, the inclination of the wheel axis from the horizontal, for the unladen crane, must be between  $+0,2\%$  and  $-0,05\%$  (see figure 8.2.2.3.)

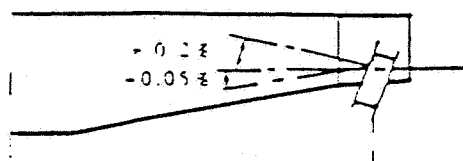


Figure 8.2.2.3.

By unladen crane is meant the crane bridge without trolley, freely supported on the end carriages.

- 8.2.2.4. The trolley rail centre distance must not differ from the nominal dimension  $s$  by more than  $\pm 3$  mm (see figure 8.2.2.4.).

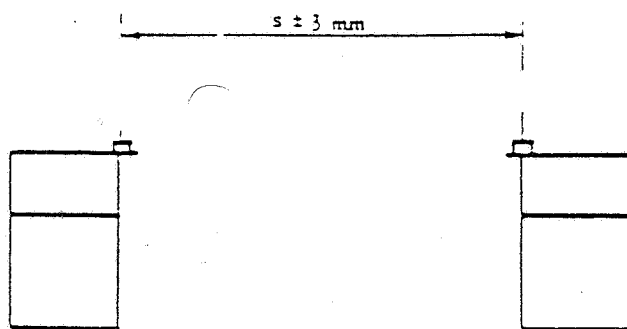


Figure 8.2.2.4.

- 8.2.2.5. In a plane perpendicular to the travel direction of the trolley, the difference in height of two opposite points of the trolley track shall not exceed  $0,15\%$  of the trolley rail centre distance, with a maximum of 10 mm (see figure 8.2.2.5.).

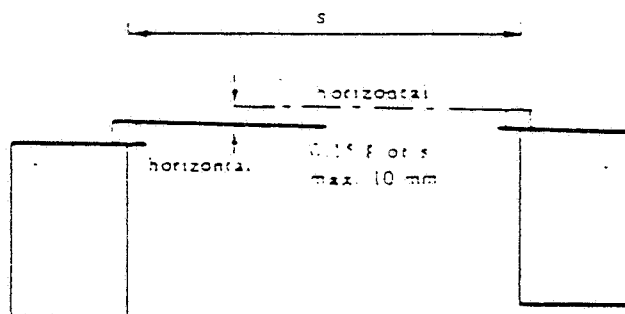


Figure 8.2.2.5.

8.2.2.6.

Trolley rails shall be laid in such a way that the running surface is horizontal and that the greatest unevenness of the bearing surface is no more than  $\pm 3$  mm for rail centres up to 3 m and no more than  $\pm 0,1\%$  of the trolley wheel centre distance if it exceeds 3 m (see figure 8.2.2.6.).

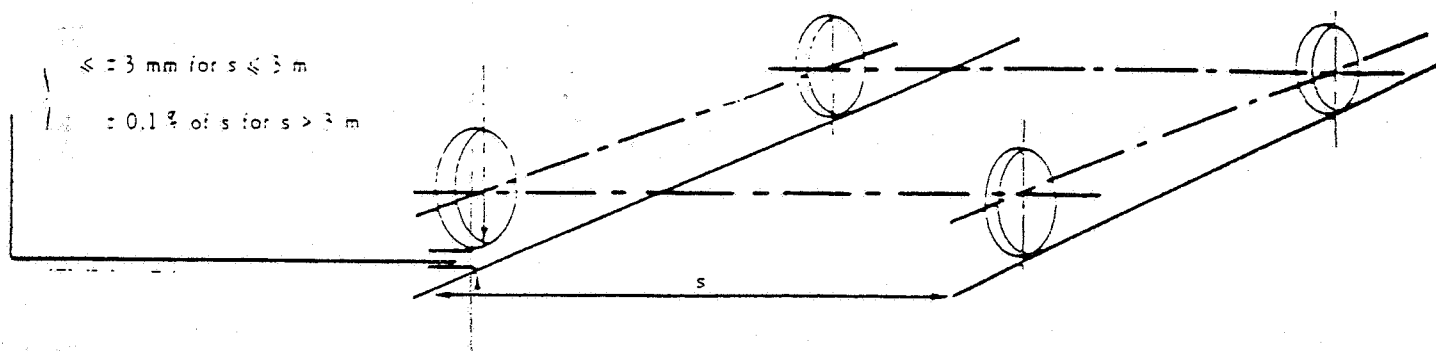


Figure 8.2.2.6.

8.2.2.7.

The vertical axis of the trolley rail must not diverge from the vertical axis of the rail girder web by more than half the thickness of the rail girder web (see figure 8.2.2.7.).

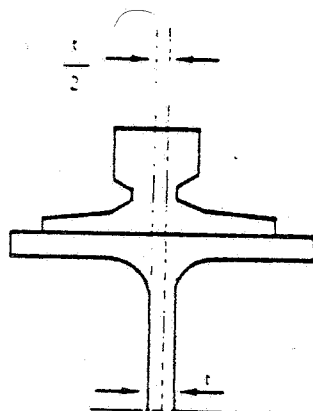


Figure 8.2.2.7.

8.2.2.8.

The axes of the trolley rails must not diverge from their theoretical axis by more than  $\pm 1,0$  mm in a rail length of 2 m. There should be no misalignments at rail joints (see figure 8.2.2.8.).

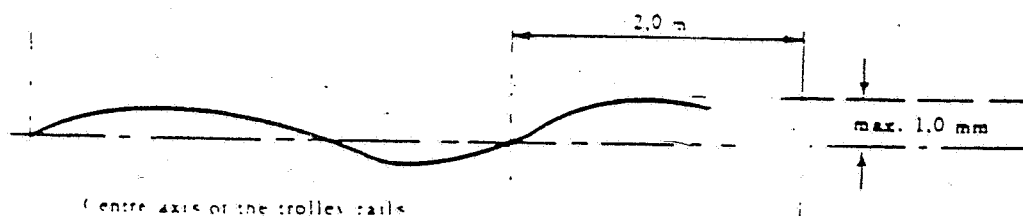


Figure 8.2.2.8.

8.2.2.9.

The axes of the wheel bores must not have an angular deviation greater than  $\pm 0,04\%$  from its theoretical axis, in the horizontal plane (see figure 8.2.2.9.).

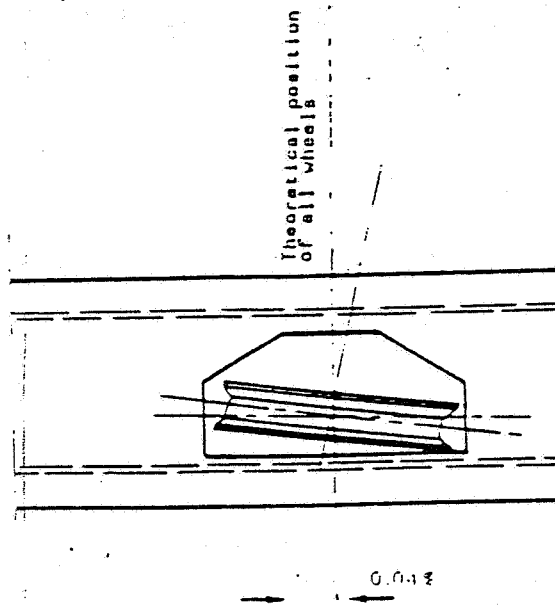


Figure 8.2.2.9.

8.2.2.10.

The axle bores of wheels opposite to each other at each side of the track, and if wheels are mounted in bogies the axes of the bogie pins of the unwarped trolley and crane bridge shall have an alignment divergence in the vertical plane, less than  $0,15\%$ , maximum  $2\text{ mm}$ , of the wheel centre distance (see figure 8.2.2.10.).

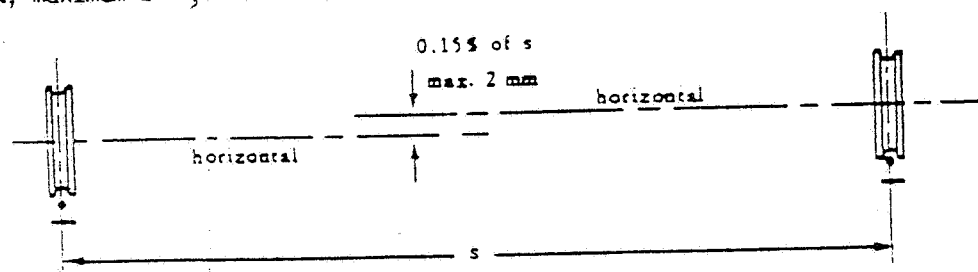


Figure 8.2.2.10.

8.2.2.11. The centre planes of wheels rolling on a common rail must not diverge more than  $\pm 1\text{ mm}$  from the rail axis (see figure 8.2.2.11.).

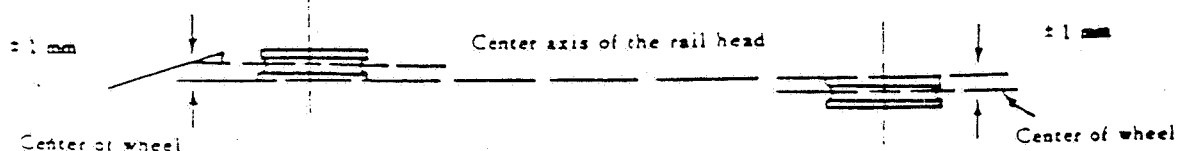


Figure 8.2.2.11.

For bushed wheels the above tolerances apply with the wheel in a central position between the contact surfaces at either side of the wheel.

- 8.2.2.12. If horizontal guide rollers are used, the centre of the distance between guide rollers at one corner must not deviate more than  $\pm 1$  mm from the axis of the rail (see figure 8.2.2.12.)

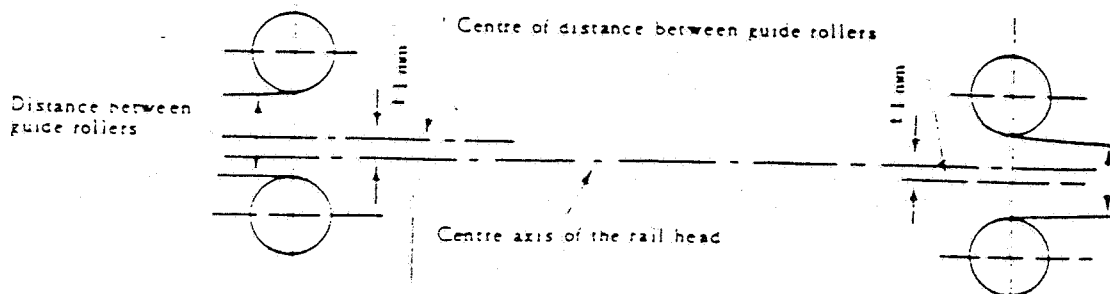


Figure 8.2.2.12.

- 8.2.2.13. The diameter tolerance of the wheels should correspond to the ISO tolerance classification h9. If runner wheel speeds are synchronized by an "electrical shaft", tighter tolerances may be required. These will have to be determined from case to case. These tolerances will apply also to non driven wheels, as the wheels must be interchangeable.

### 8.2.3.

### TOLERANCES FOR CRANE TRACKS

The tolerances specified below apply to new crane tracks. If in the course of use, these tolerances are exceeded by 20 %, the track must be realigned. If the travelling behaviour is noticeably deteriorating, it may be necessary to realign the track, even if the tolerance excess has not reached 20 %.

- 1 - The greatest divergence  $\Delta s$  from the span  $s$  is :  
 for  $s \leq 15$  m :  $\Delta s = \pm 3$  mm  
 for  $s > 15$  m :  $\Delta s = \pm [3 + 0,25 \cdot (s-15)]$  mm (max.  $\pm 25$  mm)  
 ( $s$  is to be expressed in m)  
 (see figure 8.2.2.1.)

If horizontal guide rollers are provided on one rail only, the tolerances for the other rail only may be increased to three times the above values, but must not exceed 25 mm.

- 2 - It is assumed that with the trolley positioned in the centre of the span the deflection of both rail tracks is approximately equal.
- 3 - The greatest permissible tolerance of the upper edge of the rail is  $\pm 10$  mm from the theoretical height position. The theoretical height is either the horizontal position, or if applicable, the theoretical camber curve. The height position of the two rails may show a divergence of 10 mm. The curvature in a longitudinal direction may, at each point of a measured length of 2 m, not exceed a rise of  $+ 2$  mm.

- 4 - The inclination of the rail rolling surface must not exceed the following values as compared with the theoretical position :

Longitudinally : 0,3 %

Laterally : 0,3 %

(see figure 8.2.3.a.)

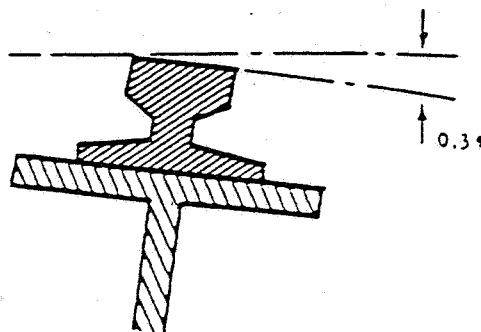


Figure 8.2.3.a.

- 5 - The maximum permissible lateral deviation of each rail in a horizontal plane is  $\pm 10$  mm. The curvature in the longitudinal axis at any point shall not exceed  $\pm 1$  mm in a length of 2 m (see figure 8.2.3.b.).

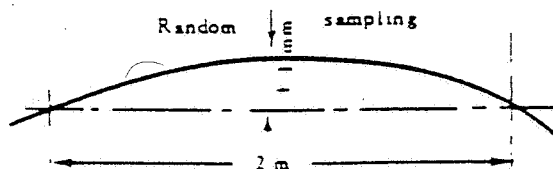


Figure 8.2.3.b.

For cranes guided on both sides by horizontal rollers, the above values are valid also for the rail surfaces of the horizontal rollers.

For cranes guided on one rail only, the requirement for the straightness of the non guiding rail can be lowered, in agreement with manufacturer.

- 6 - No account has to be taken of misalignment at the rail joints. It is recommended that welded rail joints are used.

# APPENDIX A - 8.1.3.

## TEST LOADS FOR CRANES IN SOME EUROPEAN COUNTRIES

| Country          | Dynamic tests                                                                                          | Static tests                                                                                 | Comments                                          |
|------------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------|
| AUSTRIA          | 125 % up to 25 t<br>110 % over 25 t                                                                    |                                                                                              |                                                   |
| BELGIUM          | Up to 20 t ..... 125 %<br>From 20 to 50 t .. + 5 t<br>Over 50 t ..... 110 %                            | 25 t ..... 140 %<br>25 to 50 t .... 10 t<br>50 t ..... 120 %                                 |                                                   |
| SUIZERLAND       |                                                                                                        |                                                                                              | According to<br>DIN 15030                         |
| GERMANY          | $P_k = 1,25 P$<br>$P_g = 1,33 P$ (H1 and H2)<br>$P_k = 1,25 P$<br>$P_k = 1,25 P_1 + 0,25 P_0$          | $P_g = 1,50 P$ (H3 and H4)<br>$P_g = 1,33 P - 1,4 P$                                         | DIN 15018 part 1<br>DIN 15019 part 1<br>DIN 15030 |
| FRANCE           | 120 %<br>(excluding builder's tower<br>cranes and some dismount-<br>able appliances : 110 %)           | 150 %<br>(excluding builder's tower<br>cranes and some dismount-<br>able appliances : 133 %) |                                                   |
| GREAT<br>BRITAIN | 125 % of the SWL                                                                                       |                                                                                              |                                                   |
| ITALY            | 128 % self propelled cranes<br>120 % tower cranes<br>110 % other lifting<br>appliances                 |                                                                                              | During 15 min.                                    |
| NETHERLANDS      | Up to 20 t ..... 125 %<br>From 20 to 50 t .. + 5 t                                                     | Not compulsory                                                                               |                                                   |
| NORWAY           | Up to 20 t ..... 125 %<br>From 20 to 50 t .. + 5 t<br>Over 50 t ..... 110 %<br>or FEM                  | FEM                                                                                          |                                                   |
| SWEDEN           | Up to 5 t ..... 125 %<br>From 5 to 20 t ... 120 %<br>From 20 to 50 t .. 115 %<br>Over 50 t ..... 110 % |                                                                                              |                                                   |

