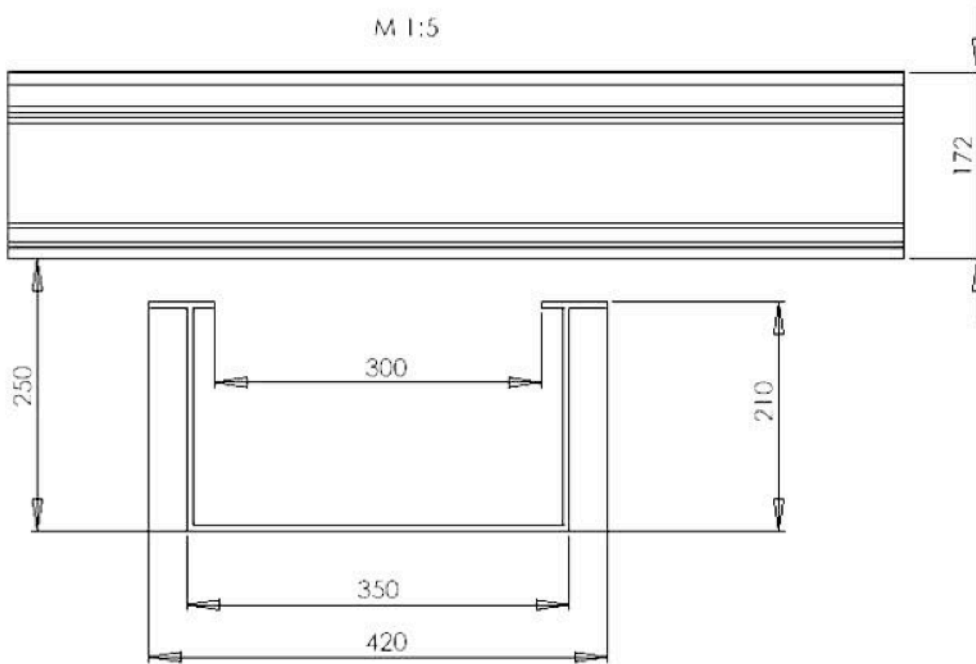


Functional requirements for hollow sleepers for UIC 60 and similar types of switches



INNOTRACK GUIDELINE

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1. Executive Summary

The present specification is based on the requirements of European railway operators to applications of integral switch setting and monitoring systems. This specification is to be declared a European standard.

In specifying the geometrical requirements maximum importance was attached to small dimensions (compact components) so that especially for the switch setting systems no restrictions shall apply with regard to mounting, layout and transport. Nevertheless the mounting space should be determined in such a way that the majority of the existing solutions for setting system components can be integrated into the hollow sleeper without difficulty. Preferably UIC 60 stockrail and switchers are to be used which is the scope of the Innotrack project. The proposed hollow sleeper can be used or adapted to other profiles also.

The specification covers in detail:

- Geometric specifications for the hollow sleeper
- Functional requirements
- Requirements in terms of availability and reliability
- Description of the tests required.

2. Introduction

For many decades now no standard for hollow sleepers has been valid throughout Europe. Because of the lack of specifications, different national solutions have been developed and accepted which are not compatible with each other from a geometrical point of view.

This document summarises in the form of a proposal for a future European standard the geometric, structural and other requirements to be fulfilled by a standardised hollow sleeper for the EU countries.

The standardised hollow sleeper is to fulfil the following functions:

- To accommodate one or more switch locks

- To accommodate one or more switch mechanisms
- To accommodate heating unit for the DLD components
- To accommodate monitoring elements for monitoring the limit position of the switch
- To accommodate the electronic / control unit for the switch mechanism or for inspection units
- To protect the components from mechanical damage.

3. Functional requirements for hollow sleepers for UIC 60 and similar type switches

3.1. Technical requirements

3.1.1. Functional requirements

No	Requirement to be met	Remarks
1	<p>Material</p> <p>Steel</p> <p>The steel material must be selected in such a way that the tests and requirements stated in the present specifications are fulfilled.</p>	
2	<p>Weight</p> <p>Weight of sleeper including rail fastening, cover plates and ballast retainer plate of ≥ 125 kg/m.</p>	Including inner lock and switch mechanism components, outer lock is not included.
3	<p>Manufacturing method</p> <p>If possible, the load-bearing construction of the hollow shaft should be manufactured without welding. The hollow sleeper should preferably be manufactured in a bent construction. If</p>	

No	Requirement to be met	Remarks
	documented evidence of conformity is available, welding is permissible.	
4	<p>Insulation</p> <p>An electric resistance of at least 5 kΩ must be ensured between the two rails (stipulation by LST Technik).</p>	Evidence in accordance with DIN EN 13146-5 Inspection report master
5	<p>Wheelset load</p> <p>It must be ensured that the hollow sleeper is sufficiently dimensioned to take up a wheelset load of up to 300 kN.</p>	
6	<p>Warranty</p> <p>5 years</p> <p>The warranty must be valid for an unlimited volume of traffic and be independent of the other inspections in these specifications. The railway operator must ensure proper mounting and maintenance of the fastening of the hollow sleeper. The railway operator must observe the maximum wheelset load.</p> <p>During the warranty period no incipient cracks, fractures and clearly critical damage through corrosion may occur especially on welded connections.</p>	
7	<p>Static strength</p> <p>Rated bending moment underneath the rail bearing surfaces and in the centre of the sleeper with symmetric load application: 25 kNm.</p>	Static or FEM proof
8	<p>Rail fastening: recommended components</p> <p>Hollow sleeper with internal stock-rail clamping:</p> <p>Use of the grooved baseplate with slide chair URG 56 R/Error! Reference source not</p>	Engineering drawing

No	Requirement to be met	Remarks
	<p>found.</p> <p>Internal clamping of the stock rail in standard construction using at least one bracket SSb 2 on each side of the sleeper</p> <p>External clamping of the stock rail using one Skl 19 for each grooved baseplate with slide chair</p> <p>Use of a rail pad Zw 661-1 underneath the stock rail</p> <p>Arrangement of the attachment holes for the grooved baseplates URg 56 L/R and necessary rail bearing surfaces.</p>	
9	<p>The rail fastening system selected must fulfil an endurance test in accordance with DIN EN 13146-4. The loads must be scaled up in a linear progression in order to simulate an increase of the wheelset load from 25 t to 30 t.</p> <p>Error! Reference source not found..</p>	
10	<p>Cross-section geometryError! Reference source not found.</p> <ul style="list-style-type: none"> - Maximum outside outline in accordance with specifications (ensure that the sleepers can be tamped using machines) <p>The hollow sleeper must be designed in such a way that it cannot be damaged as a result of rail maintenance work (packing, straightening, dynamic stabilisation, etc.) or by the operations for laying the sleepers.</p> <ul style="list-style-type: none"> - Minimum inside outline in accordance with the specifications (ensuring the required free space for mounting and maintenance of switch lock, control rod, inspection rods and bell-crank connecting rods) - Section height from rail upper edge to hollow sleeper lower edge in accordance with switches UIC 60 with rail fastening using hollow sleepers 	<p>Engineering drawing</p> <p>Testing of function samples</p>

No	Requirement to be met	Remarks
	accordance with EBO taking into account the manufacturing tolerances of the sleeper and switch as well as of the operating tolerances of switch and wheelset.	
15	<p>Covering of the sleepers with stud plates between the rails and on both sides outside the rails.</p> <p>Note: The covers outside the rails serve as protective covers for the lock.</p> <p>Electrical insulation to the locking piece/the stock rail must be ensured.</p>	<p>Engineering drawing</p> <p>Testing of function samples</p>
16	Installation of a ballast retainer plate on either end face of the sleeper body as a protection against the ingress of ballast.	Engineering drawing
17	Drainage through a sufficient number of sufficiently large holes in the sleeper bottom.	Engineering drawing

3.1.2. Conditions of use for hollow sleepers

No.	Requirement to be met
18	Wheelset load up to 30 t.
19	Permissible speed \leq 300 km/h.

3.2. Product-specific requirements

3.2.1. Requirements based on existing infrastructure

No.	Requirement to be met	Remarks
20	<p>Compatibility with the following lock types:</p> <p>Deutsche Bahn (DB)</p> <ul style="list-style-type: none"> • Latch lock CKA 12 in accordance with Iow 50.0012 and addition unit CKA 13 in accordance with Iow 50.0013, • Clamp lock WKV in accordance with Iow 50.0015 and switch end lock WEV in accordance with 50.0016. <p>SNCF (France)</p> <ul style="list-style-type: none"> • Vossloh VCC <p>The attachment with suitable holes, etc. to the hollow sleeper must be possible and the overall design must not impair it.</p>	<p>Compatibility means the assembly of such a lock must not be restricted by built in parts such as ribs, plates, etc.</p>
21	<p>The following attachment parts must be mounted to the hollow sleepers without further adaptation:</p> <ul style="list-style-type: none"> - Support and transmission parts: Holes for attaching the bearing bars for components of the setting system with 6 screws M 20 - Switch heating: Lock heating in accordance with technical document Technische Unterlage TU 954.9101A03, drawing 3 Elh 00.09.10 und 3 Elh 00.09.11 (heating unit in lock space 2 x 250 W), <p>For this purpose 2 holes for stay rods M 10 in accordance with Annex 2 and 3 tube sections (in the area between the rails and in the two areas outside the rails) with inside diameter \geq 20 mm must be present at the side wall facing</p>	<p>Engineering design</p> <p>Testing of function samples</p> <p>No longer relevant with new lock drive solution in accordance with WP 3.2.4 INNOTRACK</p> <p>The drawing should be prepared for this. The actual implementation</p>

No.	Requirement to be met	Remarks
	the switch end for laying the connecting cables	can be ordered by the customer.
22	Can be used in all simple switches of rail form UIC 60 (ballast superstructure).	Engineering drawing Testing of function samples

3.2.2. Requirements for approval

Details described in the Annex. Click to follow the link to the Annex.

No.	Requirement to be met
23	Geometry
24	Annex II Endurance test of fastening system
25	Annex III Endurance test of the sleeper cross section

3.3. Requirements in terms of availability and reliability

No.	Requirement to be met	Remarks
26	Hollow sleepers must resist atmospheric influences; functional efficiency must be ensured even under conditions of snow and ice.	Design Trial in operation
27	Resistance to dropping ice	Trial in operation
28	Warranty 5 years Warranty is valid till 31 th December of the 5th year after production year. The warranty must be valid for an unlimited volume of traffic and be independent of the other inspections in these specifications. The	

No.	Requirement to be met	Remarks
	<p>railway operator is to ensure proper mounting and maintenance of the hollow sleeper fastening. The railway operator is to observe the maximum wheelset load.</p> <p>During the warranty period no incipient cracks, fractures and clearly critical damage through corrosion may occur especially on welded connections.</p>	
29	<p>Mechanical life > 25 years</p> <p>Mechanical stiffness must be ensured in new condition.</p>	
30	<p>Mowing away the covers it should bear at least 15 occasions/year without losing the functionality (one actuator/switch examination per month, plus maintenance per half year)</p> <p>Covers must be fixed to the hollow sleeper in such a way, that it should be easy to unfix, but it should be able to prevent the unauthorized intervention. Besides this the covers (outer and inner) should be strong enough to bear the workers' weight stepping on them without permanent deformation, and to bear the beats of hanging coupling device.</p>	new

4. Bibliography

4.1. Standards, regulations and other basic stipulations

Short designation/issue date	Designation of document
EBO date: 08 May 1967	Eisenbahn Bau- und Betriebsordnung (Act on the Construction and Operation of

	Railways)
DIN EN 13230-1	Track; Concrete sleepers and bearers Part 1: General requirements
DIN EN 13146-4	Railway applications – Track; Test methods for fastening systems; Part 4: Effect of repeated loading
DIN EN 13146-5	Railway applications – Track; Test methods for fastening systems; Part 5: Determination of electrical restraint
DIN EN 13481-2	Performance requirements for fastening systems Part 2: Fastening systems for concrete sleepers
TU 954.9101A03	Electrical switch heating units
BN 918 235	Elastic rail pads rail pads and rail plates
EN 13146-3:2002	Railway applications. Track. Test methods for fastening systems. Determination of attenuation of impact loads

Annex I Geometry

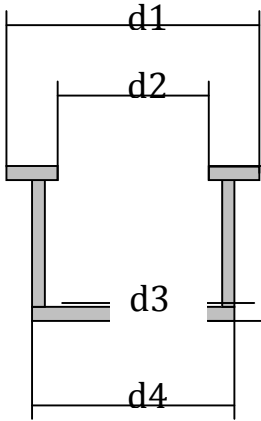
Main	Description	Short designation	Dimensions in mm
 <p>Figure 1: Main cross section name conventions</p>	External width of hollow sleepers	d4	< 350
	Internal width of hollow sleeper	a2	> 300
	Internal width of hollow sleeper (opening). Exception in the area of stock rail support, profile may be locally reinforced	d2	300
	Width of hollow sleeper (inside)	d3	300
	Height of hollow sleeper	h	210
	Distance from lower edge of stock rail to underneath surface of sleeper		250 (rigid support)
	Max. width of hollow sleeper	d1	420
	Total length of hollow sleeper	l	2620
	Slope of rail support hollow sleeper		0 degrees +/- 0.25 degrees

Table 1: Definition of dimensions of the hollow sleeper

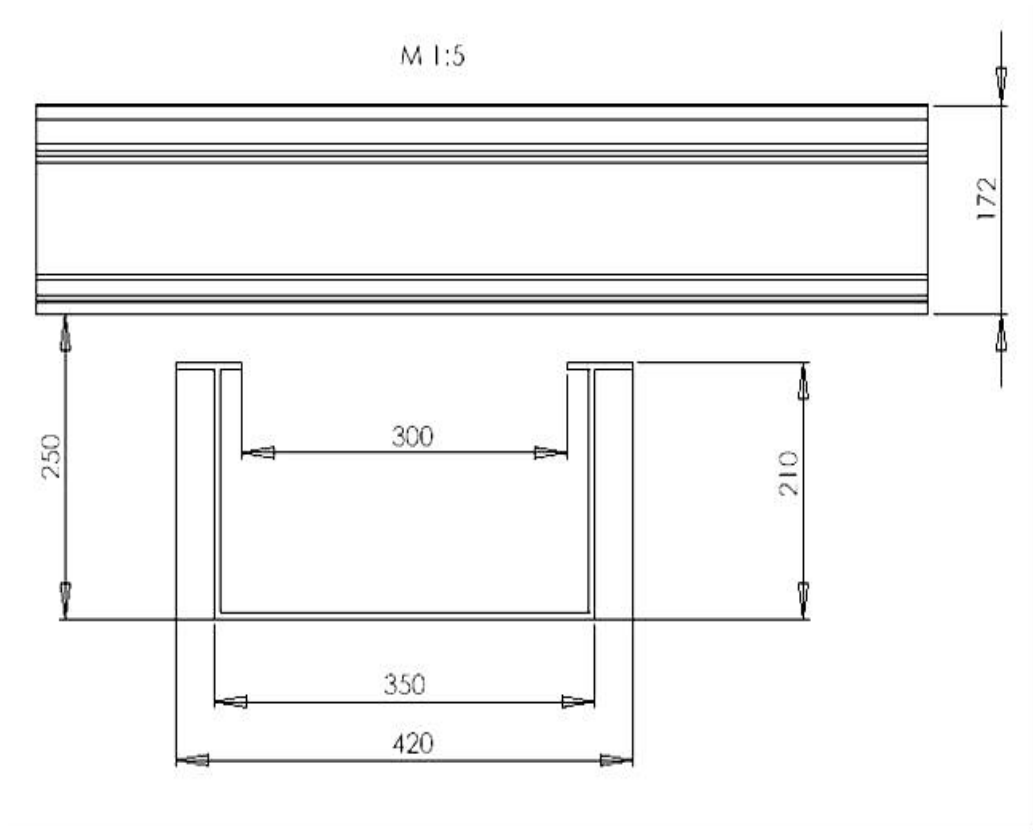


Figure 2: Profile of hollow sleeper with UIC 60 rail without fastening elements

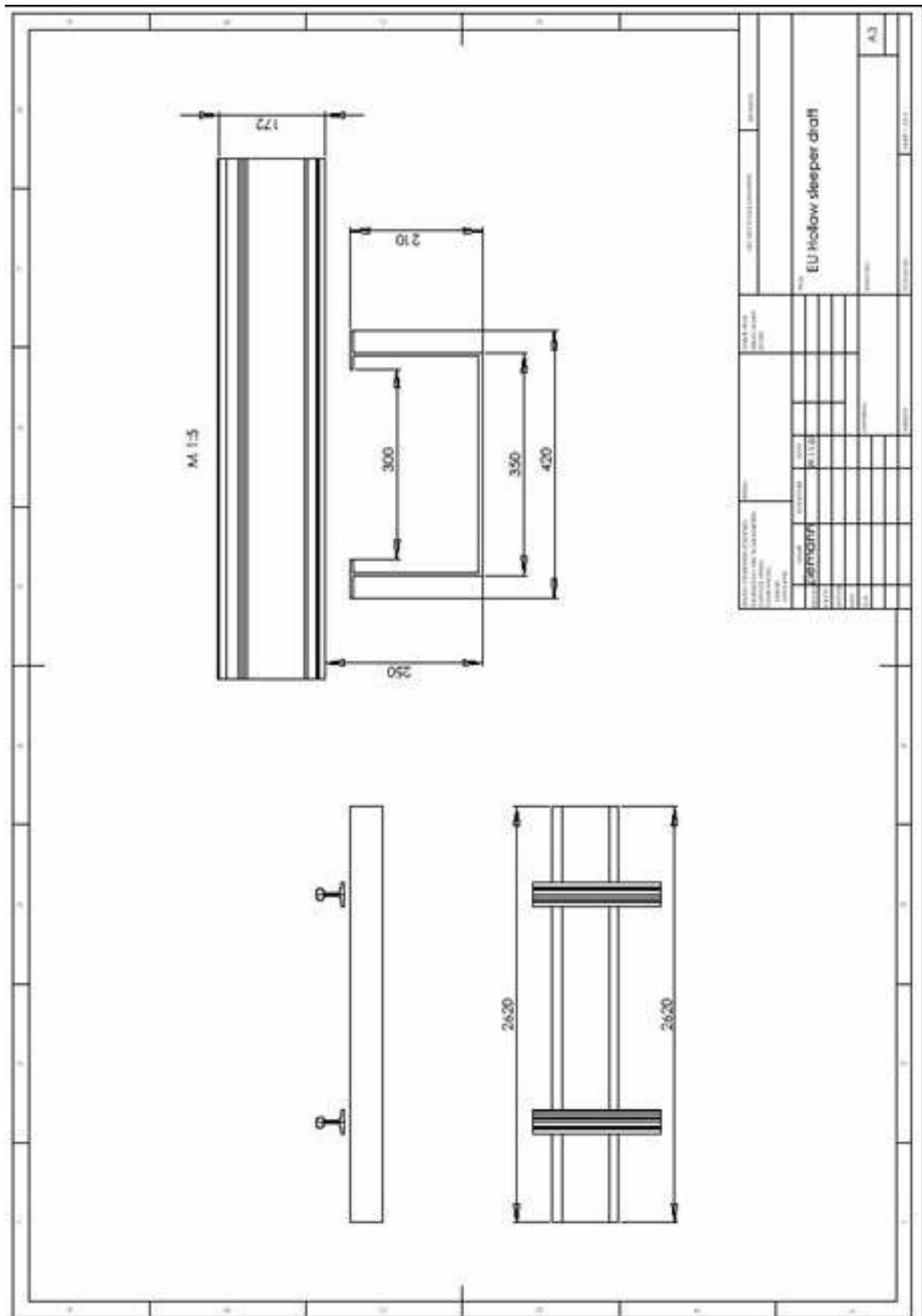


Figure 3: Main dimension and cross section of the hollow sleeper

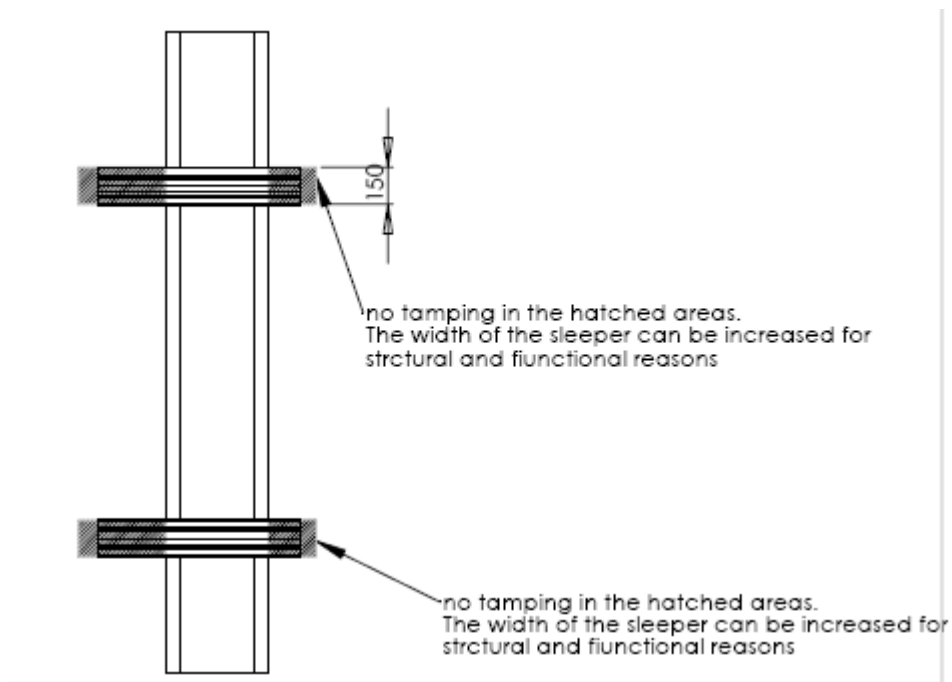


Figure 4: Top view of the sleeper

Annex II Endurance test of fastening system

This test is to document the operational stability of the fastening system and the local effects of the loads applied.

The endurance test of the fastening system consists of subjecting two rail sections mounted to a sleeper to a sinusoidal oscillating load between 10 and 300 kN for 3 million cycles. This testing method is described in EN 13146-4:2002 page 9/10.

The adapted test loads are defined in Figure 5. The lateral forces are due to the geometry and result from the testing load.

After removal of the load the acceptance criteria after 3×10^6 cycles are as follows:

- There must be no damage to the fastening elements or the sleeper.
- The welds must satisfy a visual inspection and a dye penetrating inspection.

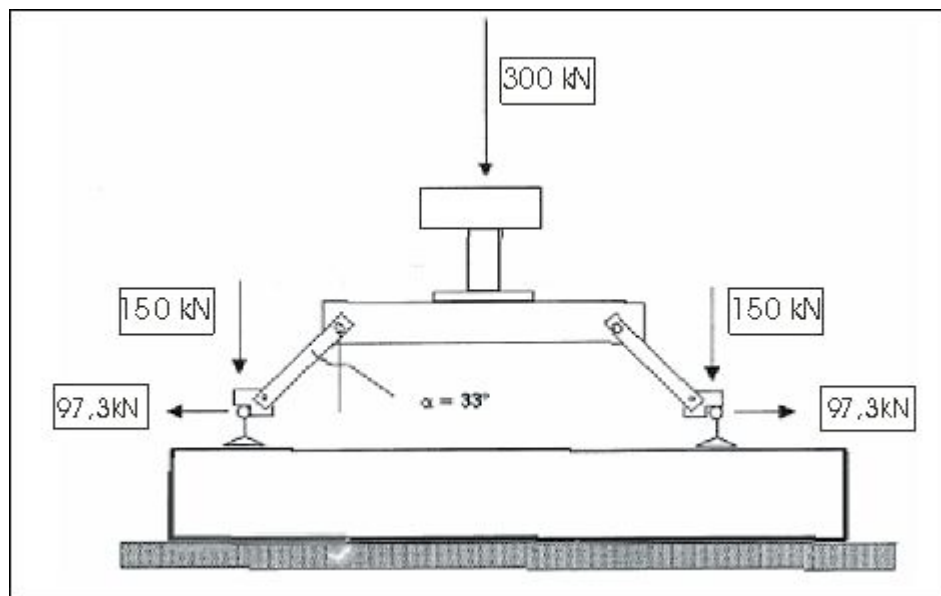
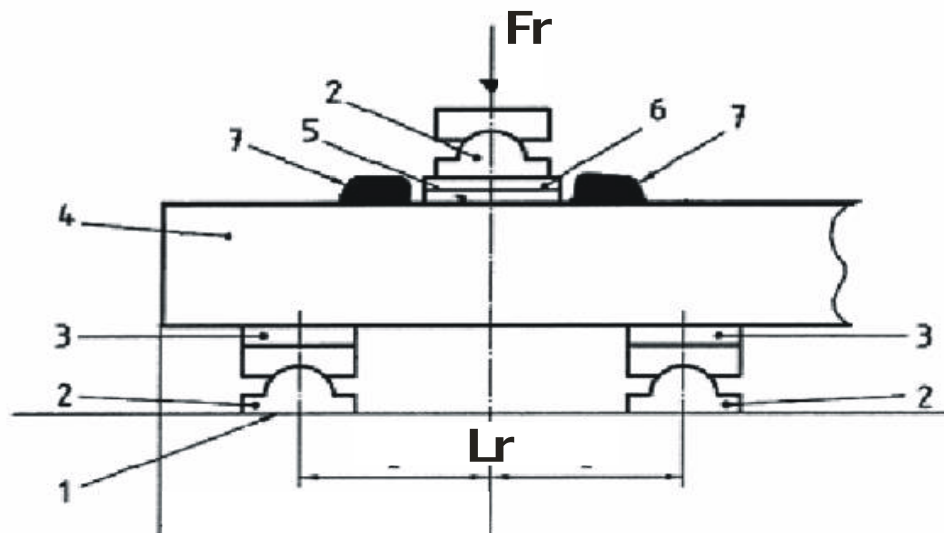


Figure 5: Endurance test of fastening system

Annex III Endurance test of the sleeper cross section

Test loads in the cross section below the rail:

F_r :	load perpendicular to the rail support	
L_r	distance of support points of sleeper	0.6 m
F_{ru}	lower amplitude of oscillating load	50 kN
F_{ro}	upper amplitude of oscillating load	200 kN



1. Dimensionally stable support
2. Flexible support
3. Elastic support
4. Hollow sleeper
5. Standard support plate and/or insulating element of rail fastening system
6. -
7. Intended fastening system

Figure 6: Scheme for application of load to hollow steel sleeper

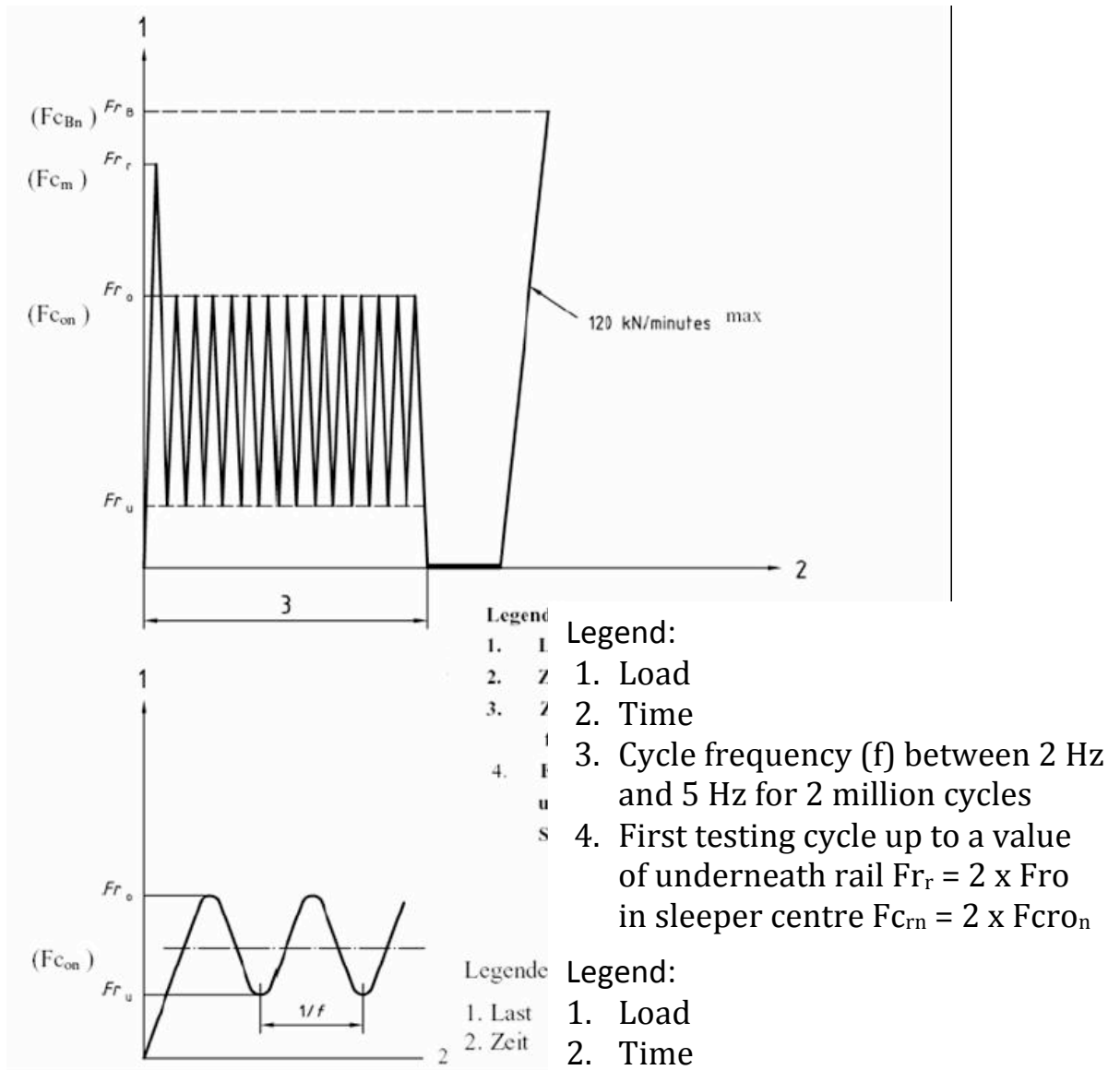


Figure 7: Load curve in endurance test

The test is performed on the cross section underneath the rail of a hollow sleeper in accordance with the load spectrum shown in Figure 7 and the scheme for load application shown in Figure 6.

The acceptance criteria after 2×10^6 cycles are as follows:

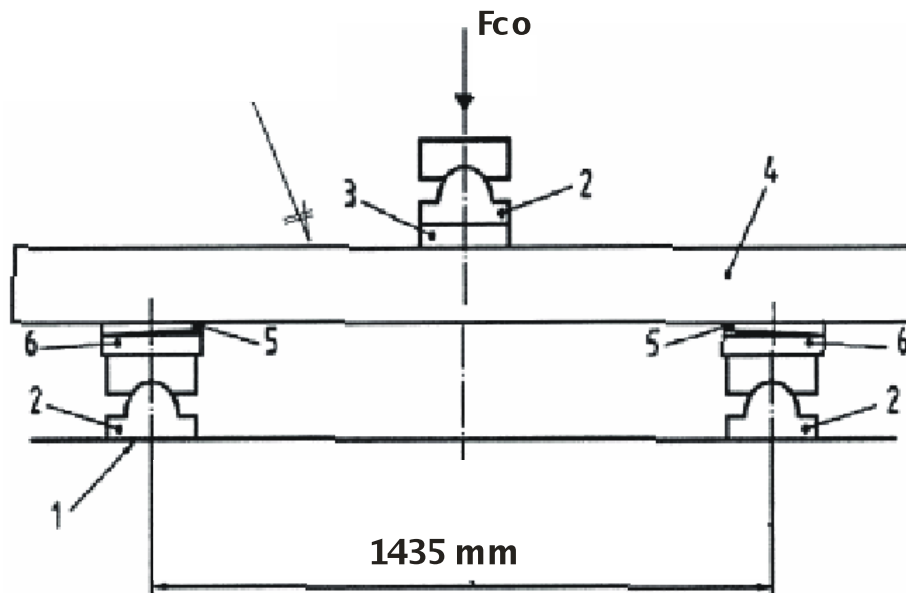
- After 2×10^6 cycles no damage, cracks or plastic deformation should have occurred.
- After the end of the test and the increase of the load in the cross section underneath the rail by 120 kN/minute max

from 0 kN to $F_{rB} = 2.5 \times F_{ro}$ no damage, cracks or plastic deformation is permitted; the welds must be subjected to visual and dye penetrant inspections.

Endurance test of central sleeper cross section

Test loads in the cross section beneath the centre of the sleeper:

F_r :	load perpendicular to the rail support	
L_r	distance of support points of sleeper	1,435 mm
F_{ru}	lower amplitude of oscillating load	18.75 kN
F_{ro}	upper amplitude of oscillating load	75 kN



1. Dimensionally stable support
2. Flexible support
3. Elastic support
4. Hollow sleeper
5. Standard support plate and/or insulating element of rail fastening system

Figure 8: Inspection scheme for oscillation test in central sleeper cross section

The test is performed on the cross section underneath the centre of the sleeper in accordance with the load spectrum shown in Figure 7 and the method shown in Figure 6.

The acceptance criteria after 2×10^6 cycles are as follows:

- After 2×10^6 cycles no damage, cracks or plastic deformation should have occurred.
- After the end of the test and the increase of the load in the cross section underneath the rail by 120 kN/minute max. from 0 kN to $F_{CBn} = 2.5 \times F_{con}$ no damage, cracks or plastic deformation is permitted; the welds must be subjected to a visual and dye penetrant inspections.

Annex IV Reference of preferred standard components

D.1. Rail fasteners, rail support

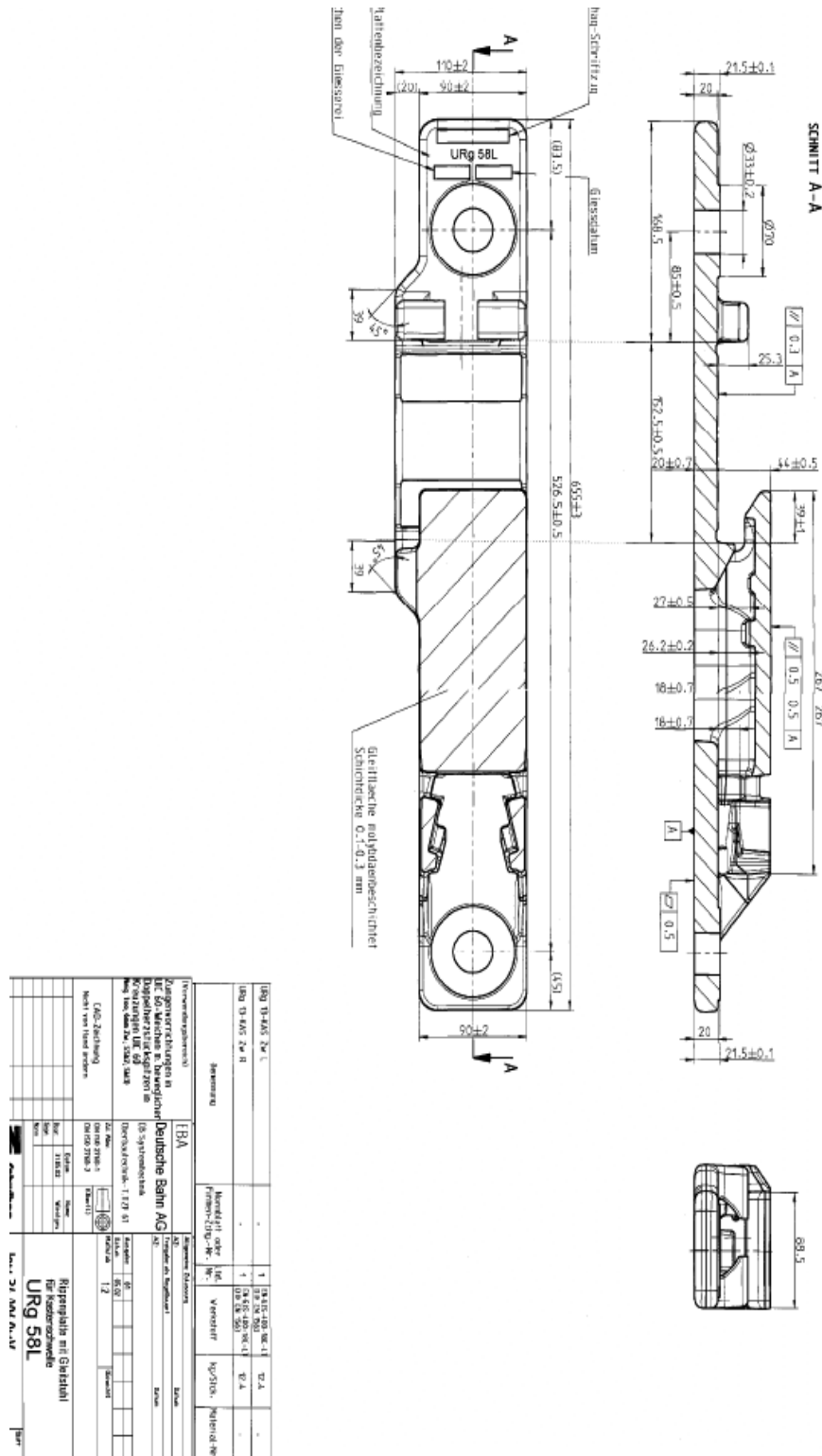


Figure 9 Drawing of the rail support URg 56 R/L by Schwiagh