

**ISRAEL RAILWAYS LTD.
INFRASTRUCTURE DIVISION**

**Technical Specification
for
Manufacture and Supply of
FORGED TRANSITION
RAILS:**

- **60E2/54E1 profiles and R260 Grade**
- **54E1/50E6 profiles and R260 Grade**

No. E-01-0043.1

September 2019



This technical specification differs from version No. E-03-0043 February 2019 as follows:

- i. Section 1.3 has been revised;
- ii. The technical specification has been editorially revised.



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1. **SCOPE**

- 1.1. These technical specifications describe the requirements for the manufacture and supply of:
Forged Transition Rails with different rail profiles: 60E2/54E1 and 54E1/50E6 and Steel Grade - R260 ("**The Forged Transition Rails**") for use on Railway tracks.
- 1.2. Every Forged Transition Rail shall be manufacture as a one single section rail continuously profile changing from one symmetrical Vignole Rail Profile to another symmetrical Vignole rail by forged technology.
- 1.3. The Forged Transition Rails shall be supplied as a couple set (left and right) with full lengths of 8400 [mm] (every Forged Transition Rail), the forged area shall be in the middle of the Forged Transition Rail, with tolerance of maximum ± 100 [mm].
- 1.4. Unless otherwise and to the extent specified hereafter, the Forged Transition Rails shall be complied in every aspect with the standards EN13674-1, EN16273 and EN14587-1.
- 1.5. Forging Process and/or Welding Process carried out by subcontractors -- Details on subcontractors performing the Forging Process and/or Welding Process shall be submitted (Name and Factory address, experience, welding machine type).

2. **REFERENCE DOCUMENTS**

EN13674-1	Track - Rail - Part 1: Vignole railway rails 46 kg/m and above;
EN14587-1	Railway applications Track - Flash butt welding of rails - Part 1 New R220 R260 R260Mn and R350HT grade rails in a fixed plant;
EN16273	Railway applications - Track - Forged rail transitions;
ISO9001	Quality management systems – Requirements;
ISO/IEC17025	General requirements for the competence of testing and calibration laboratories;
EN10163-1	Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 1: General requirements;



EN10168	Steel products – Inspection documents;
EN10204	Metallic products - Types of inspection documents;

Note – the latest edition of the referenced document should be considered

3. **DEFINITIONS**

- | | | |
|-------|-------------------------------|--|
| 3.1. | FBWM | shall have the meaning assigned to it in section 7.1 aforementioned; |
| 3.2. | Forged Transition Rail | as defined in EN16273, section 3.11. |
| 3.3. | The Inspector | shall have the meaning assigned to it in section 9.1 aforementioned; |
| 3.4. | The Laboratory | shall have the meaning assigned to it in section 8 aforementioned; |
| 3.5. | The Rail/(s) | shall have the meaning assigned to it in section 1 aforementioned; |
| 3.6. | Rail Profile 50E6 | as defined in EN13674-1, Annex A, figure A.13; |
| 3.7. | Rail Profile 54E1 | as defined in EN13674-1, Annex A, figure A.15; |
| 3.8. | Rail Profile 60E2 | as defined in EN13674-1, Annex A, figure A.24; |
| 3.9. | Steel Grade R260 | as defined in EN13674-1, section 5; |
| 3.10. | Warranty Period | as defined in The Agreement. |

4. **RAILS GENERAL REQUIREMENTS**

- 4.1. The Rails, to be used in the Forged Transition Rails manufacturing process, shall be manufactured in continuous casting process, and no other process shall be approved.
- 4.2. The Forged Transition Rails chemical composition/mechanical properties shall conform with the requirements of EN13674-1, table 5a; table 5b.

- Table 5a – Chemical Composition and Mechanical properties:



**FORGED TRANSITION RAILS 60E2/54E1
and 54E1/50E6 profiles and R260 Grade
No. E-01-0043.1 September 2019**

Steel Grade		% by mass										10 ⁻⁴ % (ppm) by mass max.		Tensile strength	Elongation	Hardness of the Rail running surface centerline HBW
Steel Name	sample	C	Si	Mn	P max.	S max.	Cr	Al max.	V max	N max	O	H	Rm min. MPa	A min. %		
R260	Liquid	0.62 to 0.80	0.15 to 0.58	0.70 to 1.20	0.025	0.025	≤0.15	0.004	0.030	0.009	20	2.5				
	Solid	0.60 to 0.82	0.13 to 0.60	0.65 to 1.25	0.030	0.030	≤0.15	0.004	0.030	0.010	20	2.5	880	10	260 to 300	

• Table 5b – Maximum Residual Elements, % by mass:

Steel Name	Mo	Ni	Cu	Sn	Sb	Ti	Nb	Cu + 10 Sn	others
R260	0.02	0.10	0.15	0.030	0.020	0.025	0.01	0.35	0.35 (Cr + Mo + Ni + Cu + V)

4.3. The Rails Profiles Tolerances shall conform with Profile Class X, and Straightness, Surface Flatness and Twist Tolerances shall conform with Class A, all in compliance with EN13674-1, section 9.2, table 7, and table 8:

• Table 7 - Profile Tolerances

Reference points (EN13674-1, figure E.1)		Profile class (tolerances in [mm])	
Location/ property		symbol	X
Height of Rail ^a	< 165 [mm]	*H	± 0.5
	≥ 165 [mm]		± 0.6
Crown profile - Class A straightness		*C	+ 0.6 - 0.3
Crown profile - Class B straightness			N/A
Width of Rail head		*WH	± 0.5
Rail asymmetry		*As	± 1.2
Height of fishing	< 165 [mm]	H	± 0.5
	≥ 165 [mm]		± 0.6
Web thickness		*WT	+ 1.0 - 0.5
Width of Rail foot		*WF	± 1.0
Foot toe thickness		*TF	+ 0.75

		- 0.5
Foot base concavity		0.3 max.

- **Table 8- Straightness, Surface Flatness and Twist Tolerances -- Class A:**

Location/Dimensional properties		60E2/54E1 and 54E1/50E6			
		Class A			
		d	L		
BODY	Vertical flatness V	≤ 0.3 [mm]	3 [m]		
		and			
	Horizontal flatness H	≤ 0.2 [mm]	1 [m]		
		≤ 0.45 [mm]	1.5 [m]		
ENDS	End "E"	2 [m]		<p>If $e > 0$ $F \geq 0.6$ [m]</p>	
	Vertical straightness	≤ 0.4 [mm]	2 [m]		
		and			
		≤ 0.3 [mm]	1 [m]		
	and		$e \leq 0.2$ [mm]		
	Horizontal straightness	≤ 0.6 [mm]	2 [m]		
and					
		≤ 0.4 [mm]	1 [m]		
OVERLAP	Length of overlap	2 [m]			
	Vertical flatness V	≤ 0.3 [mm]	2 [m]		
	Horizontal flatness H	≤ 0.6 [mm]	2 [m]		
SWEEP (whole The Rail)	Upsweep and down sweep	10 [mm]			
TWIST	Whole The Rail	max. gap of 2.5 [mm]		In accordance with EN13674-1,	

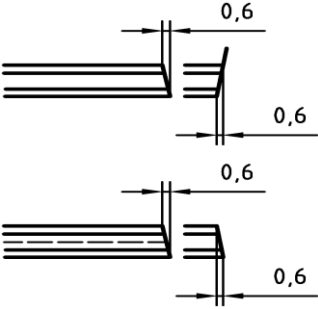


			section 9.2.2, and figure 10
	End (1 [m])	Max. rotational twist of 0.2° and max. relative twist of 0.0035 x c	In accordance with EN13674-1, section 9.2.2, and figure 11

- 4.4. The Rails manufacturing process shall be complied with the requirements according with EN13674-1, section 7.
- 4.5. The Rails used to manufacture the Forged Transition Rails shall be rails which have been successfully passed the Acceptance Tests in accordance with EN13674-1, section 9.
- 4.6. The center of the holes shall be at a height, and at a length from The Rail end, as described in Technical Appendix A – Fishplate Bolt Hole Position in The Rail Web.
The drilled holes, and The Rail ends shall be deburred.
- 4.7. The Forged Transition Rails lengths, the size and location of drilled holes tolerances and the rail ends squareness tolerance shall be in accordance with EN13674-1 Table 9.

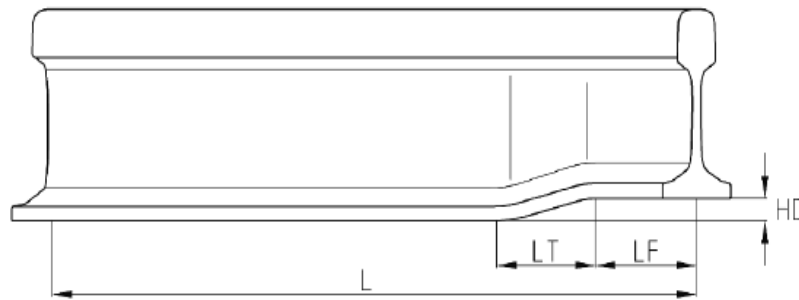
5. Table 9 – Drilling and cutting tolerances:

No.	Dimensional requirement	Tolerance
1	Drilling Diameter ≤ 30 [mm] Centering and positioning of the holes vertically and horizontally	± 0.5 [mm] The horizontal position of the holes shall be checked using a gauge as specified in EN13674-1, Figure E.12. The diameter of the pins for horizontal and vertical clearances shall be smaller than the diameter of the holes by: <ul style="list-style-type: none"> • 1 [mm] for holes less than or equal to 30 [mm] in diameter; The distances between the center lines of the pins and the stop shall be equal to the nominal distances from the center line of the holes to the end of The Rail. The gauge pins shall be able to enter the holes at the same time while the stop is touching the end of The Rail. The vertical centering of the holes shall be checked using a gauge as specified in EN13674-1, Figure E.13. The side of the hole, left or right, shall be determined by proceeding from the side with the relief markings.
2	Squareness of ends	0.6 [mm]

		
3	Length ^a -both ends drilled ≤ 24 [m]	± 3 [mm]
^a The given Rail lengths apply for +15 °C. Measurements made at other temperatures shall be corrected to take into account expansion or contraction of the Rail.		

6. FORGED PROCESS GENERAL REQUIREMENTS

- 6.1. All heating, forging, cooling and dressing shall be carried out in a controlled process.
- 6.2. forging technology process and any post heat treatment, including the working ranges, shall be submitted, and shall not be changed without prior ISR approval.
- 6.3. The forged process parameters shall be monitored and checked against approval limits. These records shall be available to ISR by request.
- 6.4. Post heating or controlled post cooling, if required, shall be monitored.
- 6.5. The Forged Transition Rails finishing shall be carried out in the longitudinal direction using machining and optionally additional grinding. The roughness limit shall be maximum 6.3 [Ra].
- 6.6. The Forged Transition Rails profile finishing shall not cause any thermal or mechanical damage. The rail profile in the wheel contact area shall be maintained during profile finishing.
- 6.7. The Forged Transition Rails profile finishing shall not end in the zone S as described in EN16273 section 6.4.
- 6.8. The Forged Transition Rails tolerances shall be in accordance with EN16273, Table 2
 - Table 2 - Tolerances for the transition rail, before welding:



Dimension	Length [mm]	Measurement equipment
Length of forged rail transition LT	Minimum 3xHD	Measuring stick, tape or gauge
Dimension	Admissible tolerance [mm]	Measurement equipment
Length of forged Vignole part, measured on the foot LF	±20	Measuring stick, tape or gauge
Total length of the transition rail L	±20	Measuring stick, tape or gauge
Vertical alignment across the running surface along the longitudinal center line measured by moving a 1 [m] straight edge and a thickness gauge.	-0.1 / + 0.2	1 [m] straight edge and a thickness gauge
Horizontal alignment on the running edge at 14 [mm] below the running surface measured by moving a 1 [m] straight edge and a thickness gauge.	±0.4	1 [m] straight edge and a thickness gauge

6.9. The Forged Transition Rails production shall be recorded to enable the traceability of the product for at least the Warranty Period. These records shall include at least:

- the sign of the manufacturer;
- the year of manufacturing;
- the identification number for the forged part.

7. WELDING PROCESS GENERAL REQUIREMENTS

7.1. The Flash Butt procedure approval test result report in accordance with EN14587-1, section 6.4; 6.5, and annex B, including photos of weld fracture faces (one per sample) of all broken test welds as well as macro and micro examination and the rail profile grid shall be submitted.



- 7.2. a management and supervision system of flash butt welding that complies with the requirements of EN14587-1 and these technical specifications shall be maintain.
- 7.3. The welds production shall be carried out in accordance with the approved welding procedure by Flash Butt Welding Machine ("FBWM") using an automatic, programmed welding sequence in according with EN14587-1.
- 7.4. Before welding the rail end, squareness shall be in tolerance as specified in EN13674-1, table 9, it shall be carried out by saw or disc cut.
- 7.5. Areas of electrical contact on the rails and the machine shall be cleaned to bright metal to give a consistent and good electrical contact at the interface.
- 7.6. The rails shall be welded with the brand marks on the same side.
- 7.7. For every weld, the weld parameters shall be automatic monitored and recorded, these records shall be referenced to a specific weld. The records shall be retained for not less than five years, and shall enable traceability of the records obtained at the time of production.
- 7.8. Every weld shall be checked for alignment and shall conform to the requirements of EN14587-1, section 9.9.

The weld tolerances for straightness and flatness shall be in accordance with the requirements of EN14587-1, section 9.9.1, Table 3.

- Table 3 – Tolerances for straightness and flatness of Flash Butt welds at ambient temperature

Weld alignment	Class 1
Vertically on the running surface	+0.3 +0.1
Horizontally on the head at the running edge	+0.3 0
Horizontal step on the foot tip	1.5
Running surface flatness, measured over the length of the ground area	0.1

Profile finishing grinding of the rail head shall be carried out and

contained in the shortest possible length, but shall not exceed 250 [mm] either side of the weld.

8. **FORGED TRANSITION RAIL DRAWING**

The technical drawing of Forged Transition Rails with rail profiles sections 60E2/54E1 and 54E1/50E6 including dimensions, material main characteristics, coating description, heat treatment, etc., complying with the EN16273, section 4.2, EN 13674-1 and these technical specifications, section 1.3 shall be submitted.

9. **QUALITY CONTROL AND QUALITY ASSURANCE**

The Forged Transition Rails shall be manufactured under a comprehensive quality control management system, which shall ensure confidence consistently compliance in the conformity of the finished product, including documented evidence, all in accordance with these technical specifications and prEN16843, EN10025-2, ISO6305-4, ISO898-1, ISO898-2, ISO10684, ISO965-1, ISO965-4, ISO4759-1, ISO 6157-1 and ISO 6157-2, DIN 65151, EN 10204, and any other relevant standard to provide assurance of product safety in track.

The production control management system procedures, and ISO9001 certificate shall be submitted.

10. **QUALIFYING TESTS (FORGED TRANSITION RAILS PROCEDURE APPROVAL)**

10.1. Forging Procedure Approval Tests ("**Qualifying Tests**") on Rail Grade R260 in accordance with the requirements described in EN16273, shall be carried out.

10.2. A full Qualifying Tests report, from the last five years, carried out and signed by The Laboratory, approving the fulfillment of The Forged Transition Grade R260 manufacture, with the requirements of EN13674-1, sections - 7.4.1.2, 7.4.2, 7.4.3, 7.4.4, 7.5.1, and this technical specifications, shall be submitted, and shall include as a minimum:

- Identification of the machine;
- Identification of the document describing the forging process, including post treatment and the working ranges;
- Rail grade;



- Results of all approval tests.

11. ACCEPTANCE TESTS (PRODUCTION TESTS)

11.1. *The Rails Acceptance Tests before forging process*

11.1.1. All Rails, before forging process shall conform with the requirements of EN13674-1, section 9,

11.1.2. The Rails Acceptance Tests (before forging process) shall be carried out, during The Rails manufacture process, by The Laboratory, in accordance with the requirements of EN13674-1, section 9, and EN10168, at the frequencies specified in EN13674-1, table 4.

- Table 4 – Testing frequency –

Test	EN13674-1 section	Steel Grade
		R260
Chemical composition	9.1.3	One per heat
Hydrogen	9.1.3.2	One per heat (2 tests from first heat in sequence)
Total oxygen	9.1.3.3	One per sequence ^a
Decarburization	9.1.5	One per 1,000 [ton] or part thereof ^{a, b}
Oxide cleanness	9.1.6	One per sequence ^b
Sulfur print	9.1.7	One per 500 [ton] or part thereof ^{a, b}
Hardness	9.1.8	One per heat ^{a, b}
Tensile	9.1.9	one test per 2,000 [ton]
^a Samples shall be taken at random but only The Rails from blooms outside the mixing zone between heats when continuously cast in sequence. ^b Samples shall be cut after rolling.		

In addition, the following tests shall be carried out and conform with the following quality requirements:

11.1.3. MECHANICAL PROPERTIES AND CHEMICAL COMPOSITION TESTS

11.1.4. The Rails mechanical properties and chemical composition inspection tests results shall conform with the requirements of EN10204, Type 3.1 or Type 3.2, shall be submitted.

11.1.5. TENSILE STRENGTH AND ELONGATION TEST

The tensile strength and elongation test results in compliance with the management calculations procedures in accordance with the requirements of EN13674-1, sections - 8.7 and 9.1.9, shall be submitted.

11.1.6. DIMENSIONS TOLERANCES

The Rails nominal dimensions shall conform with EN13674-1, Annex A - figure A.24., and the actual dimensions on any of The Rails shall conform with the tolerances, in accordance with EN13674-1, table 7.

The Rails flatness tests shall be carried out automatically. The tolerances for straightness, surface, flatness and twist shall conform with the requirements of EN13674-1, table 8.

The Rail twist shall not exceed 2.5 [mm], and the rotation twist at the end meter of The Rail, measured by the gauge instrument specified in EN13674-1, Figure 11, shall not exceed 0.2°.

The size and location of the drilled holes, and The Rail ends squareness, and The Rail lengths shall conform with the tolerances, specified in EN13674-1, table 9.

11.1.7. INTERNAL QUALITY

11.1.7.1. **Internal defects**

The Internal Quality Test shall be carried out on 100% of The Rails, by an automatic continuous ultrasonic process ensuring that the entire length and the cross-sectional area is inspected with particular emphasis on The Rail ends.

The Rail ends, which the automatic continuous ultrasonic test system cannot cover, separate ultrasonic procedure shall be carried out on each of The Rail ends, or these Rail ends shall be cut off.

The technique used shall ensure that the minimum cross-sectional area covered by the inspection is no less than:

- (a) 70% of the head;
- (b) 60% of the web;
- (c) The area of the Rail foot specified in EN13674-1, Figure 15.

The Rail head shall be tested from both sides and from the Rail running surface.

The method of inspection shall be in accordance with EN13674-1,

section 9.4.1.3, and 9.4.1.4.

A detailed description of the ultrasonic test method, including the separate ultrasonic procedure or The Rail end cut off process, and in additional the locations and dimensions of the artificial defects in The Rail head, web and foot shall be submitted on request.

11.1.8. SURFACE QUALITY

11.1.8.1. **Protrusions**

Protrusions on The Rail running surface and/ or the underside of The Rail foot, and/or any protrusions affecting the fit of the fishplate at less than 1 [m] from the extremity of The Rail shall not be permitted.

11.1.8.2. **Hot marks, seams**

The depth of hot marks and seams, in accordance with EN10163-1, shall not exceed:

- ☒ 0.35 [mm] for The Rail running surface;
- ☒ 0.5 [mm] for the rest of The Rail.

11.1.8.3. **Guide marks**

There shall not be more than two longitudinal guide marks, to the depth limits specified above and to the width of maximum 4 [mm], with width to depth ration of minimum 3:1, at any point along The Rail length, but no more than one of these guide marks shall be on The Rail running surface.

11.1.8.4. **Hot formed marks**

Hot formed marks originating from the vicinity of the mill rolls on The Rail crown - a maximum of 3 per 40 [m] shall be permitted.

11.1.8.5. **Cold marks**

Longitudinal or transverse cold formed scratches discontinuity depth shall not be larger than:

- ☒ 0.3 [mm] for The Rail running surface and underside of foot;
- ☒ 0.5 [mm] for the rest of The Rail.

11.1.8.6. **Surface Microstructural Damage**

Any sign of surface microstructure damage resulting in martaensite or white phase shall be dressed or The Rail shall be rejected. The dressed area shall be proved by suitable hardness testing. The hardness shall not be 50 HBW greater than the surrounding material.

11.1.8.7. **Surface imperfections**



Every of The Rails shall be inspected by NDT (Non-Destructive Testing) automatic system, for surface imperfections, on the following faces along the entire Rail length:

- on the underside of The Rail foot;
- on The Rail head (running surface and sides).

All The Rails shall conform with the acceptance criteria specified in EN13674-1, section 9.4.2.1., and dressing of imperfections shall conform with the requirements of EN13674-1, section 9.4.2.3.

the NDT automatic system shall be able to detect artificial imperfections on the underside of the foot with sizes in accordance with the requirements of EN13674-1, table 10, with ± 0.1 [mm]

- table 10 – Dimensions of test imperfections,

Depth [in mm]	Length [in mm]	Width [in mm]
1.0	20	0.5
1.5	10	0.5

An edge loss for the NDT automatic technique is permitted for the extreme 5 [mm] of the flat portion of the foot width at each side.

A detailed description of the automatic NDT test method, including drawing showing the locations and dimensions of the artificial defects in The Rail head and foot shall be submitted on request.

11.1.8.8. Dressing of surface imperfections

Imperfections exceeding the limits specified in EN13674-1, sections - 9.4.2.1.(a), and 9.4.2.1.(b) shall be dressed out. Any protrusions affecting the fit of the fishplate in accordance with EN13674-1, section 9.4.2.1.(a) shall be dressed to shape.

The Rail microstructure shall not be affected dressing operation.

The depth of dressing shall not be larger than:

- 0.35 [mm] for The Rail running surface;
- 0.5 [mm] for the rest of The Rail.

Dressing of no more than three defects within a length of 10 [m] of The Rail and, over the whole length, a maximum of one defect per 10 [m] of The Rail length shall be permitted. After dressing The Rail profile tolerances shall be in accordance with EN13674-1, table 7, and The Rail flatness tolerances shall be in accordance with EN13674-1, table 8.

- 11.1.9. The Acceptance Test samples and pieces shall conform with the requirements of EN13674-1, sections - 9.1.2; 9.1.3; 9.1.4; 9.1.5;



9.1.6; 9.1.7; 9.1.8; and 9.1.9.

11.1.10. The complete set of results for The Rails Acceptance Tests (testing The Rails before the forging process), carried out by The Laboratory, for every Israel Railways ("ISR") purchase order, of Forged Transition Rails, shall be submitted.

11.2. ***The Transition Rails Acceptance Tests during and after forging process***

11.2.1. All The Forged Transition Rails, which will be supplied shall conform with the requirements of EN16723, section 8.2.

11.2.2. The Forging Production Tests ("**Forging Acceptance Tests**") shall be carried out, by The Laboratory, in accordance with the requirements of EN16723, section 8.2, and EN10168, at the frequencies specified in EN16723, table 7, shall be submitted.

• Table 7 – Production tests on Transition Rails

Test	Comply with the requirements of	Steel Grade
		R260
Visual inspection	EN16723 section 7.4.2	Every piece
Surface finish	7.4.3 EN16723 section	Every piece
Geometry	EN16723 section 7.4.1.2	Every piece
Hardness	EN16723 section 8.2.2 -	For every grade and profile: the first and last produced piece of 1 day

11.3. ***The Transition Rails Acceptance Tests after welding and machining process***

11.3.1. Every Transition Rail following the welding process shall be additionally tested on the forged area and the weld area in accordance with the following requirements:

Test	Comply with the requirements of	Steel Grade
		R260
NDT -- Dye Penetrant or Magnetic Particle Inspection	EN16723 section 7.4.4	Every piece – on the forged area and weld area
NDT – Ultrasonic Testing	EN16723 section 7.4.5	Every piece – on the forged area and weld area

11.3.2. Forged Transition Rails Acceptance Test Report

The Forged Transition Rails Acceptance Test Report, carried out by

The Laboratory, and contains the tests results shall be submitted.

12. **LABORATORY CERTIFICATES**

12.1. The Laboratory, that is carrying out the Qualifying Tests and Acceptance Tests is certifying with at least the following certifications:

- The Laboratory certified in accordance with ISO/IEC17025 in the field of steel quality testing;

or

- The Laboratory accredited by national laboratory accreditation authority in the field of steel quality testing;

12.2. The Laboratory certificate, include its appendixes, approving its compliance with the requirements of section 12.1, above, shall be submitted.

13. **INSPECTION BY A REPRESENTATIVE OF ISR**

13.1. The ISR technical team and/or an inspection body appointed by the ISR ("**The Inspector**") shall inspect the manufacture processes, the Qualifying Tests results, and Acceptance Tests process and results of The Rails, as specified in EN16273 and EN13674-1 and these technical specifications.

13.2. It is the manufacturer's responsibility to guarantee dimensional accuracy and to ensure that the inspection is carried out with the appropriate measuring instruments.

13.3. The Manufacturer shall be responsible to coordinate inspection process time table with The Inspector in accordance to the delivery date defined in the purchase order.

13.4. The Manufacturer shall extend, to The Inspector, all necessary assistance and cooperation, and shall give access to all test records, calibrations and calculations that contribute to the final results.

13.5. All the gauge/measuring instruments for manufacture verification and inspection of The Rails shall be made available by The Manufacturer to The Inspector on request.

13.6. The Manufacturer shall provide, for every purchase order, all Acceptance Tests results to The Inspector for approval.

13.7. The Acceptance Tests Report and Certificates signed by The Manufacturer, and The Laboratory shall be submitted.



- 13.8. The Qualifying Tests Report and Certificates signed by the Laboratory shall be made available to The Inspector on request.
- 13.9. The Calibration Certificates of the gauge/measuring instruments signed by the Laboratory shall be made available to The Inspector on request.
14. **MARKING AND PACKING**
- 14.1. The Forged Transition Rails 60E2/54E1 and 54E1/50E6 shall be identified with a color mark on the gauge side on the rail foot at the transition area, in accordance with Technical Appendix B. A picture or a drawing shall be submitted.
- 14.2. The Forged Transition Rails shall have permanent identification on the Rail Web and shall include at least:
- The product identification type;
 - The gauge side;
 - The Manufacturer mark or name;
 - The last two figures of the year of manufacture.
- 14.3. The Forged Transition Rails shall be tight in couples (left and right) with 4 bands, 1" width: Two bands shall be tight 1 [meter] from the end of the Forged Transition Rail, and two bands shall be tight 1 [meter] from every side of the Forged Transition Rail center.
15. **LIST OF DOCUMENTS TO BE SUBMITTED WITH BIDDER'S PROPOSAL**
- 15.1. Details on subcontractors performing the Forging Process and/or Welding Process shall be submitted (Name and Factory address, experience, welding machine type)
- 15.2. Documents described the forging technology process on the rails, and any post heat treatment, including the working ranges (section 6.2).
- 15.3. The Flash Butt procedure approval test result report in accordance with EN14587-1, section 6.4; 6.5, and annex B, including photos of weld fracture faces (one per sample) of all broken test welds as well as macro and micro examination and the rail profile grid (section 7.1).
- 15.4. Technical drawing of the Forged Transition Rail with rail profiles sections 60E2/54E1 and 54E1/50E6 including dimensions and

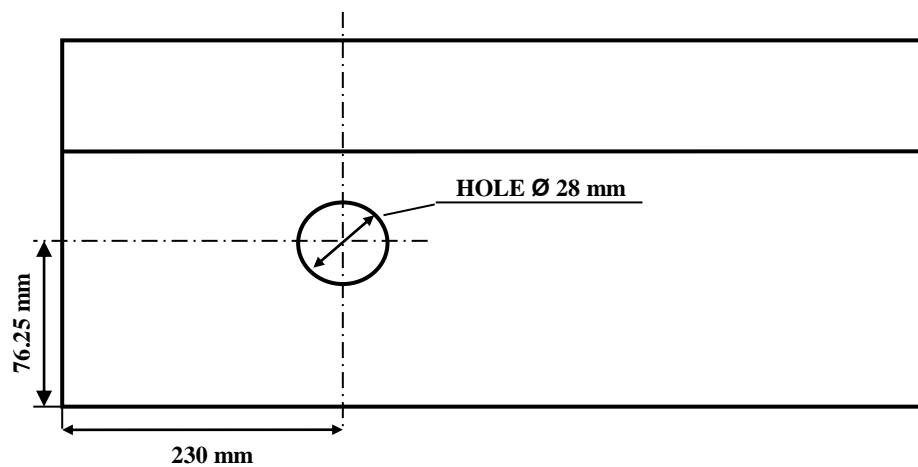
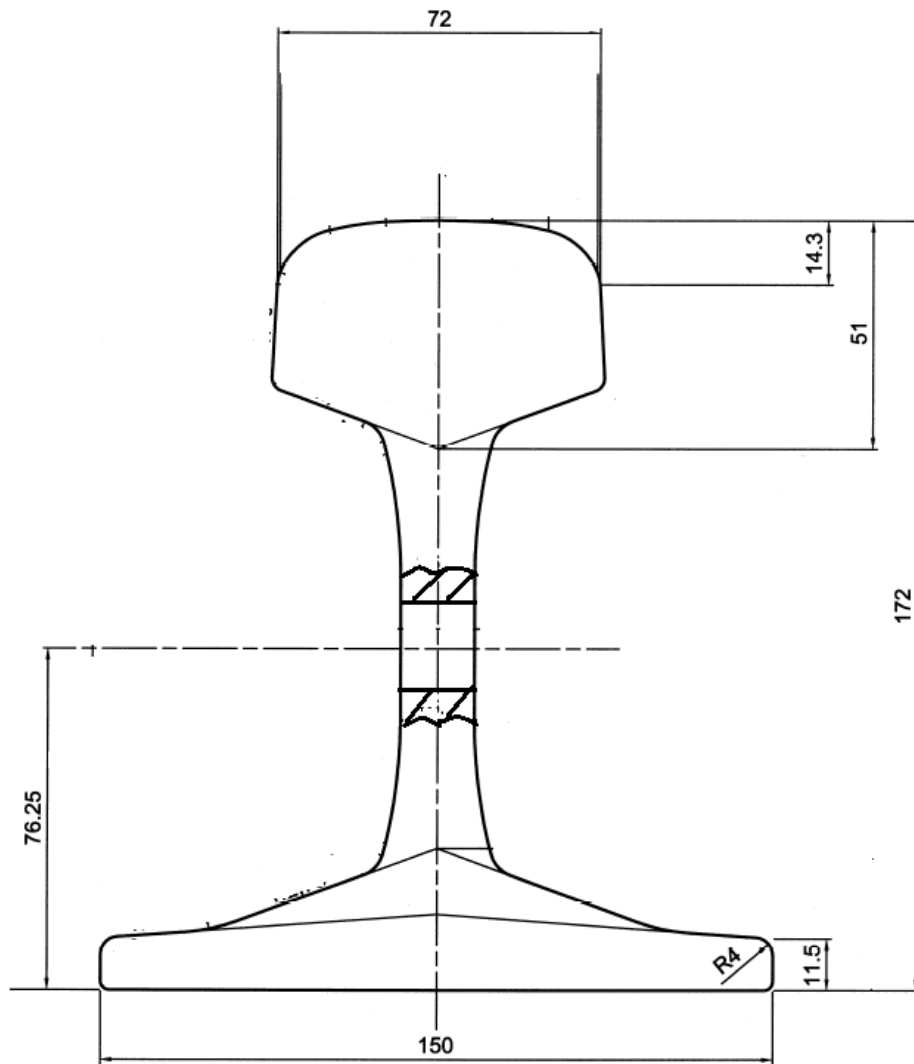
- tolerances in accordance with EN16273, section 4.2, EN13674-1 and these technical specifications (section 8).
- 15.5. Documents described the factory manufacturing and quality control instruction procedures for the forging process follow by ISO9001 and in accordance with EN13674-1, EN16273, EN14587-1 and these technical specifications (section 9).
- 15.6. A full Qualifying Tests report, from the last five years, carried out and signed by The Laboratory, approving the fulfillment of The Forged Transition Grade R260 manufacture, with the requirements of EN13674-1, sections - 7.4.1.2, 7.4.2, 7.4.3, 7.4.4, 7.5.1, and this technical specifications, it shall include as a minimum:
- Identification of the machine;
 - Identification of the document describing the forging process, including post treatment and the working ranges;
 - Rail grade;
 - Results of all approval tests. (section 10.2).
- 15.7. The Laboratory certificate, approving its complains with one of the following requirements:
- The Laboratory certified in accordance with ISO/IEC17025 in the field of steel quality testing.
- or
- The Laboratory accredited by national laboratory accreditation authority in the field of steel quality testing.(section 12).
- 15.8. A picture and/or a drawing of the color mark (section 14.1), and the permanent identification on the Rail Web (section 14.2).
16. **LIST OF DOCUMENTS TO BE SUBMITTED WITH EVERY ORDER**
- 16.1. *Testing Documents on The Rails before the forging process*
- 16.2. The Rails Acceptance Tests, carried out and signed by The Laboratory, approving the fulfillment of The Rail Grade R260 manufacture with the requirements of EN13674-1, section 9, and EN 10204, Type 3.1 or Type 3.2. (section 11.1.10).
- 16.2.1. The Rails mechanical properties and chemical composition inspection tests results, which conform with the requirements of EN10204, Type 3.1 or Type 3.2, (section 11.1.4).



- 16.2.2. The Rails tensile strength and elongation test results in compliance with the management calculations procedures in accordance with the requirements of EN13674-1, sections - 8.7 and 9.1.9, (11.1.5).
- 16.2.3. The complete set of results for The Rails Acceptance Tests (testing The Rails before the forging process), carried out by The Laboratory, for every Israel Railways ("ISR") purchase order, of Forged Transition Rails (section 11.1.10).
- 16.3. *Testing Documents on The Forged Transition Rails after the forging process*
- 16.3.1. The Forged Transition Rails Acceptance Test Report, carried out by The Laboratory, in accordance with the requirements of EN16723, section 8.2, and EN10168, at the frequencies specified in EN16723, table 7, and contains the tests results (section 11.2.2).
- 16.4. *Testing Documents on The Forged Transition Rails after the welding process*
- 16.4.1. The Forged Transition Rails Acceptance Test Report, carried out by The Laboratory, in accordance with the requirements of EN16723, section 7.4.4 and 7.4.5, and these technical specifications on the frequencies specified in section 11.3.1 aforementioned.

TECHNICAL APPENDIX A – FISHPLATE BOLT HOLE POSITION – IN THE RAIL WEB

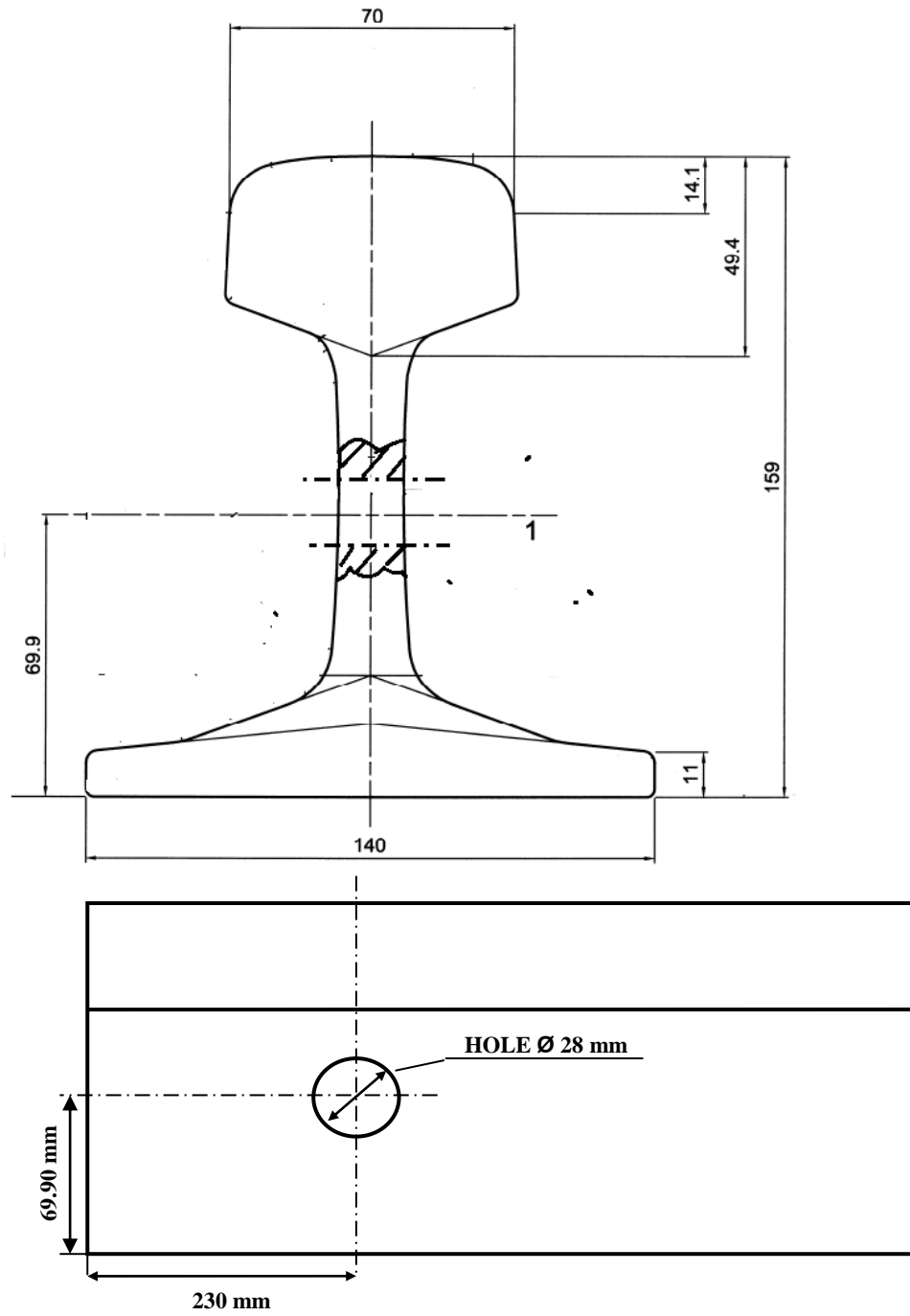
A.1 -- Rail Profile 60E2



A.2 – Rail Profile 54E1

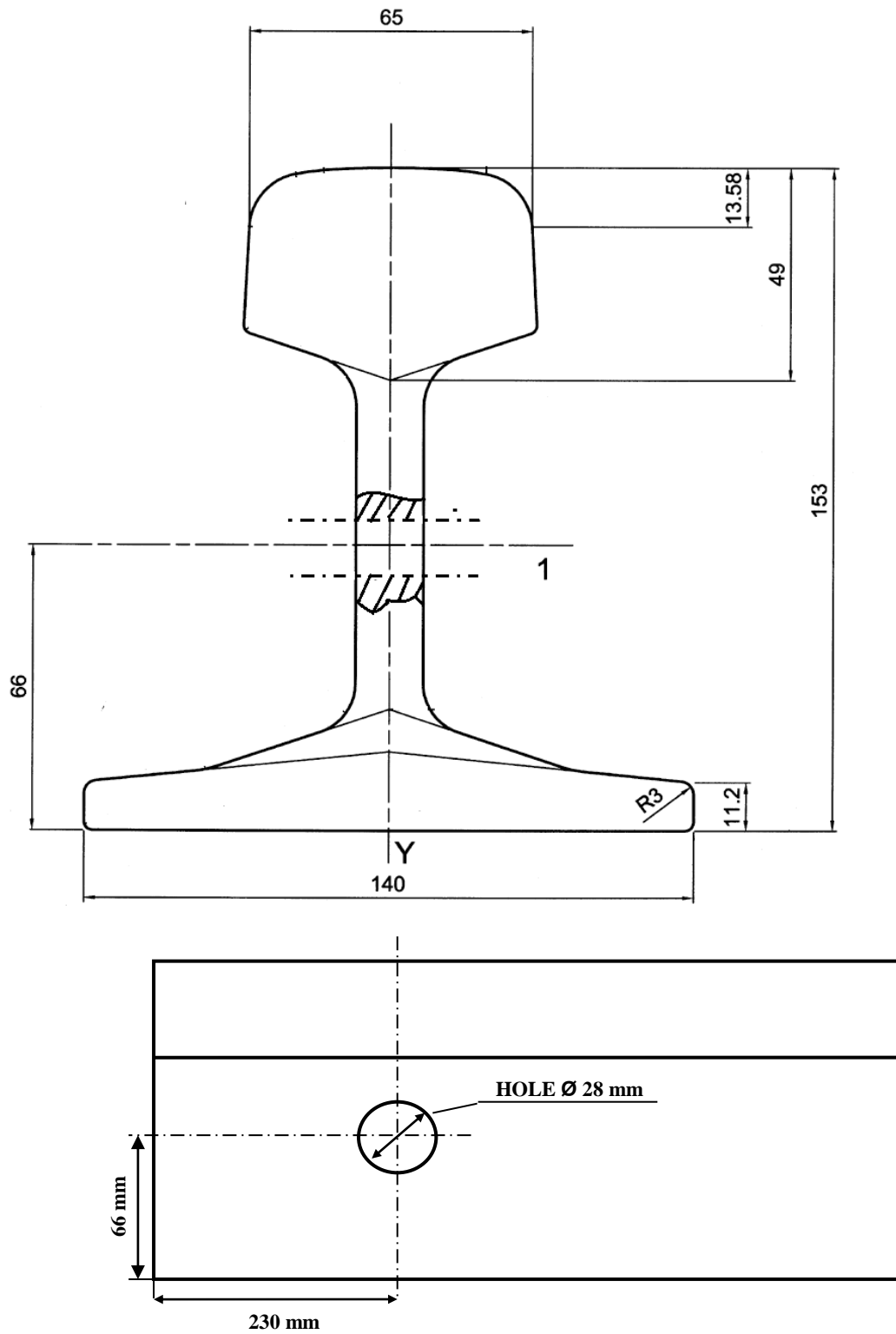


**FORGED TRANSITION RAILS 60E2/54E1
and 54E1/50E6 profiles and R260 Grade
No. E-01-0043.1 September 2019**



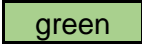








A.3 – Rail Profile 50E6





TECHNICAL APPENDIX B – COLOR MARK ON RAIL

<u>Transition Rail</u>	<u>Profile Color</u>	<u>Grade Color</u>	<u>Color Mark on Rail</u>
60E2/54E1 R260	 green +  red +  white =>		
54E1/50E6 R260	 red +  yellow +  white =>	