A division of Transnet SOC Limited

RAIL NETWORK – TECHNICAL (WELDING)

TESTING REQUIREMENTS FOR THE APPROVAL OF ALUMINOTHERMIC WELDING PROCESSES OF RAILS

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Transnet Freight Rail

Approved third parties

Table of Contents

Foreword

This document details the technical requirements for the testing and approval of aluminothermic or exothermic welding procedures and processes for railway rails used by Transnet Freight Rail. All references to clauses, figures, tables and annexures refer to BS EN 14730-1:2017 , unless otherwise stated. The acceptance criteria will be as stipulated in BS EN 14730-1:2017 , any deviation shall be stated otherwise.

1.0 Introduction

1.0.1 This document provides guidelines for the technical testing requirements for approval of aluminothermic welding procedures and processes for new rails under laboratory conditions.

1.0.2 The guidelines detail the approval of rails by testing conducted on joints cast from new rail sections of the same rail grade with no difference in profile and wear.

1.0.3 The guidelines herein cover the requirements for initial compliance testing of welding processes and procedures.

1.1 Railway Authority

1.1.1 Transnet Freight Rail (TFR) as the railway authority uses exothermic welding to join two rails in track in accordance to the Track Welding Manual (**BBB8341_latest version**).

1.1.2 TFR currently has the following types of rails installed in track as per EN 13674-1:2011 specification;

1.1.2.1 R260 / Grade 900 rail grade with SAR 48 and SAR 57 profiles**. See attached annexure.**

1.1.2.2 R350LHT rail grade with 60E1 rail profiles, equivalent rail profiles of UIC60 and S-60-SAR shall be used for 60E1. **See attached annexure.**

1.1.3 Radiographic Evaluation on Transnet Freight Rail Lines **BBB8375_Revision 2.**

1.1.4 Other maintenance procedures conducted for rails and other track components are in accordance with the Manual for Track Maintenance (**BBB0481_latest version**).

1.2 General Requirements

1.2.1 The supplier shall provide TFR with an aluminothermic welding procedure and process that follows a single execution which allows for single use set up of all consumables , the processes' shall be approved in accordance with the specification BS EN 14730-1:2017.

1.2.2 The aluminothermic welding products, apparatus and consumables shall be compatible for satisfactory welding of the rail profile/rail grade combinations as stipulated in Table 1.

Table 1: Rail Profile and Rail Grade requirements

Rail Profile	Grade
60 E1	R350LHT
SAR57	R260
SAR48	R260

1.2.3 The welding process proposed by the bidder shall be capable of being carried out successfully on new rails , worn rails and combinations of such rails once it has been approved.

1.2.4 The supplier shall submit all documents that are specific to the welding process as listed in **clause 5.4 of BS EN 14730-1:2017 including a technical report or product manual.**

1.2.5 The supplier shall submit a comprehensive metallurgical report detailing all the results of the tests **in clause 1.3.2)** of this document excluding ultrasonic testing of this document.

1.2.6 The process shall be identified according to **clause 5.2 of BS EN 14730-1:2017.**

1.2.7 It shall be capable of being carried out in track, at or near a trackside or in a workshop.

1.2.8 The pre-heating process shall achieve the required welding temperature of 950°C as stipulated in the **Track Welding Manual** (**BBB8341_latest version)**. The process shall not result in excessively large austenite grains that weaken the heat affected zone.

1.2.9 The crucible shall tap automatically and shall be designed in a manner as to avoid spattering in accordance with **clause 5.3** i**n BS EN 14730-1:2017.**

1.2.10 Riser removal shall be done in such a manner that the resultant surface is flush or red**.**

1.2.11 The entire welding process shall not damage the rail.

1.3 Metallurgical Compliance Requirements

The bidder is required to provide quality analysis report(s) which includes a minimum of **four** aluminothermic welded samples tested by a third party (external) ISO 17025 accredited laboratory. Two types of tests will be conducted for the welded rails, that is, bend test and other quality tests such as chemical analysis, hardness (Vicker's), macroscopic examination and microscopic examination.

1.3.1 Compliance shall be achieved by undertaking the tests specified in category 3 of Table 2, **clause 5.5 in BS EN 14730-1:2017** specification exclusive of ultrasonic inspection. Tests will be conducted using R350LHT and R260 steel grade for 60E1, SAR57 and SAR48 rail profiles respectively.

1.3.2 The tests in Table 2 shall be conducted in accordance **with clause 7 of BS EN 14730-1:2017** using the steps listed in Annex A in the same standard. An IS0 17025 (or equivalent standard) accredited laboratory shall be used for testing, unless otherwise special permission is granted by a Principal Engineer of Rail Network Technical.

1.3.3 **Radiographic Testing (RT)** shall be conducted on all the samples as an additional non-destructive testing requirement. The x-ray film results shall be examined by a certified NDT organisation and will be evaluated in accordance to **Radiographic Evaluation on Transnet Freight Rail Lines BBB8375 Revision 2.**

1.3.4 Preparation and allocation test welds shall be done according to clause 5.7 of BS EN 14730-1:2017.

1.3.5 Approval shall be granted upon full compliance of the requirements of this document and specification **BS EN 14730-1:2017**.

1.3.6 **Re-approval following any change in the process after initial approval shall be conducted in accordance with clause 6 of BS EN 14730-1:2017**.

NB all references to tables and figures mentioned herein are in the BS EN 14730-1:2017 specification*

1.4 Additional Requirements

1.4.1 Vickers hardness test load 30kg shall be used for clause 1.3.2 of this document and any conversions from various loads must be stated clearly in the report.

1.4.2 Hardness profile measurements shall be made on a smooth ground surface in "as cast" condition. The hardness shall include the heat softened zone extending to both sides of rail until 20 mm of the unaffected parent rail (see Annex I in BS EN 14730-1:2017). Indents shall be taken longitudinally between 3 and 5 mm from the running surface of the rail crown at 2 mm intervals.

1.4.3 Hardness measurements for hardness profile shall graphically be represent as shown in Annex I2 in BS EN 14730-1:2017.

1.4.4 Samples for microscopic examination shall be taken and prepared in accordance to Annex H in BS EN 14730-1:2017. The microstructure shall be pearlite. The visible heat affected zone shall not contain any bainite or martensite examined at x100 magnification.

1.4.5 Cold etching shall be done to reveal the fusion zone of weld. The fusion zone shall exhibit a nominally symmetrical shape about the weld.

1.4.6 TFR shall request additional electronic images of the microstructures from the microscopic examination and of the visible heat affected zone if necessary.

1.4.7 TFR representatives shall witness all the welding tests including surface visual examination, slow bend test and radiographic testing.

1.5 Reference

EN 14730-1:2017, Railway Applications-Track-Aluminothermic welding of rails-Part 1: Approval of welding processes.

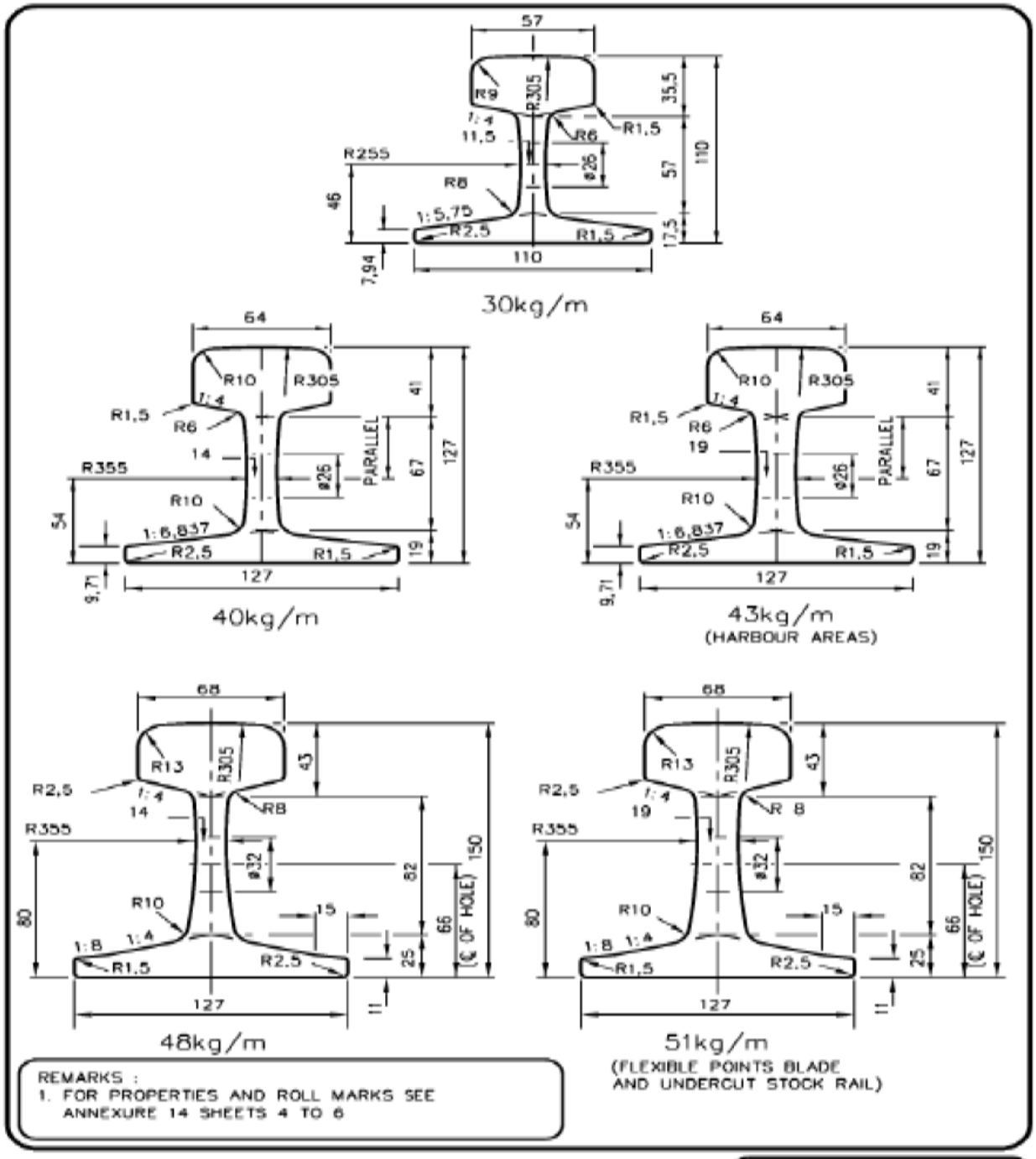
BS EN 13674-1:2011, Railway Applications-Track-Rail-Part 1: Vignole railway rails 46kg/m and above

1.6 Annexures

1.6.1 The rails profiles below are as per annexure 14 of Transnet Freight Rail Manual for Track Maintenance (latest version). Other rail profiles not in this Annexure shall be found in BS EN 13674-1:2011 specification.

RAIL PROFILES

ANNEXURE 14
SHEET 1 of 6

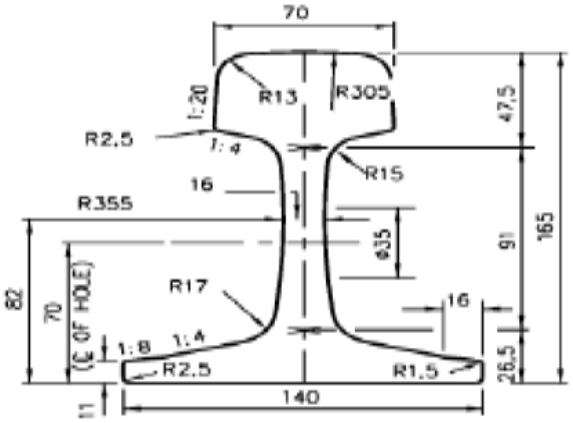


REMARKS :
1. FOR PROPERTIES AND ROLL MARKS SEE ANNEXURE 14 SHEETS 4 TO 6

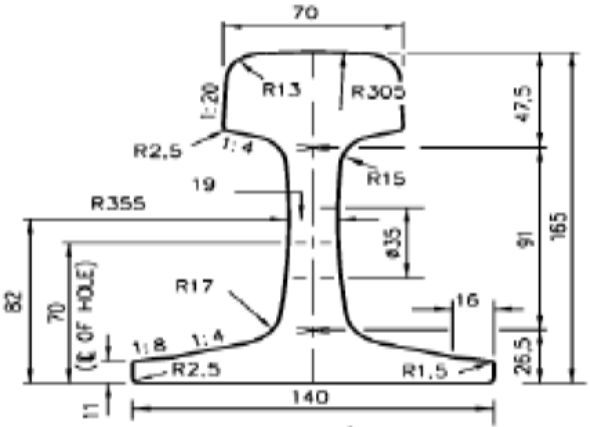
BE 97-14 Sht 1 Version 2

RAIL PROFILES

ANNEXURE 14
SHEET 2 of 6

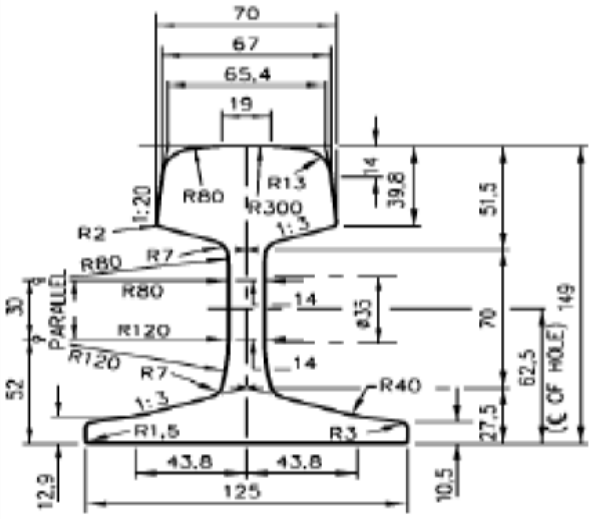


57kg/m



60kg/m

(FLEXIBLE POINTS BLADE
AND UNDERCUT STOCK RAIL)



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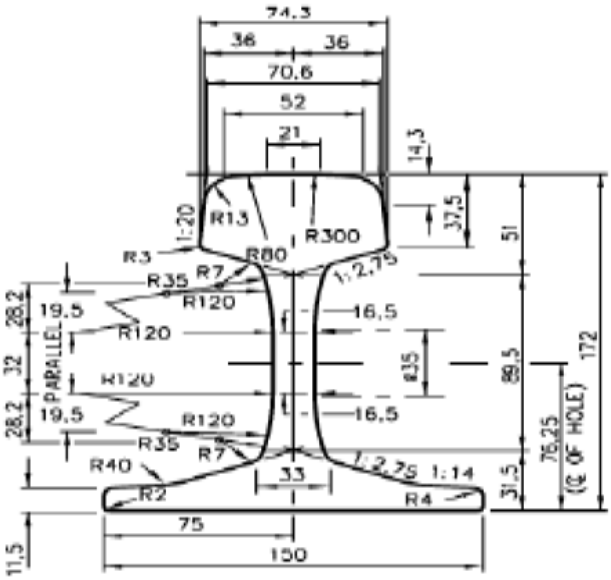


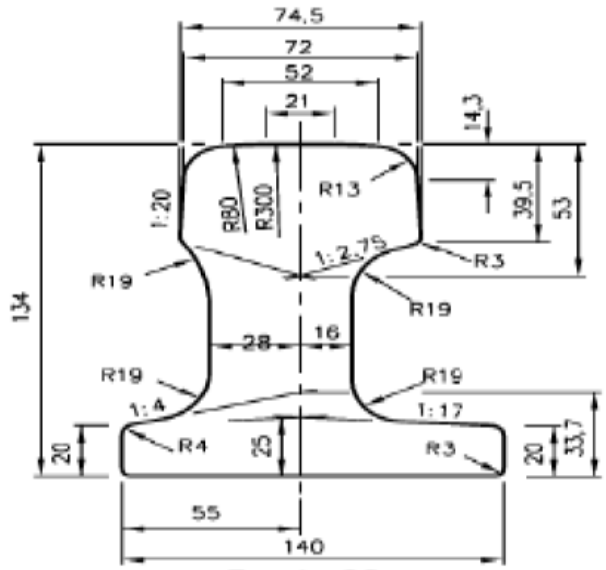
UIC–60

REMARKS :
1. FOR PROPERTIES AND ROLL MARKS SEE ANNEXURE 14 SHEETS 4 TO 6

BE 97–14 Sht 2 Version 2

RAIL PROFILES

ANNEXURE 14
SHEET 3 of 6



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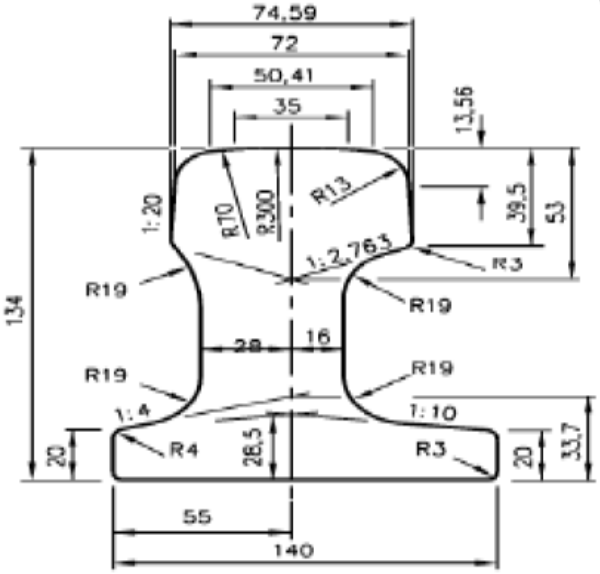

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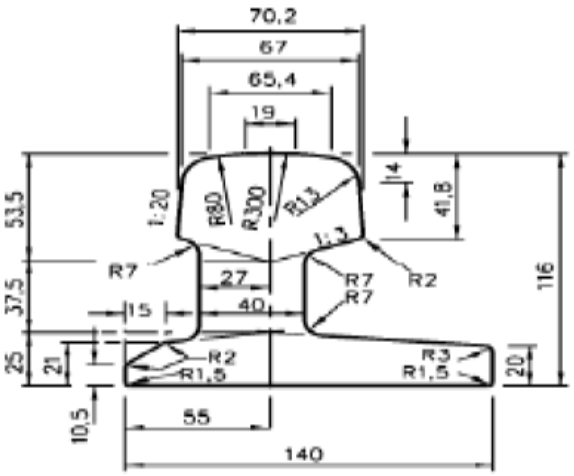

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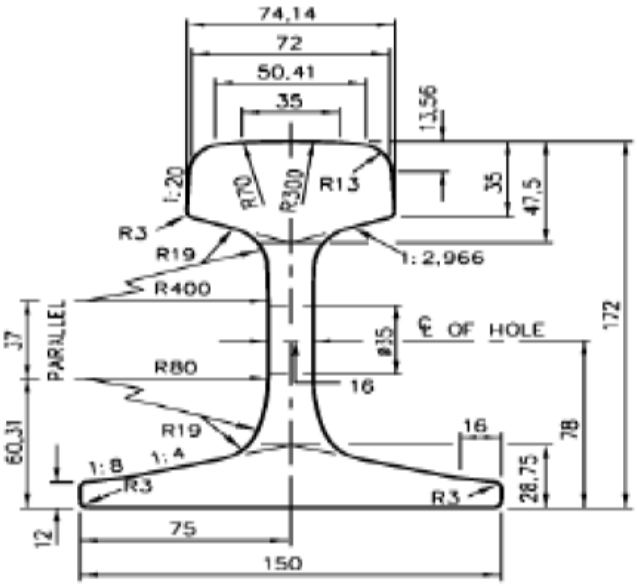

S–60–SAR

REMARKS :
1. FOR PROPERTIES AND ROLL MARKS SEE ANNEXURE 14 SHEETS 4 TO 6

BE 97–14 Sht 3 Version 2