

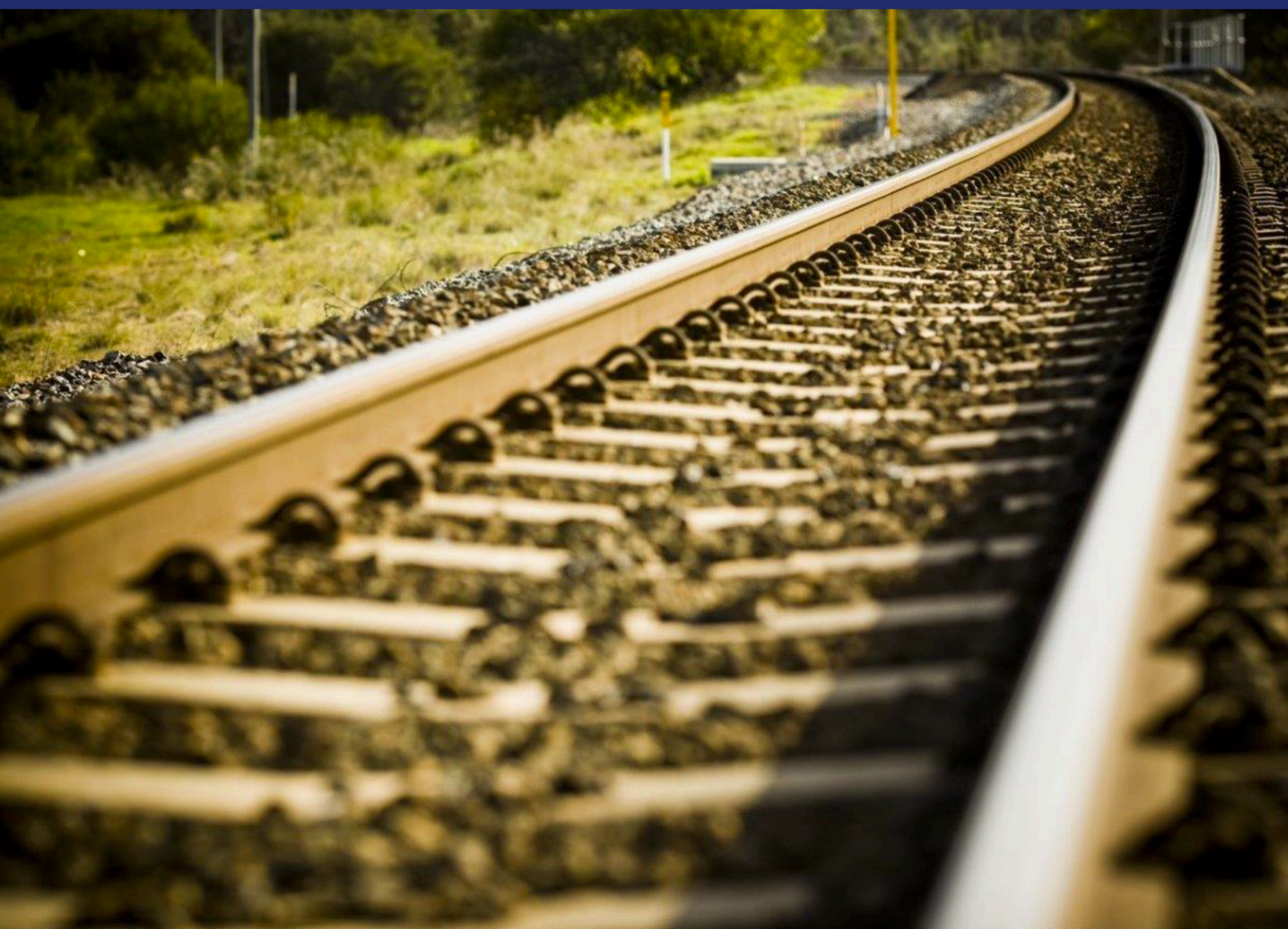
AS 1085.1:2019



Railway track material, Part 1: Steel rails



Infrastructure Standard



This Australian Standard® AS 1085.1 Railway track material, Part 1: Steel rails was prepared by a Rail Industry Safety and Standards Board (RISSB) Development Group consisting of representatives from the following organisations:

Transport for NSW,
Public Transport Victoria,
Monash University,

Arc Infrastructure,
Queensland Rail,
Liberty One Steel

ARTC,
Aurizon,

The Standard was approved by the Development Group and the Infrastructure Standing Committee in September, 2019. On September 25, 2019 the RISSB Board approved the Standard for release.

This standard was issued for public consultation and was independently validated before being approved.

Development of the Standard was undertaken in accordance with RISSB's accredited process. As part of the approval process, the Standing Committee verified that proper process was followed in developing the Standard.

RISSB wishes to acknowledge the positive contribution of subject matter experts in the development of this Standard. Their efforts ranged from membership of the Development Group through to individuals providing comment on a draft of the Standard during the open review.

I commend this Standard to the Australasian rail industry as it represents industry good practice and has been developed through a rigorous process.



Deb Spring
Exec. Chair / CEO
Rail Industry Safety and Standards Board

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AS 1085.1:2019

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Document details

First published as: AS 1085.1 2019 Railway track material, Part 1: Steel rails
 ISBN 978-1-76072-598-3

Document history

	Document	Version	Date	ISBN
Originating:	AS E1-1925T and AS 1085.11—1985			
Prev. edition	AS 1085.1 Railway track material, Part 1: Steel rails	2002 (R2013)	01/08/2002	0 7337 4619 5
Current. edition	AS 1085.1 Railway track material, Part 1: Steel rails	2019	25/09/2019	978-1-76072-598-3

Approval

Name	Date
Rail Industry Safety and Standards Board	25/09/2019

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This Standard was prepared by the Rail Industry Safety and Standards Board (RISSB) Development Group AS 1085.1 Railway track material, Part 1: Steel rails. Membership of this Development Group consisted of representatives from the organisations listed on the inside cover of this document

This Standard supersedes AS1085.1 :2000 and AS 1085.1/Amdt 1/2005-03-14.

Objective

The objective of this Standard is to provide purchasers and suppliers, including owners, operators, designers and manufacturers of railway rail with requirements for as-rolled and hardened steel rails, made from continuously cast blooms for railway purposes.

This Standard is Part 1 of the AS 1085 (Railway track material) series.

Compliance

There are two types of control contained within Australian Standards developed by RISSB:

1. Requirements.
2. Recommendations.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard. Requirements are identified within the text by the term ‘shall’.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred. Recommendations are identified within the text by the term ‘should’.

Recommendations recognise that there could be limitations to the universal application of the control, i.e. the identified control is not able to be applied or other controls are more appropriate or better.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities, or interfacing organisations where the risk may be shared.

Controls in RISSB standards address known railway hazards are addressed in an appendix.

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1 Scope and general

1.1 Scope

This Standard specifies requirements for as-rolled and hardened steel rails made from continuously cast blooms and profiles for asymmetric switch rails and elevated guardrails for railway purposes.

This Standard does not apply to the manufacture of steel rails with a nominal minimum surface hardness greater than 350 HB, including super-pearlite, hyper-eutectoid or other premium alloy rails.

NOTES:

1. Guidelines for purchasers are given in Appendix A.
2. Guidance on the means for demonstrating compliance with this Standard is given in Appendix B.
3. Information on residual stresses in rail is given in Appendix C.

1.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

- AS 1003, Engineers' straightedges (metric units)
- AS 1085.20 Railway track materials, Part 20: Welding of steel rails
- AS 1100.201, Technical drawing Mechanical engineering drawing
- AS 1199.0 Sampling procedures for inspection by attributes Introduction to the ISO 2859 attribute sampling system
- AS 1199.1 Sampling procedures for inspection by attributes Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
- AS 1391, Metallic materials - Tensile testing at ambient temperature
- AS 1816.1, Metallic materials - Brinell hardness test Test method (ISO 6506-1:2005, MOD)
- AS 1817.1, Metallic materials - Vickers hardness test Test methods (ISO 6507-1:1997, MOD)
- AS 1817.2 Metallic materials - Vickers hardness test Verification of testing machines
- AS 1817.3 Metallic materials - Vickers hardness test Calibration of reference blocks
- AS 1929, Non-destructive testing—Glossary of terms
- AS 2205.5.1, Methods for destructive testing of welds in metal Macro metallographic test for cross-section examination
- AS 2706, Numerical values - Rounding and interpretation of limiting values
- AS/NZS 1050 (all parts), Methods for the analysis of iron and steel
- AS/NZS ISO 9001, Quality management systems—Requirements
- AS/NZS ISO 9004, Quality management systems—Guidelines for performance improvements
- HB 18.28, Guidelines for third-party certification and accreditation Guide 28 - General rules for a model third-party certification system for products

- ASTM E1180, Practice for preparing sulfur prints for macrostructural examination
- UIC 860, Technical specification for the supply of rails
- UIC 861-2, Standard sections for points rails adapted to the UIC 54 and 60 kg/m rail sections

1.3 Definitions

For the purpose of this Standard, the definitions given in AS 1929 and those given below apply:

(a) *as-rolled rail*

rail that is cooled off the mill, without accelerated cooling, and is not subsequently heat treated

(b) *head-hardened rail*

rolled rail in which the head has a hardened zone extending inwards from its top and side surfaces

NOTE: For the purpose of this Standard, head-hardened rail has been treated by accelerated cooling of the head to produce a fine pearlitic structure.

(c) *hardened rail*

rolled rail that has been head-hardened or full section hardened by in-line or off-line processes

General rail industry terms and definitions are maintained in the RISSB Glossary:

<https://www.rissb.com.au/products/glossary/>

2 Context of use

2.1 Function

Steel rail forms the direct longitudinal support member of the railway permanent way and provides the guiding and running surface for rolling stock. Rail can also be used to conduct current for signalling and traction purposes.

2.2 Action

Steel rail is subjected to:

- (a) loads imposed by the passage of rolling stock and during maintenance;
- (b) the effects of temperature, fastening systems, joints and welding; and
- (c) fatigue, wear, damage and corrosion.

3 Rounding of numbers

3.1 General

For the purpose of assessing compliance with this Standard, the specified limiting values herein shall be interpreted in accordance with the 'rounding method' described in AS 2706, that is, the observed or calculated value shall be rounded to the same number of figures as in the specified or calculated value and then compared with the specified limiting values. For example, for specified limiting values of 2.5, 2.50 and 2.500, the observed or calculated value would be rounded respectively to the nearest 0.1, 0.01 and 0.001.

3.2 Tensile properties

The determined value of tensile strength shall be rounded off to the nearest 10 MPa, and the determined value of yield stress shall be rounded off to the nearest 5 MPa.

4 Designation

The nominal rail size shall be designated by the nominal mass, in kilograms, of a 1 m length of rail. For example, 31 kg rail means a rail section having nominally a mass of 31 kg per metre.

The switch rail profiles are matched with 50 kg and 60 kg rails. They shall be referred to as 50 kg asymmetrical switch rails and 60 kg asymmetrical switch rails, respectively. The elevated guardrail profile is for use with either 50 kg or 60 kg rails. It shall be referred to as '50/60 kg elevated guardrail'. The guardrail specified in this Standard, also known as check rail, is for use in points and crossings.

NOTE: The masses used to refer to asymmetrical switch rails and elevated guardrails refer to the rail profile with which they are commonly used and not the actual mass of the section. This naming convention does not preclude their use with other rail profiles.

5 Track system compatibility

5.1 Profile shape

The dimensions of rails shall conform to the appropriate profile drawing given in Appendix D within the dimensional tolerances given in Table D1. Methods for testing the dimensional tolerances shall be as given in Appendix D.

5.2 Materials

Requirements for materials for track system compatibility shall be deemed to be met when Section 6.1 is satisfied.

6 Service life

6.1 Materials

When tested in accordance with Appendix E, the chemistry shall conform with the limits given in Table E1 for the basic chemical elements and Table E2 for the residual elements.

6.2 Shape stability and wear resistance

Shape stability and wear resistance requirements shall be deemed to be met when the requirements of Sections 6.1 and 7 are satisfied.

6.3 Fatigue

Fatigue requirements shall be deemed to be met when the requirements of Sections 6.1 and 7 are satisfied.

7 Material integrity

7.1 Material properties

7.1.1 As-rolled rail

When tested in accordance with Appendix F Section F1.1 (tensile testing) and Appendix F Section F1.2 (surface hardness test) of Appendix F, the material properties shall conform to the limits given in Table E3 of Appendix E.

7.1.2 Head-hardened rail

Head-hardened rail shall comply with the following performance requirements:

- (a) Tensile testing: When tested in accordance with Section F1.1 of Appendix F, the material properties shall conform to the limits given in Table E3 of Appendix E.
- (b) Surface hardness test: When determined in accordance with Section F1.2 of Appendix F, surface hardness shall be within the limits given in Table E3 of Appendix E.

- (c) Test for depth of heat treatment (etch test): When determined in accordance with Section F1.3 of Appendix F, the dimensions of the heat-affected zone shown in Figure F1(c) shall be in accordance with Table E5 of Appendix E.
Note: This test is only applicable for off-line heat treated rails.
- (d) Hardness gradient test: When determined in accordance with Section F1.4 of Appendix F, the hardness results obtained shall vary gradually toward the centre of the rail, with no sharp drop or discontinuity and shall be within the limits given in Table E4 of Appendix E.
- (e) Microstructure test: When examined in accordance with Section F1.5 of Appendix F, the microstructure of the entire cross-section shall be substantially pearlitic and shall not exhibit grain boundary cementite.

Note: For rails where additional hardening of the rail section has taken place, the above tests may be specified, and additional tests could be necessary to cover further requirements such as the hardness throughout the cross-section.

7.2 Internal soundness

7.2.1 Bloom reduction

The cross-section of the rail shall not exceed one-ninth (0.111) that of the bloom from which the rail is rolled.

7.2.2 Post-rolling operations

Rails shall be ground or machine-cut to length and drilled, if required, in such a way that the temperature of the rail is not high enough to cause any changes in the microstructure of the steel.

7.2.3 Sulfur print test

When tested in accordance with ASTM E1180 (Bauman sulfur print test), the sulfur segregation in the rail shall not exceed the following:

- (a) Segregation, which can take the form of a single line, a double line or a cluster of spots, and which occurs within the web region shown in Figure F2 of Appendix F, shall not extend beyond that boundary into the rail head or foot.
- (b) Outside the web region, as shown in Figure F2 of Appendix F, the sum of the lengths of other streaks shall not exceed:
 - i. 6 mm in the head; and
 - ii. 6 mm in the foot.

7.2.4 Ultrasonic test

When tested in accordance with Section F2.2 of Appendix F, discontinuities shall—

- (a) not extend outside the web region shown in Figure F2 of Appendix F; and
- (b) not exceed 10 mm in vertical height transverse to the direction of rolling.

NOTE: In view of the significant probability of false rejection, rails that register apparent discontinuities may be retested or cut back and retested. No rail should be accepted until the full length delivered has been confirmed to be satisfactory. Rails containing confirmed discontinuities exceeding the limits given should be rejected or cut back to remove the affected portion.

7.2.5 Hydrogen-induced cracks

The rail shall be free of hydrogen-induced cracks.

7.3 External finish

7.3.1 Visual inspection

When inspected visually, the depth of surface imperfections such as seams, rolled-in scale and other marks in the zones indicated (see Figure F5, Appendix F) shall be:

- (a) less than 0.5 mm in zone A (rail head) and zone C (edge of rail foot);
- (b) less than 0.75 mm in zone B (rail web and top of foot); and
- (c) less than 1 mm in zone D (underside of rail foot).

Subject to agreement between the supplier and purchaser, discontinuities deeper than the above may be removed by grinding out smoothly. After any such grinding, the rail dimensions shall be not less than specified in Section 5.1. All grinding shall be conducted in such a way that the temperature of the rail is not high enough to cause any changes in the microstructure and the finished surface is free of sharp edges.

Recurrent or extensive discontinuities in zone A within the limits set in this Section are unacceptable.

7.3.2 Eddy current test

When tested in accordance with Section F3 of Appendix F, discontinuities in 50, 60 and 68 kg rail shall not exceed 1.0 mm in depth on the underside of the foot of the rail.

NOTE: The eddy current test for 31 and 41 kg rails may be specified at the option of the purchaser (see Appendix A).

8 Suitability for connection

8.1 Profile consistency and end squareness

Requirements for the suitability of rail profile and end squareness for connection purposes shall be deemed to be met when Section 5.1 is satisfied.

8.2 Suitability for welding and drilling

Requirements for the suitability of rail for welding and drilling for connection purposes shall be deemed to be met when Section 6.1 is satisfied.

8.3 Holes for fishbolts

Where drilling is required, rails shall be drilled for the fishbolts conforming to the centres and dimensions shown on the appropriate profile drawing in Appendix D. In the process of drilling, the rails shall not be split or damaged, and any resulting burrs or projections shall be removed.

9 Suitability for maintenance

9.1 Suitability for welding, drilling and grinding

Requirements for the suitability of rail for welding, drilling and grinding for maintenance purposes shall be deemed to be met when Section 6.1 is satisfied.

9.2 Material properties

Requirements for the material properties of rail for maintenance purposes shall be deemed to be met when Sections 6.1 and 7 are satisfied.

10 Handling

Rails shall not be supplied with burrs or sharp edges, which could be a hazard for those handling the rail.

11 Marking

11.1 General

Rolled-in and stamped brands shall be legible, readily found and shall not compromise the integrity of the rail. These requirements shall be deemed to be met when Sections 11.2 and 11.3 are satisfied.

NOTE: Manufacturers making a statement of compliance with this Australian Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

11.2 Rolled-in brands

Rolled-in brands shall be applied as follows:

- (a) They shall be rolled into the web of each rail at a spacing of not greater than 1.8 m.
- (b) The characters shall be a minimum of 20 mm in height.
- (c) The characters shall be raised at least 0.5 mm from the plane surface of the web.
- (d) The brand shall show the following:
 - i. Nominal rail size.
 - ii. Mill brand.
 - iii. Month and year of rolling.
 - iv. If head-hardened rail, the letter 'H', to indicate 'head-hardened'.

NOTES:

1. For 68 kg rail a stamped 'NH' may be used to indicate 'head-hardened' if agreed between the supplier and the purchaser.
2. The month and year of manufacture is to be used for the purpose of identification only and should not be used as a basis for rejection of the steel rails.

11.3 Stamped brands

Stamped brands shall be applied as follows:

- (a) They shall appear at least once on each piece of rail.
- (b) They shall be positioned on the opposite side of the web to the rolled-in brand.
- (c) One of the stamped brands shall appear at least 500 mm from the end of the piece of rail.
- (d) Characters shall be a minimum of 16 mm in height.
- (e) Characters shall be sloped 10° off vertical and shall be so designed that they will not initiate cracking (see Figure 1).

NOTE: Sloping and rounding of marks is intended to reduce the opportunity for initiation of cracking.

- (f) They shall include a unique identification code that indicates the production history of the rail (e.g., heat number, bloom number).
- (g) The action of applying the brand shall not cause metallurgical changes in the rail.



FIGURE 1 LETTERS FOR STAMPED BRANDS

Appendix A Information to be supplied by the purchaser (Informative)

The following information should be supplied by the purchaser (see also Section 4):

- (a) Number and part of this Australian Standard, i.e. AS 1085.1.
- (b) Nominal rail size (e.g., 50 kg) where this applies, or the number of the appropriate drawing.
- (c) Quantity (mass or number of pieces).
NOTE: It should be remembered that the actual mass of the profile can be different to the nominal size.
- (d) Lengths of rails, including the supply of short lengths.
- (e) Whether rails are to be drilled or undrilled.
- (f) Any exceptions to the requirements specified in this Standard, and any special or supplementary requirements.
- (g) Information required to be supplied on production quality, such as a quality plan or appropriate acceptable quality levels (see AS 1199).
- (h) Whether inclusion is required of the following tests for all rails in a continuous manner during production:
 - i. Ultrasonic testing (see Appendix F Section F2.2).
 - ii. Visual surface inspection (see Appendix F Section F3.1).
 - iii. Eddy current testing (see Appendix F Section F3.1).