Australian STANDARD®

Australian railway rolling stock - Body structural requirements - Part 1 - Locomotive

RISSB
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

Rolling Stock Standard

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This Australian Standard® AS 7520.1 Australian railway rolling stock - Body structural requirements - Part 1 - Locomotive was prepared by a Rail Industry Safety and Standards Board (RISSB) Development Group consisting of representatives from the following organisations:

Click here to enter the organisations represented on the Development Group. Tab between them.

The Standard was approved by the Development Group and the Rolling Stock Standing Committee in Select SC approval date. On Select Board approval date the RISSB Board approved the Standard for release.

Choose the type of review

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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This Standard was prepared by the Rail Industry Safety and Standards Board (RISSB) Development Group AS 7520.1 Australian railway rolling stock - Body structural requirements - Part 1 - Locomotive. Membership of this development group consisted of representatives from the organisations listed on the inside cover of this document

Objective

This document describes requirements for the structural strength of railway locomotive bodies.

The main purpose of the requirements is to:

(a) prescribe the minimum structural integrity level of the vehicle body to ensure safe performance under normal operating conditions and extreme operating conditions;

(b) minimize risks to train crew and members of the general public in the event of collisions or derailments.

Compliance

There are four types of provisions contained within Australian Standards developed by RISSB:

1. Requirements.
2. Recommendations.
3. Permissions.
4. Constraints.

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 recognize 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.

Permissions – conveys consent by providing an allowable option. Permissions are identified within the text by the term 'may".

Constraints – provided by an external source such as legislation. Constraints are identified within the text by the term 'must'.

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.

RISSB Standards address known hazards within the railway industry. Hazards, and clauses within this Standard that address those hazards, are listed in Appendix A.

This Standard includes a commentary on some of the clauses. The commentary directly follows the relevant clause is designated by 'C' preceding the clause number and is printed in italics in a box. The commentary is for information and guidance, it does not form part of the requirements and recommendations of this Standard.

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Appendix Contents

1 Scope and general

1.1 Scope

This document applies to new and modified locomotive rolling stock.

The requirements mandated in this Standard do not retrospectively apply to any existing vehicles other than vehicles which are being modified in areas covered by this Standard so far as reasonably practicable.

The document covers the design, construction and maintenance rolling stock.

Operation of rolling stock is not covered.

This Standard is not specifically intended to cover rolling stock used on light rail, cane railways and monorail networks, but items from this Standard may be applied to such systems as deemed appropriate by the relevant RIM.

1.2 Normative references

The following documents are indispensable for the application of this Standard:

- AAR Standard S-5506 - Performance requirements for diesel electric locomotive fuel tanks, 2001.
- AAR Standard S-580 - Locomotive crashworthiness requirements, 2008.
- AS/NZS 2080 - Safety Glass for Land Transport.
- British Railways Board specification - BR 566 High impact resistant windscreens.
- EN 15152 - Railway applications - Front windscreens for train cabs.
- EN 15227 - Railway applications - Crashworthiness requirements for railway vehicles.
- EN 12663 Railway applications – Structural requirements for railway vehicles.
- FRA Standard 49 CFR Part 223 Safety Glazing Standards - Locomotives, passenger cars and cabooses.
- UK RSSB Standard - GM/RT2130 Vehicle fire safety and evacuation.
- UK RSSB Standard - GM/RT2100 Requirements for Rail Vehicle Structures.

NOTE: Documents for informative purposes are listed in a Bibliography at the back of the Standard.

1.3 Terms, abbreviations and definitions

For the purposes of this document, the terms and definitions given in RISSB Glossary: https://www.rissb.com.au/products/glossary/ and the following apply:

1.3.1
cab
driving cabs or any enclosed occupiable workspace

1.3.2
Cantrail
main longitudinal structural member of vehicle body which forms the extreme edges of the frame. Also referred to as roof rail in AAR Standards

1.3.3
CEMS
crash energy management system; a system integrated into a vehicle body design for controlling the energy absorbed, deceleration and structural deformation during crashes in particular collisions

1.3.4
critical design stress
shall be taken as either the yield stress (0.2% proof limit), 80% of the ultimate stress or 80% of the critical buckling stress whichever is less

1.3.5
derailment
an incident where one or more rolling stock wheels leave the rail or track during railway operations

1.3.6
draft gear
components which provide resilience in the connection of the drawgear to the structure of the rolling stock

1.3.7
draw gear
a set of fittings used to connect railway vehicles for the purpose of transmitting longitudinal forces between adjacent vehicles; connection can be made manually or automatically

1.3.8
external door
a door on the side or end of a vehicle which provides access between the outside and the inside for either the train crew or the passengers

1.3.9
heavy duty locomotive
a heavy locomotive used for example in freight heavy haul or standard gauge (1435 mm) interstate operations, typical axle load greater than 22 tonnes

1.3.10
light duty locomotive
a lighter locomotive used for example in loco-hauled passenger operations or light duty freight operations with typical axle load less than 18 tonnes

1.3.11
locomotive rolling stock
self-propelled, non-passenger-carrying railway vehicles used for hauling other (typically freight or passenger) rolling stock

1.3.12
maximum service mass
represents the mass of the vehicle in full working order (including all passengers, crew, and payload)
Also known as gross mass or crush condition.

1.3.13
medium duty locomotive
a medium sized locomotive used for example in intrastate main and branch line operations, typical axle load between 18 tonnes and 22 tonnes.

1.3.14
modifications
changes to a railway vehicle body structure or components which could affect its original structural integrity or safety in areas covered by this Standard

1.3.15
power car locomotive:
a locomotive used exclusively for hauling passenger rolling stock and typically forms an integral part of the train set

1.3.16
RIM
rail infrastructure manager

1.3.17
RTO
rail transport operator

1.3.18
underframe
a framework carrying the main body structure of a vehicle usually located under the floor level

1.3.19
wheel guard
a deflector mounted in front of the leading wheels of a vehicle to deflect small obstacles from the track, also known as a 'lifeguards' or 'guard-irons'

2 Design verification

Verification of compliance with the requirements of this Standard shall be undertaken by calculation, inspection, comparison with other vehicles or test.

Validation of compliance with the crashworthiness requirement of this Standard shall be based on:

(a) test of energy absorbing devices and crumple zones;

(b) calibration of the numerical model of the structure;

(c) numerical simulation of the design collision scenarios.

Verification of compliance with the requirements of this Standard shall account for the full range of variations in vehicle condition that are likely to be experienced.

Where experimental verification is undertaken, a correlation between the analysis and test results should be carried out.

C2.1 Commentary
It is suggested to apply a load factor to the proof load cases defined within this Standard where demonstration of compliance is exclusively by calculation to account for the possible inaccuracies in the assessment.
GM/RT2100 and EN 12663 suggest that the proof load factor could be 1.15.
GM/RT2100 and EN 12663 suggest using a 1.5 ultimate load factor to prevent catastrophic failure.

The stress criteria used in this Standard is the Critical Design Stress. Using a no-permanent deformation criterion instead of the Critical Design Stress is also acceptable.
If demonstration of compliance with this Standard is undertaken using Finite Element Analysis, high localized stresses may acceptably exceed the stress criteria limits set in this Standard so long as one of the following conditions is fulfilled:

(a) They are associated with model singularities.

(b) They would not result in significant permanent deformation being experienced by the vehicle structure when the load is removed.

Methods used to demonstrate that no significant permanent deformation is experienced include:

(a) engineering judgement;
(b) the use of non-linear analysis to determine if there is any deformation after a load application/removal cycle; and
(c) Relating the results of physical tests to analysis results.

Where this Standard adopts a prescribed load case from a specific nominated Standard (i.e. AAR, EN etc.) then the stress criteria proposed in that particular Standard would also be used.

Further guidance on the Finite Element Analysis of rolling stock body structures and the acceptability of calculated stresses is available in the AAR Manual Section C-II and EN 12663.

3 Construction

Construction of rolling stock shall meet the requirements of Standards and Codes of Practice appropriate to the material of construction.

The quality of the workmanship in construction shall be sufficient to ensure that the actual structure meets the structural requirements of this Standard.

Structural welding shall be in accordance with relevant Australian or International Standards applicable to the material.

The construction of the rolling stock shall be verified to be in accordance with the design documentation.

C3 Commentary

Materials used in the construction of vehicles and their parts is not limited to steel and aluminium. They include other materials such as bronze, stainless steel, ductile iron, grp and composites. Relevant Standards include but are not limited to:

(a) AS/NZS 1554 for carbon and stainless steel;

(b) AS/NZS 1665 for aluminium; and

(c) EN 15085 Railway Applications – Welding of Railway Vehicles and Components.

Where rolling stock compliance certification is carried out as per the requirements of AS 7501, the construction conformance certificate issued by the manufacturer is one method of providing this verification.

4 Maintenance

Rolling stock shall have their structural integrity maintained over their service life.

Any structural damage to a rolling stock body shall be repaired in such a way that the structural integrity is restored to the extent required by the RTO and maintainer.

Where a structural repair introduces design features that are different from the original design, the structural integrity of these features shall be demonstrated to meet the requirements of this Standard so far as is practicable either absolutely or by comparison with other local design features.

Fasteners, brackets and supports associated with equipment mounted to the exterior of the body including but not limited to:

(a) underframe mounted equipment;

(b) modular vehicle attachments including cabs; and

(c) roof mounted equipment,

shall be maintained to prevent the equipment from detaching from the vehicle, encroaching upon the kinematic envelope, or adversely affecting the crashworthiness performance.

C4 Commentary

It is desirable that the vehicle designer feed the output from any fatigue assessment (see Section 8) into the vehicle maintenance manual to guide the RTO and maintainer on what areas of the vehicle structure are to be particularly inspected.

Repair considerations include:

(a) the remaining serviceable life of the vehicle; and

(b) planned maintenance or overhaul activities.

The intent of this clause is to ensure adequate controls are introduced to address hazards associated with the failure of mounting systems due to inadequate maintenance procedures. When determining appropriate maintenance procedures considerations include material type, component serviceable life and failure modes of mounting system components.

5 Vehicle masses

Unless otherwise stated, the rolling stock mass that shall be used in all structural assessment presented in this Standard relates to the maximum service mass of the vehicle. This includes the full operating reserves of water, waste products, sand, fuel, etc., and the overall weight of the crew, luggage, and catering for passenger stock.

C5 Commentary
EN 15663 and AS 7501 provide definitions of vehicle reference masses and further guidance.

6 Structural rating

Locomotive rolling stock designs shall comply with the appropriate structural rating given in this Standard based on the intended mode of operation and the likely loads the vehicle will experience in service.

For new locomotives, the structural rating used for the design and assessment of the structural performance in accordance with this Standard shall be either:

(a) marked on the underframe of the locomotives; or

(b) recorded in the vehicles data register as per the requirements of AS 7501.

C6 Commentary
Issues such as the anticipated trailing load, track profile and train performance requirements are important when considering likely loading.
This Standard defines in Section 1.3 four main categories for structural rating:
(a) Heavy duty locomotives.
(b) Medium duty freight locomotives.
(c) Light duty locomotives.
(d) Power car locomotives.
For railway applications which do not fall under these categories, alternative load cases could be considered.

7 Proof loads

7.1 Longitudinal proof loads

7.1.1 Compressive loads

Locomotive bodies should be designed to withstand a compressive longitudinal load, applied along the centre line of the draft gear at each end of the body without exceeding the critical design stress, of the following applicable magnitude:

(a) 4450 kN for heavy duty locomotives.

(b) 3500 kN for medium duty locomotives.

(c) 2000 kN for light duty and power car locomotives.

7.1.2 Tensile loads

Locomotive bodies should be designed to withstand a tensile longitudinal load applied along the centre line of the draft gear at each end of the body without exceeding the critical design stress, of the following applicable magnitude:

(a) 3375 kN for heavy duty locomotives.

(b) 2700 kN for medium duty locomotives.

(c) 1500 kN for light duty and power car locomotives.

7.1.3 Anti-Climb Devices

Anti-climb devices shall be fitted to both leading and trailing ends of locomotive vehicles.

Locomotive vehicle bodies should be designed to withstand a compressive longitudinal load of 1500 kN applied on the anti-climb devices without exceeding the critical design stress. Loads may be shared between anti-climb devices.

7.1.4 Collision posts

A minimum of two collision posts shall be provided at the cab end of the locomotive body.

Collision post should be located as per the requirements of AAR Standard S-580 for narrow nose locomotives.

Collision posts should be designed to withstand the following applicable above-floor loading:

(a) For heavy duty locomotives with an axle load of 25 tonnes or greater, as stated in AAR Standard S-580 for narrow nose locomotives.

(b) For medium duty locomotives and heavy duty locomotives with an axle load less than 25 tonnes, each collision post should be designed to withstand a longitudinal load applied 760 mm above the top surface of the underframe of 890 kN without exceeding the ultimate strength of the material.

(c) For light duty and power car locomotives, each collision post should be designed to withstand a longitudinal load applied 760 mm above the top surface of the underframe of 445 kN without exceeding the ultimate strength of the material.

Collision posts should be designed to withstand the following applicable at-floor loading:

(d) For heavy locomotives with an axle load of 25 tonnes or greater, as stated in AAR Standard S-580 for narrow nose locomotives.

(e) For medium duty locomotives and heavy duty locomotives with an axle load of less than 25 tonnes, each collision post should be designed to withstand a longitudinal load applied in line with the top surface of the underframe of 2250kN without exceeding the ultimate strength of the material.

(f) For light and power car locomotives, each collision post should be designed to withstand a longitudinal load applied in line with the top surface of the underframe of 1000 kN without exceeding the ultimate strength of the material.

When there are more than two posts, the total load prescribed for two posts should be distributed evenly between all posts.

C7.1.4 Commentary
It is acceptable to profile or even split the collision post so as to match the general shape of the vehicle end.

7.1.5 End cab structure

Locomotive cab end structure should be designed to AAR Standard S-580 for narrow-nose locomotives.

C7.1.5 Commentary
Glazing requirements are covered in section 13.

7.1.6 Corner posts

Corner posts should be provided at each corner of the cab structure.

Corner posts should be designed to withstand the following applicable loading:

(a) For heavy duty and medium duty locomotives, as stated in AAR Standard S-580 for narrow nose locomotives.

(b) For light duty and power car locomotives, each corner post should be designed to withstand a longitudinal load applied at cantrail level of 300kN and a longitudinal load applied anywhere up the post of 150kN.

7.2 Vertical proof loads

7.2.1 Live loads

Locomotive bodies, when loaded to their maximum service mass, shall be capable of supporting the effects of a dynamic load factor representative of its operation for that load without exceeding the critical design stress.

C7.2.1 Commentary
EN 12663 uses a dynamic factor of 1.3.

7.2.2 Vertical and longitudinal loads

Locomotive bodies, when loaded to their maximum service mass, shall be capable of supporting that load in the static condition combined with the longitudinal loads described in section 7.1.1 to 7.1.2 without exceeding the critical design stress.

7.2.3 Lifting and Jacking

Locomotive rolling stock shall be designed to incorporate facilities for jacking and lifting operations during maintenance or after derailment.

Fully loaded vehicles (except crew) complete with bogies, shall withstand the loads arising from lifting and jacking in the following situation:

(a) Lifting or jacking from either end, on or near the draft gear carrier and coupler, with the vehicle supported by the other bogie without exceeding the critical design stress.

(b) Lifting or jacking on jacking pads, or lifting brackets where fitted, without exceeding 0.6 x critical design stress.

The supplementary requirements of AS 4991 may be used for the design of lifting devices used to lift railway vehicles.

7.2.4 Coupler vertical loads

Locomotive bodies shall be designed to withstand a vertical load of 220 kN applied to the coupler, both upwards and downwards, without exceeding the critical design stress.

7.2.5 Anti-climb devices vertical loads

Locomotive bodies shall be designed to withstand a vertical load, applied upwards or downwards, applied on the anti-climb devices without exceeding the critical design stress, of the following applicable magnitude:

(a) 890 kN for medium and heavy duty locomotives.

(b) 220 kN for light duty locomotives.

The vertical load should be applied individually to each shelf of an anti-climb device, centrally and uniformly between centre sill webs.

The shelves or bars on anti-climb devices should consist of the following physical characteristics:

(a) There should be not less than three.

(b) They should be spaced vertically 100 mm to 110 mm apart (Centre-distance spacing).

(c) They should be located horizontally to cover the fullest width of the body structure as practicable.

(d) Each should not be less than 15 mm thick (vertically).

(e) Each should protrude 25 mm or more (horizontally).

(f) They should be located vertically to span the range of at least 1300 mm to 1530 mm above rail.

C7.2.5 Commentary
The configuration of anti-climb devices ideally matches that of anti-climb devices on other rolling stock with which the locomotive is most likely to encounter.

8 Fatigue loads

A fatigue assessment shall be performed for all new locomotive designs.

Where available load spectra that reflect the anticipated operating condition should be used.

C8 Commentary
A suitable example of the process for fatigue assessment is described in the AAR Manual of Standards, Section C, Part II and EN 12663.
Generic structural Standards such as AS 4100 or AS 3990 (for steel) and AS/NZS 1664 (for aluminium), or international equivalents such as BS 7608 and EN 1993-1-9, also contain suitable fatigue assessment processes.
An example of the fatigue assessment process is provided below:
(a) the fatigue loading spectrum is determined from direct measurement, simulation, from other Standards, or sinusoidal approximation (e.g. for locomotives +/-0.2 g vertical for 107 cycles and + /-0.25 g lateral for 107 cycles extracted from EN 12663);
(b) the designer identifies all locations that are subject to fatigue loading;
(c) for non-welded details and fusion welded fabrications BS 7608 is used to determine relevant classification and associated allowable stress at 107 cycles;
(d) Miner's rule is used to add cumulative damages from each load case at each critical location; and
(e) mean - 2 Standard deviation data (i.e. 97.7% probability of survival) is the minimum level of confidence for fatigue life acceptance.

9 Crashworthiness performance

9.1 Collision performance

Power car locomotive structures shall be designed with a CEMS (crash energy management system) to dissipate kinetic energy during a collision as per the requirements of EN 15227 or equivalent applicable Standards.

The CEMS shall provide a controlled deformation and collapse of designated sections (crumple zones) within the unoccupied areas of the vehicles in the consist to absorb collision energy and to reduce the decelerations on passengers and crew members.

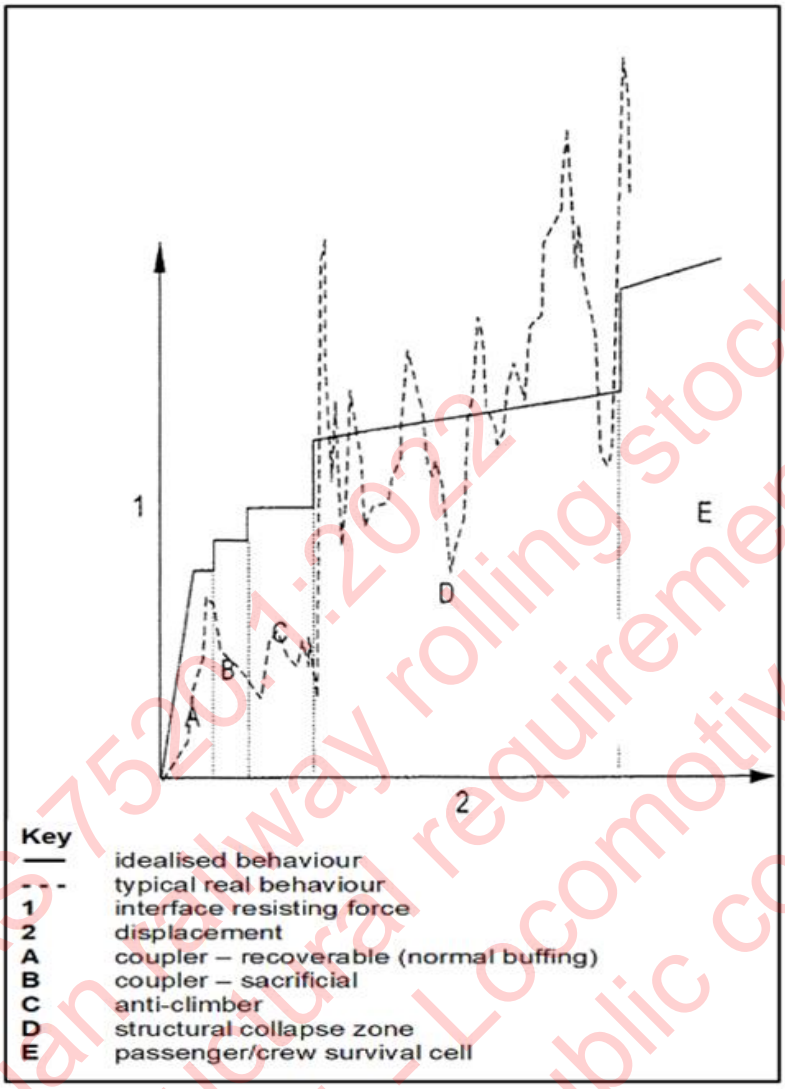

Figure 9:1 – Example of how controlled deformation and collapse can be achieved at one end of a vehicle.

The amount of energy required to be absorbed in each crumple zone shall be appropriate for the intended service and operating conditions and shall be defined based on the relevant collision scenarios.

The details of the collision scenarios (applicable collision scenarios, impact speeds, state of braking, mass of vehicles, angle of impact, etc) should be agreed between the purchaser and the manufacturer and should reflect the operating conditions of the train.

An acceptance criteria shall be defined and agreed between the purchaser and the manufacturer.

The acceptance criteria should include the following:

(a) a limit on deceleration of the vehicles or a maximum collapse force as identified by the CEMS; and

(b) a requirement that collapse of the vehicle structures is confined to the areas that have been identified in the CEMS as crumple zones.

Particular attention should be given to choosing crashworthiness requirements that are compatible with the proof strength requirements defined in section 7.1.1.

The front exterior face of the driver's cab, except for glazing, but including framework, panels and external doors shall have sufficient impact strength to resist penetration into the vehicle of a sharp-cornered hollow steel cube having sides of 70 to 75mm and a mass of 0.9kg and travelling corner first at twice the maximum operational speed of the vehicle.

C9.1 Commentary

The following international Standards could be considered when defining the CEMS for power car locomotives:

(a) EN 15227 C-I
(b) APTA SS-C&S-034-99;
(c) 49 CFR, Part 238, Subpart C - Tier I vehicles; or
(d) 49 CFR, Part 238, Subpart D - Tier II vehicles.

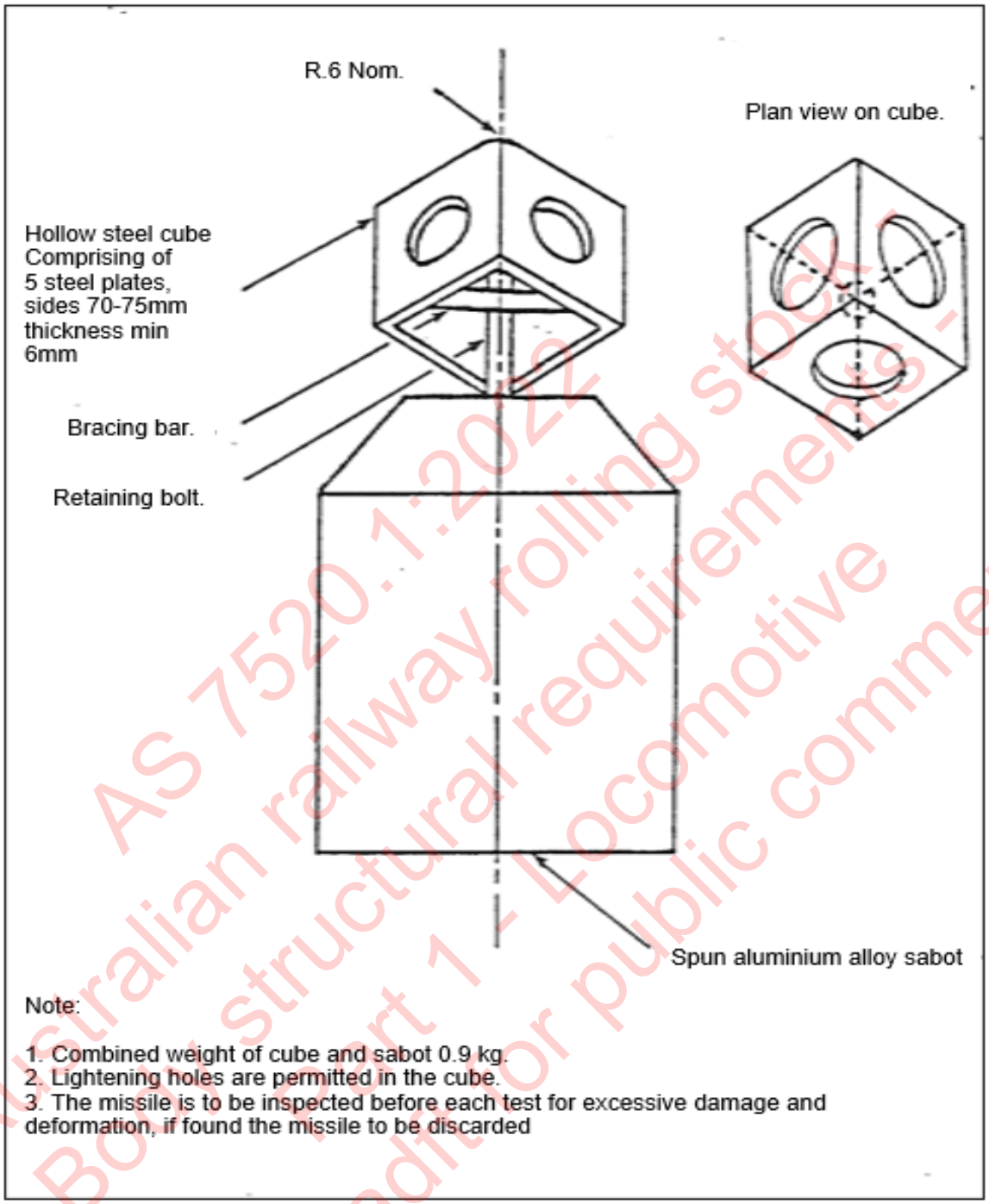

Figure 9:2 – Example of a sharp-cornered hollow steel cube design.

9.2 Rollover performance – locomotive rolling stock

The cab roof structure, cab mounting systems and adjacent structures shall be capable of supporting half the mass of the locomotive (including the bogies) in the situation when the locomotive is inverted without exceeding the critical design stress in the main supporting members.

The cab roof structure, cab mounting systems and adjacent structures should be capable of supporting the weight of the locomotive (including the bogies) in the situation when the

locomotive is resting on its side without exceeding the critical design stress in the main supporting members, assuming the locomotive is supported on the side of the underframe and at the cantrail of the cab and adjacent structures.

The locomotive structure, other than the cab structure, shall be capable of retaining the principal components (engine, alternator, compressor) in the event of derailments, collisions and rollovers.

The cab roof structure shall be capable of resisting the penetration of a concrete block (typical cube size 300 x 300 x 300 mm) weighing 100 kg dropped so that a flat surface hits the roof from 3 m above the roof without loss of interior ceiling height.

C.9.2. Commentary

The intent is to provide a safety cage for crew within the cab in the case of rollover. Therefore, it is important to consider to what extent the adjacent structure such as vestibules or end wall cabinets are able to contribute.

Clause 15.2 of this Standard provides a method of demonstrating compliance with this clause.

10 Cow catchers

A cowcatcher shall be fitted to any leading ends of the locomotive.

A cowcatcher should meet the requirements of EN 15227.

11 Wheel guards

As an additional safety measure, the leading bogie or wheelset of a locomotive vehicle may be fitted with wheel guards to minimize the risk of derailment due to small objects on the rails.

C11 Commentary
Refer to GM/RT2100 for a suitable set of requirements on wheel guards.

12 Doors

A closed and locked door panel including the glazing should withstand a force of 1000 N per metre over the width of the exposed internal surface applied from inside the vehicle onto the door panel over a strip of 200 mm in height, positioned 1300 mm above car floor level without exceeding the critical design stress.

C12 Commentary
Refer to AS 7522 for other requirements on doors.

13 Glazing

13.1 Front windscreen

The front windscreens of locomotives shall be manufactured to comply with the requirements of AS/NZS 2080 supplemented by the impact requirements defined in one of the following Standards:

(a) FRA Standard 49 CFR Part 223 Type 1.

(b) EN 15152.

(c) BR 566.

(d) GM/RT2100.

C.13.1 Commentary

The structural requirements of BR 566 have been superseded by the requirements in GM/RT2456 but it is still called up by some RTOs.

13.2 Side windows

All side window units and their attachment to the vehicle body (including windows fitted to side access doors) shall be manufactured to comply with the requirements of AS/NZS 2080 supplemented by the strength and impact requirements defined in one of the following Standards:

(a) FRA Standard 49 CFR Part 223 Type 2.

(b) GM/RT2100.

14 Towing fixtures

There are no requirements applicable to locomotives in this Standard.

15 Body mounted equipment

15.1 General requirements

The retention of underframe components within the limits of the rolling stock shall have at least one level of redundancy.

C15.1 Commentary

Appropriate ways of meeting the requirements of clause 15.1.1 include the over design of mountings and attachments, the use of fasteners incorporating high strain energy or the provision of emergency restraints in addition to ensuring mountings and attachments meet the shock/minor impact loading requirements of section 15.2.

Particular attention is warranted to the mounting and support of underframe equipment that is frequently removed.

15.2 Shock/minor impact loading

The following accelerations applied individually to components and their mountings to the body shall not cause the critical design stress to be exceeded in any member:

(a) Longitudinally 4 g.

(b) Laterally 2 g.

(c) Vertically 2 g.

C15.2 Commentary
The accelerations quoted above should be applied to the centre of inertia of the equipment.

16 Fuel tanks

Fuel tanks mounted beneath the underframe should be designed to comply with one of the following Standards:

(a) AAR S-5506 excluding load cases 1, 2 & 3.

(b) GM/RT2130 for light duty and power car locomotives only.

Appendix A Australian Railway Risk Model

(Informative)

Australian Railway Risk Model (ARRM) hazardous event category
Maintenance vehicle collision with infrastructure on running line
Maintenance vehicle collision with other train on running line
Maintenance vehicle collision with other train in yard
Train collision with infrastructure on running line
Train collision with other train on running line
Train collision with other train in yard
Collision between train and projectile
Collision between maintenance vehicle and projectile
Train derailed or load dropped at loader / unloader in yard

For addition information, including how you can become part of ARRM, please contact RISSB. If you are already participating in ARRM please go directly to https://arrm.org.au/

Appendix B Bibliography

(Informative)

The following referenced documents are used by this Standard for information only:

(a) AS/NZS 1554 - Structural steel welding.

(b) AS/NZS 1665 - Welding of aluminium structures.

(c) AAR Manual of Standards, Section C, Part II.

(d) FRA Standard 49 CFR Part 238 Passenger equipment safety Standards.

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The Standards development process is rigorous and transparent.

Authors work with RISSB's Standards Development Managers and Development Groups to ensure that products are acceptable to industry. Standing Committees oversee this work and ensure that proper governance and process is followed. The products are exposed to the public and industry for comment and validated by an independent validator.

Once agreed by the Development Groups, Standing Committees and Validator, the drafts are passed to the RISSB Board for approval.

The same process is used in developing other RISSB products, although Guidelines are not exposed to the public for comment or validated, given their non-binding nature.

Standards Development and Accreditation Committee

RISSB is accredited by the Standards Development and Accreditation Committee (SDAC), and all Standards produced by RISSB since 31 July 2007 are published as Australian Standards.

The Standards Development and Accreditation Committee audits RISSB annually to ensure that RISSB's processes are in accordance with SDAC accreditation requirements.

RISSB
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

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