AS 7518:2018

Suspension

Rolling Stock Standard

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RAIL INDUSTRY SAFETY AND STANDARDS BOARD

This Australian Standard® AS 7518 Suspension was prepared and reviewed by a Rail Industry Safety and Standards Board (RISSB) Suspension Development Group consisting of representatives from the following organisations:

Downer Rail	Lovells Springs	Pacific National
Aurizon	V/Line	Queensland Rail
KiwiRail		

The Standard was approved by the Development Group and the Suspension 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.

Paul Daly
Chief Executive Officer
Rail Industry Safety and Standards Board

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Contents

1 Introduction

1.1 Purpose

This document describes requirements for rolling stock suspension.

The main purpose of the requirements is to reduce the risk of hazards due to inadequate design or maintenance of suspension components.

1.2 Scope

This document applies to new and modified Locomotive, Freight, Passenger and Infrastructure rolling stock.

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

Operation of rolling stock in regard to network safe working rules and route standards is not covered.

The requirements mandated in this standard do not apply to infrastructure maintenance rolling stock that travel at 25km/h or less.

Rolling stock used on light rail, cane railway and monorail networks are not covered.

1.3 Compliance

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

(a) Requirements.

(b) 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 cannot be able to be applied or other controls can be appropriate / 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 as included in an appendix.

1.4 Referenced documents

1.4.1 Normative references

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

(a) AS 7509 Dynamic behaviour.

(b) AS 1210 Pressure vessels.

(c) AS 2971 Serially produced pressure vessels.

(d) AAR Manual of Standards and Recommended Practices - Section D - Truck and Truck Details.

1.4.2 Informative references

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

(a) AS 1447 Hot-rolled spring steels.

(b) AS 4292 Railway safety management.

(c) AS 7501 Railway rolling stock - Rolling stock certification.

(d) ASTM A 125 Standard Specification for Steel Springs, Helical, Heat-Treated.

(e) EN 13298 Railway applications - Suspension components - Helical suspension springs, steel.

(f) EN 13802 Railway applications - Suspension components - Hydraulic dampers.

(g) EN 13906-1 Cylindrical helical springs made from round wire and bar - Calculation and design - Part 1: Compression springs.

(h) EN 13913 Railway applications - Rubber suspension components - Elastomer-based mechanical parts.

(i) EN 14200 Railway applications - Suspension components - Parabolic Springs, steel.

(j) EN 15049 Railway applications - Suspension components - Torsion bar, steel.

(k) ISO 3302-1 Rubber - Tolerances for Products - Part 1: Dimensional Tolerances.

(l) ISO 3302-2 Rubber - Tolerances for Products - Part 2: Geometrical Tolerances.

(m) UIC 820 Technical specification for the supply of spring steel flat bars for parallel leaf or volute springs.

(n) UIC 821 Technical specification for the supply of parallel leaf springs for vehicles.

(o) UIC 822 Technical specification for the supply of helical compression springs, hot or cold coiled, for tractive and trailing stock.

(p) UIC 823 Technical specification for the supply of volute springs for vehicles.

(q) EN 286-3 Simple unfired pressure vessels designed to contain air or nitrogen - Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock.

(r) EN 286-4 Simple unfired pressure vessels designed to contain air or nitrogen - Aluminium alloy pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock.

(s) EN 13597 Railway applications - Rubber suspension components - Rubber diaphragms for pneumatic suspension springs.

(t) EN 14817 Railway applications - Suspension components - Air spring control elements.

1.5 Definitions

AAR bogie: Conventional three-piece freight bogie based on the technical requirements of the AAR Manual Of Standards And Recommended Practices. Note that the ancillary requirements in the AAR Manual, such as those pertaining to AAR approval, are not applicable.

Air Spring: A powered pneumatic device using compressed air as a spring. By controlling air volume air springs also permit active levelling for constant suspension height with load.

Balancing valve: A balancing valve is fitted in the pneumatic pipe that connects both air springs on one bogie. The balancing valve is closed for the normal range of pressure differentials between the two air springs. If there is a large pressure differential between the two air springs, possibly due to deflation of one air spring, the valve opens to give equal pressures in both air springs to avoid uneven wheel loads on that bogie.

Cane railway network: A railway system dedicated to hauling harvested sugar cane from farms to a raw sugar factory. Typically, 610mm gauge.

Coil spring: A mechanical device made of an elastic material formed into the shape of a helix which returns to its natural length when unloaded. It is used to absorb shock, or to maintain a force between contacting surfaces.

Damper: A mechanical device designed to smooth out (or damp) shock impulses and dissipate kinetic energy. They can be a hydraulic, pneumatic or friction type and include friction snubbers/wedges, hydraulic dampers, axlebox/pedestal guides and hydraulic stabiliser units.

Elastomeric primary spring: A primary suspension spring that utilises a natural or synthetic material to provide the elastic force versus deflection properties. Although not common, some elastomeric primary suspension springs include voids filled with fluid to offer a level of damping.

Leaf spring: A mechanical device to fulfil spring and damper functionalities. It takes the form of one or several rectangular cross-section spring steels shaped as a slender arc and tied up together.

Light rail network: A passenger-carrying railway system operating with trams or other similar shorter length, lower speed and lower axle-load self-propelled vehicles. Typically used in urban areas and often having a shared right-of-way with road traffic.

Monorail network: A passenger-carrying system in which vehicles travel over a single broad beam (rather than two narrow rails connected by sleepers as with conventional railway rolling stock).

Operator: The person or body responsible by reason of ownership, control or management, for the provision, maintenance or operation of trains, or a combination of these, or a person or body acting on its behalf.

Regulator: A government body responsible for ensuring compliance with particular laws, acts and regulations, e.g. rail safety regulator.

Resilient component: A mechanical device made of elastomer (rubber). It has elastic property and is generally used in vehicle suspension systems, equipment mounting systems, limit stops, etc.

Road-Rail Vehicle: *A vehicle that can travel on a road and can also travel on rail by use of a rail wheel guidance system.*

Rolling stock: Any vehicle that operates on, or intends to operate on, or uses a railway track, including any loading on such a vehicle, but excluding a vehicle designed for both on- and offtrack use when not operating on the track. Rolling stock is a collective term for a large range of rail vehicles of various types, including locomotives, freight wagons, passenger cars, track machines and road-rail vehicles.

RSO: a person who has effective control and management of the operation or movement of rolling stock on rail infrastructure for a railway, but does not include a person by reason only that the person drives the rolling stock or controls the network or the network signals;

Three-piece bogie: A freight bogie for which the structure is made of three main elements: two side frames and one bolster assembled in a non-rigid H pattern.

RIM: Rail Infrastructure Manager. In relation to rail infrastructure of a railway, means the person who has effective control and management of the rail infrastructure, whether or not the person-

(a) owns the rail infrastructure; or

(b) has a statutory or contractual right to use the rail infrastructure or to control, or provide, access to it

Torsion spring: A spring that works by torsion or twisting; that is, a flexible elastic object that stores mechanical energy when it is twisted. The amount of force (actually torque) it exerts is proportional to the amount it is twisted. On railway vehicles they are generally made from a bar of steel and used as anti-roll bars.

Wedge rise: Extension of the wedge spring, caused by wear of the wedge, wedge pocket and sliding surfaces, that could eventually result in insufficient damping force.

2 General

The RSO shall implement procedures that specify regular inspections, maintenance regimes and operational limits for all types of suspension systems that they use to identify and rectify potential or actual failures likely to affect suspension performance or operating safety.

The RSO should not place into service, or continue in service, vehicles with any configuration of defective, broken, misplaced, or incorrectly fitted springs, or defective damping devices or resilient components, where these result in the vehicle failing to meet the requirements for dynamic behaviour given in AS 7509.

The RSO shall have mitigating procedures in place which set safe operational limits and controls for vehicles with defective or missing suspension components.

The vehicle suspension design should incorporate suspension bumpstops and liftstops in order to protect the suspension components, to support the vehicle in case of suspension failure and to retain the suspension components during lifting and jacking or transport of bogies.

A suspension design should provide suspension movements that do not adversely affect the performance of the braking system.

Some recommendations for inspection, maintenance and operational limits for suspension components are included in the relevant sections of this standard.

Suspension components should be selected, installed, inspected and maintained in accordance with the manufacturer's specifications.

3 Springs

3.1 Coil springs

3.1.1 Coil spring design and manufacture

Coil springs shall be designed and manufactured in accordance with applicable industry standards.

Industry standards for coil springs include –

(a) AAR M-114;

(b) ASTM A 125;

(c) EN 13298;

(d) EN 13906-1;

(e) UIC 820;

(f) UIC 822;

(g) UIC 823.

Industry standards for spring materials –

(a) AS 1447;

(b) or as referenced in the spring standards listed in 3.1.1.2.

Where coil springs are nested, it is accepted as good practice for the adjacent (outer, intermediate and inner) springs in each nest should be of opposite hand winding, i.e. left-hand winding adjacent to right hand winding.

Coil spring retaining devices such as spigots or shrouds should be of a height of 1.5 times the spring wire diameter from the base of the spring, or at least 0.5 times the spring wire diameter after maximum packing has been added under the spring.

An identifier for coil springs such as a drawing or part number, which should be stamped on the tapered end of coil springs or etched on cold wound springs (used in friction wedges) and the end coils dipped in paint for colour coding. It can sometimes be difficult to distinguish coil springs which are of a similar size.

For AAR bogies, all load bearing springs, and friction wedges where used, should:

(a) conform to AAR Specifications M-114;26;

(b) conform to AAR Standards S-332 to S-338 inclusive; and

(c) be used in groups shown in AAR Standards S-339 to S-343 inclusive.

3.1.2 Coil spring inspection and maintenance

Inspection and maintenance procedures for coil springs should include identification of any of the following that are likely to affect suspension performance or operating safety:

(a) Suspension springs are not missing, cracked or broken, misaligned or displaced within the spring seat.

(b) Coils are not heavily bruised or showing flat spots caused by coil binding, nicks, gouges, indentations or any corrosion with pit marks.

(c) Springs are of the correct number, type and capacity appropriate to the bogie model, vehicle class and maximum axle load.

(d) Adequate clearance exists between all adjacent coils in any load spring when loaded to the nominal maximum gross mass on rail.

(e) Free height and normal working load height of springs is in accordance with appropriate specification.

(f) The condition of electrical insulation pads (where applicable) is satisfactory.

(g) Suspension heights are in accordance with appropriate specifications.

(h) Spring seats, suspension beams, liners and adaptors are not worn or damaged.

(i) Spring pockets are free from accumulations of dirt and debris that can retain moisture.

(j) Condition of resilient pads located in spring pockets are satisfactory.

(k) Replacement of springs is carried out in matched sets where appropriate. (This is generally required when one broken spring could have caused overload of an adjacent spring, so both should be replaced. Alternatively, where springs need to be matched due to tolerance in components to control wheel load variations, suspension heights, etc.)

3.1.3 Operation with defective coil springs

Defects that might prevent a vehicle to enter into or to continue in service should include:

(a) Any outer coil spring that is broken or missing; or

(b) Any springs that are compressed solid; or

(c) Any suspension beams, brackets or fixings that are cracked or broken.

3.2 Torsion springs

3.2.1 General

Anti-roll bars are a common application of torsion springs in rolling stock.

3.2.2 Torsion spring design and manufacture

Torsion springs shall be designed and manufactured in accordance with EN 15049 or applicable industry standards.

3.2.3 Torsion spring inspection and maintenance

Inspection and maintenance procedures for torsion springs shall include identification of any of the following that are likely to affect suspension performance or operating safety:

(a) Missing, cracked, broken or damaged torsion springs.

(b) Inadequately secured torsion spring mountings.

(c) Inadequately secured or worn torsion spring connections.

3.3 Leaf springs

3.3.1 Leaf spring design and manufacture

Leaf springs shall be designed and manufactured in accordance with applicable industry standards including relevant parts of those listed below.

Industry standards for leaf springs include –

(a) EN 14200; and

(b) UIC 821.

3.3.2 Leaf spring inspection and Maintenance

Inspection and maintenance procedures for leaf springs shall include identification of any of the following that are likely to affect suspension performance or operating safety:

(a) Reversal of spring camber towards the ends of the springs is not excessive.

(b) There is no evidence of leaf separation at the areas where reverse camber has formed.

(c) There is no horizontal rotation of spring leaves relative to each other.

(d) There are no cracks visible in the spring leaves, buckles, eyes or eyebolts.

(e) The springs are properly fitted and secured.

(f) The spring eyebolts are adjusted to give the correct bogie height and/or suspension clearances and the eyebolts are adjusted to be of equal length.

(g) Leaf springs should not be lubricated when they provide damping to the suspension system.

3.3.3 Operation with defective leaf springs

The operator should not place or continue in service a vehicle where any leaf spring has its top (long) leaf broken or any other three leaves broken, except:

(a) When that spring is part of a nest of three or more springs; and

(b) Where none of the other springs in the nest has its top leaf or any other three leaves broken.

3.4 Air springs

3.4.1 Air spring design and manufacture

Air springs, their supplementary air volume and their associated control components shall be designed and manufactured in accordance with applicable industry standards including the relevant parts of those listed below.

Industry standards for air springs and their associated control components include:

(a) AS 1210;

(b) AS 2971;

(c) EN 13597;

(d) EN 14817;

When designing an air spring suspension arrangement, the air spring in both the inflated and deflated conditions shall be given, as follows: (inflated requirements)???

(a) With air springs deflated the vehicle shall meet the wheel unloading performance on twisted track as per AS 7509.

(b) With deflated air springs, bogie rotational resistance requirements of AS 7509 shall be met. This can be achieved by having very low friction sliding surfaces within the air spring to permit low rotation torques with air springs.

(c) With deflated, under-inflated or over-inflated air springs the vehicle shall remain within the rolling stock outline.

(d) Vehicle dynamic performance is to be taken into account where air springs are used to provide pneumatic damping, and where pneumatic forces are lost when air springs are deflated.

(e) For air spring arrangements where there is a pair of air springs on one bogie, and a separate air supply and levelling valve to each air spring, a cross-pipe and a balancing valve for protection is to be provided between the two air springs. To ensure that in the event of one air spring deflating that the opposite air spring also deflates to avoid uneven wheel loads.

(f) An alternative arrangement is for the two air springs to be joined by an open cross-pipe and supplied by a single central levelling valve. With this arrangement, the air springs provide no roll restraint to the body and the roll restraint is entirely dependent upon the antiroll bar.

(g) Air spring and supplementary air volumes shall be designed to safely meet maximum system air pressure or have suitable pressure regulators and/or pressure relief valves.

(h) Supplementary air volumes shall be designed as air reservoirs and meet AS 1210 (Class 3), or AS 2971, or an equivalent standard (e.g. EN 286-3, EN 286-4).

(i) It is desirable for the vehicle to have means for detecting height out of limits or suspension pressure out of limits.

3.4.2 Air Spring Inspection and Maintenance

Inspection and maintenance procedures for air springs shall include identification of any of the following that are likely to affect suspension performance or operating safety:

(a) Correct inflated height assessed by using the rolling stock manufacturer's procedure.

(b) Excessive pressure inbalance.

(c) Wear or damage.

(d) Bulges in the outer ply.

(e) Abrasion of the plies between convolutions.

(f) Air leaks, particularly at the bead rings and around the air supply lines and levelling valves.

(g) Inspect air spring shrouds and skirt for physical damage that may impede operation of the air spring. Skirts are sometimes used to control lateral rate.

(h) Air supply pressure.

(i) Levelling valves admit, lap and exhaust air properly, with the balance within the prescribed limits.

(j) Damage or wear to levelling valve operating linkage.

(k) Where the assembly has been dismantled, that the correct size of orifice damping plate has been fitted.

(l) Correct operation of balancing valves.

Long term changes to the spring performance in the inflated and deflated positions.

A scheduled discharge approach should be taken to ensure the maximum service age of the components is not reached.

3.4.3 Operation with Defective Air Springs.

Defects that might prevent a vehicle to enter into or to continue in service should include:

(a) Deflated air springs.

(b) Defective levelling valves.

(c) Defective balancing valves.

3.5 Elastomeric primary springs

3.5.1 Design and Manufacture

Elastomeric springs shall use an elastomeric compound as the primary means of support of the axle box.

Elastomeric primary springs shall be manufactured in accordance with applicable parts of EN13913, DIN7716 and with applicable industry standards.

This should be of block/homogenous or laminated construction, including conical or chevron type springs.

Elastomeric primary springs shall be marked with the date of manufacture.

In addition, markings should include:

(a) Product batch number;

(b) Part number;

(c) Nominal height of the spring under a reference load.

The original design assessment shall place a limit on the maximum allowable stiffness range.

The design shall detail the impact of physical property changes and creep over the life cycle.

Where the axle is retained solely by elastomer, or bonds to elastomer components, a secondary restraint shall be provided in the form of an extension bump-stop or a safety strap that will retain the axle in event of derailment and permits safe lifting of the assembled bogie.

Coil over rubber springs, which place less emphasis on the elastomer to provide the means of support should be managed as a generic elastomeric component.

3.5.2 Inspection, testing and maintenance

Elastomeric primary spring maintenance and inspection controls shall be detailed to ensure components that are in service remain within the acceptable performance range.

Inspection and maintenance procedures for elastomeric primary springs should include identification of any of the following that are likely to affect suspension performance or operating safety:

(a) Creeping/Settling.

(b) Cracking (surface condition).

(c) Splitting (deeper damage).

(d) Delamination.

(e) Extrusion.

(f) Increased stiffness could occur due to age hardening.

(g) Decreased stiffness could be due to splitting, delamination or extrusion

The spring stiffness should be measured at a predefined velocity and over a range that represents the nominal vehicle suspension loading.

Refer EN 13913 for test and measurement methods.

Inspection methods should include:

(a) Scheduled replacement;

(b) Monitoring of settling;

(c) Physical appearance.

Stiffness change should be managed on a calendar-based discard basis.

The RSO should also sample and test springs periodically to determine the average rate of change, under operating conditions.

It should be noted that significant performance deterioration can occur with stored components.

Alternative methods of assessment based on overall performance, such as twist, sway and slew tests, based on overall vehicle performance should also be used to determine the change of performance during the life cycle.

The results from this assessment should be used to assess the impact on derailment risks. Refer to AS 7509 for this assessment

4 Dampers

4.1 General

Dampers should be of two types, hydraulic (or viscous) dampers or friction dampers.

Stiffness of the damper mountings can be very important in ensuring the effectiveness of the damper. Particularly important for high rate dampers such as yaw dampers.

4.2 Hydraulic dampers

4.2.1 Hydraulic damper design and manufacture

Hydraulic dampers shall be designed and manufactured in accordance with applicable industry standards.

Industry standards for hydraulic dampers include EN 13802.

4.2.2 Hydraulic damper inspection and maintenance

Inspection and maintenance procedures for hydraulic dampers shall include identification, and rectification as necessary, of any of the following that are likely to affect suspension performance or operating safety:

(a) The physical condition of all horizontal, vertical and yaw hydraulic dampers and their end mounting bushes.

(b) Dampers are correctly fitted and secured.

(c) Dampers which are leaking are to be replaced (but note that a slight amount of weepage may be acceptable).

(d) Excessively worn dampers are to be replaced.

(e) Excessively worn or damaged end mounting bushes are to be replaced.

(f) Where applicable, the quantity of oil in dampers is sufficient.

(g) Damper characteristics are in accordance with appropriate specifications.

4.3 Friction dampers

4.3.1 General

Examples of friction dampers should include axle box liners, wedge-type friction elements, telescopic friction dampers, the top surface of constant contact side bearers, etc.

4.3.2 Friction damper design and manufacture

Friction dampers shall be designed and manufactured in accordance with applicable industry standards.

Where any changes are to be made to the original friction component design a new design assessment shall be undertaken.

Industry standards for friction dampers should include those within the AAR Manual of Standards and Recommended Practices Section D.

4.3.3 Friction damper inspection and maintenance

For friction dampers, the friction surfaces or wear plates shall not have lubricated or painted (except by design).

The condition of friction wedges or friction elements should comply with the bogie manufacturer's instructions.

When an alternative to the bogie manufacturer's friction wedge is utilised, such as a wedge with wear reducing elements on the slope face the allowable friction wedge rise shall be reduced accordingly.

Friction wedge rise should be measured whenever a bogie is in a repair facility.

Operators should establish wedge rise limits for return-to-service from maintenance facilities that will allow bogies to operate until their next scheduled service without wedge rise reaching the condemning limit.

Friction wedge pockets can be reclaimed by welding.

All welding used in friction wedge pocket reclamation shall be ground to restore the correct geometry of flatness, roughness, angle of the sloping face and size as per the bogie manufacturer's specifications. Welded wedge pockets that are not smooth are known to bind on the welds in a bolster and cause the operation of the damping system to become ineffective.

Undressed weld beads resulting from welds used in reclamation shall not be permitted in wedge pockets.

Typical inspection and maintenance procedures should include:

(a) Checking wear plates or axle box wear liners for damage, wear, excessive clearance, binding, seizure or failure of wear plate fasteners.

(b) Checking the spring working length.

(c) Checking the wear on working faces.

(d) Checking for undamped suspension movement (Undamped movement in constant contact side bearers occurs with clearance between the cap and cage or low horizontal stiffness of the resilient spring).

(e) Periodic overhaul and performance testing of telescopic friction dampers or others which cannot be inspected in-situ.

(f) Checking constant contact side bearers for excessive wear.

(g) Checking constant contact side bearers for correct preload set-up heights.

(h) For constant contact side bearers, checking for deterioration of underframe wear plates (associated with the side bearers) to ensure that any significant wear does not create an unintended bogie bolster yaw limit.

4.3.4 Operation with defective friction dampers

Defects that might prevent a vehicle to enter into or to continue in service should include:

(a) Wear plates which are loose, missing (except by design), or worn beyond the manufacturer's condemning limit.

(b) Broken, missing or incorrect friction damper activating spring.

(c) Broken friction damper unit.

(d) Seized friction wedge assembly.

(e) For axlebox / pedestal guide assemblies, loose wear plates that will allow foreign matter to lodge behind the wear plate, or missing wear plates on either the axlebox or the bogie pedestal.

(f) Any friction wedge or friction element worn beyond the manufacturer's condemning limit.

(g) Wear on any face of the wedge or wedge pocket exceeding the manufacturer's wear limits or the condemning notch limits.

5 Resilient components

5.1 General

Resilient components should include:

(a) Bushes as used in anti-roll bar drop-links, axlebox pivot bushes, damper end mountings, lateral control rods, traction links, etc;

(b) Primary suspension springs, linear or conical laminated types;

(c) Air spring pedestals as auxiliary or emergency springs;

(d) 'Hourglass'-type secondary suspension springs;

(e) Progressive-rate bumpstops including as used in constant-contact sidebearer components.

(f) 'Flexitor' suspension units fitted to Road-Rail Vehicles.

(g) 'Meggi-rubber' suspension units fitted to many infrastructure maintenance vehicles.

5.2 Resilient component design and manufacture

Resilient components shall be designed and manufactured in accordance with applicable industry standards.

Industry standards for resilient components include –

(a) EN 13913;

(b) ISO 3302-1;

(c) ISO 3302-2;

(d) AAR M-948.

Resilient component design should need to be taken into account the prevention of contact between the vehicle underframe and bogie side frame when the underframe rolls on the bogie bolster. For example, where there is only limited clearance between the bolster and bogie side frame (typically narrow gauge rolling stock) then "long travel" constant contact side bearers may not be appropriate.

5.3 Resilient component inspection and maintenance

Inspection and maintenance procedures for resilient components shall include identification of any of the following that are likely to affect suspension performance or operating safety:

(a) Resilient components that are missing, excessively worn, deformed, damaged, cracked or perished.

(b) Tearing or delamination between the resilient material and the backing plate.

(c) Distortion, swelling or deterioration of the resilient material. (Ageing, excessive heat, moisture, contact with damaging chemicals or other substances or other environmental conditions can cause these defects).

(d) Proper clearances as per the bogie manufacturer's instructions.

Where applicable, resilient components should be replaced in matched sets.

6 Other suspension components

6.1 General

Other suspension components should include:

(a) Gap side bearers;

(b) Centre plate;

(c) Lateral control rods and steering linkages.

6.2 Other suspension components design and manufacture

Other suspension components shall be designed and manufactured in accordance with applicable industry standards.

Industry standards for gap side bearers should include AAR M-948.

Stops, safety hangers or other retaining devices should be provided to prevent (where applicable) springs, spring planks, spring seats, bolsters, or other similar components from dropping to track level in the event of a suspension component failure.

6.3 Other suspension components inspection and maintenance

Inspection and maintenance procedures for other suspension components shall include identification of any of the following that are likely to affect suspension performance or safety:

(a) correct clearances of gap side bearer as per the bogie manufacturer's instructions.

(b) wear and appropriate type and level of lubrication to centre plate and liner.

(c) wear of pins, bushes, bearing blocks and cracks in the swing hangers and

(d) spring plank.

Appendix A Hazard Table

Hazard Reference	Hazard	Section Addressing
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