



Powered industrial trucks

Part 1: General requirements



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The following are represented on Committee ME-026:

- Australian Industrial Truck Association
 - Australian Industry Group
 - Construction and Mining Equipment Industry Group
 - Hire and Rental Industry Association of Australia
 - Safety Institute of Australia
 - WorkCover New South Wales
 - WorkSafe Victoria
-

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Australian Standard[®]

Powered industrial trucks

Part 1: General requirements

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PREFACE

This Standard was prepared by the Standards Australia Committee ME-026, Industrial Trucks, to supersede AS 2359.1—1995, *Powered industrial trucks, Part 1: General requirements*.

This Standard incorporates Amendment No. 1 (May 2017). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

For the AS 2359 series of Standards, wherever practicable, the relevant International Standards have been adopted. However, Parts 1, 2 and 12 continue to be locally developed, in the absence of suitable International Standards.

This Standard is Part 1 of AS 2359, *Powered industrial trucks*, which currently comprises the following parts and those proposed for revision listed below:

AS

- 2359 Powered industrial trucks
- 2359.1 Part 1: General requirements (this Standard)
- 2359.2 Part 2: Operations
- 2359.5 Part 5: Symbols for operator controls and other displays
- 2359.6 Part 6: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks (ISO 3691-1:2011, MOD)
- 2359.9 Part 9: Overhead guards—Specification and testing (ISO 6055:2004, MOD)
- 2359.10 Part 10: Fork-lift trucks—Hook-on type fork arms—Vocabulary
- 2359.12 Part 12: Hazardous areas
- 2359.14 Part 14: Fork arms—Technical characteristics and testing
- 2359.15 Part 15: Fork-arm extensions and telescopic fork arms—Technical characteristics and strength requirements
- 2359.16 Part 16: Safety signs and hazard pictorials—General principles
- 2359.19 Part 19: Additional stability tests for industrial variable-reach trucks handling freight containers of length 6 m and above

ISO is in the process of developing a number of new International Standards in relation to industrial trucks, e.g. on stability, safety, etc. It is intended that the ISO Standards will be adopted as Australian Standards under a new series number. The designation of existing Australian adoptions currently in the AS 2359 series will be changed by amendment. It is anticipated that the number of AS 2359 Standards will be reduced to only those parts that are written specifically for Australian conditions.

A1 | The following new Australian Standards have been published, which relate to industrial trucks:

- AS 5143:2015 Fork-lift trucks—Hook-on type fork arms and fork arm carriages—Mounting dimensions
- AS 5144.5:2015 Industrial trucks—Safety requirements and verification
Part 5: Pedestrian-propelled trucks

This Standard does not cover industrial tractors with a drawbar pull greater than 50 kN.

Visibility and noise level requirements are receiving considerable attention from ISO, but at this stage are not covered by this Standard. Lighting requirements are not included, but adequate lighting may be required to suit requirements of statutory authorities or to allow operation in areas of low light intensity.

This Standard needs to be read in conjunction with AS 2359.6. AS 2359.6 is a modified adoption of ISO 3691-1:2011. When ISO 3691-1:2011 was being developed it became clear that not all requirements relating to each country could be included in the ISO 3691 series of Standards. Therefore, the revision of AS 2359.1 provides general requirements but any provisions that duplicate those in Part 6 have been removed from this Standard.

NOTE: The regional requirements from ISO/TS 3691.8:2012 for Australia have been included in this Standard to ensure that they are complied with.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

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STANDARDS AUSTRALIA**Australian Standard
Powered industrial trucks****Part 1: General requirements****SECTION 1 SCOPE AND GENERAL****1.1 SCOPE**

This Standard sets out additional requirements not found in AS 2359.6 for the design, manufacture, marking and testing of self-propelled industrial trucks (hereafter referred to as ‘trucks’) and their attachments, as defined in AS 2359.7. Therefore, this Standard and AS 2359.6 need to be read in conjunction.

Stability testing is specified in Appendix A.

NOTES:

- 1 Guidance on the principles of stability is given in Appendix B.
- 2 The operation of powered industrial trucks is covered by AS 2359.2.

1.2 APPLICATION

The duties of designers, manufacturers, importers, suppliers, users and owners of plant, including powered trucks, are set out in legislative requirements. This Standard offers a way in which designers, manufacturers, importers, suppliers, users and owners of powered trucks can meet these duties. However, compliance with this Standard may not ensure compliance to such legislation and legislation takes precedence where any contradiction occurs.

Designers, manufacturers, importers, suppliers, users and owners of multipurpose equipment (e.g. telehandlers) are advised to consult the legislative requirements and determine their specific obligations. This Standard may be applied to multipurpose equipment designed to be used as a powered industrial truck in order to control the specific risks unique to its operation in this mode; however, it is recognized that the duties under the law may be discharged in other ways, including compliance with other more appropriate Standards.

NOTES:

- 1 Telehandlers, also known as ‘rough terrain variable reach trucks’, are covered by AS 1418.19.
- 2 Because of the range of designs of multipurpose equipment currently on the market it is not possible to provide more precise advice on the application of this Standard to such equipment that will be valid in all instances.
- 3 It is not intended that multipurpose equipment be required to simultaneously comply with all of the requirements of a range of Standards.

1.3 INNOVATION

It is not intended that this Standard impose unnecessary restrictions on design, manufacture, marking and testing of trucks, or on the development and use of new, improved or unusual methods and materials.

1.4 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1418 Cranes, hoists and winches
1418.19 Part 19: Telescopic handlers

1657 Fixed platforms, walkways, stairways and ladders—Design, construction and installation

2359 Powered industrial trucks

2359.2 Part 2: Operations

2359.5 Part 5: Symbols for operator controls and other displays

2359.6 Part 6: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks (ISO 3691-1:2011, MOD)

2359.7 Part 7: Terminology

2359.9 Part 9: Overhead guards—Specification and testing (ISO 6055:2004, MOD)

2359.13 Part 13: Brake performance and component strength

2359.14 Part 14: Fork arms—Technical characteristics and testing

A1 | 2359.15 Part 15: Fork-arm extensions and telescopic fork arms—Technical characteristics and strength requirements

2359.16 Part 16: Safety signs and hazard pictorials—General principles

2359.19 Part 19: Additional stability tests for industrial variable-reach trucks handling freight containers of length 6 m and above

2402 Traction batteries—Lead-acid

2402.1.1 Part 1.1: Vented cells—Requirements

2402.2.1 Part 2.1: Valve-regulated cells—Requirements

2444 Portable fire extinguishers and fire blankets—Selection and location

2548 Battery chargers for lead-acid traction batteries

2548.1 Part 1: Battery chargers for vented cells

2549 Cranes (including hoists and winches)—Glossary of terms

2951 Earth-moving machinery—Nomenclature

2951.0 Part 0: General introduction and listing

3990 Mechanical equipment—Steelwork

A1 | **Text deleted**

4983 Gas fuel systems for forklifts and industrial engines

AS IEC

61672 Electroacoustics

61672.1 Part 1: Sound level meters—Specification

A1 | AS ISO

6292 Powered industrial trucks and tractors—Brake performance and component strength

13564 Powered industrial trucks—Test methods for verification of visibility

13564.1 Part 1: Sit-on and stand-on operator trucks and variable-reach trucks up to and including 10 t capacity

22915 Industrial trucks—Verification of stability

22915.1 Part 1: General

22915.2 Part 2: Counterbalance trucks with mast

22915.3 Part 3: Reach and straddle trucks

A1	AS ISO		
	22915.4	Part 4:	Pallet stackers, double stackers and order-picking trucks with operator position elevating up to and including a 1200 mm lift height
	22915.11	Part 11:	Industrial variable-reach trucks
	22915.13	Part 13:	Rough-terrain trucks with mast
	22915.16	Part 16:	Pedestrian-propelled trucks
	22915.21	Part 21:	Order-picking trucks with operator position elevating above 1200 mm
	22915.22	Part 22:	Lateral and front-stacking trucks with and without elevating operator position
	AS/NZS		
	1554		Structural steel welding (series)
	1891		Industrial fall-arrest systems and devices
A1	1891.1	Part 1:	Harnesses and ancillary equipment
	60079		Explosive atmospheres
	60079.10.1	Part 10.1:	Classification of areas—Explosive gas atmospheres
	60079.10.2	Part 10.2:	Classification of areas—Combustible dust atmospheres
	AS/NZS CISPR		
	14		Electromagnetic compatibility—Requirements for household appliances, electric tools and similar apparatus
	14.1	Part 1:	Emission
	ISO		
	2860		Earth-moving machinery—Minimum access dimensions
	2883		Rubber, vulcanized—Antistatic and conductive products for industrial use—Electrical resistance limits
A1	3450		Earth-moving machinery—Wheeled or high-speed rubber-tracked machines—Performance requirements and test procedures for brake systems
	6292		Powered industrial trucks and tractors—Brake performance and component strength
	13851		Safety of machinery—Two-hand control devices—Functional aspects and design principles
	20898		Industrial trucks—Electrical requirements
	22915		Industrial trucks—Verification of stability
	Text deleted		
	22915-5	Part 5:	Single-side-loading trucks
	22915-8	Part 8:	Additional stability test for trucks operating in the special condition of stacking with mast tilted forward and load elevated
	22915-9	Part 9:	Counterbalanced trucks with mast handling freight containers of 6 m (20 ft) length and longer
	22915-10	Part 10:	Additional stability test for trucks operating in the special condition of stacking with load laterally displaced by powered devices
A1	Text deleted		
	22915-15	Part 15:	Counterbalanced trucks with articulated steering
A1	Text deleted		

24134	Industrial trucks—Additional requirements for automatic functions on trucks
24135	Industrial trucks—Specifications and test methods for operator restraint systems
24135-1	Part 1: Lap-type seat belts
ISO/TR 29944	Powered industrial trucks and tractors—Brake performance—Determination of measurement procedures
ISO/TS 3691	Industrial trucks—Safety requirements and verification
3691-8	Part 8: Regional requirements for countries outside the European Community
EN 1175	Safety of industrial trucks—Safety requirements (series)
12053	Safety of industrial trucks—Test methods for measuring noise emissions
12895	Industrial trucks—Electromagnetic compatibility
UL 583	Electric-battery-powered industrial trucks

1.5 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 2359.7, AS 2359.6 and those below apply.

1.5.1 Aisles

The operating area of the truck between the racks.

1.5.2 Auxiliary lift

A lift mechanism in addition to the main lifting device.

1.5.3 Clear aisles

The operating area of the truck between the pallet face to pallet face or rack to rack, whichever is smaller.

1.5.4 Dimensions

1.5.4.1 Load centre

The point corresponding to the load centre of gravity in a cubic homogeneous load.

1.5.4.2 Load-centre distance

The horizontal distance from the intersection of the horizontal load-carrying surfaces and vertical load-engaging faces of the forks (or equivalent load-positioning structure) to the load centre.

1.5.5 Electrical functions

1.5.5.1 Electrical isolation

The function of interrupting the electric supply to an electrical system or part thereof from its source of electric power supply by an isolating switch that normally operates under electrical no-load conditions, but which may operate under electrical load conditions in an emergency.

1.5.5.2 Electrical protection

The function of automatically isolating an electrical system or part thereof under fault or overload conditions which includes:

- (a) *Overload protection* The function of automatically interrupting the electric supply to a component which is being subjected to a load in excess of the design application. This type of protection usually is applicable only to the component concerned and usually does not suffice to protect the conductors leading to the component. This type of protection operates before the component has become electrically defective.
- (b) *Short-circuit protection* The function of automatically interrupting the electric supply when a fault has developed in either a component or the conductors leading to that component.

1.5.6 Elevating operator position

Operator platform, which can be elevated more than 1200 mm from the ground to the floor of the platform, measured with the truck unladen.

1.5.7 Four-directional lift truck

A lift truck with each wheel assembly arranged so that it can be rotated about a vertical axis to enable the truck to move in any horizontal direction.

1.5.8 Guidance system

System that guides the truck on a predetermined path not directly controlled by the operator.

1.5.9 Inclined surfaces

1.5.9.1 Gradient

The tangent of the angle between the surface and the horizontal, usually expressed as a percentage.

1.5.9.2 Incline

A surface of gradient greater than 2%. Surfaces of a lesser gradient may be considered as being level.

1.5.9.3 Test slope

Slope of test surface, expressed in terms of gradient as a percentage.

1.5.10 Lift truck

1.5.10.1 Low-lift truck

Truck having a lift height of 500 mm or less.

1.5.10.2 Medium-lift truck

Truck having a lift height between 501 mm and 1799 mm.

1.5.10.3 High-lift truck

Truck having a lift height greater than 1800 mm.

1.5.11 Load handling device

Means that supports the load, e.g. forks, platform, attachment.

1.5.12 Low level order picker

Truck which allows the operator to be elevated to a height of no more than 1200 mm. It does not include a low lift truck, where the operator elevates with the lifting mechanism.

1.5.13 Mechanical components

1.5.13.1 Axle lock

A device that locks out vertical axle oscillation to improve lateral stability.

1.5.13.2 Lift truck attachment

A device, other than a fork arm, that is designed for a load handling requirement.

1.5.13.3 Load backrest extension

A device extending vertically from the fork carriage frame (load backrest) to support that portion of the load above the load backrest when it is tilted rearward or upward.

1.5.13.4 Work platform

A platform that is designed for mounting on a high-lift truck or other elevating device to provide for one or more persons to be elevated to do work at height.

1.5.14 Narrow aisle lift truck

An electric lift truck that can operate in aisles smaller than counterbalance trucks, typically 2400 mm to 3100 mm clear aisle.

1.5.15 Operating with elevated load

Operating with an elevated load means to elevate, suspend or lower a load with the load handling device whilst the truck is travelling.

1.5.16 Operation

1.5.16.1 Lateral levelling

The changing of the lateral relationship between the truck lifting mechanism and the load axle. It is generally used to adjust the mast to the vertical when the truck is standing sideways on a slope.

1.5.16.2 Reach

The range of substantially horizontal movement of the reach mechanism or boom relative to the truck.

1.5.16.3 Work cycle

A complete series of movements associated with the normal duty of a truck including the following:

- (a) Move to load.
- (b) Pick up load.
- (c) Move with load.
- (d) Deposit load.
- (e) Move away from load.

1.5.17 Personal fall protection system

System that prevents or limits the fall of a person.

1.5.18 Powered industrial truck (forklift)

An item of mobile equipment as defined in AS 2359.7 designed to transport or lift materials and equipment in industry, commerce and other applications by means other than manual power but excluding mobile cranes as defined in AS 2549, earth-moving machinery as defined in AS 2951 and telehandlers (also known as 'telescopic handlers' and 'variable reach trucks') as defined in AS 1418.19.

1.5.19 Shall

Indicates that a statement is mandatory.

1.5.20 Should

Indicates a recommendation.

1.5.21 Supplementary platform

A load carrying platform accessible from the operator's platform designed for mounting on the elevating device of a high lift order picking truck. This platform may be removable and cannot be a pallet.

1.5.22 Very narrow aisle lift truck (VNA)

A lift truck with a load carrier that pivots about a vertical axis. VNAs, also known as 'turret trucks', are designed to operate in clear aisles of typically 1525 mm to 2100 mm.

NOTE: Stacking cranes, which fulfil an identical function to turret trucks but are supported and restricted in movement by fixed rails, guides, etc. so that they cannot leave the aisles in which they operate, do not come within the scope of this Standard.

SECTION 2 LOAD RATING

2.1 BASIS OF RATING

Powered trucks (including low, medium and high-lift) shall be load rated in terms of their stability and strength as a value for the rated, actual or alternative capacity. The purpose of the load rating is to ensure that appropriate truck(s) can be selected to carry out specific tasks.

Refer to Annex A of AS 2359.6—2013 for additional information on load centre distance and rated capacity.

NOTE: Trucks that are imported with a 500 mm load centre may require the capacity recalculated and displayed on the information plate for a 600 mm load centre.

2.2 DESIGNATION OF RATED CAPACITY

The rated capacity is the maximum capacity established by the manufacturer based on component strength and truck stability.

NOTE: Typically the rated capacity is not shown on the nameplate that shows the actual capacity and any alternative capacity.

2.3 DESIGNATION OF ACTUAL CAPACITY

The actual capacity at maximum lift height, which is shown on the nameplate, is typically based on the standard load centre distance in Annex A of AS 2359.6—2013.

The actual capacity for trucks with a tilting mast shall show on the nameplate mast-vertical and mast tilted-forward capacities at maximum lift height.

Load charts (graphs) shall not be fitted due to the fact they are often confusing to read. Often these graphs do not reflect the actual configuration of the truck, i.e. lift height of the mast.

2.4 DESIGNATION OF ALTERNATIVE CAPACITY

2.4.1 General

Alternative capacities, in kilograms, may be designated for other load-centre distances, attachments, lift heights and truck attitudes or positions, other than those used to establish the actual capacity.

Mast forward tilt capacity shall be shown on all trucks equipped with a tilting mast in addition to the vertical capacity.

NOTE: See ISO 22915-8 for stability test requirements.

Where an alternative capacity is designated, it shall be based on stability tests using the load-centre distance, lift height and truck attitude or position which have been designated. If an alternative capacity is designated for a lift height which is less than the maximum lift height, the variation between actual capacity and the designated alternative capacity shall be considered as being linear unless otherwise specified, e.g. designation of intermediate values.

Where more than one rating (vertical) is required to be on a truck, as a minimum, a means shall be used to indicate to the operator the lift height, for example a digital display or marking on the mast.

2.4.2 Using a jib attachment

The designation of alternative capacity of a truck when using a jib attachment (which allows for a freely suspended load) shall be 0.8 times the actual capacity rating of the truck when fitted with a fixed-load attachment of equal overturning moment and operating in accordance with Clause 2.3.

The nameplate plate shall indicate the position of the lifting point(s), e.g. position 1, position 2, etc. See Figure 6.1.

SECTION 3 STABILITY

3.1 METHODS OF DETERMINING STABILITY

The stability tests to determine the rated capacity and actual capacity are typically carried out at the time of design but may also be carried out to verify a modification where necessary.

This Section specifies the type of truck and the stability test method to verify the capacity. Clause 2.3 specifies the requirements for actual capacity at maximum lift height. Requirements for alternative capacity ratings are set out in Clause 2.4.

3.2 STABILITY CONDITIONS

3.2.1 General

A1 | Stability conditions shall be in accordance with Clause 4.8 and Paragraph A4 of AS 2359.6—2013, AS ISO 22915.1 and this Clause 3.2.

3.2.2 Reach and straddle trucks

Deviations caused by deflections may be corrected by varying the tilt of the mast or retracting the mast or fork within the limits imposed by the design.

A1 | For determination of stability the Datum F_1 may be corrected in accordance with the requirements for all other regions in AS ISO 22915.3 Clause 4.3.2.2, by adjustment of the fork arms, fork carriage tilt, fork carrier retraction or retraction of the mast, within the limits of the design.

A1 | NOTE: This is despite AS ISO 22915.3 containing a regional requirement for Australia that does not allow correction of the datum F_1 .

3.2.3 Single-side-loading trucks

Single-side-loading trucks shall comply with the stability conditions given in ISO 22915-5.

3.2.4 Turret type high-lift trucks (VNA)

A1 | Turret type high-lift trucks shall comply with the stability conditions given in AS ISO 22915.22.

3.2.5 Trucks for stacking with mast tilted forward

Trucks for stacking with mast tilted forward shall comply with the stability and test conditions given for each category as follows:

- (a) *Counterbalanced trucks*—ISO 22915-8.
- (b) *Reach-and-straddle trucks*—ISO 22915-8.
- (c) *Rough terrain trucks*—ISO 22915-8.

The load shall be equal to the designated alternative capacity, and the mast shall be tilted fully forward.

3.2.6 Pedestrian propelled trucks

A1 | Manually propelled high lift trucks shall comply with the stability conditions given in AS ISO 22915.16.

3.2.7 Counterbalance trucks handling freight containers 6 m and longer

A1 | Counterbalance trucks handling freight containers of 6 m and longer shall comply with the stability conditions given in ISO 22915-9.

3.2.8 Industrial variable reach trucks (reach stacker) handling freight containers of 6 m and longer

Industrial variable reach trucks handling freight containers of 6 m and longer shall comply with the stability conditions given in AS 2359.19.

NOTE: A new edition of ISO 22915-12, *Industrial trucks—Verification of stability, Part 12: Industrial variable-reach trucks handling freight containers of 6 m (20 ft) length and longer*, was published in 2015.

3.2.9 Counterbalance trucks with articulated steering

Counterbalance trucks with articulated steering shall comply with the stability conditions given in ISO 22915-15.

3.2.10 Rough terrain trucks with mast

A1 | Rough terrain trucks with mast shall comply with the stability conditions given in AS ISO 22915.13.

3.2.11 Orderpicking trucks with an elevating operator position above 1200 mm

A1 | Order-picking trucks with an elevating operator position above 1200 mm shall comply with the stability conditions given in AS ISO 22915.21.

3.2.12 Other types of trucks

Until stability conditions for other types of trucks defined in AS 2359.7 are developed and incorporated in this Standard, it is recommended that the stability conditions of such trucks be determined in accordance with the philosophy contained in Appendix B, and be based on any relevant conditions in this Clause 3.2, where no ISO Standard is available.

A1 | **Table and figures deleted**

SECTION 4 BRAKES

A1 | Brakes shall be in accordance with AS 2359.6—2013, Clause 4.3, and the following requirements:

- A1 |
- (a) All trucks, including trucks over 50 000 kg rated capacity shall be designed with service and parking brakes complying with AS ISO 6292.
 - (b) Brake systems for masted rough terrain trucks shall comply with ISO 3450.
 - (c) The parking brake shall be equipped with a system preventing any unintentional release.

NOTES:

- A1 |
- 1 See Appendix C for further information.
 - 2 ISO/TR 29944 provides guidance on how the calculation for stopping distance as set out in AS ISO 6292 was developed.

SECTION 5 TYRES AND RIMS

5.1 SELECTION

5.1.1 Tyres

Tyres shall withstand the maximum rated loads imposed to maintain longitudinal and lateral stability.

The principal matters to be considered when selecting tyres for industrial applications are as follows:

- (a) Maximum load to be carried.
- (b) Maximum speed likely to be attained. Tyre manufacturers' data shall be consulted for load/speed/distance recommendations. In the main, industrial tyres are made for slow speed, short distances and intermittent operating conditions, i.e. not suitable for highway use. Only 'Not for Highway Service' (NHS) tyres shall be used on fork-lift trucks for pneumatic tyre application.
- (c) The physical dimensions in which the tyre will operate, i.e. ground and truck structure clearances.
- (d) The ground conditions, i.e. smooth, rough, wet, dry.
- (e) The type of motive power in the equipment involved, e.g. battery, diesel, LP Gas.
- (f) The environmental considerations, e.g. stability, fire/explosion risk, floor marking.
- (g) The nature of the loads being carried by the equipment.

The tyre tread pattern shall give the truck a handling characteristic which is appropriate to the intended usage. The use of specifically designed smooth or slick tread pattern tyres is acceptable for forklifts. Smooth or slick tread pattern tyres are not recommended where a forklift is registered for use on public roads.

All tyres on any axle shall be of the same type and also shall have the same tread pattern, size and rating. Where it is necessary for tyres on the front and rear axles to be of the same size and tread pattern, they shall have the same rating.

All tyres shall have correct outside diameters, to avoid having one tyre larger in diameter than the other, on the same axle. Cushion tyres on each axle shall retain correct bonding to the metal bands or rims, and shall be of similar condition.

Pneumatic tyres shall be inflated to the inflation pressures specified by the truck manufacturer.

For pneumatic tyres, the tyre inflation valve and stem shall be located within the wheel profile. Where sidewall damage is likely, e.g. operation in a steelyard, recycling operation or similar, consideration should be given to—

- (i) tyre 'in-fill' materials; or
- (ii) fitment of resilient tyres.

If pneumatic tyres are utilized in a harsh environment, the tyres should be of the 'wide wall' or 'side guard' design or scuff rings fitted to minimize damage and the possibility of blowouts or sudden deflation.

NOTE: For description of various types of truck tyres, see Appendix D.