

# Ballast Specification

ETA-04-01

## Applicability

ARTC Network Wide SMS

## Publication Requirement

Internal / External

## Primary Source

AS 2758.7, ARTC A1 Specification for Ballast, RIC Standard TS 3402/ARTC Standard TPS 04 Specification for Supply of Aggregate for Ballast

## Document Status

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1.2	16 Jan 19	6.11	Update to position title and rebranding of document.
1.3	19 Feb 25	Various	Added allowance for reduced testing  Amendment to testing requirements to align with TfNSW. Bulk Density, Water Absorption, Aggregate Crush and Mill Abrasion.

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## 1 Introduction

This standard specifies the material specification, stockpiling and handling of ballast.

## 2 Definitions

Ballast	A free draining coarse aggregate used to support railway tracks.
Nominal Size	The designation of an aggregate which gives an indication of the largest size particle present.

## 3 Sampling and Testing

Sampling and testing shall be carried out in accordance with the requirements of AS 2758.7 and the AS 1141 series of Standards, unless otherwise specified in this document.

The ARTC Officer or nominated delegate arranging supply of ballast shall obtain certification from suppliers for all new ballast supplied from:

- Quarries not previously used for the supply of Railway Ballast to this specification.
- Existing quarries used for the supply of Railway Ballast to this specification where the material being quarried changes.

An independent party who shall be an accredited member of the National Association of Testing Authorities (NATA) shall carry out the sampling and testing. Certification shall include documentation that the ballast meets the requirements of this specification. The material test report from the sampling and testing authority shall be submitted to ARTC, even where this specification is not met.

Unless otherwise agreed sample testing shall be obtained from the point of delivery and/or at the source of the supply for the first 300 tonnes of ballast delivered and for every 5000 tonnes of ballast subsequently delivered into track.

ARTC may permit increased tonnage between testing having considered:

- practicality and time taken to undertake test
- rate of supply to ARTC
- likelihood of parameter variance

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*Note: Test frequencies may be varied on an independent basis as agreed by ARTC. For instance, particle size distribution may be conducted frequently due to its importance, likelihood of change and relative ease of testing during a period of high supply. Whereas Los Angles Value testing may be extended. Mill abrasion test might only be performed at start up or not at all.*

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ARTC may require additional sampling and testing where ARTC suspects that the material is not to specification.

## 4 Ballast Production

ARTC shall be provided access to inspect ballast production facilities at any unscheduled time during normal working hours for the purpose of:

- Observing sampling and testing procedures.
- Review plant and ballast production facilities.
- Carry out any additional sampling and testing.

The ARTC Officer or nominated delegate shall ensure that contracts with Sub-contractors provide for these inspections.

## 5 Ballast Specifications

### 5.1 Rejection of Proposed Ballast Material

Igneous or other rock, displaying minerals considered to be harmful to the overall performance of the ballast may be rejected following petrographic analysis or durability testing, even though the rock complies with other sections of the specification.

### 5.2 Bulk Density

When determined in accordance with AS 1141.4 the compacted bulk density of ballast material shall not be less than 1.350 t/m<sup>3</sup>.

### 5.3 Particle Density

When determined in accordance with AS 1141.6.1 the particle density on a dry basis of ballast material shall not be less than 2.500 t/m<sup>3</sup>.

### 5.4 Water Absorption

When determined in accordance with AS 1141.6.1 the water absorption of ballast material shall not exceed 2%

### 5.5 Dimensional Requirements

#### 5.5.1 Particle Size Distribution

The particle size distribution (grading) of ballast aggregates, when determined in accordance with AS 1141.11 and AS 1141.12, shall conform to the requirements set out in Table 1.

Sieve Size (mm)	Nominal Size (mm)
	60
	% passing by mass
63.0	100
53.0	85-100
37.5	20-65
26.5	0-20
19.0	0-5

Sieve Size (mm)	Nominal Size (mm)
	60
	% passing by mass
13.2	0-2
9.50	-
4.75	0-1
1.18	-
0.075	0-1

Table 1 – Railway Ballast Standard Grade – Grading Requirements

## 5.6 Particle Shape

When tested as described in AS 1141.14 the proportion of misshapen particles in the fraction of the ballast material retained on the 9.50 mm test sieve shall not exceed 30% using a ratio of 2:1.

## 5.7 Flakiness Index

When determined in accordance with AS 1141.15 the proportion of flaky particles in the ballast material retained on the 6.70 mm test sieve shall not exceed 30%.

## 5.8 Crushed Particles of Coarse Aggregate

Ballast material shall not be derived from river gravel.

## 5.9 Durability

### 5.9.1 Aggregate Crushing Value

The aggregate crushing value of the ballast material when determined in accordance with AS 1141.21, for the fraction of material:

- passing the 53.0 mm test sieve and retained on 37.5 mm test sieve shall be 30% maximum
- or at ARTC's discretion, passing the 26.5 mm test sieve and retained on 19 mm test sieve shall be 25% maximum

### 5.9.2 Wet Attrition Value

The wet attrition value of the ballast material when determined in accordance with AS 1141.27, for the fraction of material passing the 53.0 mm test sieve and retained on 37.5 mm test sieve shall be:

- 6% maximum

*Note: Material having a wet attrition value in excess of the requirements may be accepted provided the corresponding aggregate crushing values does not exceed the requirement and is endorsed by ARTC's GM Infrastructure & Asset Management or nominated representative.*

### 5.10 Los Angeles Values

The Los Angeles Values of the ballast, as determined in accordance with AS 1141.23 shall be:

- 25% maximum for F or G grading

### 5.11 Mill Abrasion

The mill abrasion value, as determined in accordance with State of Queensland Department of Main Roads and Transport Material Test Method Q228 shall be:

- 5% maximum

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*Note: Mill Abrasion test method is attributed to State of Queensland Department of Main Roads and Transport, note CC statement and disclaimer found inside the Materials Testing Manual.*

*The Materials Testing Manual may be found at [www.tmr.qld.gov.au](http://www.tmr.qld.gov.au). NB: it does not cover non-technical issues associated with undertaking departmental works, such as, WH&S or environmental.*

*Mill Abrasion and Abrasion Number testing and reporting only required where requested by ARTC..*

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### 5.12 Abrasion Number

The abrasion number\* shall be:

- 40% maximum

\*The abrasion number is LAV (Los Angeles Value) + 5 x MA (Mill abrasion)

### 5.13 Weak Particles

The percentage of weak particles, when tested according to the procedure set out in AS 1141.32, shall not be greater than 5%.

### 5.14 Electrical Resistance

*Ballast shall have a minimum resistance 60  $\Omega.m$  - when tested according to the procedure set out in AS 1289.4.4.1.*

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*Note: In areas where signals rely upon track circuits or where traction power is supplied (including adjacent tracks), low electrical resistance of ballast can be problematic.*

*This test is a practical risk mitigation and does not ensure performance of track circuits. ARTC may stipulate additional testing and criteria if electrical resistance problems are encountered in track.*

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## 6 Alternative Materials

Material from new sources of supply shall be subject to petrographic / petrological analysis for approval.

Petrologic classification of ballast material shall be carried out in accordance with AS 2758.7-Appendix B.

## **7 Ballast, Delivery, Stockpiling, Loading and Handling**

### **7.1 Delivery**

Prepared ballast shall be handled at the producing plant in such a manner that it is kept clean and free from segregation. Vehicles used for transportation shall be clean and free from rubbish and substances which may foul or damage the ballast.

### **7.2 Stockpiling**

The ARTC Officer or nominated delegate shall arrange for the management of ballast. ARTC supplied ballast shall be maintained separately from any Contractors ballast. This shall include physical separation as well as separation of stockpile usage record keeping.

When ballast is removed from stockpile for distribution into track, it shall conform to the same specification requirements defined in Section 6.

Ballast distributed into track, which does not meet the specified quality requirements should be removed and replaced.

Ballast shall be stockpiled and handled in conditions which prevent material contamination, segregation and degradation. The movement of machinery over the stockpiled ballast shall be limited to minimize any degradation.

### **7.3 Loading and Handling**

The ARTC Officer or nominated delegate shall ensure that there is a procedure for loading ballast and recording amounts loaded including:

- Loading equipment to be used.
- Method of measuring loaded amounts of ballast.
- Loading Process.

The loading process shall include provisions for:

- Minimising wastage of ballast.
- Avoiding unnecessary handling which may degrade the ballast in any manner by:
  - Repeated mechanical handling.
  - Unnecessary dropping of material.
  - Contamination from the base of stockpiles or other sources.

Ballast loading records shall be maintained based on one of the following methods:

- Measured weights (using certified loading scales) of the loaded hoppers or of the ballast passing through the device used to load the ballast directly into the hoppers.
- Average weight agreements for each type of ballast hopper in the loaded condition.

Ballast shall only be transported in accredited ballast hoppers, in trains operated by an accredited Operator.

Ballast shall be loaded in a safe and environmentally acceptable manner particularly with regard to dust nuisance and noise levels.

## 8 Material Specification Summary

Criteria	Test Method	Compliance
Bulk Density	AS 1141.4	$\geq 1.350 \text{ t/m}^3$
Particle Density	AS 1141.6.1	$\geq 2.500 \text{ t/m}^3$
Water Absobtion	AS 1141.6.1	$\leq 2\%$
Particle Size Distribution	AS 1141.11	
% Passing 63.0 mm sieve	AS 1141.12	100
% Passing 53.0 mm sieve		85-100
% Passing 37.5 mm sieve		20-65
% Passing 26.5 mm sieve		0-20
% Passing 19.0 mm sieve		0-5
% Passing 13.2 mm sieve		0-2
% Passing 9.5 mm sieve		-
% Passing 4.75 mm sieve		0-1
% Passing 1.18 mm sieve		-
% Passing 75 $\mu\text{m}$ sieve		0-1
Particle Shape	AS 1141.14	$< 30\%$ passing 2:1 calliper ratio
Flakiness Index	AS 1141.15	$\leq 30\%$
Aggregate Crushing Value	AS 1141.21	$\leq 30\%$
Wet Attrition Value	AS 1141.21	$\leq 6 \%$
Los Angeles Values (LAV)	AS 1141.23	$\leq 25 \%$
Mill Abrasion (MA) <sup>[Note]</sup>	QLD TMR Test Method Q228	$\leq 5 \%$
Abrasion Number <sup>[Note]</sup>	LAV + 5 x MA	$\leq 40 \%$
Weak Particles	AS 1141.32	$\leq 5 \%$
Electrical Resistance	AS 1289.4.4.1	$\geq 60 \Omega \text{ m}$

Table 2 – Material Specification Summary

**Note:** These tests are reflective of ballast long term performance and resistance to wear.  
These tests are optional at ARTC representative discretion.