

Australian Standard®

Cranes (including hoists and winches)

**Part 14: Requirements for cranes
subject to arduous working
conditions**

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Association of Consulting Engineers, Australia
Australian Chamber of Manufactures
Australian Institute of Building
Bureau of Steel Manufacturers of Australia
Construction and Mining Equipment Association of Australia
Crane Industry Council of Australia
Department of Defence (Commonwealth)
Department of Labour, S.A.
Department of Training and Industrial Relations, Qld
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conditions**

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME/5 on Cranes as an aid to the specification for cranes subjected to arduous working conditions. The requirements it specifies are additional to the other parts of AS 1418 and should be applied to cranes which are subject to those conditions.

The Standard is a result of a consensus among representatives of the Joint Committee to produce it as an Australian Standard.

This Standard may be specified in its entirety where the entire crane is subjected to arduous working conditions or it may be specified in part where only a limited part or parts of a crane are subjected to arduous working conditions.

As an example of the need to specify this Standard in part only, consider a crane that is subjected to a normal level of duty, except for a very high frequency of lifting. In such a case, it would be proper to specify the crane Standard normally applicable to the crane (for example AS 1418.3) and to specify this Standard only for the crane mechanisms contained in Section 4. Further, it may not be necessary to specify Section 4 in its entirety. For example, if the crane is for indoor use, weather protection may be omitted.

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

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.

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STANDARDS AUSTRALIA

Australian Standard

Cranes (including hoists and winches)

Part 14: Requirements for cranes subject to arduous working conditions

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE This Standard specifies the additional requirements to AS 1418.1 for cranes subject to arduous working conditions.

1.2 APPLICATION Where assessed as necessary, the crane purchaser shall specify the complete crane or only those components of the crane (e.g. long travel, cross travel, crab) that will be subjected to arduous working conditions and which shall conform to the entire, or specific sections of this, Standard.

1.3 REFERENCED DOCUMENTS The following documents are referred to in this Standard:

AS	
B66	Worm gearing (inch series)
1403	Design of rotating steel shafts
1418	Cranes (including hoists and winches)
1418.1	Part 1: General requirements
1418.3	Part 3: Bridge and gantry cranes (including container cranes)
1418.12	Part 12: Crane collector systems
1657	Fixed platforms, walkways, stairways and ladders—Design, construction and inspection
1939	Degrees of protection provided by enclosures for electrical equipment (IP Code)
2005	Low-voltage fuses—Fuses with enclosed fuse-links
2005.1	Part 1: General requirements
2005.10	Part 10: General requirements
2074	Steel castings
2184	Low-voltage switchgear and controlgear—Moulded-case circuit-breakers for rated voltages up to and including 600 V a.c. and 250 V d.c.
2549	Cranes—Glossary of terms
2938	Gears—Spur and helical—Guide to specification and rating
3000	Electrical installations—Buildings, structures and premises (known as the SAA Wiring Rules)
3008	Electrical installations—Selection of cables
3008.1	Part 1: Cables for alternating voltages up to and including 0.6/1 kV
3190	Approval and test specification—Residual current devices (current-operated earth-leakage devices)

AS	
3439	Low-voltage switchgear and controlgear assemblies
3439.1	Part 1: Type-tested and partially type-tested assemblies
3678	Structural steel—Hot-rolled plates, floorplates and slabs
3777	Shank hooks and large-eye hooks—Maximum 25 t
3947	Low voltage switchgear and controlgear
3947.3	Part 3: Switches, disconnectors, switch disconnectors and fuse-combination units (IEC 947-3)
3947.5.1	Electromechanical control circuit devices
4024	Safeguarding of machinery
4024.1(Int)	Part 1: General principles
AS/NZS	
1891	Industrial fall-arrest systems and devices
1891.1	Part 1: Safety belts and harnesses
ISO	
4779	Forged steel lifting hooks with point and eye for use with steel chains of grade M(4)
7597	Forged steel lifting hooks with point and eye for use with steel chains of grade T(8).
BS	
721	Specification for worm gearing
721.1	Part 1: Imperial units
721.2	Part 2: Metric units
1486	Lubricating nipples
1486.2	Part 2: Heavy duty lubricating nipples
2903	Specification for higher tensile steel hooks for chains, slings, blocks and general engineering purposes
3017	Specification for mild steel forged ramshorn hooks
DIN	
780	Series of modules for gears
780.2	Part 2: Modules for cylindrical worm gear transmission
3966	Information on gear teeth in drawings
3966.3	Worms and worm wheels; information to be given to the manufacturer by the purchaser in order to obtain the gear required
3974	Accuracy of worms and worm gears
3974.1	Part 1: General bases
3974.2	Part 2: Tolerances for individual errors
3976	Cylindrical worms; dimensions, correlations of shaft centre distances and gear ratios of worm gear drives
15400	Lifting hooks; materials, mechanical properties, lifting capacity and stresses
15401	Lifting hooks for lifting appliances; Single hooks
15401.1	Part 1: Unmachined parts
15401.2	Part 2: Finished parts with threaded shank
15402	Lifting hooks for lifting appliances; Ramshorn hooks
15402.1	Part 1: Unmachined parts
15402.2	Part 2: Finished parts with threaded shank

DIN

- 15407 Lifting hooks; Laminated point hooks for spigot ladles
 15407.1 Part 1: Assembly, principal dimensions
 15407.2 Part 2: Components

AISE No. 7 Specification for laminated ladle hooks

AISE No. 8 Crane and Mill Auxiliary Drive Motor Cable Size Wiring Standards

JIS

- B1723 Dimensions of cylindrical worm gears
 B2803 Hooks

NOHSC

- 1007 National Standard for Occupational Noise
 2009 National Code of Practice for Noise Management and Protection of Hearing at work

AGMA

- 6022-C Design manual for cylindrical worm gearing

NOTE: Where a Standard consists of more than one part, all relevant parts should be taken into consideration as well as any Standard used in reference (e.g. material specifications, testing and procedures).

1.4 DEFINITIONS For the purpose of this Standard, the definitions given in AS 1418.1, AS 2549 and those below apply.

1.4.1 Arduous working conditions—include those items which induce additional stresses on the structure or mechanics of a crane not usually encountered over its working life when used in normal operation.

Arduous working criteria may be caused by the working environment, lifting requirements or other conditions.

NOTE: A guide to arduous working conditions is included in Appendix A.

1.4.2 Positive bridge camber—the height above the horizontal plane at the centre of an upwardly curved bridge beam without load.

SECTION 2 PERFORMANCE REQUIREMENTS FOR BOTH d.c. AND a.c. CRANES

2.1 GENERAL Where no duty cycle is stated, the crane shall be in accordance with the following:

- (a) The minimum average acceleration of the crane motions should be specified by the purchaser. If the accelerations are not specified by the purchaser, the acceleration times shall not be greater than the values listed in Table 2.1.
- (b) The acceleration times selected for each motion shall not be greater than the values specified by the purchaser and the selected values shall be stated in the information supplied by the manufacturer with the tender.

NOTES:

- 1 A number of duty cycles are specified in Appendix B.
- 2 An example of information to be supplied by the manufacturer is given in Appendix C.

TABLE 2.1
HOISTING AND TRAVELLING MOTION
PERFORMANCE CRITERIA

Speed V	Acceleration and braking times in seconds for AS 1418.1 classes		
m/s	M3, M4, M5	M6	M7, M8
Travelling			
0.10	1.5	—	—
0.16	2	—	—
0.25	2.5	1.5	—
0.40	3	2	1.5
0.63	4	2.5	2
1.00	5	3	2.5
1.25	6	4	3
1.60	7	5	4
2.00	—	6	5
2.50	—	7	6
Hoisting			
0.96	1.5	—	—
0.10	2	—	—
0.16	3	2	—
0.25	4	3	2
0.40	5	4	3
0.63	6	5	4
1.00	7	6	5
1.25	8	7	6

NOTES:

- 1 The acceleration times should be measured from when the crane starts to move.
- 2 Wheels shall not slip when starting under minimum static load.

2.2 MEETING PERFORMANCE CRITERIA The performance criteria shall be met when:

- (a) The electric supply voltage is maintained within 5 percent of that specified by the user in Appendix B.
- (b) The crane rails are level, straight, and true to span in conformance with AS 1418.1.
- (c) The crane alignment is in conformance with Appendix D.
- (d) Tests of outdoor cranes are taken on a calm day when the performance time shall be the average of one run in each direction under similar conditions.

SECTION 3 STRUCTURE

3.1 GENERAL Crane structures shall be in conformance with AS 1418.1.

3.2 GIRDERS

3.2.1 General Girders shall be constructed as box girders.

3.2.2 Girders design Emphasis shall be given to consideration of secondary and local stresses. Special consideration shall be given to compressive stresses caused by the wheel loads which, due to high impact factors and high number of cycles, can result in fatigue cracks in the structure. Local bending moments shall be added to overall bending moments in calculation of stress range. Local bending moments shall be assumed to be not less than $WL/6$ at midpanel and $WL/12$ at the panel end points—

where

W = the total load on the member arising from live load and also, in the case of vertical loading, the weight of the member, and

L = the distance between panel points.

3.2.3 Camber of bridge The bridge of the assembled crane shall be positively cambered under no-load conditions. The camber shall not exceed half of the deflection which would be caused by the rated capacity.

3.2.4 Attachment of girders to end carriages The main and auxiliary girders shall be attached to the end carriage by any of the following:

- (a) Welding.
- (b) Friction grip bolts.
- (c) Shear ring connections.

NOTE: The use of shear ring connections is shown in Appendix E.

- (d) Fitted bolts.

However, bolting and welding shall not be combined in such a way that they share the carrying of any particular load component. Where friction grip bolts are used, sufficient dowel pins or fitted bolts shall be used to ensure correct alignment. These pins shall not be taken into account for stress calculations.

3.3 END CARRIAGES

3.3.1 Construction End carriages shall be fabricated from rolled steel sections or plates, or both, bolted or welded together to form a box. Where more than two wheels are required—

- (a) bogies shall be provided; or
- (b) the end carriages shall be articulated.

End carriages shall withstand all stresses imposed on them under the most severe service conditions, including collision with other cranes and buffers.

If the ends of the end carriages or bogies are designed to receive and support the buffer, they shall be designed in such a way as to avoid undue dismantling when a track wheel unit has to be changed. The length of the end carriages shall be such that no part of any crane will be damaged in collision.

3.3.2 Removal of wheels Jacking points shall be provided on each end carriage so that any wheel may be readily and quickly changed. Axles and pins shall be designed with provision for removal and replacement where corrosion and wear may occur (e.g. compensating pins shall be stepped).

3.4 CRAB Axle bearings shall be mounted directly under the main frames of the crab, except where fixed axles are used, and shall be so arranged that the wheel and axle may be removed as an assembly.

Jacking points shall be provided.

Where the design of a fabricated crab structure is such that high residual stresses may be locked in, the frame shall be stress relieved after fabrication and before finish machining.

Where those parts of the frame which support equipment requiring accurate alignment are fitted with bearing pads, these should be machined after welding and stress relieving of the structure.

3.5 RAILS Where crane bridge rails are likely to need replacement within the life of the crane, they shall be clamped or bolted to the crane girder.

SECTION 4 MECHANISMS

4.1 GENERAL Typical service data for determination of mechanism requirements is provided in Tables 4.1.1 and 4.1.2.

4.2 BUFFERS Adequate means shall be provided to absorb the energy of both linearly and rotationally moving masses of the crane at 100% of travelling speed at buffer impact. Typically, this would entail the fitting of buffers at each end of the crane end carriage assembly or at the crane runway end stops, or both when particularly high energy is to be absorbed. Consideration shall be given to the frequency of buffer impact and ability of the buffers to dissipate the generated thermal energy. In the case of cabin-operated cranes, the deceleration due to buffer impact shall not exceed 5 m/s^2 .

4.3 TRACK WHEELS Track wheels shall be of the double-flanged type or flangeless wheels combined with lateral side rollers where suitable tracks are provided. The need for suitable flange lubrication shall be considered. Flange thickness calculated to the relevant requirement of AS 1418.1 shall be increased by 50%. Width of tread designed to the same requirement shall be dimensioned with consideration of possible misalignment of tracks or runway beams caused by outside influences such as cranes working in adjacent bays and deformation of building structure due to wind loads.

Wheel change facilities shall be in conformance with Clause 3.3.2. Suitable means shall be used to obtain alignment within the tolerances specified in AS 1418.1 after the exchange of any wheel.

Track wheels shall be manufactured from either cast or forged high tensile steels, quenched and tempered to a minimum ultimate tensile strength of 850 MPa.

4.4 BOLTING

4.4.1 General Bolts, set screws and studs (other than those used in crane structures) shall not be smaller than M12 where practicable, and shall be protected against corrosion by suitable electroplating or similar. Bolts and set screws in rotating parts shall be locked, but this provision shall not apply to set screws used for locking purposes. Bolted connections in tension should be avoided wherever possible. All holding-down bolts shall be adequately locked. Taper washers, spot welded in place, shall be provided on the tapered surface of steel sections. Effective pre-tensioning methods of bolt shanks should be applied.

4.4.2 Locking Bolts may be locked by the following methods:

- (a) Class 1: wire locking; split pin; scotch key.
- (b) Class 2: tab washers; selloc pin.
- (c) Class 3: stiff nuts ('Nylock' or similar); loctite; peened thread; lock nut.

NOTE: Locking methods have been arranged in accordance with their degree of safety.

4.5 DRIVES Selection of drive units shall take into consideration the performance requirements given in Section 2. A minimum of two independent drive units should be provided for the crane long travel.

All drive units shall be fitted with drum or disc brakes. Non-positive drive elements shall not be interposed between the brake and the load (i.e. fluid couplings).

TABLE 4.1.1
TYPICAL CRANE SERVICE DATA—ARDUOUS DUTY CRANES IN
INDUSTRIAL INSTALLATIONS—MECHANISM CLASSIFICATION

Type of crane	Motion	Mechanism classification		
		Class of utilization	State of loading	Group of mechanism
Crane for grabbing work	Hoist	T5 to T7	L3	M6 to M8
	Closing motion	T5 to T7	L3	M6 to M8
	Cross traverse	T5 to T7	L3	M6 to M8
	Long travel	T5 to T6	L3	M6 to M7
Ladle crane for foundry work	Hoist	T5 to T6	L2 to L3	M5 to M7
	Cross traverse	T5 to T6	L2 to L3	Me to M7
	Long travel	T5	L3	M6
Magnet crane for stockyard work	Hoist	T5 to T6	L3	M6 to M7
	Cross traverse	T5 to T6	L3	M6 to M7
	Long travel	T5	L3	M6 to M7
Magnet crane for scrapyard work	Hoist and auxiliary hoist	T5 to T6	L3	M6 to M7
	Cross traverse	T5 to T6	L3	M6 to M7
	Long travel	T5	L3	M6
Process crane	Hoist	T6 to T7	L2 to L3	M6 to M8
	Cross traverse	T5	L3	M6
	Long travel	T6	L3	M7
Shipyard crane	Hoist	T5 to T6	L3	M6 to M7
	Cross traverse	T5 to T6	L3	M6 to M7
	Long travel	T5 to	L3	M6 to M7
Ladle crane	Hoist and auxiliary hoist	T6 to T7	L4	M8
	Cross traverse	T5 to T6	L4	M7 to M8
	Auxiliary traverse	T5 to T6	L4	M6 to M7
	Long travel	T6 to T7	L4	M8
Pig/scrap breaking crane	Hoist	T5 to T6	L4	M7 to M8
	Cross traverse	T5 to T6	L4	M7 to M8
	Long travel	T5	L4	M6
Furnace charging crane	Hoist and auxiliary hoist	T7 to T8	L3	M8
	Cross traverse	T7 to T8	L3	M8
	Auxiliary traverse	T5 to T6	L2	M5 to M6
	Long travel	T7 to T8	L3	M8
Forging crane	Hoist	T6 to T8	L3	M7 to M8
	Cross travels	T5 to T6	L3	M6 to M7
	Long travel	T6 to T8	L3	M7 to M8
Process crane: on line	Hoist	T7	L3	M8
	Auxiliary hoist	T5	L3	M6
	Cross traverse	T6	L3	M7
	Long travel	T7	L4	M7
Heavy mill service crane	Hoist	T5 to T6	L2	M5 to M6
	Auxiliary hoist	T4	L2	M4
	Cross traverse	T5	L2	M5
	Long travel	T5 to T6	L2	M5 to M6
Goliath or bridge crane for container handling duty	Hoist	T5 to T7	Ls to L3	M5 to M8
	Traverse	T5 to T7	Ls to L3	M5 to M8
	Travel	T5 to T7	L2 to L3	M5 to M8
Heavy duty: Intermittent grabbing and magnet work	Hoist (hold and close)	T8 to T9	L3 to L4	M7 to M8
	Cross traverse	T6 to T7	L3 to L4	M7 to M8
	Long travel	T6	L2 to L3	M6 to M7
	Boom hoist	T4	L1	M3
Extra heavy duty continuous grabbing and magnet work	Hoist (hold and close)	T8 to T9	L4	M8
	Cross traverse	T7 to T8	L4	M8
	Long travel	T7	L3	M8
	Boom hoist	T4	L1	M3

TABLE 4.1.2
TYPICAL CRANE SERVICE DATA—ARDUOUS DUTY CRANES IN
INDUSTRIAL INSTALLATIONS—CRANE MOTION OPERATIONAL DATA

Crane type	Motion	Percentage on time per hour %	Number of starts per hour	Number of operational hours per year
Crane for grabbing work	Hoist	64	30	220
	Closing motion	30		1 100
	Cross traverse	40	25-50	1 300
	Long travel	35-40	20-55	2 500
Ladle crane for foundry work	Main hoist	60	100	1 700
	Cross traverse	30	45	850
	Long travel	30	20	850
Magnet crane for stockyard work	Hoist	35	20	2 730
	Cross traverse	30	30	2 350
	Long travel	55	30	4 300
Magnet crane for scrapyard work	Hoist	57	80	4 200
	Cross traverse	20	30	1 440
	Long travel	45	30	3 250
Process crane	Hoist	35	40	2 000
	Cross traverse	30	25	1 200
	Long travel	40	25	1 700
Shipyards crane	Hoist	35	50	2 000
	Cross traverse	30	30	1 500
	Long travel	35	25	1 700
Ladle crane	Hoist and auxiliary hoist	25	10	2 800
	Cross traverse	50	25	3 200
	Auxiliary cross traverse	40	20	1 700
	Long travel	45	35	2 950
Pig/scrap breaking crane	Hoist	50	25	3 100
	Cross traverse	40	70	2 600
	Long travel	25	70	1 600
Furnace charging crane	Hoist and auxiliary hoist	30	10	2 000
	Cross traverse	25	20	1 450
	Auxiliary traverse	25	20	1 450
	Long travel	35	15	2 850
Forging crane	Hoist	35	25	300
	Cross travels	40	40	3 200
	Long travel	45	20	7 600
Process crane: on line	Hoist	90	200	6 600
	Cross traverse	75	175	2 900
	Long travel	80	175	7 300
Process crane: off line	Hoist	60	150	3 000
	Cross traverse	50	90	2 000
	Long travel	50	75	3 600
Heavy mill service crane	Hoist	30	20	1 600
	Auxiliary hoist	25	30	1 100
	Cross traverse	30	28	1 400
	Long travel	40	20	1 900
Goliath or bridge crane for container handling duty	Hoist	75	150	5 000
	Traverse	60	120	3 000
	Travel	50	120	3 000
Heavy duty: Intermittent grabbing and magnet work	Hoist (hold and close)	80	35	3 000
	Cross traverse	50	35	3 000
	Long travel	10	10	1 000
	Boom hoist			
Extra heavy-duty continuous grabbing and magnet work	Hoist (hold and close)	70	290	3 000
	Cross traverse	65	200	300
	Long travel	10	10	1 000
	Boom hoist			