

Interim Australian Standard[®]

Cranes, hoists and winches

Part 10: Elevating work platforms



This Interim Australian Standard® was prepared by Committee ME-005, Cranes. It was approved on behalf of the Council of Standards Australia on 25 May 2004. This Interim Standard was published on 26 July 2004.

The following are represented on Committee ME-005:

- Association of Consulting Engineers Australia
 - Australian Elevator Association
 - Australian Industry Group
 - Australian Institute for Non-Destructive Testing
 - Bureau of Steel Manufacturers of Australia
 - Construction and Mining Equipment Association of Australia
 - Crane Industry Council of Australia
 - Department for Administrative and Information Services (South Australia)
 - Department of Consumer and Employment Protection, WorkSafe Division (WA)
 - Department of Industrial Relations (Qld)
 - Department of Infrastructure, Energy and Resources (Tasmania)
 - Department of Labour New Zealand
 - Institution of Engineers Australia
 - State Chamber of Commerce
 - Victorian WorkCover Authority
 - WorkCover New South Wales
-

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Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through public comment period.

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Interim Australian Standard[®]

Cranes, hoists and winches

Part 10: Elevating work platforms

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PREFACE

This Interim Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee ME-005 Cranes, to supersede AS 1418.10—1996, *Cranes (including hoists and winches)*, Part 10: *Elevating work platforms*.

This Standard incorporates Amendment No. 1 (February 2007), Amendment No. 2 (December 2007) and Amendment No. 3 (November 2008). The changes required by the Amendments are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Interim Standard is to address primarily the requirements for EWPs intended for use near live electrical conductors. These requirements have been prepared after many years of work by various organizations in an effort to reduce the risks associated with the use of EWPs in such situations. The requirements reflect the present attitude to Occupational Health and Safety Risk Management, where reliance on PPE or procedural measures is considered less preferable to alternative measures where risk is eliminated or reduced by engineering design.

The work in this area largely reflects the ideas first published by ESAA publication ISSC25 ‘Elevating Work Platform Purchasing Specifications and Operating Guide’. This specification was released in 1996 and had become the pseudo-standard adopted by a number of Electrical Supply Authorities within Australia.

This Interim Standard has been issued with the view to reviewing the necessity for the ‘Dry total leakage test’ as described in Paragraph M4, Appendix M, for wet-rated insulated elevated works platforms. It is believed that the wet tests specified in Paragraph M4.10 provide sufficient criteria for confirming the insulating properties of insulated EWPs when used in the wet or dry condition. If this proves to be the case, the total leakage test may eventually be shown to be redundant. For insulated EWPs that are rated for dry use only, it is considered that the most appropriate test for monitoring the condition of the insulating properties is the DC test (see Paragraph M4.3, Appendix M) or the surface leakage test (see Paragraph M4.4, Appendix M).

Other revisions incorporated in this interim Standard are editorial corrections and updated references particularly to Clause 1.4 and 1.12.2 and Appendices F and G.

Attention is drawn to the fact that this document is an Interim Australian Standard and should be regarded as a developmental Standard liable to future alteration.

Standards Australia invites comment on this Interim Standard from persons and organizations concerned with this subject. The date of expiry for comment is 26 July 2010 at which time this Interim Australian Standard will be confirmed, withdrawn or revised in the light of public comment.

During the life of this document the Committee will monitor all comment as it is received.

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 and figures are deemed to be requirements of this Standard.

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STANDARDS AUSTRALIA

Australian Standard

Cranes, hoists and winches

Part 10: Elevating work platforms

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Interim Standard specifies requirements for elevating work platforms as defined in AS 2549. It does not apply to passenger and goods lifts, builders' hoists, fixed elevating work platforms, or mast climbing platforms.

The insulation requirements in Clauses 1.5.10.1, 1.5.13, 1.12.5 and Appendices J, K, L, M and N apply to EWPs used in proximity to electrical networks with a system highest voltage of up to 145 kV ac.

Reference should be made to IEC 61057 or ANSI/SIA A92.2 for EWPs that are designed to be used on higher system voltages.

This Standard does not apply to any matter relating to firefighting equipment or to any matter relating to the vehicles upon which aerial devices are mounted, except to a vehicle which, while stationary, is a stable support for the aerial device.

NOTE:

- 1 Alternative methods for determining compliance with this Standard are given in Appendix A.
- 2 For typical elevating work platforms, see Figures B1 to B5, Appendix B.
- 3 For typical baskets, platforms, outriggers, stabilizers and extendible axles, see Figures C1 to C11, Appendix C.
- 4 Appendix N provides explanatory notes on the changes to EWP insulation which have been introduced in this revision.

1.2 APPLICATION

Elevating work platforms shall comply with Section 1 of this Standard and with the following Sections as applicable:

- (a) Pedestrian-controlled elevating work platforms Section 2.
- (b) Manually propelled elevating work platforms Section 3.
- (c) Self-propelled elevating work platforms Section 4.
- (d) Vehicle-mounted and trailer-mounted elevating work platforms Section 5.

Specific requirements in Sections 2, 3, 4 and 5 take precedence over corresponding requirements in Section 1.

This Standard is complementary to AS 1418.1, but the requirements given herein take precedence over corresponding requirements in that Standard.

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1.2A NEW DESIGNS, INNOVATIONS AND DESIGN METHODS

This Standard does not preclude the use of materials, designs, methods of assembly, procedures, and the like, that do not comply with a specific requirement of this Standard, or are not mentioned in it, but which can be shown to give equivalent or superior results to those specified.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

ISO 1000	The international system of units (SI) and its application
1199	Sampling procedures for inspection by attributes
1199.0	Part 0: Introduction to the ISO 2859 attribute sampling system
1199.1	Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
1319	Safety signs for the occupational environment
1418	Cranes hoists and winches
1418.1	Part 1: General requirements
1657	Fixed platforms, walkways, stairways, and ladders—Design, construction and installation
1687	Knapsack spray pumps for firefighting
1824	Insulation co-ordination
1824.1	Part 1: Definitions, principles and rules
1824.2	Part 2: Insulation coordination (phase-to-earth and phase-to-phase, above 1 kV)—Application guide
1931	High voltage testing techniques
1931.1	Part 1: General definitions and test requirements
2067	Switch gear assemblies and ancillary equipment for alternating voltages above 1 kV
2549	Cranes (including hoists and winches)—Glossary of terms
2550	Cranes—Safe use
2550.10	Part 10: Elevating work platforms
2700	Colour Standards for general purposes
4024	Safeguarding of machinery
4024.1	Part 1: General principles
AS/NZS	
1891	Industrial fall-arrest systems and devices
1891.1	Part 1: Safety belts and harnesses
3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
60479	Effects of current on human beings and livestock
60479.1	Part 1: General aspects
ISO 9001	Quality management systems—Requirements
ISO 9004	Quality management systems—Guidelines for performance improvements
IEC	
61057	Aerial devices with insulating boom used for live working

IEC/TS 62073	Guidance on the measurement of the wettability of insulator surfaces
4302	Cranes—Wind load assessment
ANSI/SIA A92.2	Vehicle-mounted elevating and rotating aerial devices
ASTM D 635	Standard test method for rate of burning and/or extent and time of burning plastics in a horizontal position.
BS 4994	Specification for design and construction of vessels and tanks in reinforced plastics
ESAA	Electricity Supply Association of Australia
NENS 04	ESAA National Guidelines for safe approach distances to electrical and mechanical apparatus
NOHSC:1007	National Standard for Occupational Noise
NOHSC:2009	National Code of Practice for Noise Management and Protection of Hearing at Work
SA HB18	Guidelines for third-party certification and accreditation
HB18.28	Guide 28—General rules for a model third-party certification system for products
SAE J920	Technical publications for off-road work machines

1.4 DEFINITIONS

For the purposes of this Standard, the definitions given in AS 2549 and those below apply.

1.4.1 Basket

A fully enclosed operator's platform.

1.4.2 Boom insulation

An insulating component(s) positioned close to the operator's platform and intended to electrically isolate the platform from earth potential at ground level via a boom.

1.4.3 Category C EWP

An EWP rated at 33kV or below and not fitted with Test Electrodes in accordance with Clause 1.5.13.7.5 of this Standard. The boom insulation system is equivalent to a Category C EWP defined in ANSI/SIA A92.2.

1.4.4 Chassis insulation

An insulating component(s) intended to electrically isolate the vehicle or chassis from portions of the EWP positioned near live electrical mains.

1.4.5 High voltage

As defined in AS/NZS 3000.

1.4.6 Low voltage

As defined in AS/NZS 3000.

1.4.7 May

Indicates the existence of an option.

1.4.8 Near (electrical mains)

A situation where there is reasonable possibility of a person, either directly or through any conducting medium, coming within the relevant minimum approach distances specified in ESAA Publication NENS 04.

1.4.9 Shall

Indicates that a statement is mandatory.

1.4.10 Should

Indicates a recommendation.

1.4.11 Transit cover

A cover provided on the EWP during storage and transit and removed before operation of the EWP.

1.5 DESIGN**1.5.1 General**

The design of an elevating work platform shall comply with the relevant statutory requirements relating to plant.

1.5.2 Basis of design

An elevating work platform shall be capable of hoisting, sustaining, and transporting the test loads specified in Clause 1.11, as applicable, and shall comply with the requirements for crane structures, and crane mechanisms given in AS 1418.1, as follows:

- (a) *Manually operated* Strength and stability only.
- (b) *Power-operated*—
 - (i) strength;
 - (ii) stability; and
 - (iii) life (fatigue and wear as applicable).

1.5.3 Classification

The classification of an elevating work platform shall be selected from requirements for the classification of cranes given in AS 1418.1.

1.5.4 Design for strength**1.5.4.1 General**

The design for strength of an elevating work platform shall comply with the requirements of Clauses 1.5.4.2, 1.5.4.3 and 1.5.4.4, as applicable.

The design shall consider the combinations of all forces, that may reasonably be considered to act simultaneously on the elevating work platform during its intended use. Such forces shall include those from dynamic effects, slope considerations, wind, transport and setting up.

NOTE: For guidance on load combinations, refer to AS 1418.1.

For elevating work platforms with alternative configurations of auxiliary and personnel loads, the worst calculated load combination(s) shall be applied in the design for strength analysis.

Calculation of dynamic forces shall be undertaken using a simplified method of analysis in accordance with Clause 1.5.4.2, or a detailed rational dynamic analysis in accordance with Clause 1.5.4.3. The design of manually operated motions may be based on static loading, that is dynamic factors need not be applied.

Where the elevating work platform is to be operated on a slope, the design shall include forces arising from the elevating work platform set on the specified slope, plus an adverse tolerance of 0.5° .

Wind forces shall be determined on the basis of a wind speed of 12.5 m/s (45 km/h).

The full area of one person exposed to wind shall be taken as 0.7 m^2 with the centre of area being 1.0 m above the platform floor.

For specific applications, higher wind velocities may require consideration.

NOTE: Computer calculations should be supported by the supplementary information set out in Appendix D.

1.5.4.2 *Design by simplified method of dynamic analysis*

The design by simplified method of dynamic analysis shall be as follows:

- (a) A dynamic factor of 1.5 shall be applied to the mass of all the components that can move simultaneously.
- (b) A factor of 1.1 shall be applied to the masses of stationary elements, unless a rational dynamic analysis in accordance with Clause 1.5.4.3, or the results of experimental tests on a prototype elevating work platform permit a reduction in these factors.
- (c) To account for slewing motions, a horizontal acceleration of 0.6 m.s^{-2} shall be applied at the boom end.
- (d) Despite Items (a), (b) and (c), the factors of 1.5 and 0.6 may be determined by experimental analysis on a prototype unit if lower factors are desired.

1.5.4.3 *Design by rational dynamic analysis*

Where the design of the load-supporting components is to be carried out by a rational dynamic analysis, the relevant requirements of AS 1418.1 shall be applied, except that the hoisting factor ϕ_2 shall be modified by multiplication by the personnel-loading factor (K_p) of value 1.2.

1.5.4.4 *Stresses in load-bearing components*

1.5.4.4.1 *General*

Stresses shall be calculated according to the principles of strength of materials and, wherever possible, recognized structural Standards. Permissible stresses shall not exceed the values specified in Clauses 15.4.4.2 to 15.4.4.6.

1.5.4.4.2 *Ductile materials*

For steels and other materials having an elongation at failure of 10% in 50 mm and a defined yield strength, $0.5 \times$ the minimum material yield strength or the permissible stresses as quoted in the appropriate Australian or other Standards applicable to the material.

The materials described in this Clause, when used in load-bearing members and subject to tension, bending or fluctuating stresses, shall not become brittle under cold conditions, that is at the minimum design temperature.

Specific consideration shall be given to buckling and fatigue behaviour of load-bearing components.

1.5.4.4.3 *Non-ductile materials*

For metals with elongation at failure less than 10% in 50 mm, the permissible tensile stress shall be not more than $0.2 \times$ the minimum ultimate tensile strength of the material. For materials where ultimate compressive strength is greater than the ultimate tensile strength, a Mohr failure analysis shall be applied to the stress element and the permissible compressive stress shall not exceed $0.25 \times$ the minimum compressive strength.

1.5.4.4.4 *Glass-fibre-reinforced plastic*

The permissible stress for glass-fibre-reinforced plastic (GRP), designed to a suitable method and from the results of material tests, shall be $0.16 Q$ or $0.16 F_u$, where Q is the calculated load limited stress and F_u is the minimum ultimate strength of the material based on a 90% probability of exceeding the ultimate strength on the normal distribution curve generated by the test results.

NOTE: A method for designing GRP booms is shown in Appendix E.

For GRP components manufactured in a controlled environment with documented quality guidelines, the permissible stress may be increased to $0.2 F_u$ provided that the following requirements are met:

- (a) The design and manufacturing method is confirmed by destructive testing of a full-scale prototype boom.
- (b) The quality of each boom is confirmed by appropriate QA methods during manufacture. These shall include at least, as a minimum, confirmation of glass content and resin hardness.
- (c) The structural integrity of the boom is confirmed throughout its service life by a recognized non-destructive test. The frequency of testing shall be commensurate with the intensity of use and should occur at intervals not exceeding 2 years or after the application of impact or accidental loads. Such requirements shall be detailed in the operator's manual.

1.5.4.4.5 *Roller chain, leaf chain and steel wire rope*

The design load shall not exceed 0.2 times the minimum guaranteed ultimate breaking load of the chain, leaf chain or wire rope assembly. Safety precautions shall be applied to ensure a fail-safe condition exists in the event of chain or wire rope breakage.

Such precautions shall include either of the following:

- (a) Support by at least two chain or rope systems arranged in parallel and capable of supporting the load, in which case the working load in one of the systems shall not exceed $0.3 \times$ the breaking load of the chain or rope and its connections, calculated on the basis that the full load is applied to one system alone and the failure shall be self-revealing.
- (b) An arresting mechanism shall be employed, which will support the load in a safe manner in the event of chain or rope failure. For platform levelling mechanisms, such device(s) shall hold the platform at an angle not exceeding 5° to the horizontal.

Adequate provision shall be made for inspection of the entire chain or wire rope assembly.

Wire rope sheaves and drums shall comply with the requirements of AS 1418.1. The groove diameter of wire rope sheave shall be not less than 18 times the diameter of the wire rope.

NOTE: The governing design load of the chain, leaf chain or wire rope assembly may be that load developed by the driving mechanism, which is caused by stalling of the motion of the elevating work platform against a fixed object.

1.5.4.4.6 *Hydraulic cylinders and pneumatic cylinders*

A factor of safety not less than 4 shall be applied to the bursting pressure of hydraulic cylinders and pneumatic cylinders based on the maximum design system pressure.

1.5.5 Design for stability

It is the manufacturer's responsibility to provide stability calculations and to identify the various configurations of the elevating work platform and combinations of loads and forces, which in combination create conditions of minimum stability.

The loads and forces to be taken into account in stability calculations are specified in Appendix F.

Elevating work platforms shall be checked for stability in accordance with Appendix G.

The tipping lines for stability calculations shall be as given in Appendix H.

1.5.6 Design life

Elevating work platforms shall be designed for a minimum life of 10 years, determined by the operating time and the load conditions applied during that operating time. Where appropriate, the effects of stresses due to additional forces imposed during transport shall be considered.

Group classification shall be established in accordance with AS 1418.1, appropriate to the use of the elevating work platform during its design life.

Mechanisms shall be designed for a minimum life of 10 years and in accordance with AS 1418.1.

1.5.7 Protection from uncontrolled motions

1.5.7.1 *General*

Except as noted in Clauses 1.5.7.2 and 1.5.7.3, all load-supporting actuators of an elevating work platform shall be automatically arrested and the load sustained when there is loss of power or failure of hydraulic or pneumatic lines.

NOTE: Velocity fuses (hose burst check valves) do not fulfil this requirement, as they may not sustain the load in instances where hose failure occurs and the resulting speed of descent is insufficient to cause the valve to close.

1.5.7.2 *Provision for manual emergency retrieval*

Notwithstanding the requirements of Clause 1.5.7.1, a hydraulic or pneumatic hose may be connected to the outlet port of a cylinder to facilitate manual (emergency) retrieval. The outlet port of the cylinder shall be fitted with a restrictor or device to ensure that in the event of failure of the hose, the platform descent velocity is not more than 0.75 times the normal lowering speed.

1.5.7.3 *Configuration-restricted platforms*

For platforms that do not extend beyond the base or travel, or slew when elevated, flow restrictors may be fitted to cylinder ports in lieu of holding valves. In the event of hose failure, the lowering velocity shall be not greater than 1.4 times the normal lowering velocity.

1.5.7.4 *Slewing mechanism*

The slewing mechanism shall be provided with effective and adequate means of arresting and retaining the slewing superstructure of the elevating work platform over the full range of slew either at infinitely variable positions or at a series of fixed positions.

Power-operated slewing mechanisms shall be provided with a service brake or equivalent (see AS 1418.1).

1.5.7.5 Platform and basket levelling

A platform, or basket levelling system, shall be provided, as applicable, and shall maintain the platform or basket level during operation. The levelling system shall prevent inadvertent tipping and be provided with a positive means of adjustment.

Where levelling is achieved by a pinion meshed with a quadrant and stops, positive means shall be provided to ensure that the pinion and quadrant always remain engaged.

Where levelling is achieved by the employment of a hydraulic actuator powered from the hydraulic system and controlled by a level-sensing device, an overriding stop control shall be provided in the basket or be accessible from the basket in order to shut off power to the levelling activator if a malfunction occurs.

1.5.8 Duplication of controls

Elevating work platforms equipped with a powered elevating mechanism and having a platform capable of being raised to more than 3 m above the support service level shall be provided with duplicated controls in a protected position at the support surface level. They shall be capable of being rendered to override the controls on the platform to enable the recovery of the platform in the event of sickness of, or injury to, the operator. Operation shall only be possible from one control station at any one time.

1.5.9 Retrieval of platform in the event of loss of normal power

Where the platform retrieval method is other than system bypass bleeding or manual operation, alternative power supplies shall be provided to enable the platform to be lowered to a safe position in the event of the loss of normal power supply.

The control devices shall be located so as to be readily accessible and within reach of the truck deck or ground level.

1.5.10 Platform equipment

1.5.10.1 General

Platforms shall be of the fully enclosed basket type or of the peripheral rail type. Requirements for each are specified in Clauses 1.5.10.2 and 1.5.10.3 respectively.

Where provided, hinged access doors should open inwards. Hinged access doors shall automatically and positively return to the closed position and be self-locking.

Where outward opening or removable doors are provided, a top rail that is independent from the door shall be fitted.

1.5.10.2 Fully enclosed platform

A fully enclosed platform shall incorporate the following:

- (a) Flat non-skid floor.
- (b) A continuous walled periphery not less than 0.95 m high above the floor.
- (c) A moulded or fabricated rim around the upper periphery.
- (d) A means of ingress and egress.
- (e) A means for emergency egress.
- (f) Floor openings, where provided, that comply with AS 1657.
- (g) A drain hole or a means of tilting the platform for the removal of debris.

NOTE: For insulated EWP's refer to the requirements of Clause 1.5.13.3.

- (h) Means of preventing the accumulation of water.

1.5.10.3 *Open platforms*

An open platform shall incorporate the following:

- (a) A non-skid floor.
- (b) Guardrailing or other structure around its upper periphery not less than 0.95 m above the platform floor.
- (c) A midrail.
- (d) Kickplates at sides and ends not less than 100 mm high. The kickplate may form part of the means of ingress and egress. Kickplates shall have a minimum clearance above the platform (see AS 1657).
- (e) Floor openings, where provided, that comply with AS 1657.
- (f) Drain holes, where the floor has no other openings.

NOTE: For orchard industry use, platform midrail and kickplate may be omitted.

1.5.10.4 *Access to platform*

The access to the platform should comply as far as possible with the relevant requirements of AS 1657.

1.5.10.5 *Anchorage for safety harness*

Boom-type elevating work platforms shall have suitable anchorages for the attachment of safety harnesses for each occupant. Each anchorage shall be designed to withstand the forces specified in AS/NZS 1891.4.

NOTE: The harness attachment point should be placed in proximity to the top of the basket.

When considering the employment of safety harnesses and the provision of anchorages, the effects on the platform occupants caused by the dynamic behaviour of the elevating work platform and the design and limitations of the platform levelling system shall be taken into account.

1.5.10.6 *Transport of a boom-type elevating work platform*

The boom and basket of a boom-type elevating work platform shall be effectively restrained whilst the elevating work platform is being transported.

1.5.11 **Personnel protection**

1.5.11.1 *General*

Pinch points, shear points, rotating shafts, gearing and other moving parts shall be guarded in accordance with AS 4024.1 to prevent accidental or inadvertent entrapment of personnel while the elevating work platform is being operated. The protection of scissor mechanisms shall be in accordance with Clause 1.5.11.2.

1.5.11.2 *Scissors-actuated elevating work platforms*

Scissors-actuated elevating work platforms shall be fitted with audible or visible warning devices to warn of raising or lowering movements.

To prevent trapping of persons doing maintenance work within the scissor mechanism, a captive chock, accessible without hazard, shall be provided and be clearly marked.

1.5.11.3 *Hot surfaces*

Means shall be provided to protect personnel from coming into contact with any hot surfaces on the elevating work platform.

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1.5.12 Outriggers, stabilizers, and extendible axles

Means shall be provided to secure extendible outriggers, stabilizers, and axles in the retracted position during transport and each extended position at which the elevating work platform is to be supported (see Clause 1.5.7).

Footplates should be self-aligning in two planes except where the elevating work platform is designed to operate only on a level support surface.

1.5.13 Elevating work platforms with electrical insulation

1.5.13.1 General

1.5.13.1.1 Risk considerations

Elevating work platforms with electrical insulation shall be designed to minimize risks to personnel—

- (a) located in the basket; and
- (b) on or adjacent to the vehicle.

The risks include the following:

- (i) Electric shock due to step and touch potentials.
- (ii) Burns from arcs from electrical short circuits.

NOTES:

- 1 The insulation systems specified in this Standard are intended to minimize the electrical risk arising from inadvertent contact and are not designed as primary insulation components subject to continuous electrical stress.
- 2 The insulation should be designed to be effective if contact is made with an overhead conductor located at or above the prescribed conductor height when the EWP is sited at ground level and with all stabilizers fully extended.

1.5.13.1.2 Use

This Standard does not address the requirements for EWPs used for high-voltage bare-hand work or high-voltage live-line work in rain, mist, fog, snow or sleet.

1.5.13.1.3 Insulation rating

Insulated EWPs shall be designed for the following nominal system voltages (see AS 1824.2):

Low voltage: < 1000 V a.c. or 1500 V d.c.

- (a) High voltage—
 - (i) 11 kV a.c.
 - (ii) 22 kV a.c.
 - (iii) 33 kV a.c.
 - (iv) 66 kV a.c.
 - (v) 132 kV a.c.

EWPs shall be designed for work in 'dry', 'wet', or 'raining' weather conditions in accordance with Appendix K.

NOTES:

- 1 The Table in Appendix K is included in recognition that EWPs cannot generally be assumed to be dry. EWPs may be used during rain, immediately following rain, or may pass through rain on transit to the work site. The 'dry' test from AS 1481.10—1996 is no longer considered sufficient.
- 2 Appendix L lists the electrical hazards addressed in this Standard.

1.5.13.1.4 *Materials and construction*

Insulation components shall be designed to meet the strength requirements of Clause 1.5.4.4. The insulation shall be protected against ingress of moisture, the effects of ultraviolet degradation and abrasion. The boom surfaces and associated components shall be hydrophobic, smooth and free of cavities, crevices, and irregularities that may promote capillary action or retain contaminants of water. The insulation components shall meet the performance requirements given in Clause 1.12.5.

Insulating components may be constructed from any suitable non-hygroscopic insulating material. Where reinforced plastics are employed, such as glass-fibre-reinforced plastic, the reinforced matrix shall not contain cavities or de-laminations, which may impair the dielectric strength of the component.

1.5.13.2 *Design*

1.5.13.2.1 *Protection of operators*

The following requirements apply:

- (a) EWPs rated for low-voltage work shall have cover insulation that complies with the requirements of Clause 1.5.13.6. They shall be fitted with an insulated basket that complies with Clauses 1.5.13.3.1 and 1.5.13.3.2 or an insulated platform that complies with Clause 1.5.13.4.
- (b) EWPs rated for high-voltage work shall have a boom-insulating insert located between the basket and ground level in accordance with Clause 1.5.13.5. The insulating insert shall be located as close as practicable to the basket. All exposed metal fittings above the insulating insert shall be protected from direct contact with live conductors or equipment in accordance with Clause 1.5.13.6.

Operators' baskets shall be insulated in accordance with Clause 1.5.13.3.

1.5.13.2.2 *Protection of personnel located at ground level*

All insulated EWPs that are intended for use near HV mains shall be provided with a chassis insulation system designed to protect personnel at ground level from electric shock. The minimum rating for the chassis insulation system shall be—

- (a) 33 kV for EWPs with a boom insulation rating of 33 kV and above; or
- (b) equal to the boom insulation rating for EWPs rated less than 33 kV.

NOTE: The majority of sub-transmission voltages are 33 kV or less. Additional risk controls will be necessary when working near electrical systems rated above the chassis insulation rating

The insulation shall be located to protect against phase-to-earth faults for any portion of the EWP capable of being raised more than 7.5 m above ground level. The location of the insulation covering or insert shall not create a touch potential hazard for a person standing on the support surface or in designated areas on the body of the vehicle intended for access to emergency controls, tools or equipment when any part of the EWP is raised above 7.5 m. Clearance distances from designated access areas and ground level shall comply with the requirements for safety clearances specified in AS 2067.

1.5.13.2.3 *Protection from short circuits*

All metallic portions of the EWP that can be raised more than 4.5 m above the support surface shall be provided with cover insulation designed in accordance with Clause 1.5.13.6, to reduce the risk of phase-to-phase short circuits.

1.5.13.3 *Insulated operator's baskets*

1.5.13.3.1 *Materials*

Insulating components of baskets shall be manufactured from flame-retardant materials capable of meeting the requirements of ASTM D635.

1.5.13.3.2 *Construction*

In addition to the requirements of Clause 1.5.10.2, outer surface of the baskets and their associated ancillary equipment (e.g., control descent devices, tool baskets and hydraulic lines) should, as far as possible, be contoured to reduce the risk of the boom being entangled in overhead conductors.

Basket external surfaces and associated components including hoses shall be hydrophobic, and free of irregularities that may promote capillary action or retain contaminants or water.

The internal surface shall be free of obstructions and uneven surfaces that may cause injury to personnel.

The basket shall be fully enclosed without holes or apertures that may affect the insulation. A means shall be provided to facilitate drainage and cleaning and emergency egress. A cover shall be provided to prevent accumulation of water when not in use.

The basket floor and step treads shall have a non-slip surface.

1.5.13.3.3 *Insulation criteria*

The basket shall be designed to provide an insulation level of at least the system voltage up to a maximum of 22 kV—

- (a) between the interior and exterior; and
- (b) between the top of the basket, the operator's controls, or power tool outlets, and the bottom of the basket.

The construction of the basket shall be such that there shall be clear separation between exposed metal components at the top of the basket and the bottom of the basket. The insulation shall be capable of meeting the performance requirements of Clauses 1.12.5.7, 1.12.5.8, and 1.12.5.12, as applicable.

1.5.13.3.4 *HV live line basket*

Where an EWP is designed for established HV live line work procedures, the basket shall be designed to provide a 22 kV insulation level—

- (a) between the interior and exterior; and
- (b) between the top of the basket, the operator's controls, or power tool outlets and the bottom of the basket.

Insulation requirements may be achieved using a fully enclosed insulated basket meeting the performance requirements of Clause 1.12.5.7 for a 22kV rating and an insulated liner.

Where a liner is used, means shall be provided to secure the liner within the basket if the basket is inverted.

Live line baskets or liners shall be capable of meeting the performance requirements of Clause 1.12.5.9.

1.5.13.4 *Low-voltage insulated platforms*

In addition to the requirements of Clause 1.5.10.3, insulating components incorporated in low voltage operators' platforms shall comply with the requirements of Clauses 1.5.13.5 and 1.5.13.6, as appropriate.

1.5.13.5 Insulation inserts

1.5.13.5.1 Length

The insert and all components that bridge the insert shall be arranged to meet the minimum requirements for creepage distance, puncture resistance and air gap as shown in Figure 1.5.13.5.

The creepage distance, is the shortest distance along any surface between two conducting components that are different electrical potentials. The distance should not be less than that required by AS 1824.2 for 'light pollution severity' (i.e., 25 mm per kV rms line to ground of the system nominal voltage), unless the use/maintenance regime is proven to permit a reduction in these distances. For example, if the nominal system voltage is 66 kV, then the creepage distance required is not less than $25 \times 66/\sqrt{3} = 953$.

The actual distance between the insulated metal components shall be sufficient to meet the dielectric strength and test requirements specified in Clause 1.12.5.3.

Where insulation is obtained by the provision of an air gap between two components at different potential the air gap shall comply with the requirements of AS 2067.

The creepage distance or air gap may vary on elevating work platforms equipped with telescoping booms or mechanical levelling systems. In such systems the insulation length shall be the minimum distance obtainable when any point of the boom or basket is raised more than 7.5 m above ground level.

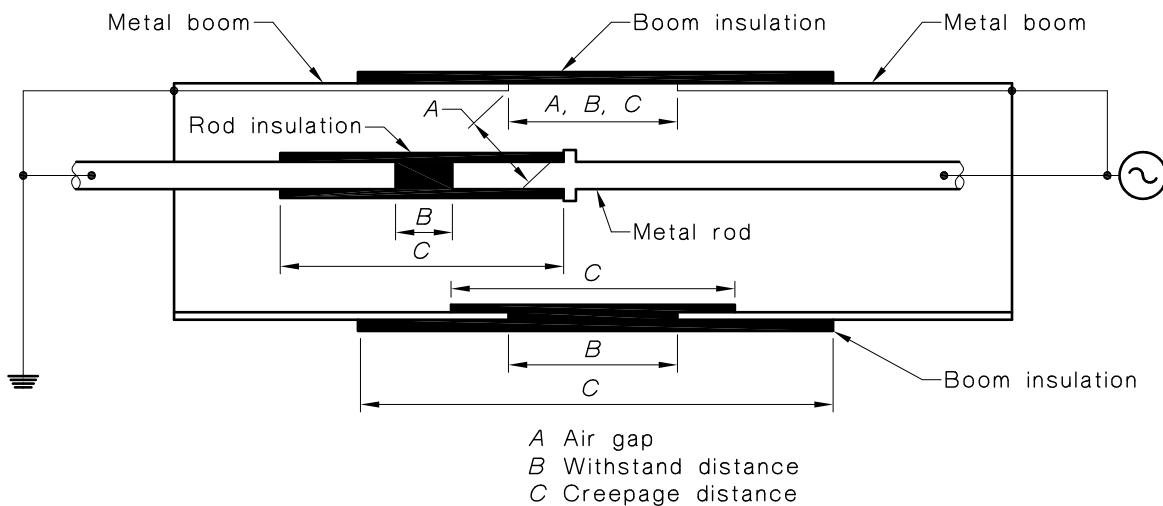


FIGURE 1.5.13.5 INSULATION DISTANCE

1.5.13.5.2 Construction

The outer surface of the booms shall be contoured to reduce the risk of the boom being entangled in overhead conductors.

The insulation system shall be designed and constructed to facilitate satisfactory regular maintenance and periodic tests during the life of the EWP.

Hydraulic hoses, levelling and control rods or links that bridge the insulating insert or that are connected to controls or fittings, either in the platform, or within reach of persons on the platform, shall be constructed from materials with electrical insulating properties capable of meeting the performance requirements given in Clause 1.12.5.4.

Arrangements shall be made so that in the event of breakage or failure of the rods or hoses, the operating controls or fittings in or within reach of the basket shall not be electrically connected to the earthed part of the structure.

1.5.13.6 *Insulated covering*

All exposed metal portions of the EWP, capable of being raised 4.5 m above the support surface, shall be insulated to reduce the risk of short circuits from contact with low-voltage conductors. In general, this will be provided by an applied surface coating at least equivalent to 4 mm of glass-reinforced plastic. Insulated covers or guards that are contoured to reduce the risk of the boom being entangled in overhead conductors may also be used. They shall be hydrophobic and not contain crevices or irregularities that may promote capillary action or retain contaminants or water.

The extent of cover shall be such that when the test voltage is applied to a simulated conductor, the voltage will not cause the insulation to break down. The simulated conductor shall be a circular ring made from 12 mm round bar and 800 mm in diameter.

Guards and cover insulation shall be designed so that—

- (a) they are not required to be removed in order to conduct routine pre-operational inspections;
- (b) they are able to withstand a force of 500 N applied normal to any external surface; and
- (c) when the force is applied, the resulting deflection does not impair the insulating performance.

The insulated covering shall be capable of meeting the performance requirements of Clause 1.12.5.6.

1.5.13.7 *Electrical test points*

1.5.13.7.1 *General*

All insulated EWPs shall be provided with clearly labelled test points to facilitate electrical testing.

1.5.13.7.2 *Upper test point*

The upper test point shall be connected to metal work above the boom insert. It shall be marked and accessible on removal of an appropriately insulated cover. Metal work above the upper boom insert and that associated with the basket shall not be permanently bonded together but may be temporarily bonded together during testing of the boom insert.

1.5.13.7.3 *Intermediate test point*

Where required, EWPs shall be provided with an intermediate test point to facilitate independent testing of the boom and chassis insulating systems.

Where two insulation inserts are provided, the metallic portions of the boom between the boom insert and the chassis insulator, and hydraulic hoses or control rods that pass through or are located in this area shall be electrically connected to the intermediate electrical test point. All hoses shall be sectioned in a manifold or via bulkhead fittings connected to the metal work.

For category C EWPs where one continuous insert is provided and acts as both chassis and boom insulation, the intermediate test point may be provided by a temporary electrode fitted to the external surface of the insert only. The temporary electrode shall be placed at a location on the boom corresponding to a height of 7.5 m from the support surface when the boom is fully raised.

1.5.13.7.4 *Lower test point*

The metallic portions of the boom below the chassis insulation insert and any metal work associated with the hoses or control rods that pass through or are located in this area shall be electrically connected to the lower electrical test point located on the vehicle chassis.

1.5.13.7.5 *Insulator surface leakage monitoring electrode(s) (for all EWP's rated above 33 kV, optional for EWP's rated at 33 kV and below)*

A non-corrosive metal collector strip at least 20×2 mm as shown in Figure 1.5.13.7 shall be permanently bonded onto the interior surface of the boom-insulating component 50-75 mm above the termination point of the metal boom. A 6 mm threaded insert shall protrude through the strip and the boom and shall form the main surface leakage current monitoring electrode. An external band shall not be permanently attached unless required for a continuous monitoring circuit that may be used during HV live line work.

All solid operating links and rods shall be fitted with permanent conductive bands and individually connected to the common pick-up point.

All hollow tubes, including hydraulic, pneumatic and fibre optic lines, shall be fitted with conductive couplings electrically connected to the exterior and interior surfaces of the tube and the pick-up point.

All covers or other components that bridge the insulating insert shall be fitted with an equivalent band on their interior surfaces, which shall be capable of being connected to the pick-up point.

Each electrode shall be electrically isolated from the metal boom.

Means shall be provided to verify the integrity of the test point either by visual inspection or test. Where a test is required, the test procedure shall be provided in the operator's and maintenance manual.

A permanent capacitive shield, where required, may be fitted to reduce capacitive coupling effects and improve indication of resistive current, (e.g., where a line monitoring system is employed).

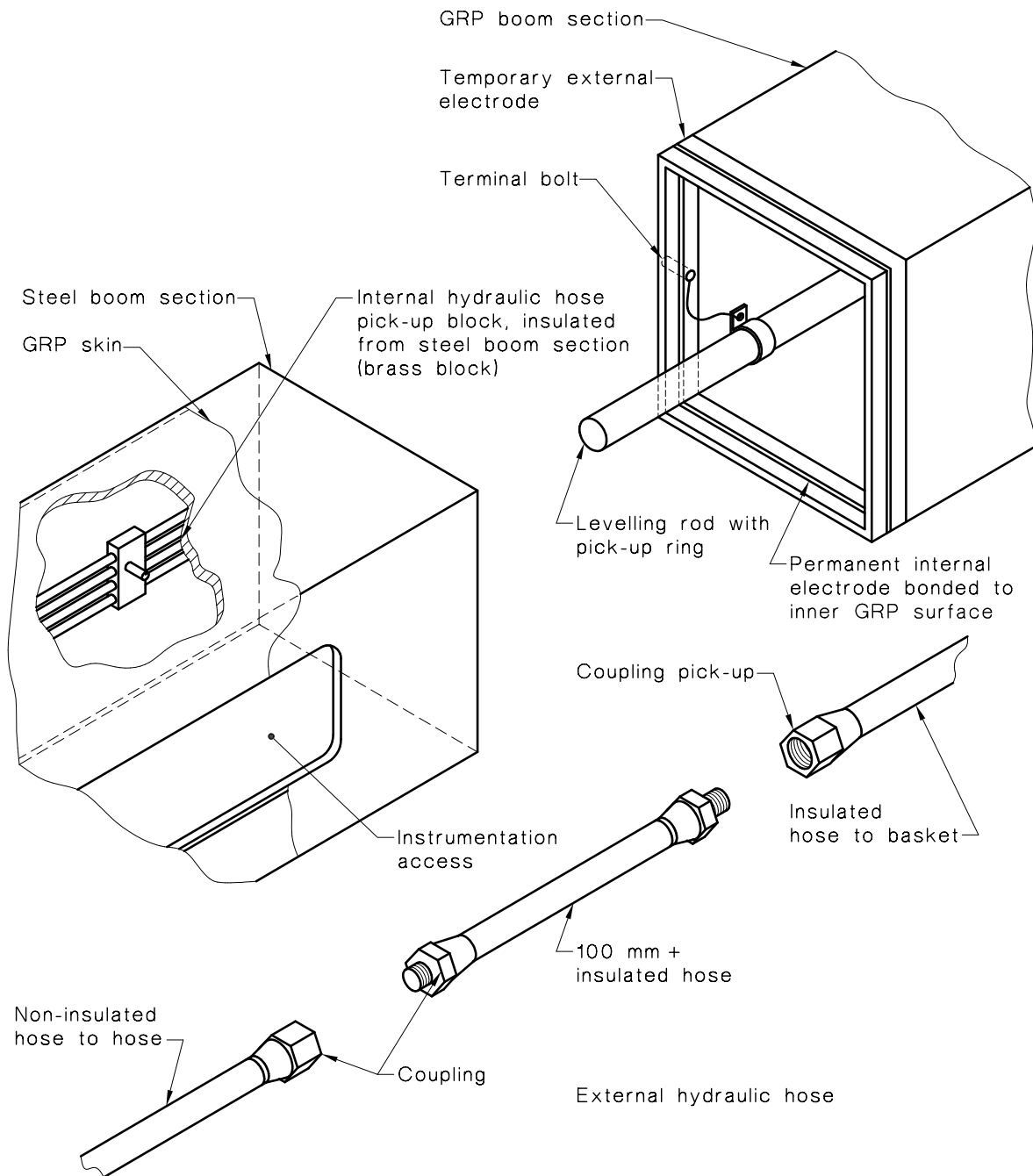


FIGURE 1.5.13.7 GENERAL ARRANGEMENT OF INSTRUMENTATION CONNECTIONS FOR INSULATED ELEVATING WORK PLATFORMS

1.5.13.7.6 Gradient control devices

Gradient control devices, where required, shall be installed on the basket end of the boom-insulating section. The gradient control device shall be connected to the upper test point.

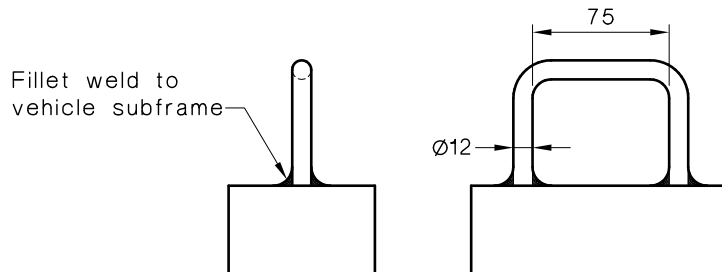
1.5.13.8 Additional requirements

1.5.13.8.1 Earthing terminal

A fault current rated earthing terminal shall be connected to the EWP chassis or subframe. A terminal constructed in accordance with Figure 1.5.13.8 has a 19 kA for 0.5 s fault rating and may be used with a fault rated earthing cable with clamp on connections. The terminal shall be readily accessible and clearly labelled and located away from vehicle fuel tank, fuel lines, access and ground control points.

The resistance between any metal surface below the chassis insulation and the earthing terminal shall be less than $0.1\ \Omega$. This resistance should be achieved preferably without the use of bonding conductors.

Where bonding conductors are used, they should be able to carry the prospective fault current of the system on which the EWP is to be used.



NOTE: A fault rated clamp shall be used to attach to the terminal.

FIGURE 1.5.13.8 EARTHING TERMINAL

1.5.13.8.2 *Reduction of fire risk*

The following applies:

- (a) All hydraulic hoses shall be contained within the boom or within a continuous guard along the length of the boom. A guard that spans an insulation insert shall comply with Clauses 1.5.13.5 and 1.5.13.7 as applicable.
- (b) Hydraulic tool outlets shall be arranged to point away from the operator. All hoses around the basket shall be provided with covers to protect occupants from direct spray in the event of hydraulic line failure.

1.5.13.8.3 *Emergency shut-off*

An emergency shut-off, designed to isolate all oil flow to the basket, shall be provided at the basket. This may be provided by an emergency stop control. Where provided, the upper emergency stop control shall be capable of being overridden at base level in order to retrieve the EWP from any elevated position.

In addition, an emergency stop control that is readily accessible from the support surface shall be fitted (e.g., on the tray of the vehicle).

1.5.13.8.4 *Emergency retrieval*

The upper controls shall be capable of being isolated and overridden at base level in order to retrieve the EWP from any elevated position.

1.5.13.8.5 *Vacuum exclusion systems*

For EWPs whose maximum height exceeds 11 m, means shall be provided so that the absolute pressure in the hoses that bridge an insulating insert, when measured at the top of the boom, shall not be less than 80 kPa.

1.5.13.8.6 *Vertical boom deflection*

The vertical deflection of an EWP boom measured at the basket at full rated load shall not exceed 1% of height plus 5% of reach.

Height is measured from level ground to the bottom of the basket.

Reach is measured from a plumb line at the outer extremity of the basket to the centre of rotation.

The booms shall be in the position of maximum deflection. When the load is removed, the booms shall return to the initial position ± 10 mm of height.

1.5.13.8.7 *Lateral boom deflection*

The EWP shall be positioned so that the height to the basket floor is greater than 6.0 m above the support surface and the boom is extended to maximum reach. A horizontal force, as defined in Paragraph F6, Appendix F, shall be applied perpendicular to the boom axis at the boom tip. The datum point is taken at the resulting deflection.

The horizontal force shall be relaxed and then applied in the opposing direction. The deflection is measured from the datum point to the resulting deflected point.

The resulting deflection shall not exceed 400 mm from the datum.

1.5.14 **Noise level**

The maximum allowable noise exposure level shall be in accordance with the level specified in NOHSC 1007.

NOTE: Practical guidance for limiting noise levels to that specified in NOHSC:1007 is provided by NOHSC:2009.

1.6 GLASS-FIBRE-REINFORCED PLASTIC*

Where GRP is used in an application in which it is required to perform a structural function, it shall comply with the following requirements:

- (a) The minimum values for properties for the design of the reinforced laminate layers shall be as given in Table 1.6.
- (b) The mass content of glass, to be used for components manufactured in the monostrand-type reinforcement, shall be established by testing.
- (c) The characteristics of a laminate should be ‘compounded’ from characteristics of the constituent layers.
- (d) Testing shall be carried out on a representative test piece removed from the laminate or laid up at the same time and in the same manner as each item being manufactured, to confirm that the mechanical properties of the material are achieved.

NOTES:

- 1 The minimum values for the respective characteristics specified in Table 1.6 apply only in the direction of the principal reinforcement and for laminates incorporating only E Glass reinforcement.
- 2 Chopped strand mat may be considered isotropic.
- 3 Guidance on a typical range of compressive strength (polyester resin) and the relation between thickness and glass content for glass fibre reinforced plastic is given in Appendix E.
- 4 Guidance on worked examples is given in Appendix E.
- 5 GRP components generally behave differently under tensile and compressive loading conditions. With tensile loading, failure can occur without warning, whereas compressive loading failure is normally preceded by local distortion or by similar indications.

* Reference publications relating to GRP systems are as follows:

- (a) Handbook of Technology and Engineering of Reinforced Plastics/Composites—Society of Plastics Industry, 250 Park Avenue, New York, 10017, U.S.A.
- (b) Engineering Design Properties of Glass Reinforced Plastics by A.F. Johnson—Joint British Plastics Federation NPL-London, U.K.

TABLE 1.6
MINIMUM PROPERTIES FOR DESIGN OF GLASS-FIBRE-REINFORCED
LAMINATE LAYERS

1	2	3	4	5
Type of glass fibre reinforcement	E Glass reinforcement content percent mass	Tensile unit strength N/mm width per kg/m ² glass	Extensibility N/mm width per kg/m ² glass	Lap shear strength MPa
Chopped strand mat	25 to 40	200	12 700	7.0
Woven roving cloth— Symmetrical and asymmetrical	45 to 60 (see Clause 1.6 and Note 1)	300 (see Clause 1.6 and Note 1)	16 200 (see Clause 1.6 and Note 1)	7.0 (see Clause 1.6 and Note 1)
Monostrand (pultruded filament wound)	(see Clause 1.6(a) and Note 1)	490	27 500	6.0

NOTE: Values nominated in Table 1.6 were established in accordance with BS 4994.

1.7 ELECTRICAL EQUIPMENT

Electrical equipment incorporated in elevating work platforms shall comply, as applicable, with the requirements for electrical equipment and controls given in AS 1418.1. Flammability of tools, hose extensions, basket and platform components, and the like, shall be considered when operating in close proximity to electrical conductors. Power tools, coupled hydraulic or electrical sources from the elevating work platform should have features such that their presence shall not decrease the safety of persons in or near the basket or platform.

1.8 HYDRAULIC EQUIPMENT

Hydraulic equipment incorporated in elevating work platforms shall comply, as applicable, with the requirements for hydraulic equipment and controls given in AS 1418.1.

A connection should be provided for the use of a pressure gauge to check the working pressure of the hydraulic system.

Flow restrictors, velocity fuses or holding valves shall be fitted in the hydraulic cylinder ports or the connection between the flow restrictors while velocity fuses or holding valves shall be hard piped and suitably protected. (Refer to Clause 1.5.7.1 for restrictions on the use of velocity fuses.)

1.9 PNEUMATIC EQUIPMENT

Pneumatic equipment incorporated into elevating work platforms shall comply with the requirements for pneumatic equipment and controls, as applicable, given in AS 1418.1 and provide means to drain the pneumatic system.

Flow restrictors, velocity fuses or holding valves shall be fitted in the pneumatic cylinder ports or the connection between the flow restrictors while velocity fuses or holding valves shall be hard piped and suitably protected. (Refer to Clause 1.5.7.1 for restrictions on the use of velocity fuses.)

A connection should be provided for the use of a pressure gauge to check the working pressure of the pneumatic system.

1.10 CONTROLS AND INDICATORS

1.10.1 General

Controls shall be such that they will enable the operator to position the elevating work platform in a manner safe for all personnel. Elevating work platforms shall be provided with controls of the 'deadman' type so that all movements shall take place only while the controls are being actuated. When released, the controls shall automatically return to the neutral position. All controls, particularly foot-operated controls, shall be designed to prevent accidental operation.

The direction of all movements of the elevating work platforms should be indicated clearly on the control device. Where practicable, all controls should be positioned for logical operation and instinctive control.

The highest point of the control members (knobs, levers, and the like) should be located at least 50 mm below guardrail level.

Other than for manually operated spool valves effecting stabilization, elevating work platforms shall be equipped with controls complying with the requirements of either Items (a) or (b) as follows:

- (a) *Emergency stop* An emergency stop control shall be provided at each control position and shall be readily accessible. Each control shall be clearly marked 'STOP' and coloured red. One emergency stop control shall be accessible from the support surface.

When activated, the emergency stop control shall effectively isolate the power supply from all motions and auxiliary circuits.

- (b) *'Power-on' controls* A 'deadman's' type power-on control shall be connected in series with all other controls so that simultaneous actuation of two independent controls is required to effect motion of the elevating work platform. When released, the power-on control shall automatically return to neutral and stop all motions. Means shall also be provided to effectively isolate the power source from all circuits.

1.10.2 Level indicator

Each elevating work platform shall have a device to indicate whether the inclination of the chassis is within the limits permitted by the manufacturer. This device shall be protected against damage and unintended change of its setting.

For elevating work platforms with power-driven outriggers, the indicator shall be clearly visible from each control position of the outriggers.

1.10.3 Articulating boom and extendible boom platform controls

Articulating boom and extendible boom platforms shall have both upper (basket or platform) and lower (chassis level) controls. The upper controls shall be in or beside the basket or platform within easy reach of the operator.

1.10.4 Interlocks

Elevating work platforms designed to achieve multiple capacities, with relevant stability media, shall be interlocked so that they will not operate in a higher capacity mode until the appropriate stability medium is set in place.

For self-propelled, vehicle-mounted and trailer-mounted elevating work platforms that require outriggers, stabilizers, or extendible axles to achieve stability then—

- (a) where the stability medium is power-operated, the controls shall be interlocked so that the elevating work platform can not be elevated until the stability medium is extended to the manufacturer's specification and the stability medium is not able to be retracted until the elevating work platform is in the retracted or out-of-service position;

- (b) where the stability medium is manually operated (see Figure C6, Appendix C), at least the first stage section on each stabilizer mechanism shall be interlocked so that the elevating work platform cannot be elevated until that section has been fully extended to manufacturer's specifications;
- (c) notice(s) shall be displayed in conformance with Clause 1.15(i); and
- (d) where motion limiting-devices are provided, they shall comply with AS 1418.1 and should be intrinsically safe and self-monitoring.

1.10.5 Boom angle indicators and boom length indicators

Where the capacity of an elevating work platform varies with radius and reach, boom angle indicators and boom length indicators, or other appropriate indicators readily visible to the operator shall be provided.

1.10.6 Control from various positions

Where a self-propelled elevating work platform has a control box that can rotate relative to the chassis, the drive controls and chassis shall be clearly marked to indicate the direction of travel that will occur when the controller is moved in either direction, irrespective of the control box position.

1.11 RATING

1.11.1 General capacity

The general capacity may be of two distinct types, e.g., the platform load (see Figure 1.11, load A) and supplemental loads (see Figure 1.11, load B) that may be affixed directly to the boom. The capacity rating in either circumstance shall be designed for boom or booms in the position of maximum overturning moment, the maximum platform loads and the maximum supplemental loads. Capacities for alternative configurations shall be specified.

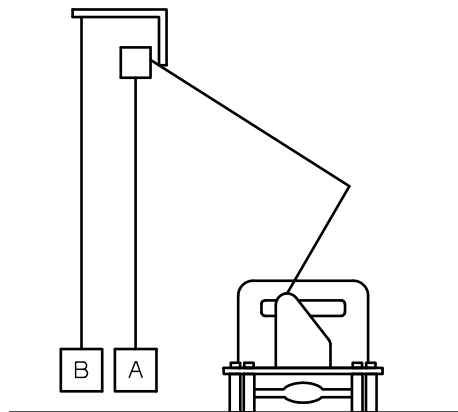


FIGURE 1.11 TYPICAL ELEVATING WORK PLATFORM WITH SUPPLEMENTAL LOADS

1.11.2 Variable capacity

Where the capacity varies within the operating range, a load chart, with print size not less than 4 mm shall be provided and displayed prominently on durable material, at the operating positions.

1.11.3 Alternative configuration

Where the elevating work platform is used in alternative configurations, these shall be clearly defined and the rated capacity in each case shall be stated. The following are examples of alternative configurations requiring such definition and statement:

- (a) With stabilization engaged or not engaged.
- (b) Used as a personnel device only or as a personnel-carrying and material-handling device.
- (c) Variation of capacity with varying platform outreach.

Elevating work platforms with multistage outriggers shall have indicators to show the extensions that correspond to the relative permissible rated capacity.

1.11.4 Rated capacity

The rated capacity shall be expressed in kilograms. Where it is necessary to restrict the position of the rated capacity, this shall be stated.

1.11.5 Operating height and reach

1.11.5.1 Height

The platform nominal height shall be the vertical distance from the floor of the platform to the support surface with the platform at its maximum height, and shall be expressed in metres.

NOTE: For vehicular-mounted elevating work platforms capable of being fitted to varying chassis, it should be assumed that all vehicles have a nominal chassis height of 1 m.

1.11.5.2 Reach

The nominal reach of an elevating work platform shall be the level distance from the centre-line of rotation to the outer edge of the platform with the platform in its most extended position, expressed in metres.

NOTE: Where required, ratings other than maximum height and maximum reach may be nominated. However, they should relate to each other using the criteria of Clauses 1.11.5.1 and 1.11.5.2, e.g., the elevating work platform has a maximum height of X metres with a reach of Y metres, or the elevating work platform has a maximum reach of X metres at a height of Y metres.

1.12 PERFORMANCE REQUIREMENTS

1.12.1 General

The following tests shall be conducted on every elevating work platform:

- (a) Stability tests in all working configurations at rated capacity in accordance with Clause 1.12.2.
- (b) Structural test in accordance with Clause 1.12.3.
- (c) Functional test to ensure all functions work correctly and safely in accordance with Clause 1.12.4.
- (d) Insulation tests in accordance with Clause 1.12.5, as applicable.

A test report shall be supplied with the elevating work platform.

1.12.2 Stability tests

1.12.2.1 General

Testing procedures shall be analysed and supervised by a competent person. Proof-testing of plant introduces potential hazards. It is essential to carefully consider the necessity for the physical security of all elevating work platforms against tipping during the stability proof test.

In the case of self-propelled elevating work platforms supported on tyres, the physical security against tipping during the stability proof test shall be mandatory.

For all other types of elevating work platforms, extreme caution shall be taken to avoid tipping during the stability proof test, especially where vehicle-mounted elevating work platforms have long booms because the high level of potential energy of the boom and the test load mass is progressively converted to kinetic energy as the point of tipping is reached.

In order to avoid inaccuracy in the stability result, the method used to safeguard against tipping (such as an anchored chain) shall not assist in stabilizing the platform prior to the point of tipping.

Specific stability test criteria shall be included in the owner's manual. Such criteria shall include a test specification detailing test loads, setting up and manner of loading, and the acceptance criteria applicable to each test. Reference shall be given to the specific requirements of this Standard.

All elevating work platforms should be tested to ensure compliance with test requirements of Clauses 1.12.2.2 and 1.12.2.3.

1.12.2.2 Static test

The elevating work platform shall be set up on the maximum allowable inclination of the chassis defined by the manufacturer $+0.5^\circ$ with outriggers (if any) used as specified by the manufacturer. The test load shall be applied to represent all of the least favourable load and force combinations (see Appendix F).

The test load should be evenly distributed to represent the working condition. If necessary, the test load may be applied to suitably strong points to avoid overstressing any part of the elevating work platform. Strong point loading shall be equitably distributed with respect to stability.

The test shall be repeated in all the most unfavourable extended or retracted positions.

The elevating work platform is stable if it can come to a stationary condition without overturning while supporting the test load(s).

Additionally, it shall be demonstrated that, following application of maximum allowable forces in any position of the work platform, the work platform shows no permanent deformation.

1.12.2.3 Dynamic tests on elevating work platforms permitted to travel with raised work platform

The elevating work platform shall be subjected to kerb tests and braking tests with the rated load distributed evenly over one half of the work platform, creating the greatest overturning moment in the specific test case as follows:

- (a) *Kerb tests* The elevating work platform shall be driven on level ground at the maximum permitted travel speed to bring one and then two wheels into contact with a fixed obstacle with a cross-section of $0.1 \text{ m} \times 0.1 \text{ m}$.

The test shall be repeated driving in both forward and reverse directions, in each extended position of the elevating work platform and, if different travel speeds are allowed for different heights, at each of those heights at the maximum permitted speeds for those heights.

During the above tests the elevating work platform shall not overturn.

- (b) *Breaking tests* The elevating work platform shall be stopped as rapidly as the controls allow in both forward and reverse directions in each elevating work platform position and combination of loads and forces which together create conditions of minimum stability and, if different travel speeds are allowed for different heights, at each of those heights at the maximum permitted speeds for those heights.

During the above tests the elevating work platform shall not overturn and the stopping distance shall be within 2 m.

1.12.3 Overload test

The overload test shall be carried out to determine the structural integrity of the elevating work platform.

The structural overload test load shall be 125% of the rated load, which shall be determined in accordance with Paragraph F3, Appendix F.

All movements with the structural test load shall be carried out at accelerations and decelerations appropriate for the safe control of the load. Where several movements with the test load have to be carried out (i.e., lifting, lowering, slewing, travelling), the intended movements shall be carried out separately and with due care, taking into account the least favourable positions, and only when vibrations associated with the preceding movements have subsided.

When, due to the various combinations of loads and outreaches of an elevating work platform, tests with different test loads are necessary, all such movements shall be carried out with all test loads except where the least favourable conditions can be sufficiently simulated by one performance test.

During the overload test the elevating work platform shall be put into all the positions that creates maximum stress in the load carrying parts of the elevating work platform.

During the overload, the test brakes shall be capable of stopping and sustaining the test load(s). After removing the test load(s), the elevating work platform shall show no permanent deformation.

1.12.4 Functional tests

Functional tests shall demonstrate that—

- (a) the elevating work platform can operate smoothly for all motions whilst carrying the rated load at the rated speeds;
- (b) all safety devices work correctly; and
- (c) the manufacturer's maximum permitted speeds are not exceeded.

1.12.5 Acceptance testing of electrical insulation

1.12.5.1 General

The electrical test procedures in Clause 1.12.5 are designed to obtain consistency in testing practices.

EWPs should be tested in a repeatable normal operating configuration with all accessories in place. To ensure results are repeatable and consistent, the configuration of the EWP during testing should comply with the requirements of Clause 1.12.5.4.3 or noted in the report.

Voltages for power frequency withstand and leakage tests shall be 50 Hz alternating voltage and measured using a peak responding meter r.m.s. calibrated. All tests shall be carried out in accordance with AS 1931.1.

All electronic systems should be electrically isolated prior to applying test voltages.

1.12.5.2 *Test schedule*

An acceptance test shall be conducted—

- (a) before the EWP is first placed in service to verify that the insulation design and materials used in construction meet the requirements of this Standard;
- (b) in accordance with Paragraph M7, Appendix M; and
- (c) on change of ownership, if the original acceptance test report is not available with the EWP.

The electrical insulation testing schedule shall be compiled using the criteria in Tables K1 and K2, Appendix K. The insulation level specified for the EWP shall determine the class from Table K1, Appendix K. The tests required for each class shall be in accordance with Table K2, Appendix K.

1.12.5.3 *Dry insulated insert withstand test*

1.12.5.3.1 *Purpose*

The insulated insert withstand test is used to verify that the boom and chassis inserts are able to individually withstand a temporary overvoltage that may be imposed by the system on which it is used.

1.12.5.3.2 *Test method*

The test shall be conducted with the boom in a clean and dry condition.

The procedure shall be as follows:

- (a) Measure the insulation resistance at a minimum of 2.5 kV. The resistance shall be greater than 1000 M Ω for boom inserts and 500 M Ω for chassis insulation respectively.
- (b) A 1 min dry power frequency withstand test voltage at the test level specified in Table 1.12.5 shall be applied between the upper test point and the vehicle chassis. Inserts not under test shall be short-circuited. The vehicle chassis shall be earthed during the test.

1.12.5.3.3 *Pass criteria*

There shall be no disruptive discharge.

NOTE: The measurement of the insulation resistance is required to verify that the condition of the insulation is likely to be suitable for energizing at voltages up to the test level. Measurement of resistance alone is not a suitable means of verifying the performance of the electrical insulation.

1.12.5.4 *Total leakage current test*

1.12.5.4.1 *Purpose*

The total leakage current test is used to quantify the value of total capacitive and resistive current of each insert in turn.

1.12.5.4.2 *EWP set-up*

The following applies:

- (a) No capacitive shields shall be used.

- (b) When required, electrical stress control devices may be temporarily installed to the metal work immediately adjacent to the insulation being tested. The type and positioning of any temporary stress control device shall be noted in the record of test.
- (c) The EWP shall be set up outdoors and positioned at least 7.5 m from external buildings or structures.
- (d) The stabilizing legs and wheels shall be placed on low-voltage insulators. The insulation resistance of the chassis to earth shall be least at least 100 times the impedance of the current measuring circuit, a low voltage ohmmeter may be used.
- (e) All metalwork at the platform shall be electrically bonded and connected to the upper test electrode
- (f) The vehicle chassis shall be connected to the current measuring circuit and then to earth, through a coaxial cable that has the screen earthed.
- (g) All hydraulic lines bridging the insulation shall be completely filled with hydraulic oil from the EWP's reservoir.
- (h) The booms shall be aligned parallel to the longitudinal axis of the vehicle with the basket to the rear of the vehicle.
- (i) When under test the booms shall be positioned according to the applicable test position depicted in Figure 1.12.5.4. The height from the ground level to the top of the basket shall be 7.5 m.
- (j) Where the insulation rating varies according to the configuration of the boom, for example a dual rated boom with different boom length extensions, the boom shall be extended the minimum amount, as specified and marked by the manufacturer, applicable to the voltage rating that is being tested.
- (k) When in the test position and connected to the upper electrode, the high voltage test supply lead shall be set at an angle of approximately 45° to horizontal and in line with the EWP axis.
- (l) Inserts not under test shall be short-circuited.
- (m) Where boom and chassis insulation is formed by one continuous insert, the external intermediate test electrode shall extend to the upper electrode when the chassis insulation test is performed. (See Clause 1.5.13.7.3.)

1.12.5.4.3 *Test methods*

A dry 1 min power frequency test voltage, at the phase to earth level corresponding to the insulation rating of the insert under test as specified in Table 1.12.5 shall be applied between the upper test point and earth.

1.12.5.4.4 *Pass criteria*

When the chassis insulation is short-circuited the leakage current measured in the current measuring circuit shall be less than—

- (a) 2.5 mA; or
- (b) 10 μ A/kV for Category C EWPs.

The current shall not increase during the test.

When the boom insulation is short-circuited, the leakage current measured in the current measuring circuit shall be less than 5 mA, and the current shall not increase during the test.

NOTE: The 10 μ A/kV pass criteria for Category C EWPs is designed to achieve sufficient sensitivity to verify the boom insulation during periodic tests.

1.12.5.4.5 *Test record*

The test report shall note the following:

- (a) The specific test location of the booms in relation to the chassis and other metal structures.
- (b) A photograph of the test position.
- (c) The test voltages applied and leakage current measured in each insert.

NOTES:

- 1 In determining these maximum acceptable leakage currents, reference has been made to AS/NZS 60479.1 In particular, an absolute requirement was laid down for the current through an EWP operator, making inadvertent contact with a live conductor, not to exceed 20% of the maximum allowable current in 'zone 2' (see Figure 14 of AS/NZS 60479.1—2002) under the worst foreseeable conditions.
- 2 This test should be carried out in conjunction with the withstand test specified in Clause 1.12.5.3 and the leakage current measured at the phase-earth voltage during both increasing and decreasing voltages.

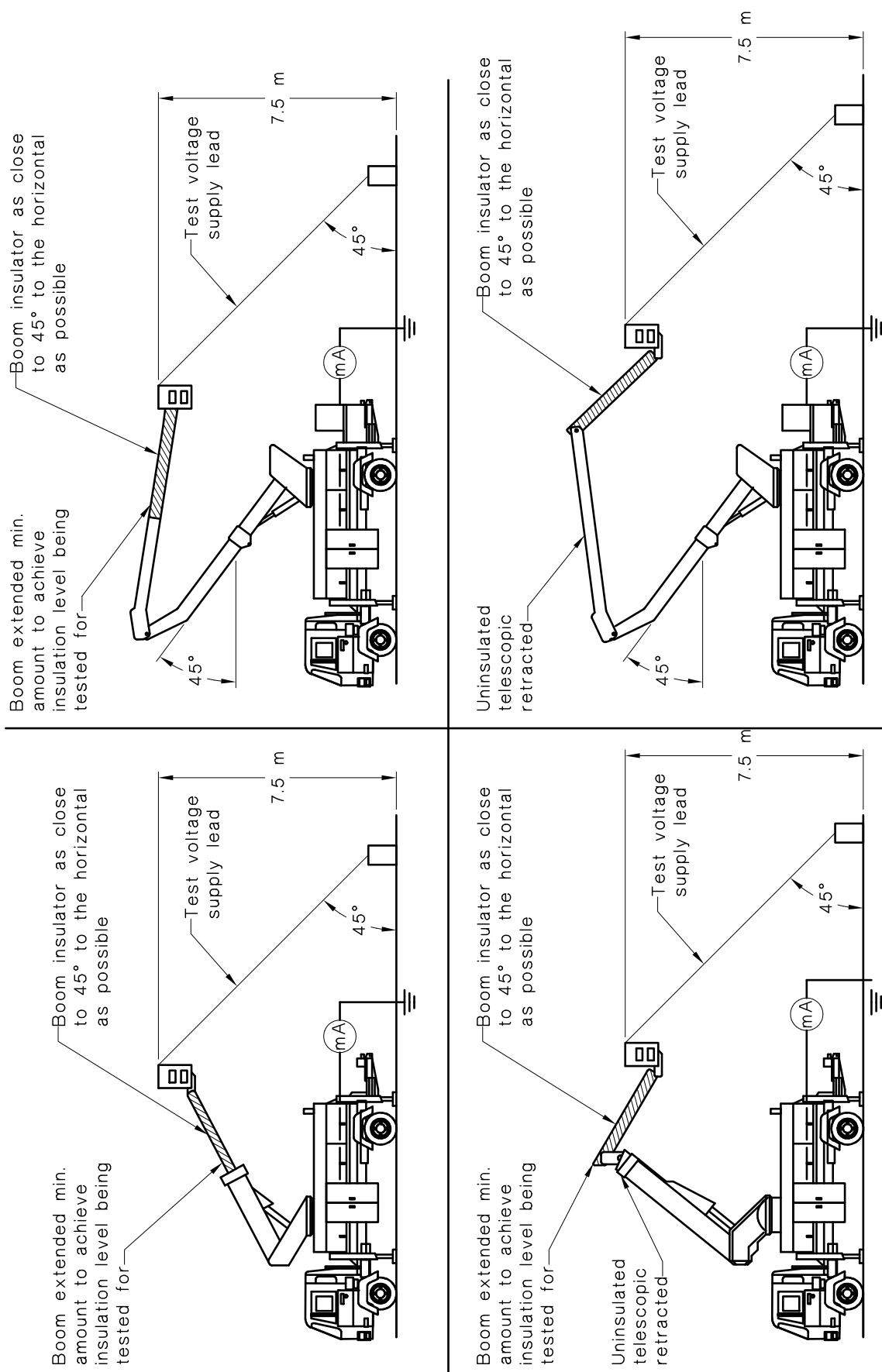


FIGURE 1.12.5.4 EWP TEST POSITIONS FOR ACCEPTANCE AND PERIODIC TESTS

1.12.5.5 *Surface leakage test for EWP's fitted with test electrodes in accordance with Clause 1.5.13.7(d)*

1.12.5.5.1 *Purpose*

The surface leakage test is used to provide a benchmark to periodically monitor surface degradation by measuring the leakage across the surface of the boom insert

1.12.5.5.2 *Test method*

Testing shall be as follows:

- (a) The vehicle chassis shall be earthed during the test.
- (b) The chassis insulation shall be short-circuited.
- (c) The current measuring circuit shall be connected to the insulator surface leakage monitoring electrode (see Clause 1.5.13.7.5) and shall also be connected to a temporary external surface electrode that shall be wrapped around the external surface of the insulator in line with the internal electrode. The external electrode shall be fitted with a capacitive shield that is connected to earth.
- (d) Neither the capacitive shield nor shield insulation shall make contact with the insulating insert surface located above the leakage current monitoring electrode.
- (e) With the capacitive shield in place the insulation resistance of the insulator surface leakage current leakage monitoring electrode shall be at least 100 times the impedance of the current measuring circuit.
- (f) A dry 1 min power frequency withstand test voltage at the test level specified in Table 1.12.5 shall be applied between the upper test point and the earth.

1.12.5.5.3 *Pass criteria*

The leakage current monitored shall be less than 1 μ A/kV and shall not increase during the test.

1.12.5.6 *Low voltage insulating covering test (all EWP's)*

1.12.5.6.1 *Purpose*

The low-voltage insulating covering test is used to prove the integrity of boom insulating covering.

1.12.5.6.2 *Test method*

Testing shall be as follows:

- (a) All metal work of the various parts of the booms and basket shall be bridged and connected to earth.
- (b) All insulating covering capable of being raised above 4.5 m from ground level shall be covered with a temporary electrode of metallic foil or similar in close contact with the external surfaces.
- (c) The foil shall be shaped into internal cavities using the simulated conductor ring (see Clause 1.5.13.6).
- (d) A dry test voltage as per Table 1.12.5 shall be applied to the temporary electrode.

1.12.5.6.3 *Pass criteria*

There shall be no puncture or flashover.

NOTE: This test may be carried out in multiple sections if the test current due to capacitive leakage on the complete temporary electrode is likely to exceed the maximum current available from the test set.

1.12.5.7 Basket vertical withstand test

1.12.5.7.1 Purpose

The basket vertical withstand test is used to verify that the insulation rating of the basket complete with all fittings and attachments installed, is adequate to minimise the risk of short-circuit in the vertical plane.

1.12.5.7.2 Test method

The test shall be set up as illustrated in Figure 1.12.5.7.

Testing shall be as follows:

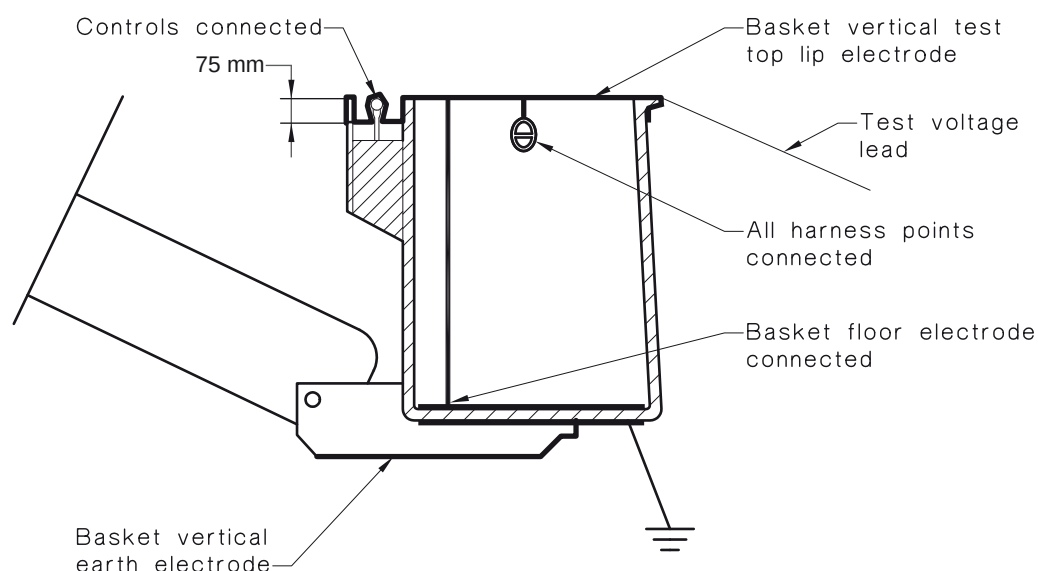
- (a) The basket shall be subject to a test voltage for 1 min between an electrode in contact with the top lip of the basket and on the internal floor, and an electrode in contact with the bottom exterior surface that is connected to earth.
- (b) The operating controls and power tool outlets shall be connected to the top electrode.

NOTES:

- 1 If radio remote controls are fitted in the basket they may be replaced with dummy units wrapped in metallic foil, or similar material, for this test.
- 2 This test may be carried out in multiple sections if required (the test current due to capacitive leakage on the complete temporary electrode may exceed the maximum current available from the test set)
- 3 The boom above the insert may be connected to the closest test electrode if audible discharges occur during the test.

1.12.5.7.3 Pass criteria

There shall be no flashover or puncture when the test voltage as per Table 1.12.5 is applied.



A2

NOTE: The basket floor electrode is not required for baskets fitted with a high voltage live line liner.

FIGURE 1.12.5.7 BASKET VERTICAL WITHSTAND TEST SET-UP

1.12.5.8 Basket puncture test

1.12.5.8.1 Purpose

The basket puncture test is used to verify that the insulation rating of the basket without removable liners but complete with all fittings and attachments installed, is adequate to minimize the risk of short-circuit through the basket. The basket puncture test is not required if a live line basket liner is fitted.

1.12.5.8.2 Test method

The test shall be set up as illustrated in Figure 1.12.5.8.

Testing shall be as follows:

- (a) The basket shall be subject to a power frequency withstand test for 1 min between two temporary electrodes, which are in close contact with the inner surface and the outer surface of the basket, respectively. Electrodes should finish 150 mm below the top lip of the basket.
- (b) The outer electrode shall be at earth potential.

1.12.5.8.3 Pass criteria

There shall be no flashover or puncture when the test voltage as per Table 1.12.5 is applied.

NOTE: Where any metal work causes audible discharges, the test should be repeated with the metal work connected to the nearest electrode.

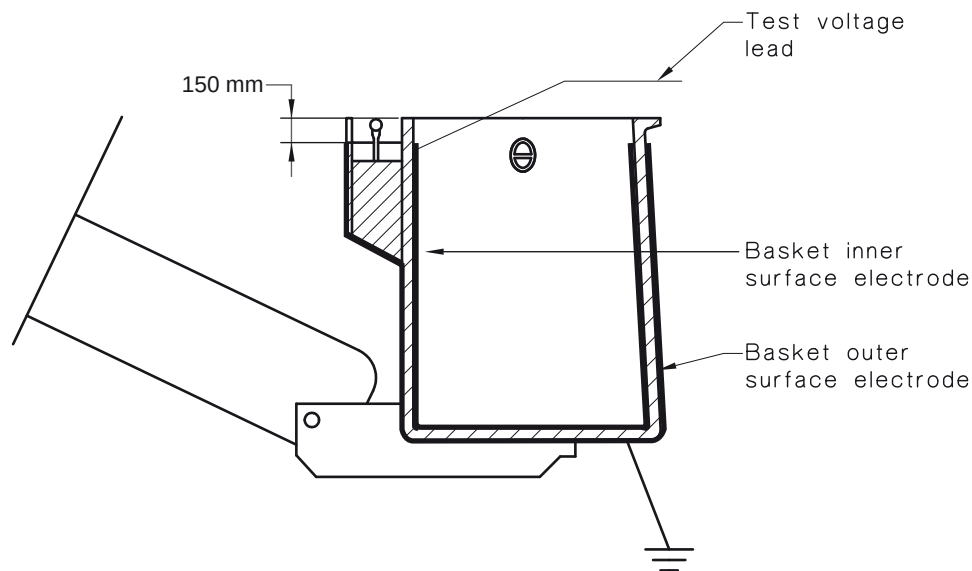


FIGURE 1.12.5.8 BASKET PUNCTURE TEST SETUP

1.12.5.9 HV live line basket test

1.12.5.9.1 Purpose

The HV live line basket test is used to establish whether the basket or the basket/liner combination may be used for HV glove and barrier work procedures up to a 33 kV system voltage.