British Standard

BRITISH STANDARD

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Specification for

Automatic safe load indicators

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Committees responsible for this British Standard

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Associated Offices Technical Committee
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British Ports Federation and the National Association of Ports Employers
British Railways Board
British Steel Corporation
Construction Plant-Hire Association
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Department of Trade and Industry (Mechanical Engineering and Manufacturing Technology Division)
Electricity Supply Industry in England and Wales
Engineering Equipment and Materials Users' Association
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Federation of Manufacturers of Construction Equipment and Cranes
Federation of Wire Rope Manufacturers of Great Britain
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Independent Engineering Insurers Committee
Institute of Materials Management
Institution of Mechanical Engineers
Institution of Plant Engineers
Institution of Production Engineers
Institution of Structural Engineers
Lloyds Register of Shipping
Welding Institute
Coopted member

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Foreword

This British Standard was prepared under the direction of the Mechanical Handling Standards Policy Committee.

Automatic safe load indicators have been used with cranes for many years. Before this standard was introduced, the design, manufacture and type testing of these devices was largely influenced by the need, in certain circumstances, to use an automatic safe load indicator of a type approved by the Health and Safety Executive. This standard was developed from a specification produced by the Health and Safety Executive to define the essential requirements required for approval. This British Standard replaces the Health and Safety Executive's specification with regard to all aspects of approval under Health and Safety Legislation.

It is important to ensure that close cooperation exists between manufacturers and purchasers in order that automatic safe load indicators are correctly specified, installed and operated.

This British Standard has been written on the basis that the automatic safe load indicator manufacturer is responsible for the specification, installation and type testing of the automatic safe load indicator in conjunction with the crane on which it is to be used.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 20, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies constructional and testing requirements for automatic safe load indicators for cranes.

It is common practice to fit devices associated with an automatic safe load indicator which prevent certain motions of the crane after the point has been reached where the overload warning is given; these additional motion limiting features are not covered by this British Standard.

Appendix A lists British Standards for material and equipment suitable for use in the manufacture of automatic safe load indicators. Appendix B details legislation relating to cranes.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1
safe load indicator

a device which when fitted to a crane gives, within certain specified tolerance limits (see **3.8.2** and **3.8.3**), a warning of the approach to the safe working load of the crane, and a further warning when the safe working load has been exceeded

NOTE 1 In addition, a safe load indicator may have to supply certain defined information (see **3.8.5**) associated with the safe use of the crane.
NOTE 2 Rated capacity indicator is an equivalent term.

2.2
automatic safe load indicator (ASLI)

a safe load indicator which requires no manual resetting or adjustment, from the application of a load to the crane until the release of that load

2.3
configuration

the combination of structural members, counterweights, hook block reeving and other items which when assembled according to the crane manufacturer's instructions permit the crane to lift a range of safe working loads

2.4
fail to a safe condition

a condition in which a fault causes an overload warning or some equally obvious indication to be given by the ASLI

2.5
radius

for slewing cranes, the horizontal distance between the point at which the axis of rotation meets the ground and the vertical centre line through the hook. For non-slewing cranes, the horizontal distance between the front axle or other forward support and the vertical centre line through the crane hook

2.6
safe working load (SWL)

the maximum load that can be lifted by the crane under certain specified conditions

NOTE 1 The safe working loads for a particular crane and, when appropriate, corresponding operating radii or jib angle are given in the current certificate of test for that crane.
NOTE 2 Rated capacity is an equivalent term.

2.7
actual load

the mass of all loads and of all lifting attachments suspended from the hook or fixed lifting appliance. For mobile cranes the mass of the hook block, if fitted, is also included in the actual load

NOTE See also ISO 4306-1 ADD 2.

2.8
watchdog

a hardware timer which monitors the duration of internal hardware functions, and/or application program functions, and/or system software functions, and which will fail to a safe condition if not periodically reset at a predetermined interval

2.9
continuous warning

a warning that is given visually by either a flashing or uninterrupted light or audibly by either a pulsing or uninterrupted sound and persists throughout the time that the condition being indicated exists

2.10
protective circuit

the circuit which includes connections to the conductive mass of the crane which might in turn be connected to earth mass

3 General

3.1 Construction

All parts of the automatic safe load indicator necessary for its operation shall comply with this standard for all configurations of the type of crane to which it is to be fitted. For a particular crane, the ASLI shall comply with this standard for all safe working loads indicated on the SWL charts of that crane.

NOTE 1 The safe working loads given on the SWL chart for a crane should be consistent with those given on the test certificate.

An automatic safe load indicator shall operate automatically to the extent that from the application of a load to the release of that load, using any motion or combination of motions permitted by the crane manufacturer, no manual resetting or adjustment of the safe load indicator is required.

The location/design of the configuration selecting device shall prevent alteration of the configuration during the lifting cycle while remaining readily accessible between lifting operations.

NOTE 2 The design should minimize the risk of accidental or inaccurate changing of any manual setting device. For example, toggle switches, which can be easily knocked to change the setting, are unsuitable and a switch having a number of possible settings exceeding the number of crane configurations by ten would be unsatisfactory.

NOTE 3 The equipment should be sufficiently robust in its construction and/or protected to prevent damage from shock, vibration and the general rigours of crane duties including erection, rope changing, use and dismantling or maintenance including arc welding on the crane.

NOTE 4 Special consideration should be given to the material strength of any part of the construction that is likely to be exposed to accidental damage.

The ASLI shall function such that at intermediate radii, between those shown on the SWL chart for the crane, it follows an interpolation of a smooth curve graph of the plots of the safe working loads and the radii given on the SWL chart.

For telescopic jib cranes capable of operating at intermediate jib lengths, between those shown on the crane SWL chart, the ASLI shall follow the duties determined for the crane by the crane designer.

Where the duties are of interpolated form the ASLI shall function as illustrated by the three dimensional graph shown in Figure 1.

Where the duties are of stepped form the ASLI shall function as illustrated by the three dimensional graph shown in Figure 2.

3.2 Environmental operating conditions

The correct operation (see **3.8**) of the ASLI shall not be affected by the mechanical shocks and vibration transmitted by the crane structure during transportation and operation.

The ASLI shall be designed to operate in ambient temperatures between – 20 °C and + 60 °C. It shall be designed, constructed and installed so that when tested in accordance with **7.2.4** to **7.2.10**, the ASLI meets the relevant acceptance criteria in accordance with Table 3.

The ASLI shall be protected against rain, water spray, frost, snow, dirt, dust, condensation or other adverse conditions. The degree of protection shall be in accordance with **5.7**.

NOTE 1 Steps should be taken to dissipate any heat which may be generated within an enclosure that could possibly affect the correct operation of the ASLI.

NOTE 2 Guidance on the degree of protection to be adopted for explosive atmospheres is given in BS 5345-1.

NOTE 3 The automatic safe load indicator should be protected against corrosion (see clause **8**).

NOTE 4 The construction and installation of the automatic safe load indicator should give adequate protection from all the effects of lightning so far as is reasonably practicable.

3.3 Overload testing of crane

The design of the ASLI shall permit overload testing of the crane without any disconnection or adjustment.

3.4 Provision for routine inspection and verification

The ASLI shall be designed so that it can be verified other than by applying loads to the crane (see **3.9** and **6.4**).

NOTE The need for routine inspection and testing should be taken into account at the design stage. When testing the ASLI without the application of loads it may be practicable for limit switches to be operated manually without the need for additional facilities. However specific provision may need to be made for checking other devices such as those incorporating electrical resistances.

3.5 Security

All adjusters affecting the performance of the ASLI shall be located within enclosures or at a position giving the same level of security.

3.6 Special provision for the rigging of mobile cranes

The ASLI design shall allow for rigging operations on mobile cranes by either of the following:

a) the installation of a rigging switch, which, when activated, causes the audible overload warning provided for persons in the vicinity of the crane to be cancelled, but which allows the remaining audible overload warning provided for the driver to remain in full operation at all times;

NOTE 1 The rigging switch should be arranged such that it cannot be left inadvertently activated when rigging operations are completed and the crane is restored to normal duties.

NOTE 2 It is important to emphasize that this facility should only be provided to avoid the disturbance otherwise caused during long rigging operations.

b) the indicator giving all the appropriate warnings whenever a load is applied to the crane when it is in the rigging position.

3.7 Control positions and markings

All visual warning devices, information displays, switches and controls shall have clear markings on or adjacent to them, with symbols or words in English to indicate their function and mode of operation (see ISO 7000).

NOTE Due consideration should be given to good ergonomic practices both in the operation of controls and in the presentation of warnings and information.

3.8 Warnings and indications

3.8.1 *General.* The ASLI shall give warnings and indications in accordance with **3.8.2** to **3.8.4** for all permitted motions of the crane that induce an overload and for all configurations shown on the certificate of test and thorough examination of the crane to which it is fitted.

NOTE All graduations and markings on analogue instruments should be clearly visible from the crane operating position and should enable all the positions and loads given on the certificate of test and thorough examination of the crane to be clearly distinguished within the specified accuracy. All pointers and similar devices should provide a fast response to changing conditions and be suitably damped to prevent excessive oscillation or overrun.

3.8.2 *Warning of approach to SWL.* The ASLI shall give a clear and continuous warning of approach to SWL. The warning shall commence at not less than 90 % of the SWL and at not more than 97.5 % of the SWL. The approach to SWL warning shall continue to function until the percentage of the load to the SWL falls to some value which is less than the value at which the warning was initiated.

3.8.3 *Warning of overload.* The ASLI shall give a clear and continuous warning of overload. The warning shall commence at not less than 102.5 % of the SWL and at not more than 110 % of the SWL. The overload warning shall continue to function until the percentage of the load to the SWL falls to some value which is less than the value at which the warning was initiated.

3.8.4 *Form of warnings.* The warnings for both approach to SWL and overload shall be continuous and shall be audible and visual in accordance with Table 1.

The audible warnings for approach to SWL and overload shall be clearly distinguishable from each other and also from other relevant sounds such as telephones.

The visual warnings shall be clearly distinguishable under all conditions (see **3.8.6.2**).

3.8.5 *Indications required at the driver's control station(s)*

3.8.5.1 *Proximity to safe working load.* Continuous visual indication of the load on the crane relative to the safe working load shall be provided in accordance with Table 2.

NOTE This may be by means of a needle moving across a scale, the approach of two pointers or by some other equally clear continuous visual indications.

3.8.5.2 *Other indications.* The following shall be indicated by continuous visual indications in accordance with Table 2.

a) *The radius of the load*. The radius with the safe working load suspended from the crane including any deflection caused by that load.

b) *The angle of the jib*. The angle with the safe working load suspended from the crane, given in degrees.

c) *The SWL*. The SWL corresponding to either the radius of the load or the angle of the jib.

d) *The load on the crane*. The load on the crane for cranes having a maximum safe working load exceeding 10 tonnes.

e) *The configuration of the crane*.

NOTE There should be a clear and precise indication of the crane configuration for which the ASLI has been set and this should be visible from the crane operating position. As a minimum the configuration selecting device should provide either a direct description of the configuration selected or indicate a code from which the configuration selected can be obtained using a list of codes kept in the driver's cabin.

Table 1 — Form of warnings

Function	Audible warning	Visual warning
Approach to SWL	At driver's control station(s)	Amber lamp at driver's control station(s)
Overload	At driver's control station(s) and at a position[a] to warn persons in the vicinity of the crane	Red lamp at driver's control station(s)

[a] This warning should be audible at a distance of not less than 1.5 × maximum working radius for any configuration of the crane, but should not subject the crane driver to excessive noise levels.

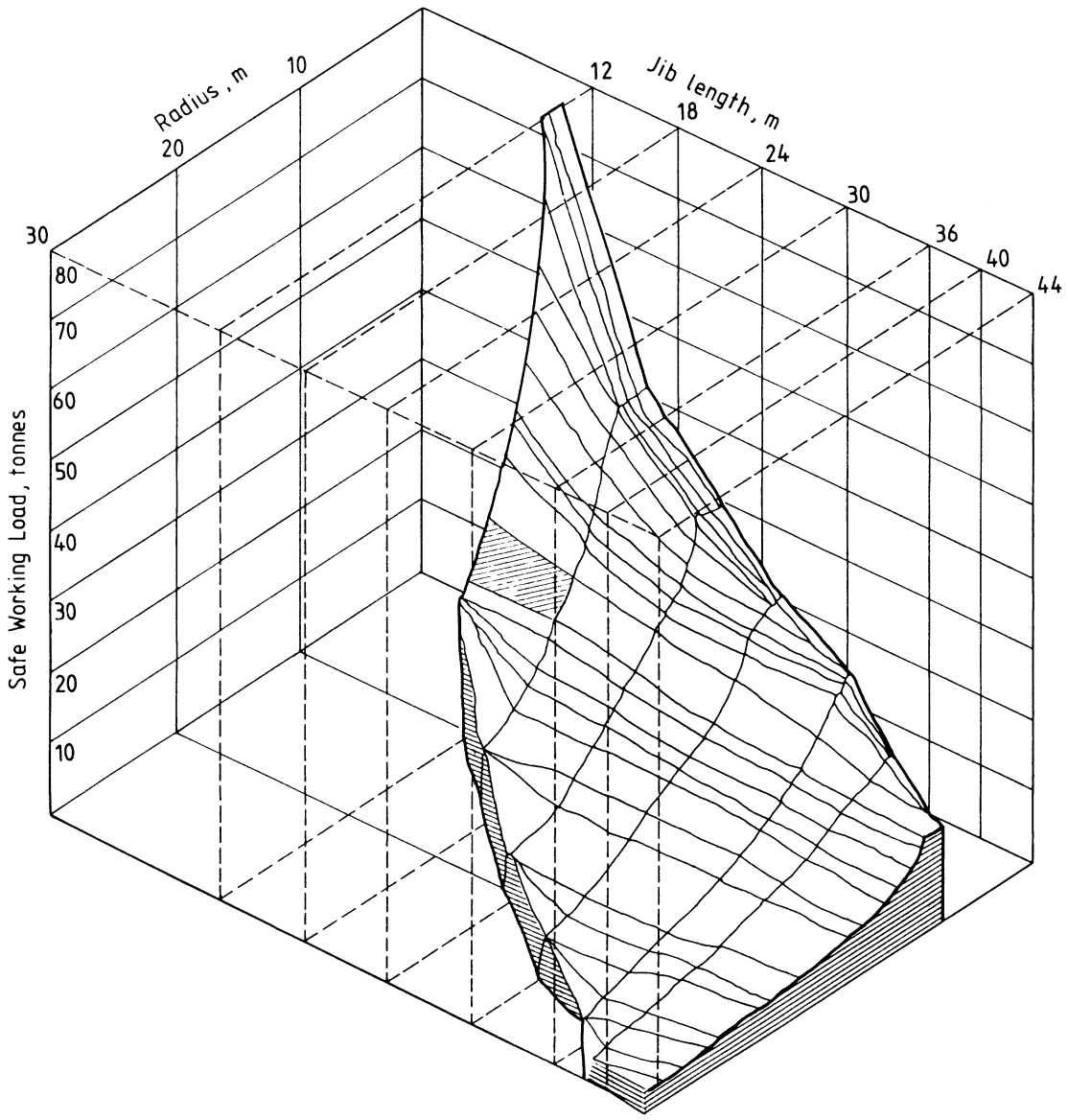

Figure 1 — Interpolated duties

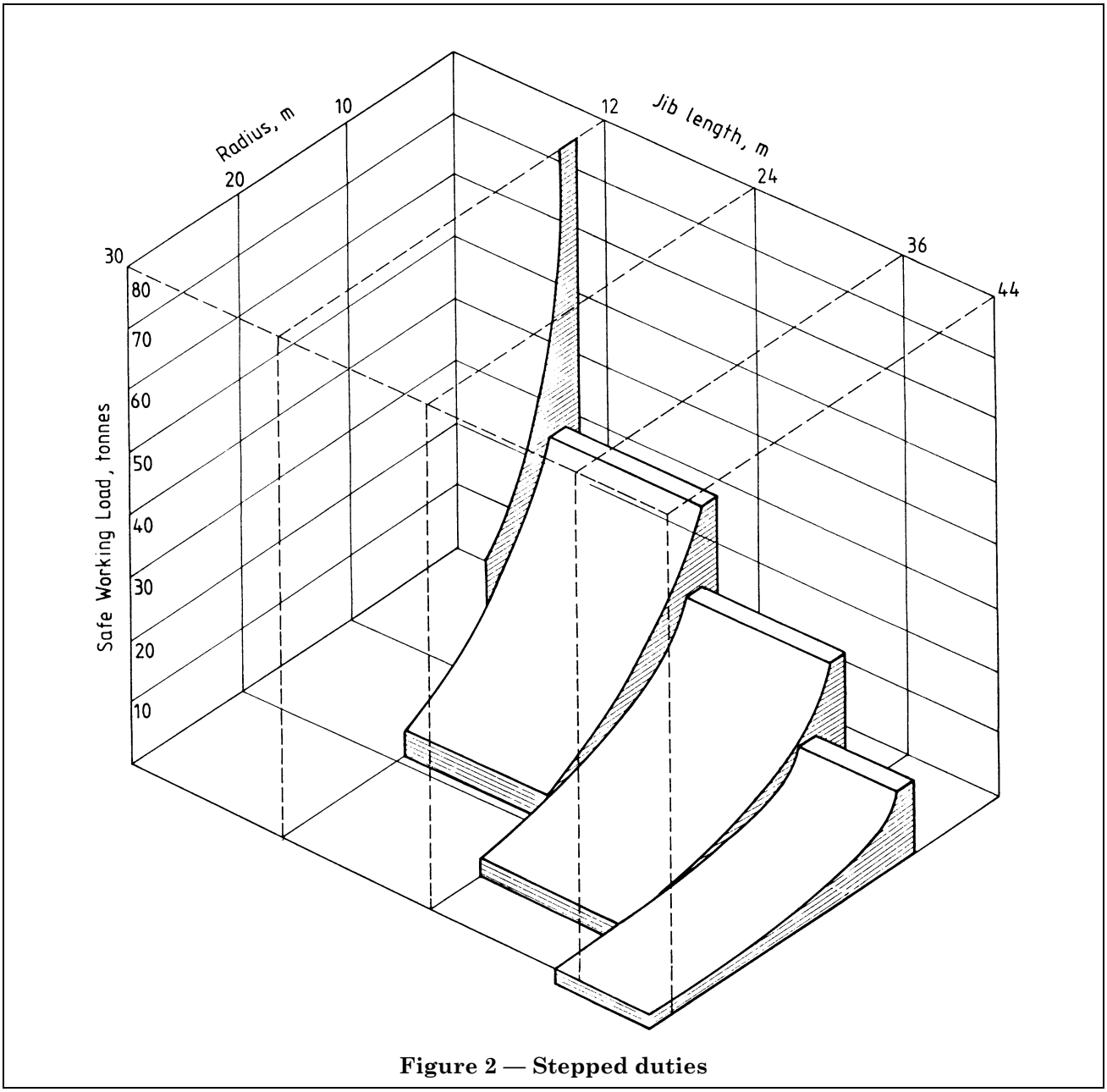

Figure 2 — Stepped duties

3.8.5.3 *Tolerances of indication*

3.8.5.3.1 *Proximity to safe working load.* The accuracy of indication shall be within ± 5 % when all the load suspended from the crane is equal to the safe working load.

3.8.5.3.2 *The radius of the load.* The accuracy of indication of the displayed radius shall be within a band determined from a graph of SWL against radii, the graph being plotted from the values given on the certificate of test for the crane. The displayed radius shall correspond to the SWL on the graph within ± 5 % of the SWL given by the actual radius (see Figure 3).

3.8.5.3.3 *The angle of the jib.* The accuracy of indication of the displayed angle shall be within a band which is determined from a graph of SWL against angles, the graph being plotted from the values given on the certificate of test for the crane. The displayed angle shall correspond to the SWL on the graph within ± 5 % of the SWL given by the actual angle.

3.8.5.3.4 *Load on the crane hook.* The accuracy of indication shall be within ± 5 %.

3.8.6 ***Display panels***

3.8.6.1 Display panel(s) shall be provided at every position where controls are provided to move the load to give the crane driver the warnings and indications in accordance with **3.8.1** to **3.8.5**.

3.8.6.2 A display panel shall be positioned so that the crane driver has a clear view of the warnings and indications given on the panel. The display panel shall not interfere with his view of the load and its surroundings. Glare-free illumination of display panel instruments shall be provided and the information given shall be clearly distinguishable under all conditions, including bright sunlight.

3.8.6.3 Analogue displays shall indicate increasing values by movement from left to right, bottom to top, or clockwise rotation. Displays provided to indicate the quantities specified in **3.8.5.2** shall clearly distinguish the radii, jib angles and SWLs given on the SWL chart for the crane.

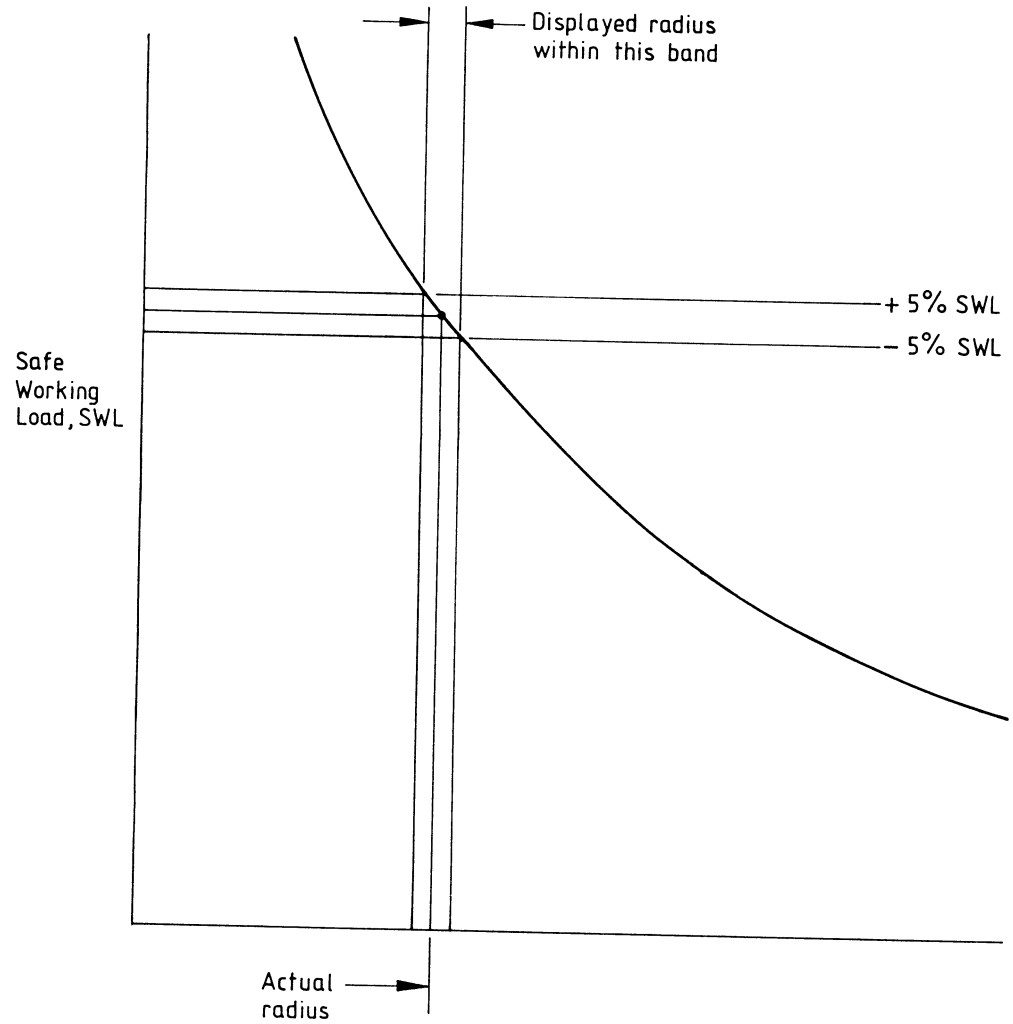

Figure 3 — Graph of safe working load against radius

Table 2 — Indications required for ASLIs for different types of cranes

Type of crane	Continuous indications of proximity to safe working load (see **3.8.5.1**)	Actual radius [see **3.8.5.2** a)]	Jib angle [see **3.8.5.2** b)][a]	Safe working load [see **3.8.5.2** c)]	Actual load [see **3.8.5.2** d)]	Crane configuration [see **3.8.5.2** e)]
Mobile	Required	Required	Required only for angle rated duties	Required	Required when maximum safe working load exceeds 10 tonnes	Required when the crane has more than one configuration
Articulated jib cranes, e.g. excavators used as cranes	Required	Required	—	Required	Required when maximum safe working load exceeds 10 tonnes	Required when the crane has more than one configuration
Lorry loaders	Required	—	—	—	Required when maximum safe working load exceeds 10 tonnes	—
Material handler (telescopic boom when used as a crane)	Required	Required	—	Required	Required when maximum safe working load exceeds 10 tonnes	—
Shipbuilding and dockside (Portal type)	Required	Required	—	Required	Required when maximum safe working load exceeds 10 tonnes	Required when the crane has more than one configuration
Container handling	Required	—	—	Required	Required when maximum safe working load exceeds 10 tonnes	—
Tower: horizontal Jib	—	—	—	—	—	Required when the crane has more than one configuration
Tower: luffing jib	—	Required	—	Required	Required when maximum safe working load exceeds 10 tonnes	Required when the crane has more than one configuration

NOTE It should be assumed that the safe working loads given on a certificate of test and SWL chart include the mass of the hook and block unless the converse is clearly stated on these documents.

[a] Rating of cranes in terms of jib angle are to be in accordance with the requirements of Certificate of Exemption No. 6 (Construction (Lifting Operations) 1961) (see Appendix B).

3.8.6.4 Digital displays shall contain sufficient digits to show clearly the relevant indication within the accuracy specified in **3.8.5.3**.

3.8.6.5 The response of indicating devices shall be appropriate to the speed of operation of the crane when driven correctly.

3.9 Verification of warnings and displays

A test facility shall be provided on the display panel to enable verification of indications specified in **3.8** (see **3.4**).

4 Mechanical

4.1 Gearing, rotating and fixed shafts and axles

Gearing, rotating and fixed shafts and axles shall comply with BS 2573-2.

4.2 Keys, key ways, splines and serrations

Keys and key ways shall comply with BS 4235.

Splines and serrations shall be of straight sided or involute form. Straight sided splines and serrations shall comply with BS 2059 and involute splines shall comply with BS 6186-1.

4.3 Guarding

4.3.1 *General*. All potentially dangerous parts of the ASLI shall be guarded in accordance with BS 5304.

NOTE Where reasonably practicable, guard designs should permit inspection of critical parts of mechanisms without having to remove the complete guard or cover and without the need to dismantle components.

4.3.2 *Inspection covers.* Where an inspection cover is provided, the possibility of access to dangerous parts when the cover is removed shall be prevented (for example, by providing a wire mesh screen) unless the cover is secured by fasteners that require the use of a tool to open the cover.

4.3.3 *Gear wheels, pinions and chain drives.* All gear wheels, pinions and chain drives shall be completely encased.

4.3.4 *Revolving shafts and couplings.* Guards shall be provided for revolving shafts and couplings unless they have no protruding set screws, bolts or keys and are so situated in relation to the structure of the crane as to be as safe as if guards were provided.

4.4 Bearings, springs, chains and chain wheels

NOTE A list of British Standards for bearings, springs, chains and chain wheels suitable for use in the manufacture of automatic safe load indicators is included in Appendix A.

Provision shall be made for the service lubrication of all bearings unless they are sealed or lubricated for life. Ball and roller bearings shall, in addition, be suitably lubricated before assembly. All lubricating nipples shall comply with BS 1486-1 or BS 1486-2 and shall be of the same type and size.

5 Electrical

5.1 General

The ASLI installation shall be designed to protect persons against electric shock.

NOTE Attention is drawn to the IEE Regulations for Electrical Installations[1)] and BS 2771. The principles embodied in the Regulations and BS 2771 should be complied with where appropriate and where not specified otherwise in this standard.

Assurance of system safety integrity shall be achieved by:

a) causing the ASLI to fail to a safe condition in the event of an open circuit, short circuit or earth fault on all external wiring and devices;

b) carrying out periodic functional checks to verify that warnings and displays are operating correctly (see **3.4**).

NOTE Manufacturers should use components which comply with BS 9000 or other standards that provide an equivalent integrity.

BS 9000 describes electronic components of adequate reliability and integrity. Components should be conservatively rated to achieve a high mean time between failures.

5.2 Power supply

The power supply for an ASLI shall have a nominal voltage not exceeding 50 V a.c. or 120 V d.c.

NOTE It is recommended that the power supply voltage should be as low as is reasonably practicable. 12 V d.c. or 24 V d.c. are normal supply voltages.

The ASLI shall be designed to operate correctly for supply voltages in the range + 20 % to – 15 % of the nominal voltage. The ASLI shall continue to function correctly or fail to a safe condition if the supply voltage is outside this range. It shall operate correctly in the event of voltage recovery from the minimum value. Protection against voltage variations and surges, supply voltage reversal (in the case of d.c.), overloading, short-circuit and earth faults shall be provided.

The ASLI shall be designed to operate correctly for supply frequency variations (in the case of a.c.) as follows:

a) ± 2 % for power supplies derived from the mains;

b) ± 5 % for power supplies derived from engine driven generators.

[1)] Available from Station House, Nightingale Road, Hitchin, Herts.

NOTE 1 If it is intended to use the ASLI with systems having a wider frequency variation than ± 5 %, the ASLI should be type tested to meet such requirements. The ASLI should not be used on systems with a wider frequency variation than allowed for in the type tests.
NOTE 2 It is important that the power supply be arranged so that motions of the crane cannot be operated without the automatic safe load indicator being energized.

5.3 Interconnecting of units

5.3.1 *General.* All signals and power supplies transmitted between units of the ASLI shall be by means of discrete insulated conductors. The chassis of the crane shall not be used to transmit power, signals or the functional signal return.

5.3.2 *Protective circuits.* One end of the secondary winding of the power supply transformer shall be connected to the protective circuit.

For d.c. circuits, one pole of the rectifier shall be connected to the protective conductor.

The metal case of all electrical equipment shall be efficiently bonded to the protective conductor. A separate insulated protective conductor shall be provided in the wiring for each circuit.

5.4 Protection against earth faults

5.4.1 One side of the control circuit shall be connected to the protective circuit.

5.4.2 The coil of an electromagnetic device shall be placed in the protected side of the control circuit and shall not be interrupted by a fuse or single pole contact. Contacts and other switching elements shall be placed in the side of the control circuit which is not connected to the protective conductor.

5.4.3 The input and output of an electronic control circuit shall be inserted in the side of the supply which is not connected to the protective conductor or alternatively steps shall be taken to ensure that the ASLI fails to a safe condition.

5.5 Components

5.5.1 *Security of plug-in devices.* Where plug-in devices, except integrated circuit components are connected into the circuit by means of socket bases, they shall be retained in position by spring clips or other means.

5.5.2 *Final switching devices for warnings.* Where the final switching device for an alarm circuit is an electromagnetic relay, the alarm circuit shall be energized by normally closed contacts of the relay. All other safety functions shall be switched by normally open contacts. In the case of a solid-state switch being the final switching device, this shall be in the normal conducting state to operate the warning device.

5.5.3 *Position control switches.*

5.5.3.1 *General.* Switches used to detect the condition of the crane affecting the SWL shall comply with **5.5.3.2** and **5.5.3.3**.

The specification of switches shall ensure that the electrical endurance rating, the maximum safe travel of the actuator, the force required for normal operation and the general mechanical specification for the actuator are compatible with the circuit requirements and the need for high quality and conservative rating.

5.5.3.2 *Limit (position) switches.* Limit switches shall comply with BS 4794-2.20:1982. They shall be directly actuated mechanically as described in BS 5304. Limit switches shall be connected such that the open-circuit condition relates to the limiting or more hazardous condition of the crane. Contacts used in safety circuits shall be a positive break contact element coupled to the switch actuator by a positive linkage. The movement of the actuator shall separate the contacts.

5.5.3.3 *Other switches.* Other types of switch, including proximity switches, shall only be used where the system safety integrity will be equivalent to that achieved by using limit switches.

5.6 Separation of signals

Electrical signals which initiate continuous audible and visual warnings shall be separated from those used to drive visual displays and other circuits to minimize common cause failures.

5.7 Enclosures

Enclosures shall be provided for all electrical components.

Enclosures for components which will not be subjected to the external environment shall have a degree of protection of at least IP 54 in accordance with BS 5490.

NOTE Equipment located in the driver's cab may be exposed to rain and other forms of abuse likely to result in damage to the equipment and the use of IP 55 enclosures should be considered.

Enclosures erected or mounted on the crane structure which are exposed to the external environment shall have a degree of protection of at least IP 65.

The method of cable entry for incoming cables and circuits shall not impair the degree of protection of the enclosure.

5.8 Interconnecting cables, conductors and terminations

5.8.1 *Protection of cables.* Cables shall be positioned or constructed to protect them from mechanical damage:

a) by running in conduit, trunking or on trays; and/or

b) by being clipped to the crane structure in a position where they are protected from mechanical damage; and/or

c) by being of armoured construction.

Trunking shall comply with BS 4678-1. If cables are housed in a conduit of steel tube, the tube shall be heavy gauge, welded or solid drawn in accordance with class B of BS 31 or BS 4568-1.

5.8.2 *Radius of bends.* The radius of cable bends shall be not less than 10 × diameter of the cable.

5.8.3 *Armoured cables.* Where armoured cables are used to provide for movement, vibration or shock, the cable shall be securely anchored at its end so to avoid any mechanical strain on the connection. Flexing of the cable or the radius of any hanging loops shall be within that recommended by the cable manufacturer.

5.8.4 *Protection of the cable insulation.* All sharp edges, rough surfaces or ragged threads likely to make contact with cables shall be smoothed to prevent damage to the insulation of the cable.

5.8.5 *Cable entry.* Cable entries shall be by means of glands to suit the cable.

NOTE Cable entries should preferably be mounted on the underside of the enclosure.

5.8.6 *Conductors.* Conductors shall be multi-stranded or flexible. Single strand cables shall not be used.

5.8.7 *Connections.* Electrical connections shall only be made within junction boxes, terminal boxes, sockets or enclosures.

5.8.8 *Conductors of different circuits.* If conductors of different circuits, other than those described in clause **6**, are operated at different voltages, they shall either be separated by isolating barriers or shall be insulated for the highest voltage to which any conductor within the same cable may be subjected.

NOTE Conductors of different circuits, other than those described in clause **6**, can be laid side by side, occupy the same duct or be contained in the same cable.

5.9 Plugs and sockets

Where plugs and sockets are used as connectors they shall be retained together by a locking device to prevent accidental separation. The plug and socket shall also be provided with cable grips. This does not apply to plugs and sockets at enclosure terminations.

Plugs and sockets which are not within an enclosure shall have the same degree of protection as the enclosure (see **5.7**).

5.10 Monitoring

The operation of transducers, associated conductors and connections shall be continuously monitored for out of range condition. Should a fault occur, the automatic safe load indicator shall fail to a safe condition.

All hardware devices, with the exception of audible and visual warning devices and displays and data input switches, the failure of which would cause the ASLI to fail or malfunction in a manner that would not be immediately obvious to the driver shall be automatically monitored. The automatic safe load indicator shall fail to a safe condition when a failure or a malfunction occurs.

6 ASLIs using programmable electronic systems

6.1 Program instructions and data defining the crane operating parameters shall be stored in a type of memory the contents of which cannot be altered except by means of a separate programming device.

6.2 Automatic verification of programme instructions, data and information processing shall be carried out during crane operation at intervals not exceeding 5 s. The automatic safe load indicator shall fail to a safe condition if the corruption of programme information or data occurs.

6.3 A watchdog timer shall be incorporated to monitor the performance of the programmable electronic device by checking the time taken to perform a specified task.

6.4 At start-up the correct operation of warnings and displays required by **3.8** shall be verified. Warnings and displays shall remain in the test condition for a minimum time of 5 s.

7 Type testing

7.1 General

7.1.1 Testing shall be carried out in two stages, in accordance with Table 3, **7.2** and **7.3**.

7.1.2 The tests shall be made on a single sample which shall withstand all the relevant tests. Failure of fuses shall not constitute a type test failure.

NOTE Where a particular test would be destructive and equivalent results could be obtained by testing part of the equipment in isolation, a sample of that part may be used instead of the whole equipment sample for the purposes of obtaining the results of the test.

7.1.3 The manufacturer shall state in the instruction manual the sequence in which the tests are carried out.

NOTE A recommended sequence of tests is given in Table 4.

Table 3 — Summary of tests

Test location	ASLI electric power supply source		Description of test								
			Simulated operation	Temperature, voltage and frequency variation	Response to failure conditions	Electrical interference	Electrostatic discharge	Electromagnetic interference	Data cable interference	Intermittent induction field	Performance
In laboratory	Mains	Test method	**7.2.1**	**7.2.2**	**7.2.3**	**7.2.4**	**7.2.7**	**7.2.8**	**7.2.9.2**	**7.2.10.2**	
		Acceptance criteria	**7.4.4**	**7.4.2**	**7.4.4**	**7.4.2** (**7.2.4.1**) **7.4.4** (**7.2.4.2**) **7.4.2** (**7.2.4.3**)	**7.4.4**	**7.4.4**	**7.4.4**	**7.4.4**	
	Engine-driven generator	Test method	**7.2.1**	**7.2.2**	**7.2.3**	**7.2.4** and **7.2.5**	**7.2.7**	**7.2.8**	**7.2.9.2**	**7.2.10.2**	
		Acceptance criteria	**7.4.4**	**7.4.2**	**7.4.4**	**7.4.2** (**7.2.4.1**) **7.4.4** (**7.2.4.2**) **7.4.2** (**7.2.4.3**) **7.4.4** (**7.2.5**)	**7.4.4**	**7.4.4**	**7.4.4**	**7.4.4**	
	Vehicle electrical system	Test method	**7.2.1**	**7.2.2**	**7.2.3**	**7.2.6**	**7.2.7**	**7.2.8**	**7.2.9.3**	**7.2.10.3**	
		Acceptance criteria	**7.4.4**	**7.4.2**	**7.4.4**	**7.4.3**[a] (**7.2.6.1**) **7.4.4** (**7.2.6.3**) **7.4.4** (**7.2.6.4**) **7.4.4** (**7.2.6.5**)	**7.4.4** **7.4.4**	**7.4.4** **7.4.4**	**7.4.4** **7.4.4**	**7.4.4** **7.4.4**	
On crane	Mains	Test method									**7.3.2**
		Acceptance criteria									**7.4.2**
	Engine-driven generator	Test method									**7.3.2**
		Acceptance criteria									**7.4.2**
	Vehicle electrical system	Test method									**7.3.2**
		Acceptance criteria									**7.4.2**

[a] After replacement of fuse or protective device, if necessary.

The results of all type tests shall be recorded, together with details of the construction and design of the ASLI and the crane to which it is fitted, when appropriate.

7.1.4 The tests shall be carried out with the equipment, or any movable part of it, placed in the most unfavourable position which may occur in normal use.

7.1.5 If the results of a test could be influenced by conditions such as mains supply voltage, atmospheric pressure, ambient temperature, relative humidity, or operating mode, the equipment shall be tested under the most unfavourable operating conditions.

7.1.6 Equipment for use on a.c. supplies only shall be tested with a.c. at the specified frequency, that for use on d.c. supplies only shall be tested with d.c. and that for a.c./d.c. at the more unfavourable supply.

Equipment marked with a specified frequency range shall be tested at the most unfavourable frequency within that range. Equipment specified for more than one supply voltage shall be tested at the most unfavourable voltage.

7.1.7 Equipment supplied by a power source other than the crane power source shall be tested together with that power source.

Table 4 — Test sequence

Test sequence	Clause number	Test
	Tests in laboratory	
1	**7.2.1**	Simulated operation
2	**7.2.2**	Immunity to variations in temperature, voltage and frequency
3	**7.2.3**	Response to failure conditions
4	**7.2.4**, **7.2.5** or **7.2.6**	Immunity to electrical interference
5	**7.2.7**	Immunity to electrostatic discharge
6	**7.2.8**	Immunity to electromagnetic interference
7	**7.2.9**	Data cable interference
8	**7.2.10**	Immunity to intermittent induction field
	Tests after installation on crane	
11	**7.3.2**	Performance

7.2 Laboratory tests

7.2.1 *Simulated operation*

7.2.1.1 The ASLI shall be connected up according to the system diagrams.

The interconnecting cable shall be of the type and length to be used in the final installation. All enclosures shall be electrically bonded (where appropriate) by means of a wide braided ribbon cable or, preferably, mounted on a metal ground plane, e.g. aluminium sheet.

If electronic amplifiers, etc., are included in the transducer, they shall be part of the circuitry under test.

NOTE Transducers may be operated by hand and hydraulic load transducers may be simulated by applying an equivalent electrical signal to the ASLI controller.

7.2.1.2 The simulated load shall be increased slowly from its minimum value until the warning of overload occurs, then further increased until the overload warning occurs. During the test the response of the displays, where fitted, shall be consistent with the variation in load. This test shall be carried out for each crane set-up as described below:

The angle shall be decreased from the maximum angle in 20 % steps to the minimum angle, or until the alarm position is reached.

The jib length shall be increased from the minimum length in 20 % steps to the maximum length, or until the alarm position is reached.

All other configurations of the crane shall be similarly tested.

7.2.1.3 At switch-on for programmable electronic systems the ASLI shall carry out automatic verification referred to in **6.4**.

7.2.2 *Immunity to variations in temperature, voltage and frequency*

7.2.2.1 The ASLI shall be tested in all operating modes and shall maintain normal operation during and after the tests.

NOTE The tests are designed to evaluate the immunity of the ASLI to temperature, voltage and frequency changes in normal use.

7.2.2.2 The supply voltage shall be varied within the range specified in **5.2**.

7.2.2.3 The supply frequency shall be varied within the range specified in **5.2**. This shall be carried out in a continuous sweep between the two extremes, over a duration of 10 s to 20 s.

7.2.2.4 The ASLI shall be operated under conditions of maximum ambient temperature as specified in **3.2** until thermal equilibrium is achieved.

7.2.2.5 The ambient temperature shall be reduced slowly so that condensation is avoided, until thermal equilibrium is achieved at the minimum temperature specified in **3.2**. The ASLI shall be operated under these conditions.

7.2.3 ***Response to failure conditions***

7.2.3.1 Tests shall be made on critical hardware devices and any components including fuses that fail during these tests shall be replaced before proceeding with subsequent tests.

7.2.3.2 The transducers and inter-connecting cables between any transducer and the main body of the ASLI shall be tested for the effects of the following induced failure modes:

a) open circuit of one or more connections;

b) short circuit between conductors;

c) short circuits to earth of one or more conductors.

7.2.4 ***Immunity to electrical interference (mains supply)***

7.2.4.1 For ASLIs where the power supply is derived directly from the mains supply, power supply interruptions and reductions down to and including zero voltage as given in **7.2.4.2** and **7.2.4.3** shall be applied to one ASLI in all operating modes. The time interval between two consecutive tests shall be at least 10 s.

7.2.4.2 The supply voltage shall be reduced to 90 %, 80 %, 70 %, 60 %, 50 %, 40 %, 30 %, 20 % and 10 % of its nominal value, for periods varying from 10 ms to 100 ms in 10 ms steps.

7.2.4.3 The supply voltage shall be reduced to 90 %, 80 %, 70 %, 60 %, 50 %, 40 %, 30 %, 20 % and 10 % of its nominal value for periods varying from 100 ms to 1 s in 100 ms steps, then 1 s to 10 s in 1 s steps.

7.2.4.4 Common mode and differential mode randomly phased transient overvoltage of either polarity in accordance with Table 5 shall be applied using the appropriate source impedance.

Tests 1,2 and 3 shall be continued for at least 10 min.

Tests 4 and 5 shall be carried out either by:

a) incremental spot checks of 10 s duration each at a series of frequencies incrementing by 10 %; or

b) sweeping the test band at a maximum sweep rate (in Hz) of $F/100$ where F is the instantaneous frequency in Hz.

7.2.5 *Immunity to electrical interference (generator supply).* For ASLIs where the power supply is derived from engine driven generators which are used for site supplies and/or capable of supplying all the power requirements of a crane, the motions of which are driven electrically, the tests shall be applied to one ASLI in all operating modes. The time interval between two consecutive tests shall be at least 10 s.

Positive and negative common mode and differential mode transient overvoltages shall be applied in accordance with Table 6.

The test duration shall be 10 min.

Table 5 — Common and differential mode transient overvoltage tests for mains supplied ASLI

Test	Source impedance (resistive)	Amplitude	Type of wave form	Repetition
	Ω	V		Hz
1	200	500	1 MHz damped sine wave with 6 μs half amplitude duration	400
2	200	1 500	Pulse with 5 ns risetime and 100 ns half amplitude duration	12
3	50	2 000	Pulse with 35 ns risetime and 3 μs half amplitude duration	1
4	50	1	Continuous sine wave on mains 150 kHz to 1 000 MHz	—
5	50	5 % of mains	Continuous sine wave on mains 30 kHz to 150 kHz	—
6	50	10	Continuous sine wave on mains 13.56 MHz and 27.12 MHz	—

Table 6 — Common and differential mode transient overvoltage tests for generator supplied ASLI

Amplitude	Rise time	Half amplitude duration	Repetition rate
V	ns	µs	Hz
1 500	300	50	6

7.2.6 ***Immunity to electrical interference (vehicle supply)***

7.2.6.1 For ASLIs supplied from a vehicle electrical system, the tests given in **7.2.6.2** to **7.2.6.5** shall be applied to one ASLI in all operating modes. The time interval between two consecutive tests shall be at least 10 s.

Tests shall be carried out in accordance with Table 4.

The ASLI shall continue to operate normally after the tests described below are complete.

7.2.6.2 A reverse power supply of 80 V shall be applied to the ASLI.

The test duration shall be 10 min.

NOTE A fuse or protective device may need to be replaced after this test.

7.2.6.3 The power supply voltage shall be varied between + 20 % to – 15 % of the nominal battery voltage.

7.2.6.4 Positive and negative differential mode transient overvoltages shall be applied to the power input terminals in accordance with Table 7. In addition, where the vehicle electrical system is of the insulated return type then common mode interference pulses shall also be applied to this specification.

NOTE Figure 4 shows the position of the interference pulse generator for these tests.

Table 7 — Common and differential mode transient overvoltage tests for vehicle supplied ASLI

Amplitude	Rise time	Half amplitude duration	Repetition rate	Source impedance
V				Ω
300	1 µs	0.50 ms	5.0 Hz	10
250	1 µs	0.05 ms	5.0 Hz	10
250	1 µs	2 ms	0.2 Hz	10
200	5 ns	100 ns	[a]10 kHz	50

[a] This pulse is to form part of a train of pulses at the repetition frequency of 10 kHz. Each pulse train should last for 10 ms and the pulse train repetition frequency should be 10 Hz.

7.2.6.5 Surge voltages shall be applied to the power input terminals as follows:

a) 120 V applied for 500 ms for equipment powered from a nominal 12 V supply; or

b) 200 V applied for 200 ms for equipment powered from a nominal 24 V supply.

7.2.7 *Immunity to electrostatic discharge.* Electrostatic discharges of 10 kV ± 10 % from a source capacitance of 100 pF in series with a resistor or 150 Ω, shall be applied to the ASLI.

Where the surface area of any part of the ASLI is greater than a square of side 60 mm, a discharge test shall be systematically applied over the enclosure at a rate of one test per 60 mm square.

The discharge test shall also be applied to all other individual metal parts.

NOTE Individual metal parts include the metal parts of knobs, switches, push buttons, etc.

Discharges shall also be applied to all metal fastenings whether a plastic or metal case is used.

7.2.8 *Immunity to electromagnetic interference.* Electromagnetic radiation of 10 V/m field strength at frequencies of 100 kHz to 1 000 MHz keyed on and off while the frequency is being varied shall be applied.

NOTE The frequency band over which electromagnetic radiation is likely to be prominent is: 13 MHz, 27 MHz, 68 MHz to 88 MHz, 100 MHz to 108 MHz, 138 MHz to 174 MHz, 420 MHz to 470 MHz, 934 MHz.

7.2.9 ***Data cable interference***

7.2.9.1 The data cable interference tests specified in **7.2.9.2** and **7.2.9.3** shall be carried out on the ASLI.

7.2.9.2 Tests in accordance with Table 8 shall be carried out on ASLIs supplied from power systems derived from mains or engine driven generators. Interference pulses, of both polarities, shall be applied to every data cable entering/leaving the ASLI in turn. The coupling to the cable under test shall be made by means of a capacitive cable clamp having a coupling capacitance of approximately 50 pF.

Table 8 — Data cable interference test

Amplitude	Rise time	Half amplitude duration	Repetition rate
V			Hz
500	1 MHz damped oscillation	6 ms	400
1 500	5 ns	100 ns	12
2 000	35 ns	3 ms	1

NOTE 1 The circuit shows an insulated return system.

NOTE 2 The interference pulse generator is shown connected so as to produce differential mode interference. If an insulated return system may be used common mode interference pulses should also be applied.

NOTE 3 Because of the voltage losses in the filter contained in the interference pulse generator, it may be necessary, in practice, to replace the alternator and battery by a suitable variable power supply in order to maintain the specified input voltage to the device under test.

Figure 4 — Block diagram showing the position of the interference pulse generator for the test specified in 7.2.6.4

The duration of each test shall be 10 min.

7.2.9.3 For ASLIs supplied from vehicle electrical systems interference pulses of either polarity shall be applied to each data cable entering/leaving the ASLI in turn.

The coupling to the cable shall be made by means of a capacitive cable clamp having a coupling capacitance of approximately 200 pF. The pulses to be applied are given in Table 6.

7.2.10 ***Immunity to intermittent induction field***

7.2.10.1 The intermittent induction field tests specified in **7.2.10.2** and **7.2.10.3** shall be carried out on the ASLI.

7.2.10.2 For ASLIs supplied from power systems derived from the mains or engine driven generators an induction field of 60 A/m at 50 Hz shall be applied to each signal cable in turn over at least 80 % of its length. To produce the intermittent induction field the source shall be switched "on" and "off" by mechanical means at intervals of 2 s for 1 min.

NOTE The induction field can be produced by passing an a.c. current of 10 A along a single core cable laid within 25 mm of the cable to be tested and fed from a low voltage a.c. source. The cable carrying the return current should be kept at least 400 mm from the cable under test.

7.2.10.3 For ASLIs supplied from vehicle electrical systems an induction field produced by a single core cable carrying a d.c. current of 100 A laid down within 25 mm and parallel shall be applied to each signal cable in turn, over at least 80 % of its length. The field shall be produced by switching the d.c. current on and off by mechanical means at intervals of 2 s for 1 min and the test shall be carried out for both directions of current flow. The return current connection shall be routed at least 400 mm from the cable under test.

7.3 Tests after installation of ASLI on crane

7.3.1 *General*. After the installation of the ASLI on the crane, the ASLI shall be tested in accordance with **7.3.2**.

7.3.2 *Type approval performance tests.* Verification of performance shall be obtained by applying loads to a crane to which the ASLI has been fitted.

NOTE 1 The objective is to ensure that the required level of performance can be obtained throughout the operating range of the type of crane to which the ASLI is to be fitted. While it may be possible to carry out all these tests using one crane, in some cases two or more cranes could be required to cover all possible configurations.

Tests associated with the calibration of the ASLI on subsequent cranes of the same type would not normally be as comprehensive and are not covered by this standard.

NOTE 2 These tests will involve overloading the crane and extreme caution combined with a suitable system of work are essential.

The warnings and indications specified in **3.8.2** to **3.8.5** shall be checked at five operating radii, including maximum and minimum, for every type of configuration of the type of crane to which the ASLI is to be fitted. The configurations used shall include the following.

a) *Mobile cranes.*

1) a minimum of three different lengths of the main jib, including maximum and minimum, unless the ASLI will only be fitted to cranes having one or two jib lengths;

2) operating free-on-wheels;

3) operating with outriggers or stabilizers;

4) manual jib extension;

5) fixed offset flyjib;

6) luffing flyjib;

7) suspended counterweight.

b) *Tower cranes.* A minimum of two configurations which provide the maximum and minimum structural deflections expected in service.

The approach to safe working load and overload warnings shall be checked at each of the test positions when using motions which could cause the load to approach or exceed the safe working load. In particular, these motions shall include the following.

a) *Derricking, luffing, telescoping (when permitted with the safe working load suspended) and trolleying.* The load shall be moved, using one motion of the crane, in a direction which reduces the safe working load.

NOTE 3 The radii and, when appropriate, jib lengths or jib angles corresponding to the positions at which the warnings are given are used to determine the safe working load for comparison with the actual load.

b) *Hoisting.* The magnitude of the load shall be adjusted until the relevant warning is given as the load is raised clear of the ground.

c) *Articulated jib.* With the load freely suspended, each jib member shall be moved in turn in a direction which makes the load approach and exceed the safe working load.

NOTE 4 The radii at which the approach to overload and overload warnings are given are used to determine the safe working load for comparison with the actual load.

Crane motions shall be as slow as possible.

The warnings and indications shall be given in accordance with the tolerances given in **3.8.5.3**.

If it is necessary to adjust the ASLI, any previous tests which could be affected by the adjustment shall be repeated.

7.4 Acceptance criteria

7.4.1 Acceptance criteria shall be in accordance with **7.4.2**, **7.4.3** or **7.4.4** as specified in Table 3.

7.4.2 The ASLI shall continue to function correctly during the test.

7.4.3 The ASLI shall continue to function correctly after the test.

7.4.4 The ASLI shall continue to function correctly during the test or shall fail to a safe condition.

8 Protection and painting

Protection and painting of metal parts of the automatic safe load indicator up to and including a primary coat shall be in accordance with BS 5493 as a minimum requirement.

NOTE 1 Where equipment is supplied for use in abnormal working conditions, e.g. high humidity, low temperature, corrosive atmosphere, special protection may be necessary.

NOTE 2 Where correct functioning of the automatic safe load indicator may be adversely affected by the application of paint, effective protection from corrosion should be provided by a suitable alternative means. Paint should not be applied to critical areas during manufacture of the automatic safe load indicator or crane. Suitable warnings should be included in the instruction manual to prevent subsequent application of paint to these areas.

9 Marking of equipment

The following information on the automatic safe load indicator shall be clearly and permanently marked in a prominent and accessible position such as on the indicator display panel or adjacent to the identification plate of the crane.

a) Name of manufacturer and/or supplier.

b) Date of manufacture.

c) Type, name or model number.

d) Serial number.

e) The number and date of this British Standard, i.e. BS 7262:1990[2)].

f) Number and date of the certificate of approval, when approval has been given by the Health and Safety Executive.

10 Instruction manual

An instruction manual written clearly and precisely in the English language shall be provided with every automatic safe load indicator. This manual may be an integral part of the instruction manual for the crane to which the automatic safe load indicator is fitted; if it is then care shall be taken to ensure that the instructions relate to the automatic safe load indicator actually fitted to the crane.

The instruction manual shall contain all the information to permit the correct installation, calibration, testing, inspection, maintenance and use of the automatic safe load indicator. It shall also contain any information about special procedures to be followed during erection, dismantling, maintenance, cleaning, repair and overload testing of the crane.

The instruction manual shall contain the following paragraph.

"During normal operation the SWL of a crane should not be exceeded. Therefore the warning of overload should not be used as a normal operating facility. It should be noted that certain statutory requirements do not permit the safe working load to be exceeded except for the purpose of testing"

Advice on driving technique in relation to the correct operation of the ASLI shall be given in the operating manual.

The instruction manual shall state whether the ASLI is suitable for use in explosive atmospheres.

[2)] Marking BS 7262:1990 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Appendix A British Standards for material and equipment suitable for use in the manufacture of automatic safe load indicators

BS 31, *Specification. Steel conduit and fittings for electrical wiring.*

BS 228, *Specification for short pitch transmission precision roller chains and chainwheels.*

BS 292, *Rolling bearings: ball bearings, cylindrical and spherical roller bearings.*

BS 292-1, *Specification for dimensions of ball bearings, cylindrical and spherical roller bearings (metric series).*

BS 292-2, *Specification for dimensions of ball bearings and cylindrical roller bearings (inch series).*

BS 302, *Stranded steel wire ropes.*

BS 302-1, *Specification for general requirements.*

BS 302-2, *Specification for ropes for general purposes.*

BS 463, *Specification for sockets for wire ropes.*

BS 463-1, *Inch units.*

BS 463-2, *Metric units.*

BS 464, *Specification for thimbles for wire ropes.*

BS 466, *Specification for power driven overhead travelling cranes, semi-goliath and goliath cranes for general use.*

BS 970, *Specification for wrought steels for mechanical and allied engineering purposes.*

BS 970-1, *General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels.*

BS 1429, *Specification for annealed round steel wire for general engineering springs.*

BS 1449, *Steel plate, sheet and strip.*

BS 1449-1, *Specification for carbon and carbon-manganese plate, sheet and strip.*

BS 1449-2, *Specification for stainless and heat-resisting steel plate, sheet and strip.*

BS 1452, *Specification for grey iron castings.*

BS 1486, *Lubricating nipples.*

BS 1486-1, *Lubricating nipples and adaptors for use on machinery and vehicles.*

BS 1486-2, *Heavy duty lubricating nipples.*

BS 1706, *Specification for electroplated coatings of cadmium and zinc on iron and steel.*

BS 1726, *Coil springs.*

BS 1726-1, *Guide for the design of helical compression springs.*

BS 1757, *Specification for power-driven mobile cranes.*

BS 1768, *Specification for Unified precision hexagon bolts, screws and nuts (UNC & UNF threads). Normal series.*

BS 2059, *Specification for straight-sided splines and serrations.*

BS 2452, *Specification for electrically driven jib cranes mounted on a high pedestal or portal carriage (high pedestal or portal jib cranes).*

BS 2569, *Specification for sprayed metal coatings.*

BS 2569-1, *Protection of iron and steel by aluminium and zinc against atmospheric corrosion.*

BS 2569-2, *Protection of iron and steel against corrosion and oxidation at elevated temperatures.*

BS 2573, *Rules for the design of cranes.*

BS 2573-2, *Specification for classification, stress calculations and design of mechanisms.*

BS 2771, *Electrical equipment of industrial machines.*

BS 2771-1, *Specification for general requirements.*

BS 3134, *Metric tapered roller bearings.*

BS 3134-1, *Specification for dimensions and tolerances of single row bearings.*

BS 3134-2, *Specification for dimensions of double row bearings.*

BS 3134-3, *Specification for dimensions of flanged cups.*

BS 3939, *Guide for graphical symbols for electrical power, telecommunications and electronics diagrams.*

BS 4235, *Specification for metric keys and keyways.*

BS 4235-1, *Parallel and taper keys.*

BS 4235-2, *Woodruff keys and keyways.*

BS 4360, *Specification for weldable structural steels.*

BS 4568, *Specification for steel conduit and fittings with metric threads of ISO form for electrical installations.*

BS 4568-1, *Steel conduit, bends and couplers.*

BS 4678, *Cable trunking.*

BS 4678-1, *Steel surface trunking.*

BS 4687, *Specification for extended pitch precision roller chains and chainwheels.*

BS 4794, *Specification for control switches (switching devices, including contactor relays, for control and auxiliary circuits, for voltages up to and including 1 000 V a.c. and 1 200 V d.c.).*

BS 4794-1, *General requirements.*

BS 4794-2, *Special requirements for specific types of control switches.*

BS 5200, *Specification for dimensions of hydraulic connectors and adaptors.*

BS 5216, *Specification for patented cold drawn carbon steel wire for mechanical springs.*

BS 5304, *Code of practice for safety of machinery.*

BS 5490, *Specification for classification of degrees of protection provided by enclosures.*

BS 5493, *Code of practice for protective coating of iron and steel structures against corrosion.*

BS 5773, *Metric needle roller bearings.*

BS 6186, *Specification for involute splines: metric module, side fit.*

BS 6186-1, *Dimensions and tolerances.*

BS 6253, *Electrical measuring transducers for converting a.c. electrical quantities into d.c. electrical quantities.*

BS 6253-1, *Method for specifying general purpose transducers.*

BS 9000, *General requirements for a system for electronic components of assessed quality.*

Appendix B Legislation related to cranes

B.1 Construction (Lifting Operations) Regulations, 1961

Regulation 29 requires that all cranes with a derricking jib shall be fitted with an accurate indicator of radius and corresponding safe working load. Regulation 30 requires that all cranes having a safe working load greater than 1 tonne are fitted with an approved type of automatic safe load indicator. An automatic safe load indicator complying with this standard will be of a type required for approval. Exemption from the requirements of Regulation 30 has been granted for certain cranes.

B.2 Ship Building and Ship Repairing Regulations, 1960

Regulation 47 gives the option of fitting an "approved type of indicator" as an alternative to accurately establishing the weight of the load when that load is more than 20 tonnes.

B.3 Electricity (Factories Act) Special Regulations, 1908 and 1944

These regulations refer to electrical matters in general.

B.4 Factories Act, 1961

Section 14 refers to the guarding of machinery.

B.5 Health and Safety at Work etc. Act,1974

Section 6 refers to the duties of manufacturers and importers of machinery and equipment for use at work.

An automatic safe load indicator may be necessary as part of the safe system of work required by section 2.

B.6 Docks Regulations 1988

Regulations 13 to 17 covers cranes.
Regulation 16(7) requires every mobile crane having either a fixed or derricking jib to be fitted with an ASLI of a type approved for the purposes of regulation 30 of the Construction (lifting operations) Regulations 1961.

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Publications referred to

BS 31, *Specification. Steel conduit and fittings for electrical wiring.*

BS 1486, *Lubricating nipples.*

BS 1486-1, *Lubricating nipples and adaptors for use on machinery and vehicles.*

BS 1486-2, *Heavy duty lubricating nipples.*

BS 2059, *Specification for straight-sided splines and serrations.*

BS 2573, *Rules for the design of cranes.*

BS 2573-2, *Specification for classification, stress calculations and design of mechanisms.*

BS 2771, *Electrical equipment of industrial machines.*

BS 2771-1, *Specification for general requirements.*

BS 4235, *Specification for metric keys and keyways.*

BS 4235-1, *Parallel and taper keys.*

BS 4235-2, *Woodruff keys and keyways.*

BS 4568, *Specification for steel conduit and fittings with metric threads of ISO form for electrical installations.*

BS 4568-1, *Steel conduit, bends and couplers.*

BS 4678, *Cable trunking.*

BS 4678-1, *Steel surface trunking.*

BS 4794, *Specification for control switches (switching devices, including contactor relays, for control and auxiliary circuits, for voltages up to and including 1 000 V a.c. and 1 200 V d.c.).*

BS 4794-2, *Special requirements for specific types of control switches.*

BS 4794-2.20, *Position switches with positive opening operation.*

BS 5304, *Code of practice for safety of machinery.*

BS 5345, *Code of practice for selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres (other than mining applications or explosives processing and manufacture).*

BS 5345-1, *General recommendations.*

BS 5490, *Specification for classification of degrees of protection provided by enclosures.*

BS 5493, *Code of practice for protective coating of iron and steel structures against corrosion.*

BS 6186, *Specification for involute splines: metric module, side fit.*

BS 6186-1, *Dimensions and tolerances.*

BS 9000, *General requirements for a system for electronic components of assessed quality.*

ISO 4306-1: ADD 2, *Lifting appliances — Vocabulary.*

ISO 4306-1: ADD 2-1, *General addendum 02 – 198 –.*

ISO 7000, *Graphical symbols for use on equipment — Index and synopsis.*

See also Appendix A.

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