


## TEST REPORT EN 60 204-32

### Safety of machinery – Electrical equipment of machines

<i>Product</i>	<b>Radio remote control system for crane</b>	
<i>Name and address of the applicant</i>	<b>Advanced Radiotech Corporation</b> <b>1 F, 288-3, Hsin Ya Road, Chien Chen District</b> <b>Kaohsiung City, Taiwan</b> <b>Tom Jou</b>	
<i>Name and address of the manufacturer</i>	<b>Advanced Radiotech Corporation</b> <b>1 F, 288-3, Hsin Ya Road, Chien Chen District</b> <b>Kaohsiung City, Taiwan</b>	
<i>Name and address of the factory</i>	<b>Advanced Radiotech Corporation</b> <b>1 F, 288-3, Hsin Ya Road, Chien Chen District</b> <b>Kaohsiung City, Taiwan</b>	
<i>Rating and principal characteristics</i>	<b>230 V</b>	
<i>Trade mark (If any)</i>	<b>ARC FLEX 12EX</b>	
<i>Model/type</i>	<b>FLEX12EX</b>	
<i>Serial no</i>	<b>000306</b>	
<i>Additional information</i>		
<i>Tested according to:</i>	<b>EN 60 204-32</b>	
<i>Name and address of the testing laboratory</i>	 <b>Nemko</b> P.O. BOX 73 BLINDERN, N - 0314 OSLO, NORWAY	Telephone (+47) 22 96 03 30 Fax (+47) 22 96 05 50
<i>Tested at:</i>	Manufacturer's premises, Trondheim/Norway.	
<i>Checked in period:</i>	2005-05-10	The test results relate only to the sample(s) tested.
<i>Tested by:</i>	<div style="border-bottom: 1px solid black; width: 100%; height: 20px;"></div> signature	<div style="border-bottom: 1px solid black; width: 100%; height: 20px; text-align: right;"><b>2005-06-17</b></div> date
	<b>Aage Aune</b> name in block letters	
<i>Verified by</i>	<div style="border-bottom: 1px solid black; width: 100%; height: 20px;"></div> Signature	<div style="border-bottom: 1px solid black; width: 100%; height: 20px; text-align: right;"><b>2005-06-20</b></div> date
	<b>Thor Myklebust</b> name in block letters	

This form is only for use by Nemko, or by others according to special agreement with Nemko. The completed check list is not valid for external use, unless issued by Nemko. The check list shall not be reproduced without written permission from Nemko and may then only be copied in full. Issued by Nemko 98-07

**Summary of testing:****Description of equipment :**

Electrical supply:                     AC                     DC                     Battery  
Electromagnetic compatibility:     Tested                     Not tested  
Protection against electric shock:  Direct contact     Indirect contact     Both  
Ekvipotential bonding:               Protective               Operational               Both

**Verdict:** (See right column in check list, starting from page 3)

**P = Pass**      **F = Fail**      **NA = Not applicable**

**Remarks :**

Clauses with the verdict "F", see annex to Statement of Conformity MD No. xxxxx.

It is assumed that the necessary means are taken to assure a safe and reliable power supply to the unit, through the existing system.

It is also assumed that the equipment is installed accordingly to the user manual by a qualified electrician.

Cl.	Prescribed requirements	Result – Remarks	Verd.
<b>4</b>	<b><u>General requirements</u></b>		
4.1	<u>General considerations:</u> This part of EN 60204 is intended to apply to electrical equipment used with a wide variety of machines and a group of machines working together in a coordinated manner		
4.2	<u>Selection of equipment:</u> Electrical components and devices shall be suitable for their intended use, and shall comply with the relevant European Standards where such exists	see attached component list	<b>P</b>
4.3	<u>Electrical supply:</u> Shall operate correctly under full load as well as no load unless otherwise specified by the user		<b>P</b>
4.3.1	<u>General:</u> The electrical equipment shall be designed to operate correctly with the conditions of the supply: - as specified in 4.3.2 or 4.3.3, or - as otherwise specified by the user (see annex B), or - as specified by the supplier in the case of special source of supply	OK	<b>P</b>
4.3.2	AC supply	110/220/380/440 VAC on base unit	<b>P</b>
4.3.3	DC supply	Remote; 3V battery (2x1,5V AA)	<b>P</b>
4.3.4	On-board power supply	-	<b>NA</b>
4.4	<u>Physical environment and operating conditions:</u>		
4.4.1	<u>General:</u> The electrical equipment shall be suitable for use in the physical environment and operating conditions as specified below.		
4.4.2	<u>Electromagnetic compatibility:</u> The electrical equipment shall not generate electromagnetic disturbances above levels that are appropriate for its intended use, and It shall have adequate level of immunity to electromagnetic disturbances	See EMC – test report	<b>NA</b>
4.4.3	<u>Ambient air temperature:</u> Enclosed electrical equipment shall be capable of operating correctly in an ambient temperature between +5°C and +40°C	Verified OK	<b>P</b>
4.4.4	<u>Humidity:</u> The electrical equipment shall be capable of operating correctly when the relative humidity does not exceed 50 % at maximum temperature of +40°C	Verified OK	<b>P</b>

Cl.	Prescribed requirements	Result – Remarks	Verd.
4.4.5	<u>Altitude:</u> Electrical equipm. shall be capable of operating corr. at altitudes up to 1000 m above mean sea level		P
4.4.6	<u>Contaminants:</u> Electrical equipment shall be adequately protected against the ingress of solid bodies and liquids (12.3)	See user manual	P
4.4.7	<u>Ionizing and non-ionizing radiation:</u> When equipment is subject to radiation (microwave, lasers, X-rays etc.), additional measures shall be taken to avoid malfunctioning and accelerated deterioration of the insulation	-	NA
4.4.8	<u>Vibration, shock and bump:</u> Undesirable effects of vibration, shock and bump shall be avoided by the selection of suitable equipm. or by:		P
	- mounting it away from the machine;		NA
	- use of anti-vibration mountings		P
4.5	<u>Transportation and storage:</u> Electrical equipment shall be designed to withstand transportation and storage temperatures within a range of -25 °C to +55 °C. For short periods not exceeding 24h up to 70 °C.	Verified OK	P
4.6	<u>Provisions for handling:</u> Heavy or bulky electrical equipment which have to be removed from the machine for transport shall be provided with suitable means for handling by cranes or similar equipment		P
4.7	<u>Installation and operation:</u> Electrical equipment shall be installed and operated in accordance with the supplier's instructions	See instructions	P
<b>5</b>	<b><u>Incoming supply conductor terminations and devices for disconnecting and switching off</u></b>		
5.1	<u>Incoming supply conductor terminations:</u> The electrical equipment of a machine:		P
	- single power supply;		P
	- other type of supply.		
	When other type of supply, derived from devices forming part of the electrical equipment of the machine		
	Connection to the supply:		
	- by the use of a plug;		P
	- directly connected to the supply terminals;		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- connected by separate terminals.		P
	Where a neutral conductor is used, it shall be clearly indicated in the technical documentation of the machine.	-	NA
	Separate insulated material, labelled N, shall be provided for the neutral conductor	-	NA
	There shall be no connection between the neutral conductor and the protective bonding circuit.	-	NA
	Exception: TN-C systems		
	A PEN terminal shall not be used inside the enclosure.		NA
	All terminals for the incoming supply connection shall be clearly identified.		P
5.2	<u>External protective conductor terminal:</u> A terminal for the connection of the external protective conductor shall:		
	- be provided in the vicinity of the associated phase cond. terminals and in acc, with the relevant installation standards.		NA
	- be of such size as to enable the connection of an external cu-conductor with a cross sectional area in accordance with table I		NA
	- conductor other than copper, the terminal size shall be accordingly		NA
	The terminal shall be designated by the marking with the letters PE in order to avoid confusion at the point(s) of connection between machine and fixed installation.		P
	The other terminals used for connection of machine components to the protective bonding circuit shall be designated either by the symbol 417-IEC-5019 or by the letters PE or by the use of the bicolour combination GREEN-AND-YELLOW		P
5.3	<u>Supply disconnecting (isolating) device:</u>		
5.3.1	<u>General:</u> A supply disconnecting device shall be provided: - for each incoming supply - for the source of supply to a feeder system - for each on-board power supply	Fuse provided in the power supply	P
	The supply disconnecting device shall disconnect the electrical equipment of the machine when required		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
	Where two or more supply disconnecting devices are provided, protective interlocks shall be provided		P
5.3.2	<u>Type:</u> The supply disconnecting device shall be one of the following types:	If a separate plug/cable is not used, the power supply used must be supplied with a clearly marked main breaker	
	- a switch-disconnector in acc. with EN 60947-3;	–	NA
	- a disconnector which has an aux. contact which causes switching device to break load circuit before opening the main contacts;	–	NA
	- a circuit breaker in accordance with EN 60947-2;	–	NA
	- a plug/socket comb. for a machine with a rated current not exceeding 16 A and a total power rating not exceeding 3 kW	If separate power cable is used for direct connection to the control unit.	P
	- a plug and socket outlet or appliance coupler		P
5.3.3	<u>Requirements:</u> If the supply disconnecting device is one of the first three types specified in 5.3.2, it shall fulfil all the following requirements:		
	- isolate the electr. equipment from the supply, and have one OFF and one ON position only. This shall clearly be marked with "O" and "I" symb.;	–	NA
	- have a visible gap or a position indicator which cannot ind. OFF until all contacts are actually open;	–	NA
	- have an ext. operating handle, (exception: power-operated switchgear need not to be operable from outside the enclosure where there are other means to open it).	–	NA
	- be provided with a means permitting it to be locked in the OFF position;	–	NA
	- disconnect all live conductors of its power supply circuit;	–	NA
	- have a breaking capacity sufficient to interrupt the current of the largest motor when installed, together with the sum of the normal running currents.	–	NA
5.3.4	<u>Operating handle:</u> The handle of the supply disconnecting device shall be easily accessible and located between 0,6 and 1,9 m above the servicing level.	Assuming that equipment is mounted correctly.	P
	A maximum height of 1,7 m is preferred	–	NA
5.3.5	<u>Excepted circuits:</u> The following circuits need not be disconnected by the supply disconnecting device:	Assume that supply disconnecting device is properly installed in existing equipment	NA

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- lighting circuits for lighting needed during maintenance or repair;	–	NA
	- plug and socket outlets for the exclusive connection of repair or maintenance tools and equipment;	–	NA
	- undervoltage protection circuits which are only used for automatic tripping in case of supply failure;		NA
	- circuits supplying equipment which should normally remain energized for satisfactory operation;		NA
	- control circuits for interlocking in accordance with 15.1.3		NA
	Where such a circuit is not disconnected by the supply disconnecting device:		NA
	- a permanent warning label shall be appropriately placed in proximity to the supply disconnecting device;		NA
	- a permanent warning label shall be placed in proximity to each excepted circuit, and;		NA
	- a corresponding statement shall be inserted in the maintenance manual;		NA
	- a permanent warning label shall be placed in proximity to each excepted circuits.		NA
5.4	<u>Devices for switching off for prevention of unexpected start-up:</u> Devices for switching off for the prevention of unexpected start-up shall be provided. A supply disconnecting device may fulfil this function.		P
	Such devices shall be:		
	- appropriate and convenient for the intended use;		NA
	- suitably placed and readily identifiable		NA
	- means shall be provided to prevent inadvertent, and/or mistaken closure of the disconnecting device		NA
	When devices other than supply disconnecting devices are used, such means for switching off shall be employed only where there is:		NA
	- no significant dismantling of the machine;		NA
	- adjustments requiring a relatively short time;		NA
	- no work being carried out on the electrical equipment except when:		NA

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- there is no hazard arising from electric shock and burn;		NA
	- the switching off means cannot be negated by the work, or;		NA
	- the work is of a minor nature.		NA
5.5	<u>Devices for disconnecting electrical equipment:</u> Devices shall be provided for disconnecting electrical equipment to enable work to be carried out without risk from electric shock or burn	Disconnect plug or main switch	P
	Where it is necessary to work on individual parts of the machine, a disconnecting device shall be provided for each part or machine. Devices described in 5.3.2 may fulfil that function.		NA
	Such disconnection devices shall be: - appropriate and convenient for intended use - suitably located - readily identifiable - provided with adequate means to prevent unauthorized, and/or mistaken closure		NA
5.6.	<u>Protection against unauthorized, and/or mistaken connection:</u> The devices described in 5.4 and 5.5 that are not capable of being equipped with means to lock them in the OFF position, shall be equipped with such means.		NA
	However, plug/socket combinations so positioned that it can be under supervision, means for locking need not to be provided.		NA
<b>6</b>	<b><u>Protection against electric shock</u></b>		P
6.1	<u>General:</u> The electric equipment shall provide protection of persons against electric shock from:		
	- direct contact, and;		P
	- indirect contact		P
6.2	<u>Protection against direct contact:</u>		
6.2.1	<u>General:</u> For each circuit or part of the electrical equipment, the measures of either 6.2.2, 6.2.3, and where applicable 6.2.4 shall be applied		P
	When the equipment is located in places open to all persons, measures of either 6.2.3, 6.2.2 with a minimum degree of protection corresponding to IPX4 or IPXXD shall be applied		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
6.2.2	<u>Protection by enclosures:</u> Live parts shall be located inside enclosures which comply with the relevant requirements of clauses 4, 12 and 15 and that provide protection against direct contact of at least IP2X or IPXXB		P
	Where the top surface of the enclosure is readily accessible a minimum degree of protection by the top surface shall be IP4X or IPXXD		P
	Opening an enclosure only possible under one of the following conditions:		
a)	Necessary with the use of a key or tool by skilled or instructed persons.		P
	Live parts on the inside of doors shall be protected against direct contact to at least IP1X or IPXXA.		P
	Live parts likely to be touched when resetting or adjusting shall be protected against direct contact to at least IP2X or IPXXB		P
	Rooms used as enclosures for electrical equipment accessible only for skilled persons, special requirements apply.		NA
b)	The disconnection of live parts inside the enclosure before the enclosure may be opened may be accomplished by interlocking the door with a disc. A special device or tool as prescribed by the supplier may permit skilled persons to defeat the interlock provided that:		NA
	- it is possible at all times while the interlock is defeated to open the disconnecter; and		NA
	- on closing the door, the interlock is automatically restored.		NA
	All parts which are still live after switching off the disconnecting device(s) shall be protected against direct contact to at least IP2X or IPXXB Such parts shall be marked with a warning sign according to 17.2		P
c)	Opening without the use of a key or a tool and without disconnection of live parts shall be possible only when all live parts are protected against direct contact to at least IP2X or IPXXB		P
6.2.3	<u>Protection by insulation of live parts:</u> Live parts completely covered with insulation which can only be removed by destruction.		P
	Such insulation shall be capable of withstanding the stresses to which it can be subjected.		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
6.2.4	<u>Protection against residual voltages:</u> Live parts having residual voltage > 60V discharged to 60V or less within 5 s after disconnection of power supply		NA
	For plugs or similar devices, the discharge time shall not exceed 1 s		NA
6.2.5	<u>Protection by barriers:</u> For protection by barriers, see IEC 60364-4-41.		NA
6.2.6	<u>Protection by placing out of reach or protection by obstacles:</u> For protection by placing out of reach, see IEC 60364-4-41, for protection by obstacles, see IEC 60364-4-41.		NA
6.3	<u>Protection against indirect contact:</u>		NA
6.3.1	<u>General:</u> For each circuit or part of the electrical equipment, at least one of the measures according to 6.3.2 to 6.3.3 shall be applied		NA
6.3.2	<u>Measures to prevent the occurrence of a hazardous touch voltage:</u>		NA
6.3.2.1	<u>General:</u> Measures to prevent the occurrence of a hazardous touch voltage include the following:		
6.3.2.2	<u>Protection by use of class II equipment or by equivalent insulation:</u> This measure of protection shall be provided by one or more of the following means:		
	- use of class II electrical devices or apparatus;		
	- use of switchgear and contr.gear assemblies having total insulation;		
	- application of supplementary or reinforced insulation;		
6.3.2.3	<u>Protection by electrical separation:</u> Intended to prevent hazardous touch voltage through contact with exposed conductive parts which can be energized by a failure in the basic insulation of the live parts of that circuit		
6.3.2.4	<u>Supply system design:</u> This protection is provided by the user of a supply system designed with its neutral point either insulated from or having a high impedance to earth so that an earth fault will not result in a hazardous touch voltage		

Cl.	Prescribed requirements	Result – Remarks	Verd.
6.3.3	<u>Protection by automatic disconnection of supply:</u> This protective measures comprises both: - the connection of exposed conductive parts to the protective bonding circuit - either: a) automatic disconnection of the supply in the event of an insulation failure in TN or TT systems, or b) the use of an earth fault detection or residual current detection to initiate automatic disconnection of IT systems	The power supply used must have means to disconnect in case of an earth fault.	<b>P</b>
6.4	<u>Protection by the use of PELV: (Protective Extra Low Voltage)</u>		<b>NA</b>
6.4.1	<u>General:</u> PELV circuits shall satisfy all of the following conditions:		
a)	limitation of maximum nominal voltage to 25 V a.c. or 60 V d.c.;		
b)	one side of the circuit or one point of the source of the supply connected to the protective bonding circuit;		
c)	live parts of PELV circuits shall be electrically separated from other live circuits;		
d)	conductors of each PELV circuits shall be physically separated from other live circuits;		
e)	plugs and socket-outlets shall comply with the following:		
	1) plugs shall not be able to enter socket outlets of other voltage systems;		
	2) socket-outlets shall not admit plugs of other voltage systems;		
6.4.2	<u>Sources of PELV:</u> The source of a PELV shall be one of the following: - a safety isolating transformer - a source of current providing a degree of safety equivalent to that of a safety isolating transformer - an electrochemical source or another source independent of a higher voltage circuit - an electric power supply conforming to appropriate standards specifying measures to be taken to ensure that, the voltage at he outgoing terminals cannot exceed the values specified in 6.4.1.		
<b>7</b>	<b><u>Protection of equipment</u></b>		
7.1	<u>General:</u> Measures to be taken to protect equipment against the effects of:		
	- over current arising from a short circuit;	Fuse	<b>P</b>

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- over load currents;		NA
	- earth fault;		NA
	- over voltage due to lightning and switching sources;		NA
	- abnormal temperatures;		NA
	- loss of or reduction in the supply voltage;		P
	- over speed of machines/machine elements;		NA
	- incorrect phase sequence.		NA
7.2.1	<u>General:</u> Overcurrent protection shall be provided where the current in a machine circuit can exceed either the rating of any component or the current-carrying capacity of the conductors.		NA
7.2.2	<u>Supply conductors:</u> Supplier shall state on the installation diagram the necessary for selecting the overcurrent protective device.		NA
7.2.3	<u>Power circuits:</u> All conductors (except neutral conductors with a cross-sectional area equal to or equivalent to the phase conductors) shall be protected against overcurrent. Devices for detection and interruption of overcurrent shall be inserted in all live conductors.		NA
	In IT-systems, it is recommended the neutral conductors not used.		NA
7.2.4	<u>Control circuits:</u> Conductors of control circuits directly connected to the supply voltage or circuits feeding control circuit transformers shall be protected against over current acc.to 7.2.3		P
7.2.5	<u>Socket outlets and their associated conductors:</u> Overcurrent protective devices shall be provided in the unearthed live conductors of each circuit feeding such socket outlets	No socket outlets	NA
7.2.6	<u>Lighting circuits:</u> All unearthed conductors of circuits supplying lighting shall be protected against the effects of short circuits by overcurrent devices separate from those protecting other circuits	No lighting circuits	NA
7.2.7	<u>Transformers:</u> Transformers shall be protected against overcurrent. Such protection shall:		
	- avoid nuisance tripping due to transf. magnetizing inrush curr.;		NA

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- avoid a winding temp. rise in excess of the permitted value for the insulation class of transf. when it is subject to short circuit at its secondary terminals	Tested/verified according to 60065	P
7.2.8	<u>Location of overcurrent protective devices:</u> Overcurrent protective devices shall be located at the point where the conductors are connected to their supply		P
	No over current protective devices is required for those conductors with current-carrying capacity less than that of the supply conductors provided by all of the following measures:		NA
	- the current carrying capacity is at least equal to that required for the load;		
	- each connecting cond. to the overcurrent protective device is no longer than 3 m; and		
	- the conductors are protected by an enclosure or duct.		
7.2.9	<u>Overcurrent protective devices:</u> Breaking capacity to be equal to the prospective short-circuit current at the point of installation		
	Type of over current protective device for power circuits: - fuses; - circuit breakers.		NA
7.2.10	<u>Rating and setting of overcurrent protective devices:</u> Rated current of fuses or the setting current of other overcurrent protective devices selected to be:		NA
7.3	<u>Overload protection of motors:</u> Overload protection of the motor(s) provided for each motor > 0,5 kW		NA
	Type of overload protection		
	Detection of overload in each live conductor		
	Motor with built-in thermal protection		
	Protection in addition to the above mentioned		
	Motor with automatic restarting after operation of overload protection prevented from starting due to hazardous situation		
7.4	<u>Abnormal temperature protection:</u> Resistance heated circuits (or other) provided with suitable detection to initiate an appropriate control response		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
7.5	<u>Protection against supply interruption or voltage reduction and subsequent restoration</u> Undervoltage device installed to ensure appropriate protection at a predetermined voltage level		NA
	Time delay installed on the undervoltage device		NA
	Automatic restarting of the machine prevented		NA
7.6	<u>Motor overspeed protection:</u> Overspeed protection provided for the machine		NA
	Appropriate control responses initiated		
	Automatic restarting prevented		
7.7	<u>Earth fault/residual current protection:</u> In addition to providing earth fault/residual current protection as described in 6.3, this protection can be used to reduce damage to equipment.		NA
7.8	<u>Phase sequence protection:</u> Where an incorrect phase sequence of the supply voltage can cause hazardous condition or damage to machine, protection shall be provided.		NA
7.9	<u>Protection against overvoltages due to lightning and to switching surges:</u> Such protective devices can be provided.		NA
	Devices for the suppression of overvoltages due to lightning shall be connected to the incoming terminals of the supply disconnecting device.		
	Devices for the suppression of overvoltages due to switching surges shall be connected across the terminals of all equipment requiring such protection.		
<b>8</b>	<b><u>Equipotential bonding</u></b>		
8.2	<u>Protective bonding circuit:</u>		
8.2.1	<u>General:</u> The protective bonding circuit shall consist of:		
	- the PE-terminal;		P
	- the conductive structural parts of the electrical equipm. and the machine;	The structural parts of the equipment are not conducting.	NA
	- the protective conductors in the equipment of the machine.		NA
	Any structural parts of the machine/electrical equipment may be used as part of the protective bonding circuit provided that it satisfies the requirements of IEC 60364-5-54.		NA

Cl.	Prescribed requirements	Result – Remarks	Verd.
8.2.2	<u>Protective conductors:</u> Conductor type:		
	- copper conductor;		P
	- conductor other than copper used		
8.2.3	<u>Continuity of the protective bonding circuit:</u> All exposed conductive parts of the electrical equipment and the machine connected to the protective bonding circuit	Assuming that the system is connected to a ground-circuit.	P
	Where a part is removed for any reason, the protective bonding circuit shall not be interrupted.		P
	Connection and bonding points not impaired by their mechanical, chemical or electrochemical influences		P
	Metal ducts/cable sheaths not to be used as protective conductors However, they shall be connected to the protective bonding circuit		NA
	Electrical equipment mounted on lids, doors or cover plates:		NA
	- continuity of the protective bonding circuit ensured;		P
	- it is recommended that a protective conductor is used -otherwise, hinges and sliding contacts designed to have a low resistance shall be used;		NA
	- protective conductors exposed to damage shall be ensured by appropriate measures;		P
8.2.4	<u>Exclusion of switching devices from the protective bonding circuit:</u> The protective bonding circuit must not incorporate switching or over current devices nor means for current detection		P
8.2.5	<u>Parts which need not be connected to the protective bonding circuit:</u> Exposed conductive parts not connected to the protective bonding circuit must:	No exposed conducting parts	NA
	- be untouchable on large surfaces or grasped with the hand;		
	- be small in size;		
	- be located so that cont. with live parts or an insulation failure is unlikely.		

Cl.	Prescribed requirements	Result – Remarks	Verd.
8.2.6	<u>Interruption of the protective bonding circuit by connectors:</u> Where the continuity of the protective bonding circuit can be interrupted by means of connectors or plug/socket combinations the following must apply:	Tool must be used to disconnect from ground, without disconnecting the power supply at the same time.	P
	- protective bonding circuit interrupted only after the live conductors have been interrupted;		
	- protective bonding circuit re-established before any live conductors is reconnected.		
8.2.7	<u>Protective conductor connecting points:</u> Protective conductors terminated in accordance with 14.1.1		
	Protective conductor connecting point identified by Symbol		P
	Protective conductor connecting point identified by bi-colour Green/Yellow		
8.3	<u>Bonding for operational purposes</u>		NA
8.3.1	<u>General:</u> Minimizes the consequences of:		
	- an insulation failure on the operation of the machine		
	- electrical disturbances		
8.3.2	<u>Bonding to the protective circuit:</u> One side of a control circuit fed by a transformer connected to the protective bonding circuit.		NA
8.3.3	<u>Bonding to a common reference potential:</u> Protective bonding circuit bonded to a common reference potential (Symbol)		NA
<b>9</b>	<b><u>Control circuits and control functions</u></b>		
9.1	<u>Control circuits:</u>		
9.1.1	<u>Control circuit supply:</u> Transformers shall be used for supplying the control circuits. They shall have separate windings	OK	P
9.1.2	<u>Control circuit voltages:</u> The value of the control voltage shall be consistent. The nominal voltage shall not exceed 277 V when supplied from a transformer	Assume correct power supply to the unit	P
9.1.3	<u>Protection:</u> Control circuits shall be provided with overcurrent protection	Fused	P

Cl.	Prescribed requirements	Result – Remarks	Verd.
9.1.4	<u>Connection of control devices:</u> In control circuits with one side connected to the protective bonding circuit, one terminal of any electrical device shall be connected directly to that side of the control circuit.		NA
9.2	<u>Control functions:</u>		
9.2.1	<u>Start functions:</u> Start functions shall operate by energizing the relevant circuit	OK	P
9.2.2	<u>Stop functions:</u> Stop function category 0, 1 or 2	Category 0	P
9.2.3	<u>Operating modes:</u> Number of operating modes for the machine	On and off	P
	Mode selection prevented by suitable means. (Like key, access code)		P
	Indication of the selected operating mode shall be provided	Status LED on main unit	P
9.2.4	<u>Suspension of safeguards:</u> Where suspension of safeguards is necessary, means shall be provided to prevent automatic operation		P
9.2.5	<u>Operation:</u>		P
9.2.5.1	<u>General:</u> The necessary interlocks shall be provided for safe operation		
	Movement of the machine in an unintended manner after stopping prevented		P
9.2.5.2	<u>Start:</u> Start of an operation only possible where all the safeguards are in place and functioning.		P
	Machines requiring more than one control station to initiate a start:		NA
	- each control station shall have a separate manually actuated start control device;		
	- all required conditions for machine operation met;		
	- all start control devices shall be in the released (off) position before a start may be permitted; and		
	- all start control devices shall be actuated concurrently.		
9.2.5.3	<u>Stop:</u> Category of stop determined from the risk assessment of the machine		NA

Cl.	Prescribed requirements	Result – Remarks	Verd.
9.2.5.4	<u>Emergency operations:</u>		
9.2.5.4.2	<u>Emergency stop:</u> The emergence stop function has the following requirements:		P
	- override all other functions and operations in all modes;		P
	- remove the power to the machine act. as quickly as possible; and		P
	- reset shall not initiate a restart.		P
	The emergency stop functions as a category 0 or category 1	Category 0	P
9.2.5.4.3	<u>Emergency switching off:</u> Emergency switching off should be provided where:		
	- protection against direct contact is achieved only by placing out of reach or by obstacles		NA
	- there is the possibility of other hazards or damage caused by electricity		NA
9.2.5.5	<u>Monitoring of command actions:</u> Any movement or action of a machine which can result in a hazardous situation shall be monitored		NA
9.2.5.6	<u>Hold-to-run controls:</u> Shall require continuous actuation of the control devices		P
9.2.5.7	<u>Two-hand control:</u> <u>Type 1:</u> This type requires:		
	- the provision of two control dev. requiring concurrent actuations by both hands;		NA
	- continuous concurrent actuation during the hazardous condition;		NA
	- Machine operation shall cease upon release of either one or both of the control devices when hazardous conditions are still present.		NA
	<u>Type 2:</u> This type requires:		
	- a type 1 control req. the release of both control devices before machine operation may be reinitiated.		NA
	<u>Type 3:</u> This type requires: A type 2 control requiring concurrent actuation of the control devices as follows:		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- it shall be necessary to actuate the control dev. Within a certain time limit;		P
	- where the time limit is exceeded, both control devices shall be released.		P
9.2.5.8	<u>Enabling device:</u> It shall have the following features:		
	- be connected to a cat 0 or 1 stop		P
	- be designed in consideration of ergonomic principles		P
	- for two-position type: - position 1: off-function of the switch - position 2: enabling function		P
	- for three-position type: - position 1: off-function of the switch - position 2: enabling function - position 3: off-function		NA
9.2.6	<u>Combined start and stop controls:</u> Push-buttons and similar control devices which alternately initiate an stop motion shall only be used where for functions which can not result in a hazardous condition		NA
9.2.7	Cable less control		
9.2.7.1	<u>General:</u> Means shall be provided to;		
	- readily remove or disconnect the power supply of the operator control station	Assuming system is connected via a cable with plug, or via the crane supply that has a main switch	P
	- prevent unauthorized use of the operator control station		P
	Each operator control station shall carry an unambiguous indication of which machine(s) is intended to be controlled		P
9.2.7.2	<u>Control limitation:</u> Measures shall be taken to ensure that control commands:		P
	- affect only the intended machine		
	- affect only the intended functions		
9.2.7.3	<u>Stop:</u>  Measures shall be taken to ensure that control commands:		

Cl.	Prescribed requirements	Result – Remarks	Verd.
	Operator control stations shall include a separate and clearly identifiable means to initiate stop	Emergency stop	P
	A machine with cable less control shall have means of automatically stop in the following situations:		
	- when a stop signal is received		P
	- when a fault is detected in the system		P
	- when a valid signal has not been detected within a specified period of time		P
9.2.7.4	<u>Serial data communication:</u> Error protection provided		P
9.2.7.5	<u>Use of more than one operator control station:</u> Only one control station can be enabled at a given time		P
9.2.7.6	<u>Battery-powered operator control stations:</u> A variation in the battery voltage shall not cause a hazardous condition		P
9.3	<u>Protective interlocks:</u>		
9.3.1	<u>Reclosing or resetting of interlocked safeguards:</u> Shall not initiate machine motion or operation where this can give rise to a hazardous condition		P
9.3.2	<u>Overtravel limits:</u> Fitted with a limiting device to initiate appropriate control action		NA
9.3.3	<u>Operation of auxillary functions:</u> Checked by appropriate devices		P
9.3.4	<u>Interlocks between different operations and for contrary motions:</u> Control devices shall be interlocked against incorrect operation		P
9.3.5	<u>Reverse current braking:</u> The motor not to start in the opposite direction after braking		NA
9.4	<u>Control functions in case of failure:</u>		
9.4.1	<u>General requirements:</u> Measures to reduce risk of failure or disturbances in the electrical equipment are as follows:		
	- protective devices on the machine;		P
	- protective interlocking of the electrical circuit;		P
	- use of proven circuit techniques and components;		P
	- provision of partial or complete redundancy or diversity; and		NA

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- provision for functional tests.		NA
9.4.2	<u>Measures to minimize risk in case of failure:</u>		
9.4.2.1	<u>Use of proven circuit techniques and components:</u> These measures include:		
	- bonding of control circuits for operational purposes;		NA
	- connection of control devices in accordance with 9.1.4;		P
	- stopping by de-energizing;		P
	- switching of all live conductors to the device being controlled;		NA
	- use of switching devices having positive opening operation; and		NA
	- circuit design to reduce the possibility of failures causing undesirable operations.		P
9.4.2.2	<u>Provisions for redundancy:</u> Partial, complete or off-line redundancy provided for the machine	No known redundancy	NA
9.4.2.3	<u>Use of diversity:</u> Control devices having different principles of operation or type of devices may be:		NA
	- the combination of NO and NC contacts operated by interlocking guards;		
	- the use of different types of control circuit comp. in the circuit;		
	- the combination of electromechanical and electronic circuits in redundant configurations; and		
	- the combination of electrical and non-electrical systems.		
9.4.2.4	<u>Functional tests:</u> Carried out automatically by the control system		NA
	Carried out manually by inspection or tests at start-up or a combination		
9.4.3	<u>Protection against maloperations due to earth faults, voltage interruptions and loss of circuit continuity</u>		
9.4.3.1	<u>Earth faults:</u>		
	Shall not cause unintentional starting, potentially hazardous movements or prevent stopping.	See introduction	P
9.4.3.2	<u>Voltage interruptions:</u> Requirements as in 7.5 shall apply		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
9.4.3.3	<u>Loss of circuit continuity:</u> Where loss of circuit continuity of safety-related control circuits depending upon sliding contacts can result in a hazardous condition, appr. Measures shall be taken		P
<b>10</b>	<b><u>Operator interface and machine mounted control devices</u></b>		
10.1	<u>General:</u>		
10.1.1	<u>General device requirements:</u> Devices mounted outside or partially outside enclosures		P
10.1.2	<u>Location and mounting:</u> Machine mounted devices shall be:		
	- readily accessible for service and maintenance;	Assuming that equipment is suitably mounted	P
	- mounted in such a manner as to minimize the possibility of damage from material handling	Assuming that equipment is suitably mounted	P
	The actuators of hand-operated control devices shall be selected and installed so that:		
	- they are not less than 0,6m above servicing level and within easy reach from normal working position;	Remote control	NA
	- the operator is not placed in a hazardous situation;	Remote control	NA
	- the possibility of inadvertent operation is minimized.	Remote control	NA
10.1.3	<u>Protection:</u> The degree of protection together with other appropriate measures shall afford protection against:		
	- effects of aggressive liquids, vapours or gases; and	Sufficient IP degree ensures this	P
	- the ingress of contaminants.	Sufficient IP degree ensures this	P
10.1.4	<u>Position sensors:</u> Position sensors shall not be damaged in the event of over travel.	Does not depend on crane control	NA
	Position sensors used in circuits with safety-related functions either shall have positive opening or shall provide similar reliability	Does not depend on crane control	NA
10.1.5	<u>Portable and pendant control stations:</u> Shall be so selected and arranged as to minimize the possibility of inadvertent machine operations caused by shocks and vibrations		P
10.2	<u>Push-buttons</u>		
10.2.1	<u>Colours:</u>		

Cl.	Prescribed requirements	Result – Remarks	Verd.
	Push-button actuators colour coded in accordance with table 2  The colours on the actuators shall be:		
	- START/ON;                    WHITE, GREY OR BLACK	Black	P
	- EMERGENCY STOP AND EMERGENCY SWITCHING OFF;    RED		P
	- STOP/OFF;                    BLACK, GREY OR WHITE		P
10.2.2	<u>Markings:</u> Push-buttons marked with symbols acc. to this clause		P
10.3	<u>Indicator lights and displays</u>		
10.3.1	<u>Modes of use:</u>		
	- indication; or		
	- confirmation	When button pushed or released, SQ light is continuously lit for about one second.	P
10.3.2	<u>Colours:</u> Indicator lights colour coded		P
10.3.3	<u>Flashing lights:</u> Flashing lights used to attract attention, request action or others		P
10.4	<u>Illuminated push-buttons:</u> Shall be colour coded in acc. to table 2 and 3		NA
10.5	<u>Rotary control devices:</u> Shall be mounted in such a way as to prevent rotation of the stationary member		NA
10.6	<u>Start devices:</u> Constructed and mounted to minimize inadvertent operation	Start button at remote control	P
10.7	<u>Devices for emergency stop:</u>		
10.7.1	<u>Location:</u>		
	Shall be located at each operator control station	On remote	P
10.7.2	<u>Types:</u>		
	- push-button operated switch;		P
	- pull-cord operated switch; and		
	- pedal-operated switch without mechanical guard.		

Cl.	Prescribed requirements	Result – Remarks	Verd.
10.7.3	<u>Restoration of normal function after emergency stop:</u> It shall not be possible to restore the circuit until the actuator of the emergency stop has been manually reset	Tested with equipment mounted on crane	P
10.7.4	<u>Actuators:</u> Emergency stop shall be coloured RED		P
10.7.5	<u>Local operation of the supply disconnecting device to affect emergency stop:</u> The supply disconnecting device may locally operated to serve the function of emergency stop when:		
	- it is readily accessible to the operator		P
	- it is of the type described in 5.3.2 a), b) or c)		P
10.8	<u>Devices for emergency switching off:</u>		
10.8.1	<u>Location:</u>		
	Located as necessary for the given application		P
10.8.2	<u>Types:</u>		
	- push-button operated switch;		P
	- pull-cord operated switch; and		
10.8.3	<u>Restoration of normal function after emergency switching off:</u> It shall not be possible to restore the circuit until the actuator of the emergency switching off device has been manually reset		P
10.8.4	<u>Actuators:</u> Emergency switching off devices shall be coloured RED		P
10.8.5	<u>Local operation of the supply disconnecting device to affect emergency switching off:</u> Where the supply disconnecting device is to be locally operated for emergency switching off, it shall be readily accessible and meet the colour requirements		P
10.9	<u>Displays:</u> Shall be visible from the normal position of the operator		NA
<b>11</b>	<b><u>Electronic equipment</u></b>		
11.1	<u>General:</u> This clause applies to all types of electronic equipment		
11.2	<u>Basic requirements</u>		
11.2.1	<u>Inputs and outputs:</u>		
	Status indication of digital inputs/outputs provided.		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
11.2.2	<u>Equipotential bonding:</u> All input/output racks, processor racks and power supplies are electrically bonded together		NA
11.3	<u>Programmable equipment</u>		
11.3.1	<u>Programmable controllers:</u>		
	Complies with the relevant IEC standards		P
11.3.2	<u>Memory retention and protection:</u> Memory alteration by unauthorized persons not possible		P
11.3.3	<u>Software verification:</u> Possible to verify the software-program		NA
11.3.4	<u>Use in safety-related functions:</u> Programmable electronic equipment not used for cat. 0 emergency stop		P
<b>12</b>	<b><u>Controlgear: location, mounting and enclosures</u></b>		
12.1	<u>General requirements:</u>		
	All control gear shall be located and mounted as to facilitate:	Assuming reasonable placement	
	- its accessibility and maintenance;		P
	- its protection against external influences;		P
	- operation and maintenance.		P
12.2	<u>Location and mounting</u>	S/N on front	P
12.2.1	<u>Accessibility and maintenance:</u> Control gear easy to identify without moving them		
	Control gear maintenance and operation easy from the front		NA
	Special tool necessary to remove devices, and if so, supplied ?	No special tool. Only screw driver	P
	Plug-in devices provided with non-interchangeable features		P
12.2.2	<u>Physical separation or grouping:</u> Non-electrical parts not in enclosure containing control gear		
	Terminals shall be separated in to two groups:		
	- power circuits;		P
	- associated control circuits;		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- other control circuits		P
12.2.3	<u>Heating effects:</u> Heat generating components located so that the temperature remains within the permitted limit		NA
12.3	<u>Degrees of protection:</u> Enclosures for control gear at least IP 22. (See exceptions)		P
12.4	<u>Enclosures, doors and openings:</u> Enclosures shall be of materials capable of withstanding the mechanical, electrical and thermal stresses likely to be encountered in normal service		P
	Fasteners used to secure doors etc. of captive type.	Screws	P
	Observation windows with sufficient strength/thickness.		NA
	Equipment that can attain surface temperatures sufficient to cause a risk of fire:		NA
	- shall be located within an enclosure that will withstand such temperatures;		
	- shall be mounted and located at sufficient distance from adjacent equipment;		
	- shall be otherwise screened by material that can withstand the heat emitted by the equipment		
12.5	<u>Access to controlgear:</u> Doors and gangways and access to electrical operating areas shall:		NA
	- be at least 0,7 m wide and 2,0 m high;		
	- open outwards;		
	- have means to allow opening from the inside without the use of key or tool.		
<b>13</b>	<b><u>Conductors and cables</u></b>		
13.1	<u>General requirements:</u>		
	Conductors and cable suitable for the operating conditions which can exist		P
	Conductors and cables with flame-retardant properties used		P
13.2	<u>Conductors:</u> Conductors of copper, cross sectional area	The conductors are made of copper	P
	Conductors of any other material, type of material, cross-sectional area		NA
	Class of conductors		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
13.3	<u>Insulation:</u> Type of insulation	PVC	P
	Adequate dielectric strength		P
	Adequate thickness of insulation and mechanical strength		P
13.4	<u>Current carrying capacity in normal service:</u> Type of insulation		
	Max. conductor temp. under normal conditions		P
	Max. conductor temp. under short-circuit conditions		P
13.5	<u>Conductor and cable voltage drop:</u> The voltage drop shall not exceed 5% of the nominal voltage		P
13.6	<u>Minimum cross sectional area:</u> Cross sect. area of the conductors not less than shown in table 6	Not used for control system	NA
13.7	<u>Flexible cables:</u>		
13.7.1	<u>General:</u> Cables subjected to severe duties shall be adequate protected against:		NA
	- abrasion		
	- kinking		
	- stress		
13.7.2	<u>Mechanical rating:</u> The tensile stress shall not exceed 15 N/mm <sup>2</sup> of the copper cross.sectional area		P
	Material other than copper used	Copper used	P
13.7.3	<u>Current-carrying capacity of cables wound on drums:</u> Cables selected such that when wound on drum, the maximum temperature is not exceeded		NA
13.8	<u>Collector wires, collector bars and slip-ring assemblies:</u>		
13.8.1	<u>Protection against direct contact:</u> Protection against direct contact shall be achieved by one of the following measures:		
	- protection by partial insulation of live parts;		P
	- protection by enclosures or barriers of at least IP2X		P
13.8.2	<u>Protective conductor circuit:</u> Where collector wires are installed as part of the protective bonding circuit, they shall not carry current in normal operation.		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
13.8.3	<u>Protective conductor current collectors:</u> Shall have shape and constructions that they are not interchangeable with the other current collectors		P
13.8.4	<u>Removable current collectors with a disconnecting function:</u> Shall be so designed that the protection conductor circuit is:		
	- interrupted after live conductors	Fused	P
	- re-established before any live conductors		NA
13.8.5	<u>Clearance in air:</u> Clearance suitable for pollution degree 3 conditions		NA
13.8.6	<u>Creepage distances:</u> Creepage distances suitable for pollution degree 3 conditions		NA
13.8.7	<u>Conductor system sectioning:</u> Where collector wires or bars are arranged so that they can be divided into isolated sections energization of adjacent sections by the current collectors themselves must be prevented		NA
13.8.8	<u>Construction and installation of collector wire, collector bar system and slip-ring assemblies:</u> Collector wires, collector bar system and slip-ring assemblies used for power circuits shall be grouped separately from those used for control circuits		P
	Collector wires, collector bar system and slip-ring assemblies shall be capable of withstanding the mechanical forces and thermal effects of short-circuit currents		P
	Removable covers for collector wire and collector bar systems laid underground or underfloor shall be so designed that they cannot be opened without the aid of a tool		NA
	Where collector bars are installed in a common metal enclosure, the individual sections of the enclosure shall be bonded together and earthed at several points depending upon their length.		NA
<b>14</b>	<b><u>Wiring practices</u></b>		
14.1.1	<u>General requirements:</u>		
	Connections secured against accidental loosening		P
	Means of connections suitable and nature of conductors being terminated		P
	Only one earth conductor connected to each terminal connecting point		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
	Terminals on terminal blocks plainly identifiable with diagrams (markings)		P
	Installation of conduits and cables so that liquids drain away from fittings		P
	Identification tags legible, permanent and appropriate		P
	No internal and external wiring crossing the terminal blocks		P
14.1.2	<u>Conductor and cable runs:</u> Conductors and cables without splices		
	Termination of cables adequately supported		P
	Protective conductor placed near the live conductors		P
14.1.3	<u>Conductors of different circuits:</u> Conductors of different circuits side-by-side, in the same duct, or in the same multi core cable		
	Where different voltages, either separated with barriers or insulated for the highest voltage		P
14.2	<u>Identification of conductors</u>		
14.2.1	<u>General requirements:</u>		
	Conductors identifiable at each termination acc. to technical documentation		P
	Colour coding used	Symbols used	P
14.2.2	<u>Identification of the protective conductor:</u> The protective conductor identified by:		
	- shape;		
	- location;		
	- marking; or		P
	- colour. (green and yellow)		
14.2.3	<u>Identification of the neutral conductor:</u> Where identified by colour, the colour shall be light-blue		NA
14.2.4	<u>Identification of other conductors:</u> Other conductors shall be identified by:.		
	- colour;		
	- number;		P
	- alphanumeric.		
	Insulated single-core conductors colour coded:		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- BLACK (power circuits)		
	- RED (a.c. control circuits)		
	- BLUE (d.c. control circuits)		
	- ORANGE (interl. contr.circ., ext. power source)		
14.3	<u>Wiring inside enclosures:</u> Panel conductors supported to keep them in place		NA
	Non-metallic channels/ducts made with flame-retardant insulating material according to IEC Publ. 332-1		
	Connections to devices mounted on door or other movable parts made using flexible conductors. The conductors shall be anchored		
14.4	<u>Wiring outside enclosures</u>		NA
14.4.1	<u>General requirements:</u>		
	No reduction of degree of protection when introducing cables or ducts into an enclosure		
14.4.2	<u>External ducts:</u> Conductors external to the electrical equipment enclosed in suitable ducts		
	Fittings used shall be suitable for the environment		
	Flexible conduits/multicore cables used, when necessary, to pendant push-button stations		
14.4.3	<u>Connection to moving elements of the machine:</u> Connections to frequently moving parts made with flexible conductors		
	Cables subject to movements supported to avoid mechanical strain at connection points		
	Flexible cable of machines shall be so installed or protected as to minimize the possibility of external damage.		
	Cable sheath resistant to normal wear which can be expected		
14.4.4	<u>Interconnection of devices on the machine:</u> Where several position sensors, push-buttons e.g. are connected in series or parallel, it is recommended that the conductors between those devices are returned to terminals forming intermediate test points		
14.4.5	<u>Plug/socket connections:</u> Removable equipment used		
	Connection by plug/socket used:		

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- protective bonding circuit made before any live connections		
	- protective bonding circuit disconnected after live connections		
14.4.6	<u>Dismantling for shipment:</u> Terminals provided where necessary wiring to be disconnected for shipment		
14.4.7	<u>Additional conductors:</u> Additional conductors provided for maintenance or repair		
14.5	<u>Ducts, connection and junction boxes</u>		<b>NA</b>
14.5.1	<u>General requirements:</u>		
	Ducts provide a minimum degree of protection of IP 33		
	No sharp edges, flash, burrs, rough surf. or threads on ducts and fittings		
	Drain holes in ducts or junction boxes		
	Ducts and cable trays rigidly supported and positioned at a sufficient distance from moving parts		
14.5.2	<u>Percentage fill of ducts:</u> Consideration taken to the length and straightness of the duct		
	Insertion of conductors and cables possible		
14.5.3	<u>Rigid metal conduit and fittings:</u> Metal conduits and fittings of galvanized steel or a corr. resistant material		
	Conduits securely held in place and supported at each end		
	Fittings compatible with the conduit		
	Threaded or not threaded fittings used		
14.5.4	<u>Flexible metal conduit and fittings:</u> Flexible metal conduit of flexible metal tubing or woven wire armour		
	Fittings compatible with the conduit		
14.5.5	<u>Flexible non-metallic conduit and fittings:</u> Resistant to kinking and suitable for the expected physical environment		
	Fittings compatible with the conduit		
14.5.6	<u>Cable trunking systems:</u> Rigidly supported when external to enclosures		

<b>Cl.</b>	<b>Prescribed requirements</b>	<b>Result – Remarks</b>	<b>Verd.</b>
	Covers provided on the sides		
	Joints between sections fit tightly		
	Openings only for wiring or draining		
	Unused knockouts shall not be opened		
14.5.7	<u>Machine compartments and cable trunking systems:</u> Totally insulated from coolant or oil reservoirs and entirely enclosed		
	Secured and arranged to avoid physical damage		
14.5.8	<u>Connection boxes and other boxes:</u> Readily accessible		
	Boxes provide degree of protection against solid bodies and liquids acc. to the external influences that may occur.		
	Unused knockouts shall not be opened		
14.5.9	<u>Motor connection boxes:</u> Motor connection boxes enclosure only connections to the motor and motor-mounted devices		
<b>15</b>	<b><u>Electric motors and associated equipment</u></b>		<b>NA</b>
15.1	<u>General equipment:</u>		
	Motors comply with IEC Publ. 34-1		
	Motors and associated equipment protected against:		
	- overload;		
	- overspeed;		
	- overcurrent.		
15.2	<u>Motor enclosures:</u> Degree of protection at least IP23 (depending on the environment)		
15.3	<u>Motor dimensions:</u> Dimension of motor comply with IEC Publ. 72-1 and 72-2		
15.4	<u>Motor mounting and compartments:</u> Easily accessible for inspection, maintenance adjustment and alignment, lubrication and replacement		
	Proper cooling ensured		
	Motor compartments clean and dry, ventilated directly to the exterior of the machine		

Cl.	Prescribed requirements	Result – Remarks	Verd.
15.5	<u>Criteria for selection:</u> Characteristics of motors and associated equipment selected in accordance with the anticipated service and physical environmental conditions		
15.6	<u>Protective devices for mechanical brakes:</u> Operation of the overload and overcurrent protective devices for mechanical brake actuators shall initiate the simultaneous de-energization of the associated machine actuators		
<b>16</b>	<b><u>Accessories and lighting</u></b>		
16.1	<u>Accessories:</u> Machine provided with outlets for accessory equipments:		
	- outl. compl. with EN 60309-1, if not, clearly marked with volt and current;		NA
	- continuity of protective bonding circuit ensured;		NA
	- unearthed conductors suitably protected against overcurrent and overload.		NA
16.2	<u>Local lighting of the machine and equipment</u>		NA
16.2.1	<u>General:</u>		
	ON-OFF switch not incorporated in lampholder or connecting cord, no stroboscopic effect allowed, when fixed lightening, EMC must be taken into account.		
16.2.2	<u>Supply:</u> Nominal voltage supplied, source of supply		
16.2.3	<u>Protection:</u> Protected in accordance with 7.2.6		
16.2.4	<u>Fittings:</u> Suitable for the physical environment		
	Lampholders shall be:		
	- in acc. with relevant IEC-publication		
	- constructed with an insulating material protecting the lamp cap		
	Reflectors supported by a bracket and not the lampholder		
<b>17</b>	<b><u>Markings, warning signs and reference designations</u></b>		
17.1	<u>General:</u> Electrical equipment marked with:		
	- suppliers name;		P

Cl.	Prescribed requirements	Result – Remarks	Verd.
	- trade mark;		P
	- other identifying symbol		P
	- certification mark (where required)		P
	Warning signs, nameplates, markings and id-plates shall be of sufficient durability		P
17.2	<u>Warning signs:</u> Enclosure marked with a black lightning sign on yellow background, durably fixed		P
17.3	<u>Functional identification:</u> Control devices, visual indicator and displays clearly and durably marked with regard to their functions		P
17.4	<u>Marking of control equipment:</u> Control equipment legibly and durably marked. A nameplate giving the following information shall be fixed to the enclosure:		
	- name or trade mark of supplier;		
	- certification mark;		
	- serial number;		
	- rated voltage, number of phases and frequency and full load current for each supply;		P
	- short circuit interrupting capacity;		
	- electrical diagram number.		
17.5	<u>Reference designations:</u> Control devices shall be identified with the same designation as in the technical documentation		NA
<b>18</b>	<b><u>Technical documentation</u></b>		
18.1	<u>General:</u>		
	Necessary information for installation, operation and maintenance for the electrical equipment available		P
18.2	<u>Information to be provided:</u> Information provided with the electrical equipment shall include:		P
	a) a clear, comprehensive description of the equipment, installation and mounting, and the connection to the electrical supplies;		
	b) electrical supply requirements;		
	c) information in the physical environment;		

Cl.	Prescribed requirements	Result – Remarks	Verd.
	d) overview diagrams;		
	e) circuit diagrams;		
	f) information on:		
	- programming;		
	- sequence of operation;		
	- frequency of inspection;		
	- frequency and method on functional testing;		
	- guidance on adjustment, maintenance and repair;		
	- part lists, and in particular, spare parts.		
	g) description of the safeguards, interactive functions ;		
	h) description of the safeguarding means and methods where the primary safeguards are suspended.		
18.3	<u>Requirements applicable to all documentation:</u> Documents prepared in accordance with IEC 1082-1 and 18.4 to 18.10		NA
18.4	<u>Basic information:</u> Minimum technical information as follows:		
	- normal operation conditions of the electrical equipment;		P
	- handling, transportation and storage;		P
	- Inappropriate use of the equipment.		P
18.5	<u>Installation diagram:</u> All information given for setting up the machine		P
18.6	<u>System (block) diagram:</u> System diagram provided		P
18.7	<u>Circuit diagrams:</u> Circuit diagrams provided showing the electrical circuits on the machine		P
18.8	<u>Operating manual:</u> Operating manual provided to detail proper procedures for set-up and use of the equipment		P
18.9	<u>Maintenance manual:</u> Technical documentation containing a maintenance manual detailing proper procedures for adjustment, servicing and preventive inspection and repair		NA

<b>Cl.</b>	<b>Prescribed requirements</b>	<b>Result – Remarks</b>	<b>Verd.</b>
18.10	<u>Part list:</u> The part list shall comprise information necessary for ordering spare or replacement parts required for preventive or corrective maintenance		<b>P</b>
<b>19</b>	<b><u>Testing and verification</u></b>		<b>NA</b>
19.1	<u>General:</u> When the electrical equipment is connected to the machine, it shall be tested after clauses 19.2 - 19.7		
19.2	<u>Continuity of the protective bonding circuit:</u>		<b>NA</b>
	Continuity of the protective bonding circuit checked by a loop impedance test in accordance with 612.6.3 of IEC 60364-6-61.		<b>NA</b>
	Continuity of the protective bonding circuit checked by injecting current of at least 10 A at 50Hz for at least 10s		<b>NA</b>
19.3	<u>Insulation resistance tests:</u> Voltage: 500V d.c.		<b>P</b>
	Not less than 1 M ohm		<b>P</b>
	<u>Voltage tests:</u> Voltage: 2 x U <sub>0</sub> or 1000V, 50Hz Duration min. 1s		<b>P</b>
	No flashover		<b>P</b>
19.5	<u>Protection against residual voltages:</u> Tests shall be performed to ensure compliance with 6.2.3		<b>NA</b>
19.6	<u>Functional tests:</u> Functions of electrical equipment, in particular those related to safety and safeguarding, tested		<b>NA</b>
19.7	<u>Retesting:</u> After changes or modifications, tests acc. to 19.2 to 19.7 performed		<b>NA</b>