Test Report

（Technical Construction File）

File No.: NIMU-CE2292Y5082EL

Revision Date:2019/05/15

Applicant/Holder: Suzhou Industrial Park Surong Electric Co.,Ltd.

Address: No.298, Tangzhuang Road, Suzhou Industrial Park, Suzhou, China(Mainland)

Manufacturer: Suzhou Industrial Park Surong Electric Co.,Ltd.

Product Type: High Voltage Reactive Power Compensation Device

Models:

TBBZ10-5400(900+900+1800+1800)/300AK , TBBZ10-300/100AK,
TBBZ10-600(200+400)/(67+134)AK, TBBZ10-800(300+500)/(100+167)AK,
TBBZ10-900(300+600)/(100+200)AK, TBBZ10-1000(400+600)/(134+200)AK,
TBBZ10-1000(300+300+400)/(100+134)AK, TBBZ10-1200(600+600)/200AK,
TBBZ10-1500(300+600+600)/(100+200)AK,TBBZ10-1800(300+600+600)/(100+200)AK,
TBBZ10-2000(500+500+1000)/(167+334)AK,TBBZ10-2400(400+600+1200)/(134+200+400)AK,
TBBZ10-2500(500+800+1200)/(167+267+400)AK,
TBBZ10-2600(600+800+1200)/(200+267+400)AK,
TBBZ10-2800(800+800+1200)/(267+400)AK,TBBZ10-3000(1000+1000+1000)/334AK,
TBBZ10-3200(1000+1000+1200)/(334+400)AK,TBBZ10-3400(1000+1200+1200)/(334+400)AK,
TBBZ10-3600(900+1200+1500)/(300+400+500)AK,
TBBZ10-4800(900+1200+1200+1500)/(300+400+500)AK,
TBBZ10-5000(600+1200+1200+2000)/(300+334+400+500)AK

According to : LVD 2014/35/EU
EMC 2014/30/EU

Tested by: Kelly Sun
Date: 15, 05, 2019

Approved By:Jeff Zhang

Shanghai Jianzheng Enterprise Management Consultation Co., Ltd.

TEST REPORT
EN 60204-1:2006+A1:2009
EN 61000-6-2:2005/AC:2005 EN 61000-6-4:2007/A1:2011 EN 61000-3-2:2014 EN 61000-3-3:2013

Report Reference No.....:NIMU-CE2292Y5082EL

Tested by (Printed name and Signature).....: Kelly Sun

Approved by (Printed name and Signature).....: Jeff Zhang

Date of issue.....: 2019-05-15

Testing Laboratory Name.....: Shanghai Jianzheng Enterprise Management Consultation Co., Ltd.

Address .....: No. 101 Room, No. 54 building, No. 7222 lane, the North Jiasong Road, Jiading District, Shanghai,China

Test location.....: No.298, Tangzhuang Road, Suzhou Industrial Park, Suzhou, China(Mainland)(Mainland)

Applicant's name.....: Suzhou Industrial Park Surong Electric Co.,Ltd.

Address .....: No.298, Tangzhuang Road, Suzhou Industrial Park, Suzhou, China(Mainland)(Mainland)

Manufacturer's name.....: Suzhou Industrial Park Surong Electric Co.,Ltd.

Address .....: No.298, Tangzhuang Road, Suzhou Industrial Park, Suzhou, China(Mainland)(Mainland)

Test specification:

Standard .....: EN 60204-1:2006+A1:2009
EN 61000-6-2:2005/AC:2005
EN 61000-6-4:2007/A1:2011
EN 61000-3-2:2014
EN 61000-3-3:2013

Test procedure .....: IEC

Procedure deviation.....: N/A

Non-standard test method……..:N/A

Test Report Form No.....:NIMU-CE2292Y5082EL

Test Report Form(s) Originator .....: SEV

Master TRF.....: Dated 05-14

Test item description .....: High Voltage Reactive Power Compensation Device

Trade Mark.....: \

Model/Type reference .....:

TBBZ10-5400(900+900+1800+1800)/300AK , TBBZ10-300/100AK,
TBBZ10-600(200+400)/(67+134)AK, TBBZ10-800(300+500)/(100+167)AK,
TBBZ10-900(300+600)/(100+200)AK,TBBZ10-1000(400+600)/(134+200)AK,
TBBZ10-1000(300+300+400)/(100+134)AK,TBBZ10-1200(600+600)/200AK,
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TBBZ10-4800(900+1200+1200+1500)/(300+400+500)AK,
TBBZ10-5000(600+1200+1200+2000)/(300+334+400+500)AK

Copy of marking plate

High Voltage Reactive Power Compensation Device CE

MADE IN CHINA

Summary of testing:

The tested equipment was found to be in compliance with standard EN 60204-1:2006+A1:2009+AC:2010、EN 61000-6-2:2005/AC:2005、 EN 61000-6-4:2007/A1:2011、 EN 61000-3-2:2014、 EN 61000-3-3:2013.

Test items particulars:	
1.Special conditions	
a)Is the machine to be used in the open air?	No
b)Will the machine use , process or produce explosive or flammable material?	No
c)Is the machine for use in potentially explosive or flammable atmospheres	No
d)Can the machine present special hazards when producing or consuming certain materials	No
e)Is the machine use for mines	No
2.Electrical supplies and related conditions	
a)Anticipated voltage fluctuations(if more than ±10%)	Yes
b)Anticipated frequency fluctuations (if more than ±2%)	No
c) Indicate possible future changes in electrical equipment that will require an increase in the electrical supply requirements	Yes
d)Specify voltage interruptions in supply if longer than specified in Clause 4 where electrical equipment has to maintain operation under such conditions.	No
3.Physical environment and operating conditions	
a)Electromagnetic environment	Industrial environment
Special conditions or requirements	No
b)Ambient temperature range	5 ℃~40℃
c) Humidity range	40%RH~90%RH
d)Altitude	＜1000m
e) Special environmental conditions	No
f)Radiation	No
g)Vibration, shock	Yes
h)Special installation and operation requirements	Yes
i)Transportation and storage	Yes
4.Incoming electrical supplies	
a)Nominal voltage(V)	/
Prospective short-circuit current at the point of supply to the machine (kA r.m.s.)	No
b)Type of power supply earthing	TN
c)Is the electrical equipment to be connected to a neutral supply conductor?	No
d)supply disconnecting device	YES
Is disconnection of the neutral conductor required?	No
Is a removable link for disconnecting the neutral required?	No
Type of supply disconnecting device to be provided	YES

5. protection against electric shock	
Test items particulars:	
a)For, which of the following classes of persons is access to the interior of enclosures required during normal operation of the equipment?	Electrically skilled persons
b)Are locks with removable keys to be provided for securing the doors or covers?	Yes
6. Protection of equipment	
a)Will the user or the supplier provide the overcurrent protection of the supply conductors?	Yes
Type and rating of overcurrent protective devices	See technical file
b)Largest(kW) three-phase a.c. motor that may be started direct-on-line	10kW
c) May the number of motor overload detection devices be reduced?	No
7. Operation	
For cableless control systems, specify the time delay before automatic machine shutdown is initiated in the absence of a valid signal.	No
8. Operator interface and machine-mounted control devices	
Special colour preferences:	No
9. Controlgear	
Degree of protection of enclosures or special conditions:	＞IP22
10. Wiring practices	
Is there a specific method of identification to be used for the conductors?(see 13.2.1)	YES
Type	By a combination of numbers and alphanumerics
11. Accessories and lighting	
a)Is a particular type of socket-outlet required?	No
b)Are the socket-outlets for maintenance to be provided with additional protection by the use of Residual Curret protective Devices(RCD)?	No
c)Where the machine is equipped with local lighting:	No
12. Marking, warnings and reference designations	
a)Functional identification	Yes
b)Inscriptions/special markings	On electrical equipment, in English
c)Mark of certification	Yes, CE
13. Technical documentation	
a) Technical documentation	English
b)Size location and purpose of ducts, open cable trays or cable supports to be provided by the user	Yes

c)Indicate if special limitations on the size or weight which affect the transport of a particular machine or controlgear assemblies to the installation site	Yes
Test items particulars:	
-maximum dimensions:	/
-maximum weight:	/
d)In the case of specially built machines, is a certificate of operating tests with the loaded machine to be supplied?	No
e)In the case of other machines, is a certificated of operating type tests on a loaded prototype machine to be supplied?	Yes
test case verdicts:	
test case does not apply to the test object:	N/A
- test object does meet the requirement:	P (Pass)
- test object does not meet the requirement:	F (Fail)
Testing.....:	
Date of receipt of test item.....: 2019-05-15	
Date (s) of performance of tests..... : 2019-05-11 to 2019-05-14	

General remarks:

The test results presented in this report relate only to the object tested.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

"(See Enclosure #)" refers to additional information appended to the report.

"(See appended table)" refers to a table appended to the report.

Throughout this report a comma (point) is used as the decimal separator.

EN 60204-1:2006+A1:2009			
Clause	**Requirement- Test**	**Result**	**Verdict**
1	**SCOPE**		
	Nominal supply voltages not exceeding 1000V AC or 1500V DC between lines, and nominal frequencies not exceeding 200Hz	110V 50HZ	P
4	**GENERAL REQUIREMENTS**		
4.2	Selection of equipment		
4.2.1	General		
	Electrical components and devices shall be	The components and devices have been chosen that conforms to the relevant standard	
	- suitable for their intended use, and		P
	- conform to relevant IEC standards, and		P
	- be applied in accordance with the instructions.	See certification document for Critical components.	P
4.2.2	The electrical equipment of the machine shall satisfy the safety requirements identified by the risk assessment of the machine.		P
	Parts in compliance with EN 60439-1 and other relevant parts of the EN 60439 series may be selected.		N/A
4.3	Electrical supply		
4.3.1	General		
	The electrical equipment shall be designed to operate correctly with the supply:		
	- as specified in 4.3.2 or 4.3.3, or See 4.3.2		P
	- as otherwise specified by the user, or		P
	- as specified by the supplier in the case of a special source of supply such as an on-board generator.		P
4.3.2	AC supplies		
	Steady state voltage: 0.9 to 1.1 of nominal voltage	Operating normally at 0.9~1.1 times rated voltage	P
	Symbol nature of supply		P
	Frequency: 0.99 to 1.01 of nominal frequency continuously	50Hz	P
	Harmonic distortion not exceeding 10 %.	2~5 order harmonics sum≤10% 6~30 order harmonics sum≤2%	P
	Voltage unbalance not exceeding 2%.		P
	Voltage interruption not more than 3 ms		P
	Voltage dips shall not exceed 20 %		P
4.3.3	DC supplies		
	From batteries:		
	Voltage: 0.85 to 1.15 of nominal voltage		N/A
	Voltage: 0.7 to 1.2 of nominal voltage in the case of battery-operated vehicles		N/A
	Voltage interruption not exceeding 5 ms.		N/A
	From converting equipment:		
	Voltage: 0.9 to 1.1 of nominal voltage		N/A
	Voltage interruption not exceeding 20 ms.		N/A
	Ripple (peak-to-peak) not exceeding 0.15 of nominal voltage.		N/A
4.3.4	Special supply systems		
	For special supply systems such as on-board		N/A

	generators, the limits given in 4.3.2 and 4.3.3 may be exceeded.		
4.4	Physical environment and operating conditions	The physical environment and operating conditions has been described in the instruction manual	P
4.4.1	General		
	The electrical equipment shall be suitable for use in the physical environment and operating conditions specified in 4.4.2 to 4.4.8.		P
	When the physical environment or the operating conditions are outside those specified, an agreement may be needed between the supplier and the user (see Annex B)		N/A
4.4.2	Electromagnetic compatibility (EMC)		
	The equipment shall not generate electromagnetic disturbances above levels that are appropriate for its intended places of use.		N/A
	The equipment shall have an adequate level of immunity to electromagnetic disturbances so that it can operate correctly in its intended environment		N/A
4.4.3	Ambient air temperature		
	Electrical equipment shall be capable of operating correctly in the intended ambient air temperature (minimum-5°C~+40°C)	0°C ~ +40°C	P
4.4.4	Humidity		
	Electrical equipment shall be capable of operating correctly when the relative humidity not exceeding 50 % at a maximum temperature of 40 °C.		P
	Higher relative humidity may be permitted at lower temperatures		N/A
	Harmful effects of occasional condensation shall be avoided by proper design of the equipment or, where necessary, by proper additional measures.		N/A
4.4.5	Altitude		
	Electrical equipment shall be capable of operating correctly at altitudes up to 1 000 m above mean sea level.		P
4.4.6	Contaminants		
	Electrical equipment shall be adequately protected against the ingress of solid bodies and liquids (see 12.3).		P
4.4.7	Ionizing and non-ionizing radiation		
	When equipment is subject to radiation, additional measures shall be taken to avoid malfunctioning and accelerated deterioration of the insulation.		N/A
	A special agreement may be necessary between the supplier and the user (see Annex B).		N/A
4.4.8	Vibration, shock, and bump		
	Undesirable effects of vibration, shock and bump shall be avoided by the selection of suitable equipment, by mounting it away from the machine, or by the use of anti-vibration		P

	mountings.		
	A special agreement may be necessary between the supplier and the user (see Annex B).		P
4.5	Transportation and storage		
	Electrical equipment shall be designed to withstand, or suitable precautions shall be taken to protect against, the effects of transportation and storage temperatures within a range of - 25 °C to + 55 °C and for short periods not exceeding 24 h at up to + 70 °C.		P
	Suitable means shall be provided to prevent damage from humidity, vibration, and shock.		P
4.6	Provisions for handling		
	Heavy and bulky electrical equipment shall be provided with suitable means for handling by cranes or similar equipment (see also 14.4.6).	See the instruction manual	P
4.7	Installation and operation		
	Electrical equipment shall be installed and operated in accordance with the supplier's instructions	See instruction manual	P
5	INCOMING SUPPLY CONDUCTOR TERMINATIONS AND DEVICES FOR DISCONNECTING AND SWITCHING OFF		
5.1	Incoming supply conductor terminations		
	The electrical equipment of a machine should be connected to a single power supply.	A single power supply	P
	Where it is necessary to use another supply for certain parts of the equipment, that supply should be derived from devices as part of the electrical equipment of the machine as far as is practicable.		N/A
	For large complex machinery comprising a number of widely-spaced machines working together, there may be a need for more than one incoming supply depending on the site supply arrangements (see 5.3.1).		P
	Unless a plug is provided with the machine for the connection to the supply (see 5.3.2 d), the supply conductors shall be terminated at the supply disconnecting device.		P
	When that is not practicable, separate terminations shall be provided.		P
	Where a neutral conductor is used, it shall be clearly indicated.	No neutral conductor used on this machine	N/A
	A separate insulated terminal, labelled N, shall be provided for the neutral conductor (see also Annex B).		P
	No connection shall be used between the neutral conductor and the protective bonding circuit	No this situation	N/A
	No combined PEN terminal shall be used.		N/A
	For the identification of the external protective conductor terminal, see 5.2.		P
5.2	Terminal for connection to the external protective earthing system		
	For each incoming supply, a terminal shall be provided in the vicinity of the associated phase conductor terminals for connection of the machine to the external protective earthing		P

	system or to the external protective conductor.		
	The terminal shall be of such a size as to enable the connection of an external protective copper conductor in accordance with Table 1.		P
	Where an external protective conductor is using material other than copper, the terminal size shall be selected accordingly (see also 8.2.2).		N/A
	At each incoming supply point, the terminal for the external protective conductor shall be identified by marking with the letters PE.	Marked with “PE”	P
	The other terminals used for the connection of machine components or subassemblies to the protective bonding circuit shall be identified.		P
5.3	Supply disconnecting (isolating) device		
5.3.1	General		
	A supply disconnecting device shall be provided:		
	- for each incoming source of supply to a machine;		P
	- for each on-board power supply.		P
	The supply disconnecting device shall disconnect the electrical equipment of the machine from the supply when required		P
	When two or more supply disconnecting devices are provided, protective interlocks for their correct operation shall be used where a hazardous condition or damage can occur.		P
5.3.2	The supply disconnecting device shall be one of the following types:		
	a) a switch-disconnector in accordance with IEC 60947-3, utilization category AC-23B or DC-23B;		P
	b) a disconnector in accordance with IEC 60947-3, that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector;		N/A
	c) a circuit-breaker suitable for isolation in accordance with IEC 60947-2;		N/A
	d) any other switching device in accordance with the IEC standard and meeting the isolation requirements of IEC 60947-1 and a utilization category defined in the product standard as appropriate for on-load switching of motors or other inductive loads;		N/A
	e) a plug/ socket combination for a flexible cable supply.		N/A
5.3.3	Requirements		
	When the supply disconnecting device is one of the first three types specified in 5.3.2, it shall fulfil all of the following requirements:		P
	- isolate the electrical equipment from the supply and have one OFF and one ON position only, clearly marked with “O” and “I”	Clearly marked with ”0” and ”I”	P
	- have a visible gap or a position indicator which cannot indicate OFF until all contacts are actually open and there is an adequate isolating distance between all the contacts in accordance with IEC 60947-3;		P
	- have an external operating means in BLACK or GREY (exception: see 10.7.4); - be provided with a means permitting it to be		P

	locked in the OFF position (e.g. by padlocks). When so locked, remote as well as local closing shall be prevented;		
	- disconnect all live conductors of its power supply circuit. However, for TN supply systems, the neutral conductor may or may not be disconnected.		P
	- have a breaking capacity sufficient to interrupt the current of the largest motor when stalled together with the sum of the normal running currents of all other motors and/or loads.		P
	The calculated breaking capacity may be reduced by the use of a proven diversity factor		P
5.3.4	Operating handle		
	The handle of the supply disconnecting device shall be easily accessible and located between 0,6 m and 1,9 m above the servicing level.		P
5.3.5	Excepted circuits		
	The following circuits need not be disconnected by the supply disconnecting device:		
	- lighting circuits for lighting needed during maintenance or repair;	No lighting circuits	N/A
	- plug and socket outlets for the exclusive connection of repair or maintenance tools and equipment (e.g. hand drills, test equipment);	No plug/socket outlets	N/A
	- under-voltage protection circuits that are only used for automatic tripping in the event of supply failure;		N/A
	- circuits supplying equipment that should normally remain energized for satisfactory operation;	No this situation	N/A
	- control circuits for interlocking.	No this situation	N/A
5.4	Devices for switching off for prevention of unexpected start-up		
	Devices for switching off for the prevention of unexpected start-up shall be provided.		P
	Devices described in 5.3.2 may fulfil that function.		P
	Disconnectors, withdrawable fuse links or withdrawable links may be used, but only when located in an enclosed electrical operating area.		P
	Such devices shall be appropriate and convenient for the intended use, shall be suitably placed, and readily identifiable (e.g. by a durable marking necessary).		P
	Means shall be provided to prevent inadvertent, and/or mistaken closure of the disconnecting device (see also 5.6).		P
	When means other than supply disconnecting devices in accordance with 5.3.2 are used (e.g. a contactor switched off by a control circuit), such means for switching off are intended to be employed only for situations that include:		
	- no significant dismantling of the machine;	No this situation	N/A
	- adjustments requiring a relatively short time;	No this situation	N/A
	- no work carried out on the electrical equipment except when:		
	- there is no hazard arising from electric shock	No this situation	N/A

	(see clause 6) and burn;		
	- the switching off means cannot be negated by the work;		N/A
	- the work is of a minor nature.		N/A
5.5	Devices for disconnecting electrical equipment		
	The supply disconnecting device may be used as for disconnecting electrical equipment to enable work to be carried out without a risk from electric shock or burn.		P
	Where it is necessary to work on individual parts of the electrical equipment of a machine, or on one of a number of machines fed by a common collector bar or collector wire system, a disconnecting device shall be provided for each part, or for each machine, requiring separate isolation.		P
	Devices described in 5.3.2 may fulfill that function.		P
	Disconnectors, withdrawable fuse links or withdraw- able links may be used but only when located in an enclosed electrical operating area, and shall be:	They are used only in enclosed lectrical operating areas	
	- appropriate and convenient for the intended use;	Appropriate and convenient	P
	- suitably located;	Suitably located	P
	- readily identifiable as to which part or circuit(s) of the equipment is Cd;	Can readily identify	P
	- provided with adequate means to prevent unauthorized, inadvertent, and/or mistaken closure of the disconnecting devices (except as allowed in 5.6).		P
5.6	Protection against unauthorized, inadvertent and/or mistaken connection		
	The devices described in 5.4 and 5.5 that are located outside shall be equipped with means to secure them in the OFF position and remote as well as local reconnection shall be prevented.		P
	Where a non-lockable disconnecting device, other means of protection against reconnection, such as warning label on accordance with 16.1 may be provided.		P
	When a plug/socket combination according to 5.3.2 e) is so positioned that it can be kept under the immediate supervision of the person carrying out the work, means for securing in the disconnected state need not be provided.		N/A
6	**PROTECTION AGAINST ELECTRIC SHOCK**		
6.2	Protection against direct contact		
6.2.2	Protection by enclosures		
	Live parts shall be located inside enclosures that conform to the relevant requirements of clauses 4, 12, and 15 and that provide protection against direct contact of at least IP2X or IPXXB:	Degree of protection for live parts inside the enclosures is at least IP2X	P
	Where the top surfaces of the enclosure are readily accessible, the minimum degree of protection against direct contact provided by the top surfaces shall be IP4X or IPXXD:		N/A
	Opening an enclosure shall be possible only under one of the following condition:		
	a) The use of a key or tool is necessary for	Use a tool to open the	P

	access by skilled or instructed persons.	enclosure	
	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 devices intended for such operations while the equipment is still connected, shall be protected against direct contact to at least IP2X or IPXXB		P
	b) The disconnection of live parts inside the enclosure before the enclosure may be opened.	No this design	N/A
	Where more than one door can provide access to live parts, care should be taken to implement the intent of this sub-clause.		N/A
	All parts that are still live after switching off the disconnecting device(s) shall be protected against direct contact to at least IP2X or IPXXB.		N/A
	Such parts shall be marked with a warning sign in accordance with 17.2, excepted for		N/A
	- parts that can be live only because of connection to interlocking circuits and that are distinguished by color as potentially live in accordance with 14.2.4;		N/A
	- the supply terminals of the supply disconnecting device when the latter is mounted alone in a separate enclosure.		N/A
	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.		N/A
	Where barriers provide this protection, either they shall require a tool for their removal or all live parts protected by them shall be automatically disconnected when the barrier is removed.		N/A
6.2.3	Protection by insulation of live parts		
	Live parts protected by insulation shall be completely covered with insulation that can only be removed by destruction.	Some of electrical components Are potected by this way	P
	Such insulation shall be capable of withstanding the mechanical, chemical, electrical, and thermal stresses to which it can be subjected under normal service conditions.	They are proved to be in compliance with this requirement	P
6.2.4	Protection against residual voltages		
	Live parts having a residual voltage greater than 60 V after the supply has been disconnected shall be discharged to 60 V or less within a time period of 5 s after disconnection of the supply voltage, excepted for components having a stored charge of 60 µC or less.	In any case, the residual voltage discharged to 0 V within 1 s	N/A
	Where the rate of discharge would interfere with the proper functioning of the equipment, a durable warning notice drawing attention to the hazard and stating the delay required before the enclosure may be opened shall be displayed at an easily visible location on or immediately adjacent to the enclosure containing the capacitances.		N/A
	In the case of plugs or similar devices, the withdrawal of which results in the exposure of conductors, the discharge time shall not exceed		N/A

	1s, otherwise such conductors shall be protected against direct contact to at least IP2X or IPXXB.		
	If neither a discharge time of 1 s nor a protection of at least IP2X or IPXXB can be achieved, additional disconnecting devices or an appropriate warning device shall be applied.		N/A
6.2.5	Protection by barriers		
	Protection by barriers shall comply with 412.2 of IEC 60364-4-41.	No this situation	N/A
6.2.6	Protection by placing out of reach or protection by obstacles	No this situation	N/A
	Protection by placing out of reach shall comply with 412.4 of IEC 60364-4-41.	No this situation	N/A
	Protection by obstacles shall comply with 412.3 of IEC 60364-4-41.	No this situation	N/A
	For collector wire systems or collector bar systems with a degree of protection less than IP2X shall comply with 13.8.1.	No this situation	N/A
6.3	Protection against indirect contact		
6.3.2	Measures to prevent the occurrence of a hazardous touch voltage		
6.3.2.2	Protection by use of class II equipment or by equivalent insulation		
	This protection is provided by one or more of the following means:		
	- use of class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation in accordance with IEC 60536);	No class II electrical devices is used for this machine	N/A
	- use of switchgear and control gear assemblies having total insulation in accordance with IEC 60439-1;		N/A
	- application of supplementary or reinforced insulation in accordance with 413.2 of IEC 60364-4-41.		N/A
6.3.2.3	Protection by electrical separation		
	This type of protection shall comply with the requirements of 413.5 of IEC 60364-4-41.		P
6.3.3	Protection by automatic disconnection of supply		
	This type of protection shall comply with the requirements of 413.1 of IEC 60364-4-41.		P
6.4	Protection by the use of PELV		
6.4.1	PELV circuits shall satisfy all of the following conditions:		
	a) the nominal voltage shall not exceed:		
	- 25 V a.c. r.m.s. or 60 V ripple-free d.c. when the equipment is normally used in dry locations and when large area contact of live parts with the human body is not expected; or		N/A
	- 6 V a.c. r.m.s. or 15 V ripple-free d.c. in all other cases;		P
	b) one side of the circuit or one point of the source of the supply of that circuit shall be connected to the protective bonding circuit;	Has been connected to PE circuit	P
	c) live parts of PELV circuits shall be electrically separated from other live circuits. Electrical separation shall be not less than that required between the primary and secondary circuits of a safety isolating transformer;	Appropriate electrical separation	P
	d) conductors of each PELV circuit shall be		P

	physically separated from those of any other circuit. When this requirement is impracticable, the insulation provisions of 14.1.3 shall apply;		
	e) plugs and socket-outlets for a PELV circuit shall conform to the following:		N/A
	1) plugs shall not be able to enter socket-outlets of other voltage systems;		N/A
	2) socket-outlets shall not admit plugs of other voltage systems.		N/A
6.4.2	Sources for PELV		
	The source for PELV shall be one of the following:		
	- a safety isolating transformer;		P
	- a source of current providing a degree of safety equivalent to that of the safety isolating transformer (e.g. a motor generator with winding providing equivalent isolation);		N/A
	- an electrochemical source (e.g. a battery) or another source independent of a higher voltage circuit (e.g. a diesel-driven generator);		N/A
	- an electronic power supply conforming to appropriate standards specifying measures to be taken to ensure that, even in the case of an internal fault, the voltage at the outgoing terminals cannot exceed the values specified in 6.4.1.		N/A
7	**PROTECTION OF EQUIPMENT**		
7.2	Over-current protection		
7.2.1	General		
	Over-current 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, whichever is the lesser value.		P
7.2.2	Supply conductors		
	Unless otherwise specified by the user, the supplier of the electrical equipment shall not be responsible for providing the over-current protective device for the supply conductors to the electrical equipment.	No over-current protection is provided for the supply conductor by the manufacturer.	P
	The supplier of the electrical equipment shall state on the installation diagram the data necessary for selecting the over-current protective device (see Annex B).		P
7.2.3	Power circuits		
	Devices for detection and interruption of over-current, selected in accordance with 7.2.10, shall be applied to each live conductor.	Overcurrent protective devices have been provided	P
	Where the cross-sectional area of the neutral conductor is at least equal to or equivalent to that of the phase conductors, it is not necessary to provide over-current detection for the neutral conductor nor a disconnecting device for that conductor.	No any neutral conductor	N/A
	For a neutral conductor with a cross-sectional area smaller than that of the associated phase conductors shall comply with item b) of 473.3.2.1 of IEC 60364-4-473.	Not applicable	N/A
	In IT systems, if a neutral conductor is used, the	Not applicable	N/A

	requirements in 473.3.2.2 of IEC 60364-4-473 shall be complied with.		
7.2.4	Control circuits		
	Conductors of control circuits directly connected to the supply voltage and of circuits feeding control circuit transformers shall be protected against over-current in accordance with 7.2.3.	The overcurrent protective device is provided for conductors of control circuits	P
	In control circuits fed through a transformer, of which one end of the secondary winding is connected to the protective bonding circuit, an over-current protective device is required only in the other secondary circuit conductor.		P
7.2.5	Socket outlets and their associated conductors		
	Over-current protection shall be provided for the circuits feeding the general purpose socket outlets intended primarily for supplying power to maintenance equipment.	No this situation	N/A
	Over-current protective devices shall be provided in the unearthed live conductors of each circuit feeding such socket outlets.	No lighting circuits	N/A
7.2.6	Lighting circuits		
	All unearthed conductors of circuits supplying lighting shall be protected against the effects of short circuits by the provision of over-current devices separate from those protecting other circuits.		P
7.2.7	Transformers		
	Transformers shall be protected against over-current in accordance with IEC 60076-5 and IEC 60742 as appropriate.	The transformer has been protected against overcurrent	P
	Such protection shall (see also 7.2.10):		
	- avoid nuisance tripping due to transformer magnetizing inrush currents;	Unnecessary tipping has been avoided	P
	- avoid a winding temperature rise in excess of the permitted value for the insulation class of transformer when it is subjected to the effects of a short circuit at its secondary terminals.		P
7.2.8	Location of over-current protective devices		
	An over-current protective device shall be located at the point where the conductor to be protected is connected to its supply.	Appropriate location of overcurrent protective device	P
	Where that is not possible, no over-current protection is required for those conductors with current-carrying capacity less than that of the supply conductors, provided that the possibility of a short circuit is reduced by all of the following measures:		
	- the current-carrying capacity of the conductor is at least equal to that required for the load;		N/A
	- each connecting conductor to the over-current protective devices is no longer than 3 m;		N/A
	- the conductor is protected by an enclosure or duct		N/A
7.2.9	Over-current protective devices		
	The rated short-circuit breaking capacity shall be at least equal to the prospective fault current at the point of installation.	Every overcurrent protective device has sufficient breaking capacity	P
	Where the short-circuit current to an over-current protective device can include additional currents other than from the supply (e.g. from		N/A

	motors, from power factor correction capacitors), those currents shall be taken into consideration.		
	A lower breaking capacity is permitted where another protective device having the necessary breaking capacity is installed on the supply side.		N/A
	In that case, the characteristics of the two devices shall be coordinated so that the let-through energy (I2t) of the two devices in series does not exceed that which can be withstood without damage to the over-current protective device on the load side and to the conductors protected by that device.		N/A
	Where fuses are used, a type readily available in the country of use shall be selected, or arrangements shall be made with the user for the supply of spare parts.		P
7.2.10	Rating and setting of over-current protective devices		
	The rated current of fuses or the setting current of other over-current protective devices shall be selected as low as possible but adequate for the anticipated over-currents	The rating and setting of overcurrent protective devices is appropriate.	P
	When selecting those protective devices, consideration should be given to the protection of control switching devices against damage due to over-currents.	Settings of overcurrent protective devices have been listed in the electrical wiring diagrams	P
	The rated current or setting of an over-current protective device is determined by the current carrying capacity of the conductors to be protected by that device in accordance with 12.4, D.2 and the maximum allowable interrupting time in accordance with Clause D.3.		P
	That should take into account the needs of coordination with other electrical devices in the protected circuit.		P
7.3	Protection of motors against overheating		
	Overload protection of motors shall be provided for each motor rated at more than 0.5 kW.	Overload protection of motors have been provided for the machine.	P
	In applications where an automatic interruption of the motor operation is unacceptable (e.g. fire pumps), the overload detection shall give a warning signal to which the operator can respond.		N/A
	Overload protection of motors can be achieved by		
	- overload protection (7.3.2),		N/A
	- over-temperature protection (7.3.3), or		N/A
	- current-limiting protection (7.3.4).		P
7.3.2	Overload Protection		
	Detection of overload(s) (except in the case of current limitation or built-in thermal protection in accordance with IEC 60034-11) shall be provided in each live conductor except for the neutral conductor.		N/A
	However, the number of overload detection devices may be reduced at the request of the user (see Annex B).		N/A
	For motors having single-phase or d.c. power supplies, detection in only one unearthed live		N/A

	conductor is permitted.		
	Where overload protection is achieved by switching off, the switching device shall switch off all live conductors, but the neutral conductor may not be necessary.		N/A
	Where motors with special duty ratings are required to start or to brake frequently, the use of appropriate protective devices designed to accommodate special duty motors or over temperature protection (see 7.3.3) is necessary.		N/A
	For motors that cannot be overloaded, overload protection is not required.		N/A
7.3.3	Over-temperature protection		
	The use of motors with over-temperature protection (see IEC 60034-11) is recommended in situations where the cooling can be impaired.		N/A
	Depending upon the kind of motor, protection under stalled rotor or loss of phase conditions is not always ensured by over-temperature protection, and additional protection should then be provided.		N/A
	Over-temperature protection is also recommended for motors that cannot be overloaded, where the possibility of over temperature exists.		N/A
7.3.4	Current limiting protection		
	Where protection against the effects of overheating in three phase motors is achieved by current limitation, the number of current limitation devices may be reduced from 3 to 2 (see 7.3.2).		P
	For motors having single phase a.c or d.c. power supplies, current limitation in only one unearthed live conductor is permitted.		P
7.4	Abnormal temperature protection		
	Resistance heating or other circuits that are capable of attaining or causing abnormal temperatures and therefore can cause a hazardous condition shall be provided with suitable detection to initiate an appropriate control response.	No heat generating parts	N/A
7.5	Protection against supply interruption or voltage reduction and subsequent restoration		
	Where a supply interruption or a voltage reduction can cause a hazardous condition, damage to the machine, or to the work in progress, under-voltage protection shall be provided at a predetermined voltage level		N/A
	Where the operation of the machine can allow for an interruption or a reduction of the voltage for a short time period, delayed under-voltage protection may be provided.		N/A
	The operation of the under-voltage device shall not impair the operation of any stopping control of the machine.		N/A
7.6	Motor over-speed protection		
	Over-speed protection shall be provided where over-speeding can occur and could possibly cause a hazardous condition taking into account measures in accordance with 9.3.2.		N/A
	Over-speed protection shall initiate appropriate		N/A

	control responses and shall prevent automatic restarting.		
	The over-speed protection should operate in such a manner that the mechanical speed limit of the motor or its load is not exceeded.		N/A
7.7	Earth fault/residual current protection		
	In addition to providing earth fault/residual current protection for automatic disconnection as described in 6.3, this protection can be used to reduce damage to equipment due to earth fault currents less than the detection level of the over-current protection.	No this situation	N/A
	The setting of the devices shall be as low as possible consistent with correct operation of the equipment.	No this situation	N/A
7.8	Phase sequence protection		
	Where an incorrect phase sequence of the supply voltage can cause a hazardous condition or damage to the machine, protection shall be provided.		P
7.9	Protection against over-voltages due to lightning and to switching surges		
	Protective devices can be provided to protect against the effects of over-voltages due to lightning or to switching surges.		P
	Devices for the suppression of over-voltages due to lightning shall be connected to the incoming terminals of the supply disconnecting device.		P
	Devices for the suppression of over-voltages due to switching surges shall be connected across the terminals of all equipment requiring such protection.		P
8	**EQUIPOTENTIAL BONDING**		
8.2	Protective bonding circuit		
8.2.1	General		
	The protective bonding circuit consists of:		
	— PE terminal(s)		P
	— the conductive structural parts of the electrical equipment and the machine;		N/A
	— the protective conductors in the equipment of the machine including sliding contacts where they are part of the circuit.		P
	On mobile machines with on-board power supplies, the protective circuits, the exposed conductive parts, and the extraneous conductive parts shall all be connected to a protective bonding terminal to provide protection against electric shock.	Not a mobile machine without on-board power supplies	N/A
	When a mobile machine is also capable of being connected to an external incoming supply, the protective bonding terminal shall be the connection point for the external protective conductor.	Not a mobile machine without on-board power supplies	N/A
	When the supply of electrical energy is self-contained within stationary, mobile, or movable items of equipment, and when there is no external supply connected, there is no need to connect such equipment to an external protective conductor.		N/A
	All parts of the protective bonding circuit shall be	It is in compliance with	P

	so designed that they are capable of withstanding the highest thermal and mechanical stresses that can be caused by earth-fault currents that could flow in that part of the protective bonding circuit.	this requirement	
	Any structural part of the electrical equipment or of the machine may be used as part of the protective bonding circuit provided that it satisfies the requirements of IEC 60364-5-54.	The continuity of PE circuit can be ensured	P
	If an IT distribution system is used, the machine structure shall be used as part of the protective bonding circuit in conjunction with an earth fault supervision system.	No this situation	N/A
	The structural bonding is not required where all the equipment provided is in accordance with 6.3.2.2.		P
8.2.2	Protective conductors		
	Protective conductors shall be identified in accordance with 14.2.2.	Identification and marking of protective conductors acc. to cl. 14.2.2	P
	Copper conductors should be used. Where a conductor material other than copper is used, its electrical resistance per unit length shall not exceed that of the allowable copper conductor and such conductors shall be not less than 16 mm 2 in cross-sectional area.	Copperconductors are used.	P
8.2.3	Continuity of the protective bonding circuit		
	All exposed conductive parts of the electrical equipment and the machine(s) shall be connected to the protective bonding circuit.		P
	Where a part is removed for any reason, the protective bonding circuit for the remaining parts shall not be interrupted.		P
	Connection and bonding points shall be so designed that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influences.		P
	Where enclosures and conductors of aluminium or aluminium alloys are used, particular consideration should be given to the problems of electrolytic corrosion.		N/A
	Metal ducts of flexible or rigid construction and metallic cable sheaths shall not be used as protective conductors.	No any metal conduit is used on this machine	N/A
	Such metal ducts and the metal sheathing of all connecting cables (e.g. cable armouring, lead sheath) shall be connected to the protective bonding circuit.		P
	Where the electrical equipment is mounted on lids, doors, or cover plates, continuity of the protective bonding circuit shall be ensured and it is recommended that a protective conductor is used.		P
	Otherwise fastenings, hinges or sliding contacts designed to have a low resistance shall be used.		N/A
	The continuity of the protective conductor in cables that are exposed to damage (e.g. flexible		P

	trailing cables) shall be ensured by appropriate measures (e.g. monitoring).		
	For requirements for the continuity of the protective conductor using collector wires, collector bars and slip-ring assemblies.		P
8.2.4	Exclusion of switching devices from the protective bonding circuit		
	The protective bonding circuit shall not incorporate a switching device, an over-current protective device (e.g. switch, fuse) nor a means for current detection for such devices.	It is in compliance with the requirement	P
	The only means permitted for interruption of the protective conductors shall be links intended to be opened only by instructed or skilled persons for certain test or measurement purposes, preferably by using a tool.		P
	It is permissible to include such devices that do not interrupt the protective bonding circuit, that have electrical characteristics that under all circumstances ensure prevention of a hazardous voltage rise in any part of the circuit, and that do not impair the performance of the circuit.		P
8.2.5	Parts that need not be connected to the protective bonding circuit		
	It is not necessary to connect exposed conductive parts to the protective bonding circuit where those parts are mounted so that they do not constitute a hazard because:		
	- they cannot be touched on large surfaces or grasped with the hand and they are small in size (less than approximately 50 mm × 50 mm); or		P
	— they are located so that either contact with live parts, or an insulation failure, is unlikely.		P
8.2.6	Interruption of the protective bonding circuit		
	Where the continuity of the protective bonding circuit can be interrupted by means of removable current collectors or plug/socket combinations, the protective bonding circuit shall not be interrupted before the live conductors have been disconnected, and shall be re-established before any live conductor is reconnected.		N/A
	This also applies to removable or withdraw-able plug-in units.		N/A
	Metallic housings of plug/socket combinations shall be connected to the protective bonding circuit except where used for PELV.	No this situation	N/A
8.2.7	Protective conductor connecting points		
	All protective conductors shall be terminated in accordance with 14.1.1.		P
	The protective conductor connecting points shall have no other function and shall not be used, for example, to attach or connect appliances or parts.		P
	Each protective conductor connecting point shall be identified as such using the symbol, or by the bicolor combination GREEN-AND-YELLOW.		P
	For the use of the letters PE, see 5.2		P
8.3	Bonding for operational purposes		
8.3.1	General		

	The objective of operational bonding is to minimize:		
	- the consequence of an insulation failure on the operation of the machine (see 8.3.2);		P
	- the consequences of electrical disturbances on the operation of sensitive electrical equipment (see 8.3.3).		P
8.3.2	Bonding to the protective circuit		
	One method for protection against unintended operation as a result of insulation failures is achieved by connecting one side of a control circuit fed by a transformer to the protective bonding circuit, with the control devices connected in accordance with 9.1.4. This connection shall be made at the source of the control circuit supply.		P
	Attention is drawn to the fact that by omitting the connection of the exposed conductive parts of the devices to the protective bonding circuit as permitted by 6.3.2.2 and 6.3.2.3, the safety measures of this sub-clause may not be effective.		P
8.3.3	Bonding to a common reference potential		N/A
	The effects of disturbances can be reduced by employing a low resistance conductor in a low impedance network that is used as a reference level for high frequency signals within the electrical equipment (e.g. the chassis or ground plane).	No this situation	N/A
	The design of the bonding connections shall be such as to reduce the impedance to the ground plane as much as possible.	No this situation	N/A
	Such termination points shall be identified by the symbol	No this situation	N/A
	Bonding to a common reference potential other than that provided by the protective bonding circuit or to the terminal for connection to an external (noiseless earth) earth conductor shall be permitted providing the requirements of clauses 6 and 7 are met.	No this situation	N/A
	Single point bonding connected directly to a point as close as possible to the PE terminal or to its own terminal for connection to an external (noiseless) earth conductor shall be used, where appropriate, to minimize common mode interferences.		N/A
	This latter terminal shall be identified by the symbol.		N/A
9	**CONTROL CIRCUITS AND CONTROL FUNCTIONS**		
9.1	Control circuits		
9.1.1	Control circuit supply		
	Transformers shall be used for supplying the control circuits.		P
	Such transformers shall have separate windings.	The transformer has separate isolated windings	P
	Where several transformers are used, it is recommended that the windings of those transformers be connected in such a manner that the secondary voltages are in phase.		N/A
	Where d.c. control circuits are connected to the		N/A

	protective bonding circuit, they shall be supplied from a separate winding of the a.c. control circuit transformer or by another control circuit transformer.		
	Transformers are not mandatory for machines with a single motor starter and a maximum of two control devices (e.g. interlock device, start/stop control station).		N/A
9.1.2	Control circuit voltages		
	The value of the control voltage should be consistent with the correct operation of the control circuit.		P
	The nominal voltage shall not exceed 277 V when supplied from a transformer.	Input: 110V	P
9.1.3	Protection		
	Control circuits shall be provided with overcurrent protection in accordance with 7.2.4 and 7.2.10.		P
9.1.4	Connection of control devices		
	In control circuits with one side connected (or intended to be connected) to the protective bonding circuit, one terminal of the operating coil of each electromagnetically operated device or one terminal of any other electrical device shall be connected directly to that side of the control circuit.		P
	All switching elements of control devices that operate the coil or the device shall be inserted between the other terminal of the coil or device and the other side of the control circuit.		P
	The following exceptions are permitted:		
	- where the requirements of 9.4.3.1 are met.		N/A
9.2	Control functions		
9.2.1	Start functions		
	Start functions shall operate by energizing the relevant circuit (see 9.2.5.2).		P
9.2.2	Stop functions		
	There are three categories of stops as follows:		
	- category 0: stopping by immediate removal of power to the machine actuators;		N/A
	- category 1: a controlled stop (see 3.11) with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved;		P
	- category 2: a controlled stop with power left available to the machine actuators.		N/A
	With the exception of emergency operations (see 9.2.5.4), and depending upon the risk assessment, removal of power may be accomplished by the use of either electromechanical or solid-state components.	Power switch	P
9.2.3	Operating modes		
	Each machine can have one or more operating modes determined by the type of machine and its application.		P
	When a hazardous condition can result from a mode selection, such selection shall be prevented by suitable means. Mode selection by itself shall not initiate machine operation. A separate action by the operator shall be required.	No hazardous condition could arise from mode selection.	P

	Safeguarding shall remain effective for all operating modes (see 9.2.4 for suspension of safeguarding under special conditions).		P
	Indication of the selected operating mode shall be provided.		P
9.2.4	Suspension of safeguarding		
	Where it is necessary to suspend safeguarding, a mode selection device or means capable of being secured in the desired mode shall be provided so as to prevent automatic operation.	Mode selection by itself does not initiate machine operation.	P
	In addition, one or more of the following means should be provided:		
	- initiation of motion by a hold-to-run device or by a similar control device;		P
	- a portable control station with an emergency stop device and, where appropriate, an enabling device. Where a portable station is in use, motion may be initiated only from that station;	No this situation	N/A
	- limitation of the speed or the power of motion;		N/A
	- limitation of the range of motion.		N/A
9.2.5	Operation		
9.2.5.1	General		
	Measures shall be taken to prevent movement of the machine in an unintended manner after any stopping of the machine.		P
9.2.5.2	Start		
	The start of an operation shall be possible only when all of the safeguards are in place and are functional except for conditions as described in 9.2.4.		P
	On those machines where safeguards cannot be applied for certain operations, manual control of such operations shall be by hold-to-run controls, together with enabling devices, as appropriate.		P
	Suitable interlocks shall be provided to secure correct sequential starting.		P
	On machines requiring the use of more than one control station to initiate a start:		
	- each control station shall have a separate manually actuated start control device;		P
	- all required conditions for machine operation shall be met;		P
	- all start control devices shall be in the released (off) position before a start may be permitted;		P
	- all start control devices shall be actuated concurrently (see 3.6).		P
9.2.5.3	Stop		
	Category 0, category 1 and/or category 2 stops shall be provided where indicated by the risk assessment and the functional requirements of the machine (see 4.1).	Use category 0 stops	P
	Category 0 and category 1 stops shall be operational regardless of operating modes (see 9.2.3) and category 0 shall take priority.	Cate. 0 stop only	P
	Stop functions shall override related start functions (see 9.2.5.2).		P
	Where required, facilities to connect protective devices and interlocks shall be provided.		P
	If such a protective device or interlock causes a stop of the machine, it may be necessary for that condition to be signalled to the logic of the		P

	control system.		
	The reset of the stop function shall not initiate any hazardous condition.		P
9.2.5.4	Emergency operations (emergency stop, emergency switching off)		P
9.2.5.4.2	Emergency stop		
	In addition to the requirements for stop (see 9.2.5.3), the emergency stop function has the following requirements:		
	- it shall override all other functions and operations in all modes;		P
	- power to the machine actuators that can cause a hazardous condition(s) shall be removed as quickly as possible without creating other hazards;		
	- reset shall not initiate a restart.	Resetting does not initiate a restart	P
	The emergency stop shall function either as a category 0 stop or as a category 1 stop, which shall be determined by the risk assessment of the machine.		P
	Where a category 0 stop is used for the emergency stop function, it shall have only hardwired electromechanical components. In addition, its operation shall not depend on electronic logic (hardware or software) or on the transmission of commands over a communications network or link.		P
	Where a category 1 stop is used for the emergency stop function, final removal of power to the machine actuators shall be ensured and carried out by means of electromechanical components.		P
9.2.5.4.3	Emergency switching off		
	The functional aspects of emergency switching off are given in IEC 60364-4-46.		P
	Emergency switching off should be provided where:		
	- protection against direct contact is achieved only by placing out of reach or by obstacles (see 6.2.6); or		P
	- there is the possibility of other hazards or damage caused by electricity.		P
	Emergency switching off is accomplished by disconnecting the incoming supply of the machine effecting a category 0 stop.		P
	When a machine cannot tolerate the category 0 stop, it may be necessary to provide other protection, for example against direct contact, so that emergency switching off is not necessary.		P
9.2.5.5	Monitoring of command actions		
	Movement or action of a machine or part of a machine that can result in a hazardous condition shall be monitored.	No this situation	N/A
	On manually controlled machines, operators can provide some of this monitoring.	No this situation	N/A
9.2.6	Hold-to-run controls		
9.2.6.1	Hold-to-run controls shall require continuous actuation of the control device(s) to achieve	The hold-to-run controls have	P

	operation.	been provided.	
9.2.6.2	Two-hand control		
	Three types of two-hand control are available, which is determined by the risk assessment.		P
	Type I: this type requires		
	- the provision of two control devices and their concurrent actuation by both hands;		P
	- continuous concurrent actuation during the hazardous condition;		P
	- machine operation shall cease upon the release of either one or both of the control devices when hazardous conditions are still present.		P
	Type II:		
	a type I control requiring the release of both control devices before machine operation may be reinitiated.	No this device	N/A
	Type III:		
	a type II control requiring concurrent actuation of the control devices as follows:		N/A
	- it shall be necessary to actuate the control devices within a certain time limit of each other, not exceeding 0,5 s (see Annex B);		N/A
	- where this time limit is exceeded, both control devices shall be released before operation may be reinitiated		N/A
9.2.6.3	Enabling control		
	An enabling device is an additional manually operated control device used in conjunction with a start control and which, when continuously actuated, allows a machine to function.		P
	When an enabling device is provided as a part of a system, it shall be designed to allow motion when actuated in one position only. In any other position motion shall be stopped.		P
	It shall have the following features:		
	- be connected to a category 0 stop or to a category 1 stop (see 9.2.2);		P
	- be designed in consideration of ergonomic principles;		P
	- for a two-position type:		
	- position 1: off-function of the switch (actuator is not operated),		P
	- position 2: enabling function (actuator is operated);		P
	- for a three-position type:		
	position 1: off-function of the switch (actuator is not operated),		P
	- position 2: enabling function (actuator is operated in its mid position),		P
	- position 3: off-function (actuator is operated past its mid position).		P
	When returning from position 3 to position 2, the function shall not be enabled		P
9.2.6.4	Combined start and stop controls		
	Push-buttons and similar control devices that, when operated, alternately initiate and stop motion shall only be used for functions which cannot result in a hazardous condition		P

9.2.7	Cableless control		
9.2.7.1	General		
	Some of these application and system integrity considerations may also be applicable to control functions employing serial data communication techniques where the communications link uses a cable..	There is not any cableless control	N/A
	Means shall be provided to readily remove or disconnect the power supply of the operator control station.	There is not any cableless control	N/A
	Means shall be provided, as necessary, to prevent unauthorized use of the operator control station.	There is not any cableless control	N/A
	Each operator control station shall carry an unambiguous indication of which machine(s) is intended to be controlled by that operator control station.	There is not any cableless control	N/A
9.2.7.2	Control limitation		
	Measures shall be taken to ensure that control commands:		
	- affect only the intended machine;		N/A
	- affect only the intended functions.		N/A
	Measures shall be taken to prevent the machine from responding to signals other than those from the intended operator control station(s).		N/A
	Where necessary, means shall be provided so that the machine can only be controlled from operator control stations in one or more predetermined zones or locations.		N/A
9.2.7.3	Stop		
	Operator control stations shall include a separate and clearly identifiable means to initiate the stop function of the machine or of all the motions that can cause a hazardous condition.	No this situation	N/A
	The actuating means to initiate this stop function shall not be marked or labelled as an emergency stop device, even though the stop function initiated on the machine can be an emergency stop function.		P
	A machine which is equipped with cableless control shall have a means of automatically initiating the stopping of the machine and of preventing a potentially hazardous operation, in the following situations:		
	- when a stop signal is received;		N/A
	- when a fault is detected in the system;		N/A
	- when a valid signal has not been detected within a specified period of time (see Annex B), except when a machine is executing a pre-programmed task taking it outside the range of the cableless control where no hazardous condition can occur.	No this situation	N/A
9.2.7.4	Serial data communication		
	In a machine where the control of safety-related functions relies on serial data transfer, correct communications shall be ensured by using an error detection method that is able to cope with up to three error bits in any command sequence.		N/A

9.2.7.5	Use of more than one operator control station		
	Where a machine has more than one operator control station, measures shall be taken to ensure that only one control station can be enabled at a given time.	No this situation	N/A
	An indication of which operator control station is in control of the machine shall be provided at suitable locations as determined by the risk assessment of the machine.	No this situation	N/A
	Exception: a stop command from any one of the control stations shall be effective when required by the risk assessment of the machine.	No this situation	N/A
9.2.7.6	Battery-powered operator control stations		
	A variation in the battery voltage shall not cause a hazardous condition.		N/A
	If one or more potentially hazardous motions are controlled using a battery-powered operator control station, a clear warning shall be given to the operator when a variation in battery voltage exceeds specified limits.		N/A
	Under those circumstances, the operator control station shall remain functional long enough to put the machine into a non-hazardous condition.		N/A
9.3	Protective interlocks		
9.3.1	Reclosing or resetting of an interlocking safeguard		
	The reclosing or resetting of an interlocking safeguard shall not initiate machine motion or operation where that can result in a hazardous condition.	No interlocking guards	N/A
9.3.2	Overtravel limits		
	Where an overtravel can cause a hazardous condition, a position sensor or limit switch shall be provided to initiate appropriate control action.		P
9.3.3	Operation of auxiliary functions		P
	The correct operation of auxiliary functions shall be checked by appropriate devices.		P
	Where the non-operation of a motor or device for an auxiliary function can cause a hazardous condition, or cause damage to the machine or to the work in progress, appropriate interlocking shall be provided.		P
9.3.4	Interlocks between different operations and for contrary motions		
	All contactors, relays, and other control devices that control elements of the machine and that can cause a hazardous condition when actuated at the same time, shall be interlocked against incorrect operation.		N/A
	Reversing contactors shall be interlocked in such a way that in normal service no short circuit can occur when switching.	Reversing is not necessary	N/A
	Where, for safety or for continuous operation, certain functions on the machine are required to be interrelated, proper co-ordination shall be ensured by suitable interlocks.		N/A
	For a group of machines working together in a coordinated manner and having more than one controller, provision shall be made to co-ordinate the operations of the controllers as necessary.		N/A

	Where a failure of a mechanical brake actuator can result in the brake being applied when the associated machine actuator is energized and a hazardous condition can result, interlocks shall be provided to switch off the machine actuator.		N/A
9.3.5	Reverse current braking		
	Where reverse current braking is used on a motor, effective measures shall be taken to avoid the motor starting in the opposite direction at the end of braking where that reversal can cause a hazardous condition or damage to the machine or to the work in progress.		P
	The use of a device operating exclusively as a function of time shall not be allowed		P
	Control circuits shall be so arranged that rotation of a motor shaft shall not result in a hazardous condition.		P
9.4	Control functions in the event of failure		
9.4.1	General requirements		
	Where failures or disturbances in the electrical equipment can cause a hazardous condition or damage to the machine or to the work in progress, appropriate measures shall be taken to minimize the probability of the occurrence of such failures or disturbances.		P
	The required measures and the extent to which they are implemented, either individually or in combination, depend on the level of risk associated with the respective application.		P
	Measures to reduce those risks include but are not limited to:		
	- protective devices on the machine;		P
	- protective interlocking of the electrical circuit;		P
	- use of proven circuit techniques and components (see 9.4.2.1);		P
	- provision of partial or complete redundancy (see 9.4.2.2) or diversity (see 9.4.2.3);	A combination of electrical and non-electrical systems	P
	- provision for functional tests (see 9.4.2.4).		P
9.4.2	Measures to minimize risk in the event of failure		
9.4.2.1	Use of proven circuit techniques and components		
	These measures include but are not limited to:		
	- bonding of control circuits to the protective bonding circuit for operational purposes (see 9.4.3.1);		P
	- connection of control devices in accordance with 9.1.4;		P
	- stopping by de-energizing (see 9.2.2);		P
	- the switching of all live conductors to the device being controlled (see 9.4.3.1);		P
	- the use of switching devices having positive (or direct) opening operation (see IEC 60947-5-1);		P
	- circuit design to reduce the possibility of failures causing undesirable operations.		P
9.4.2.2	Provisions for redundancy		
	By providing partial or complete redundancy it is possible to minimize the probability that one single failure in the electrical circuit can result in a hazardous condition.	Redundancy is not required according to the result of risk assessment.	N/A

	Redundancy can be effective in normal operation or designed as special circuits that take over the protective function only where the operating function fails.		N/A
	Where off-line redundancy which is not active during normal operation is used, suitable measures shall be taken to ensure that those control circuits are available when required.		N/A
9.4.2.3	Use of diversity		
	The use of control circuits having different principles of operation or using different types of devices may reduce the probability of hazards resulting from faults and/or failures.		N/A
	Examples include:		
	- the combination of normally open and normally closed contacts operated by interlocking guards;		P
	- the use of different types of control circuit components in the circuit;		P
	- the combination of electromechanical and electronic circuits in redundant configurations;		P
	- the combination of electrical and non-electrical systems may perform the redundant function and provide the diversity.		N/A
9.4.2.4	Functional tests		
	Functional tests may be carried out automatically by the control system, or manually by inspection or tests at start-up and at predetermined intervals, or a combination as appropriate.		P
9.4.3	Protection against maloperation due to earth faults, voltage interruptions and loss of circuit continuity		
9.4.3.1	Earth faults		
	Earth faults on any control circuit shall not cause unintentional starting, potentially hazardous motions, or prevent stopping of the machine.		P
	In order to fulfil this requirement, bonding to the protective bonding circuit may be provided in accordance with 8.2 and the devices may be connected as described in 9.1.4.		P
	Control circuits fed from a transformer and not connected to the protective bonding circuit shall be provided with an insulation monitoring device that either indicates an earth fault or interrupts the circuit automatically after an earth fault.		P
	Where the control circuit is directly connected between the phase conductors of the supply or between a phase conductor and a neutral conductor that is not earthed or is earthed through a high impedance, multi-pole control switches that interrupt all live conductors shall be used for START or STOP of those machine functions that can cause a hazardous condition or damage to the machine in the event of unintentional starting or failure to stop.		P
9.4.3.2	Voltage interruptions		
	The requirements detailed in 7.5 shall apply.		P
	Where the control system uses a memory device(s), proper functioning in the event of power failure shall be ensured to prevent any	Appropriate measures have been taken to prevent	P

	loss of memory that can result in a hazardous condition.	memory loss.	
9.4.3.3	Loss of circuit continuity		
	Where the loss of continuity of safety-related control circuits depending upon sliding contacts can result in a hazardous condition, appropriate measures shall be taken.		P
10	**OPERATOR INTERFACE AND MACHINE-MOUNTED CONTROL DEVICES**		
10.1.1	General device requirements		
	As far as is practicable, those devices shall be selected, mounted, and identified or coded in accordance with IEC 60073 and IEC 60447.	The relevant standard has been followed as far as possible.	P
10.1.2	Location and mounting		
	As far as is practicable, machine-mounted control devices shall be:	It is in compliance with this requirement.	
	- readily accessible for service and maintenance;		P
	The actuators of hand-operated control devices shall be selected and installed so that:		P
	- they are not less than 0.6 m above the servicing level and are within easy reach of the normal working position of the operator;		
	- the operator is not placed in a hazardous situation when operating them;		P
	- the possibility of inadvertent operation is minimized.		P
10.1.3	Protection		
	Where mounted as intended, operator interface and machine mounted control devices shall withstand the stresses of expected use.	Effective protection	P
	The degree of protection together with other appropriate measures shall afford protection against:	Effective protection	
	- the effects of aggressive liquids, vapours, or gases found in the physical environment or used on the machine;		P
	- the ingress of contaminants.		P
	In addition, the operator interface control devices shall have a minimum degree of protection against direct contact of IPXXD.	At least IP22	P
10.1.4	Position sensors		
	Position sensors shall be so arranged that they will not be damaged in the event of overtravel.		P
	Position sensors used in circuits with safetyrelated functions either shall have positive (or direct) opening operation (see IEC 60947-5-1) or shall provide similar reliability (see 9.4.2).		P
10.1.5	Portable and pendant control stations		
	Portable and pendant operator control stations and their control devices shall be so selected and arranged as to minimize the possibility of inadvertent machine operations caused by shocks and vibrations.	No this situation	N/A
10.2	Push-buttons		
10.2.1	Colours		
	Push-button actuators shall be colour-coded in accordance with Table 2.	The suitable colour according to table 2 has been found on the	P

		control push buttons.	
	The colours for START/ON actuators should be WHITE, GREY or BLACK and RED is forbidden.		P
	The colour RED shall be used for emergency stop and emergency switching off actuators.		P
	The colours for STOP/OFF actuators should be BLACK, GREY, or WHITE but BLACK. GREEN shall not be used. RED is also permitted, but it is recommended that RED is not used near an emergency operation device.		P
	WHITE, GREY, or BLACK are the preferred colours for push-button actuators that alternately act as START/ON and STOP/OFF push-buttons. The colours RED, YELLOW, or GREEN shall not be used (see also 9.2.6).		P
	WHITE, GREY, or BLACK are the preferred colours for push-button actuators that cause operation while they are actuated and cease the operation when they are released. The colours RED, YELLOW, or GREEN shall not be used.		P
	Reset push-buttons shall be BLUE, WHITE, GREY, or BLACK. Where they also act as a STOP/OFF button, the colours WHITE, GREY, or BLACK are preferred with the main preference being for BLACK. GREEN shall not be used.		P
10.2.2	Markings		
	Push-buttons shall be marked, near to or preferably directly on the actuators , with the following symbols:		
	- START or ON		P
	- STOP or OFF		P
	- Push-buttons acting alternately as START or STOP buttons and as ON or OFF buttons		P
	- Push-buttons acting as START or ON buttons when pressed and as STOP or OFF buttons when released		P
10.3	Indicator lights and displays		
10.3.1	Modes of use		
	Indicator lights and displays serve to give the following types of information:		
	- indication: to attract the operator’s attention or to indicate that a certain task should be performed. The colours RED, YELLOW, GREEN and BLUE are normally used in this mode;		P
	- confirmation: to confirm a command, or a condition, or to confirm the termination of a change or transition period. The colours BLUE and WHITE are normally used in this mode and GREEN may be used in some cases.		P
10.3.2	Colours		
	Unless otherwise agreed between the supplier and the user, indicator (pilot) light lenses shall be colour coded with respect to the condition (status) of the machine in accordance with Table 3.		P
	Alternative meanings may be assigned (see IEC 60073) in accordance with one of the following criteria:		
	- the safety of persons and the environment;		P

	- the state of the electrical equipment.		P
10.3.3	Flashing lights		
	For further distinction or information and especially to give additional emphasis, flashing lights may be used for the following purposes:	No flashing lights	N/A
	- to attract attention;		N/A
	- to request immediate action;		N/A
	- to indicate a discrepancy between the command and actual state;		N/A
	- to indicate a change in process (flashing during transition).		N/A
	It is recommended that higher frequency flashing lights be used for higher priority information.		N/A
10.4	Illuminated push-buttons		
	Illuminated push-button actuators shall be colourcoded in accordance with Table 2 and Table 3.		P
	Where there is difficulty in assigning an appropriate colour, WHITE shall be used.		P
	The colour RED for the emergency stop actuator Shall not depend on the illumination of its light.		P
10.5	Rotary control devices		
	Devices having a rotational member, such as potentiometers and selector switches, shall be mounted in such a way as to prevent rotation of the stationary member. Friction alone shall not be sufficient.		P
10.6	Start devices		
	Actuators used to initiate a start function or the movement of machine elements shall be constructed and mounted so as to minimize inadvertent operation. However, mushroom-type actuators may be used for two-hand control.		P
10.7	Devices for emergency stop		
10.7.1	Location		
	Devices for emergency stop shall be readily accessible.		P
	Emergency stop devices shall be located at each operator control station and at other locations where the initiation of an emergency stop can be required (exception: see 9.2.7.3).		P
10.7.2	Types		
	The types of device for emergency stop include:		
	- a push-button operated switch;		P
	- a pull-cord operated switch;		N/A
	- a pedal-operated switch without a mechanical guard.		N/A
	The devices shall be of the self-latching type and shall have positive (or direct) opening operation.	They are of self-latching type	P
10.7.3	Restoration of normal function after emergency stop	Restoring an emergency stop requires manual reset.	
	It shall not be possible to restore an emergency stop circuit until the emergency stop device has been manually reset.		P
	Where several emergency stop devices are provided in a circuit, it shall not be possible to restore that circuit until all emergency stop devices that have been operated have been		P

	reset		
10.7.4	Actuators		
	Actuators of emergency stop devices shall be coloured RED.		N/A
	The background immediately around the actuator shall be coloured YELLOW.		N /A
	The actuator of a push-button operated emergency stop device shall be of the palm or mushroom head type.		N/A
10.7.5	Local operation of the supply disconnecting device to effect emergency stop		N/A
	The supply disconnecting device may be locally operated to serve the function of emergency stop when:		N/A
	- it is readily accessible to the operator;		N/A
	- it is of the type described in 5.3.2 a), b) or c).		N/A
	When intended for such use, the supply disconnecting device shall meet the colour requirements of 10.7.4.		N/A
10.8	Devices for emergency switching off		
10.8.1	Location		
	Emergency switching off devices shall be located as necessary for the given application. Normally, those devices will be located separate from operator control stations.		N/A
	Were it can be necessary to initiate the emergency switching off function from an operator control station, that control station need not also be equipped with a separate emergency stop device since the emergency switching off function effects a category 0 emergency stop		N/A
10.8.2	Types		
	The types of device for emergency switching off include:		
	- a push-button operated switch;		N/A
	- a pull-cord operated switch.		N/A
	The devices shall be of the Self-latching type and shall have positive (or direct) opening operation (see IEC 60947-5-1).		N/A
	The push-button operated switch may be in a break-glass enclosure.		N/A
10.8.3	Restoration of normal function after emergency switching off		N/A
	It shall not be possible to restore an emergency switching off circuit until the emergency switching off device has been manually reset.		N/A
	Where several emergency switching off devices are provided in a circuit, it shall not be possible to restore that circuit until all emergency switching off devices that have been operated have been reset.		N/A
10.8.4	Actuators		
	Actuators of emergency switching off devices shall be coloured RED.		P
	The background immediately around the device actuator should be coloured YELLOW		P
	The actuator of a push-button operated emergency switching off device shall be of the palm or mushroom head type.		P
10.8.5	Local operation of the supply disconnecting		

	device to effect emergency switching off		
	Where the supply disconnecting device is to be locally operated for emergency switching off, it shall be readily accessible and should meet the colour requirements of 10.8.4.		N/A
10.9	Displays		N/A
	Displays shall be selected and installed in such a manner as to be visible from the normal position of the operator.		N/A
	Where displays are intended to be warning devices, it is recommended that they be of the flashing or rotary type and be provided with an audible warning device.		N/A
11	**ELECTRONIC EQUIPMENT**		
11.2	Basic requirements		
11.2.1	Inputs and outputs		
	An indication of the status of all digital inputs and outputs should be provided.		P
11.2.2	Equipotential bonding		
	All input/output racks (remote or local), processor racks, and power supplies shall be electrically bonded together in accordance with the supplier's specifications and connected to the protective bonding circuit (see 8.2.3).		P
	Where it is necessary for operational purposes for some equipment to be isolated from the protective bonding circuit, such equipment may be excluded from this requirement in accordance with clause 8.		P
11.3	Programmable equipment		
11.3.1	Programmable controllers		
	Programmable controllers shall conform to relevant IEC standards.		N/A
11.3.2	Memory retention and protection		
	Means shall be provided to prevent memory alteration by unauthorized persons and the requirements detailed in 9.4.3.2 shall apply.		N/A
11.3.3	Software verification		
	Equipment using reprogrammable logic shall have means for verifying that the software is in accordance with the relevant program documentation.		N/A
11.3.4	Use in safety-related functions		
	Programmable electronic equipment shall not be used for category 0 emergency stop functions.		N/A
	For all other safety-related stop functions, the use of hard-wired electromechanical components is preferred.		N/A
	Where programmable electronic equipment is used for such functions, then appropriate measures in accordance with 9.4 shall be employed.		N/A
	These requirements shall not preclude the use of programmable electronic equipment for monitoring, testing, or backing-up such functions but that equipment shall not prevent the correct operation of those functions.		P
	Until such a time that this situation can be resolved, it is inadvisable to rely solely on the correct operation of such a single-channel device.		P

12	CONTROLGEAR: LOCATION, MOUNTING, AND ENCLOSURES		
12.1	General requirements		
	All controlgear shall be located and mounted so as to facilitate:	It is in compliance with this requirement.	P
	- its accessibility and maintenance;		
	- its protection against the external influences or conditions under which it is intended to operate;		P
	- operation and maintenance of the machine and its associated equipment.		P
12.2	Location and mounting		
12.2.1	Accessibility and maintenance		
	All items of controlgear shall be placed and oriented so that they can be identified without moving them or the wiring.	Can be clearly identified	P
	For items that require checking for correct operation or that are liable to need replacement, those actions should be possible without dismantling other equipment or parts of the machine (except opening doors or removing covers).	It is in compliance with this requirement.	P
	Terminals not associated with controlgear shall also conform to these requirements.		P
	All controlgear shall be mounted so as to facilitate its operation and maintenance from the front.		P
	Where a special tool is necessary to remove a device, such a tool shall be supplied.		P
	Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0.4 m and 2.0 m above the servicing level.		P
	It is recommended that terminals be at least 0.2 m above the servicing level and be so placed that conductors and cables can be easily connected to them.		P
	No devices except devices for operating, indicating, measuring, and cooling shall be mounted on doors and on normally removable access covers of enclosures.		P
	Where control devices are connected through plug-in arrangements, their association shall be made clear by type (shape), marking or reference designation, singly or in combination (see 14.4.5).		P
	Plug-in devices that are handled during normal operation shall be provided with noninterchangeable features where the lack of such a facility can result in malfunctioning.		N/A
	Plug/socket combinations that are handled during normal operation shall be located and mounted so as to provide unobstructed access.		N/A
	Test points, where provided, shall be:		
	- mounted so as to provide unobstructed access;		P
	- clearly marked to correspond with the documentation;		P
	- adequately insulated;		P
	sufficiently spaced for connection of the test equipment or means.		P

12.2.2	Physical separation or grouping		
	Non-electrical parts and devices, not directly associated with the electrical equipment, shall not be located within enclosures containing controlgear.	It is in compliance with this requirement.	P
	Devices such as solenoid valves should be separated from the other electrical equipment.	Non-electrical parts and electrical parts are mounted separately.	P
	Control devices mounted in the same location and connected to the supply voltage, or to both supply and control voltages, shall be grouped separately from those connected only to the control voltages.		P
	Terminals shall be separated into groups for:		P
	- power circuits;		P
	- associated control circuits;		P
	- other control circuits, fed from external sources.	No this situation	N/A
	The groups may be mounted adjacently, provided that each group can be readily identified.		P
	When arranging the location of devices (including interconnections), the clearances and creepage distances specified for them shall be maintained, taking into account the external influences or conditions of the physical environment.		P
12.2.3	Heating effects		
	Heat generating components shall be so located that the temperature of each component in the vicinity remains within the permitted limit.		P
12.3	Degrees of protection		
	The protection of controlgear against ingress of solid foreign objects and of liquids shall be adequate taking into account the external influences under which the machine is intended to operate and shall be sufficient against dust, coolants, and swarf.	It is in compliance with this requirement.	P
	Enclosures of controlgear shall provide a degree of protection of at least IP22 (see IEC 60529).		P
	Exceptions:		
	a) Where an electrical operating area is used as a protective enclosure for an appropriate degree of protection against the ingress of solid bodies and liquids.	Suitable protective enclosure is provided for protection	P
	b) Where removable collectors on collector wire or collector bar systems are used and IP22 is not achieved but the measures of 6.2.5 are applied.		N/A
	Some examples of applications, along with the degree of protection typically provided by their enclosures, are listed below:		N/A
	Depending upon the conditions where installed, another degree of protection may be appropriate.		N/A
12.4	Enclosures, doors and openings		
	Enclosures shall be constructed using materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity that are likely to be	Material of the enclosures is steel plate, which is able to	P

	encountered in normal service.	withstand mechanical, electrical, thermal stress, etc.	
	Fasteners used to secure doors and covers should be of the captive type.		P
	Windows provided for viewing internally mounted indicating devices shall be of a material suitable to withstand mechanical stress and chemical attack.	No such windows	P
	It is recommended that enclosure doors be not wider than 0.9 m and have vertical hinges, preferably of the lift off type, with an angle of opening of at least 95°.		P
	The joints or gaskets of doors, lids, covers and enclosures shall withstand the chemical effects of the aggressive liquids, vapours, or gases used on the machine.		
	The means used to maintain the degree of protection of an enclosure on doors, lids and covers that require opening or removal for operation or maintenance shall:		
	- be securely attached to either the door/cover or the enclosure;	It is in compliance with this requirement.	P
	not deteriorate due to removal or replacement of the door or the cover, and so impair the degree of protection.		P
	All openings in the enclosure, including those towards the floor or foundation or to other parts of machine, shall be closed by the supplier(s) in a manner ensuring the degree of protection specified for the equipment.		P
	Openings for cable entries shall be easily reopened on site.		P
	A suitable opening may be provided in the base of enclosures within the machine so that moisture due to condensation may drain away.		P
	There shall be no opening between enclosures containing electrical equipment and compartments containing coolant, lubricating or hydraulic fluids, or those into which oil, other liquids, or dust can penetrate, except for electrical devices specifically designed to operate in oil and electrical equipment in which coolants are used.		P
12.5	Access to controlgear		
	The minimum dimensions of gangways in front of and between controlgear shall be in accordance with 481.2.4 of IEC 60364-4-481.		N/A
	Doors in gangways and for access to electrical operating areas shall:		
	- be at least 0,7 m wide and 2.0 m high;		N/A
	- open outwards;		N/A
	- have a means to allow opening from the inside without the use of a key or tool.		
13	**CONDUCTORS AND CABLES**		
13.1	General requirements		
	Conductors and cables shall be selected so as to be suitable for the operating conditions and	Suitable for operating conditions	P

	external influences that can exist.		
	These requirements do not apply to the integral wiring of assemblies, subassemblies, and devices that are manufactured and tested in accordance with their relevant IEC standard.	(IEC 60439-1)	P
13.2	Conductors		
	In general, conductors shall be of copper.	Conductors are of copper	P
	Conductors of any other material shall have a nominal cross-sectional area such that, carrying the same current, the maximum conductor temperature shall not exceed the value given in Table 4.	No this situation	N/A
	Where aluminium is used, the cross-sectional area shall be at least 16 mm2.		N/A
	Although class 1 conductors are primarily intended for use between rigid, non-moving parts, they may also be used where minimal flexing occurs provided that the cross-sectional area is less than 0.5 mm2.		P
	All conductors that are subject to frequent movement shall have flexible stranding of class 5 or class 6 (see Table C.4).	No such conductors	N/A
13.3	Insulation		
	The types of insulation include (but are not limited to):		
	- polyvinyl chloride (PVC);	PVC	P
	- rubber, natural and synthetic;		N/A
	- silicone rubber (SiR);		N/A
	- mineral;		N/A
	- cross-linked polyethylene (XLPE);		N/A
	- ethylene propylene compound (EPR).		N/A
	Where the insulation of conductors and cables can constitute hazards due to the propagation of a fire or the emission of toxic or corrosive fumes, guidance from the cable supplier should be sought.	The conductors comply with related IEC standard	P
	It is important to give special attention to the integrity of a circuit having a safety-related function.		P
	The dielectric strength of the insulation shall be adequate for the test voltage required with a minimum of 2000 V a.c. for 5 min duration for cables operating at voltages higher than 50 V a.c. or 120 V d.c.	2000 VAC, 5 min No breakdown	P
	For separate PELV circuits, the dielectric strength shall be adequate for the test voltage of 500 V a.c. for a duration of 5 min.		N/A
	The mechanical strength and thickness of the insulation shall be such that the insulation cannot be damaged in operation or during laying, especially for cables pulled into ducts.	Appropriate protective measures have been provided to prevent damage of insulation.	P
13.4	Current-carrying capacity in normal service		
	The current-carrying capacity of conductors and cables is determined by both:		
	- the maximum allowable conductor temperature under the highest possible steady-state current or the thermal equivalent r.m.s. current for intermittent duty applications (see C.2); and		P
	- the ultimate allowable short-time conductor temperature under short-circuit conditions.		P
	The cross-sectional area of a conductor shall be		P

	such that, under those conditions, the conductor temperature does not exceed the value given in Table 4, unless otherwise specified by the cable manufacturer.		
	The current-carrying capacities for PVC insulated wiring between enclosures and individual items of equipment under steady-state conditions are given in Table 5.		N/A
	For the selection of conductors and cables for intermittent duty applications, see C.2 for the calculation of the thermal equivalent r.m.s. current.		P
13.5	Conductor and cable voltage drop		
	The voltage drop from the point of supply to the shall not exceed 5 % of the nominal voltage under normal operating conditions.	Voltage drop ＜1%	P
13.6	Minimum cross-sectional area		
	To ensure adequate mechanical strength, the cross-sectional area of conductors should not be less than as shown in Table 6.		P
	Where it is considered necessary, conductors with smaller cross-sectional areas than shown in Table 6 may be used in equipment provided adequate mechanical strength is achieved by other means and proper functioning is not impaired.		P
13.7	Flexible cables		
13.7.1	General		
	Flexible cables shall have class 5 or class 6 conductors (see Table C.4).	cl. 5 conductors	P
	Cables that are subjected to severe duties shall be of adequate construction to protect against:		
	- abrasion due to mechanical handling and dragging across rough surfaces;	No cables exposed to severe duties	P
	- kinking due to operation without guides;		P
	- stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums.		P
13.7.2	Mechanical rating		
	The cable handling system of the machine shall be so designed to keep the tensile stress of the conductors as low as is practicable during machine operations.	No other tensile stress other than the net weight of the conductor	P
	Where copper conductors are used, the tensile stress shall not exceed 15 N/mm2 of the copper cross-sectional area.	＜15N/mm2	P
	Where the demands of the application exceed the tensile stress limit of 15 N/mm2, cables with special construction features should be used and the allowed maximal tensile strength should be agreed with the cable manufacturer.	No this situation	P
	The allowed maximum stress of conductors of flexible cables with material other than copper should be agreed with the cable manufacturer.		P
13.7.3	Current-carrying capacity of cables wound on drums		
	Cables to be wound on drums shall be selected with conductors having a cross-sectional area such that, when fully wound on the drum and		P

	carrying the normal service load, the maximum allowable conductor temperature is not exceeded.		
	For cables of circular cross-sectional area installed on drums, the maximum current-carrying capacity in free air should be derated in accordance with Table	(see also clause 44 of IEC 60621-3).	P
13.8	Collector wires, collector bars and slip-ring assemblies		
13.8.1	Protection against direct contact		
	Collector wires, collector bars and slip-ring assemblies shall be installed or enclosed in such away that, during normal access to the machine, protection against direct contact shall be achieved by the application of one of the following protective measures:		
	- protection by partial insulation of live parts.		P
	- protection by enclosures or barriers of at least IP2X.		
	Horizontal top surfaces of barriers or enclosures that are readily accessible shall provide a degree of protection of at least IP4X.		N/A
	- prevent damage from a swinging load.		N/A
13.8.2	Protective conductor circuit		
	Where collector wires, collector bars and slip-ring assemblies are installed as part of the protective bonding circuit, the protective conductor (PE) and the neutral conductor (N) shall each use a separate collector wire, collector bar or slip-ring.	They do not carry current in normal operation	P
	The continuity of the protective conductor circuit using sliding contacts shall be ensured by taking appropriate measures.		P
13.8.3	Protective conductor current collectors		
	Protective conductor current collectors shall have a shape or construction so that they are not interchangeable with the other current collectors.		P
	Such current collectors shall be of the sliding contact type.		P
13.8.4	Removable current collectors with a disconnector function		
	Removable current collectors having a disconnector function shall be so designed that the protective conductor circuit is interrupted only after the live conductors have been disconnected, and the continuity of the protective conductor circuit is re-established before any live conductor is reconnected.		P
13.8.5	Clearances in air		
	Clearances between the respective conductors, and between adjacent systems, of collector wires, collector bars, slip-ring assemblies and their current collectors shall be suitable for operation in pollution degree 3 conditions		P
13.8.6	Creepage distances		
	Creepage distances between the respective conductors, between adjacent systems of collector wires, collector bars and slip-ring assemblies, and their current collectors shall be suitable for operation in pollution degree 3	Creepage distance between protective bonding collector bar and the live parts is more	P

	conditions.	than 30mm	
	In abnormally dusty, moist or corrosive environments the following creepage distance requirements apply:		
	- unprotected collector wires, collector bars, and slip-ring assemblies shall be equipped with insulators with a minimum creepage distance of 60 mm;		P
	- enclosed collector wires, insulated multipole collector bars and insulated individual collector bars shall have a minimum creepage distance of 30 mm.		P
	The manufacturer's recommendations shall be followed regarding special measures to prevent a gradual reduction in the insulation values due to unfavourable ambient conditions.	Protected by enclosure	P
13.8.7	Conductor system sectioning		
	Where collector wires or collector bars are arranged so that they can be divided into isolated sections, suitable design measures shall be employed to prevent the energization of adjacent sections by the current collectors themselves.		P
13.8.8	Construction and installation of collector wire, collector bar systems and slip-ring assemblies		
	Collector wires, collector bars and slip-ring assemblies used for power circuits shall be grouped separately from those used for control circuits.		P
	Collector wires, collector bars and slip-ring assemblies shall be capable of withstanding, without damage, 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 by one person without the aid of a tool.		P
	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.		P
	Metal covers of collector bars laid underground or underfloor shall also be bonded together and earthed.		P
	For equipotential bonding or protective conductor connection to covers or coverplates of metal enclosures or underfloor ducts, the usual metal hinges are considered sufficient to ensure continuity.		P
	Underground and underfloor collector bar ducts shall have drainage facilities.		P
14	**WIRING PRACTICES**		
14.1	Connections and routing		
14.1.1	General requirements		
	All connections, especially those of the protective bonding circuit, shall be secured against accidental loosening.	All connections reliable	P
	The means of connection shall be suitable for the cross-sectional areas and nature of the		P

	conductors being terminated.		
	For aluminium or aluminium alloy conductors, particular consideration shall be given to the prevention of problems of electrolytic corrosion.	No this situation	P
	The connection of two or more conductors to one terminal is permitted only in those cases where the terminal is designed for that purpose. However, only one protective conductor shall be connected to one terminal connecting point.		P
	Soldered connections shall only be permitted where terminals are provided that are suitable for soldering.	No soldered connections were found during inspection	P
	Terminals on terminal blocks shall be plainly identified to correspond with markings on the diagrams.		P
	The installation of flexible conduits and cables shall be such that liquids shall drain away from the fittings.		P
	Means of retaining conductor strands shall be provided when terminating conductors at devices or terminals that are not equipped with this facility. Solder shall not be used for that purpose.		P
	Shielded conductors shall be so terminated as to prevent fraying of strands and to permit easy disconnection.		P
	Identification tags shall be legible, permanent, and appropriate for the physical environment.		P
	Terminal blocks shall be mounted and wired so that the internal and external wiring does not cross over the terminals.	No wiring crosses over terminals	P
14.1.2	Conductor and cable runs		
	Conductors and cables shall be run from terminal to terminal without splices or joints.		P
	Where it is impracticable to provide terminals in a junction box, splices or joints may be used.		P
	Where it is necessary to connect and disconnect cables and cable assemblies, a sufficient extra length shall be provided for that purpose.		P
	The terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors.		P
	Wherever possible, the protective conductor shall be placed close to the associated live conductors in order to decrease the impedance of the loop.		P
14.1.3	Conductors of different circuits		
	Conductors of different circuits may be laid side by side, may occupy the same duct, or may be in the same multiconductor cable provided that the arrangement does not impair the proper functioning of the respective circuits.	Conductors and cables run from terminal to terminal without splices or joints	P
	Where those circuits operate at different voltages, the conductors shall be separated by suitable barriers or shall be insulated for the highest voltage to which any conductor within the same duct can be subjected.		P
14.2	Identification of conductors		
14.2.1	General requirements		

	Conductors shall be identifiable at each termination in accordance with the technical documentation.	Have identification at each termination point	P
	Where colour-coding is used for identification of conductors, the following colours may be used:	Use suitable colours	P
	BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE (including LIGHT BLUE), VIOLET, GREY, WHITE, PINK, TURQUOISE.		P
	It is recommended that, where colour is used for identification, the colour be used throughout the length of the conductor either by the colour of the insulation or by colour markers. An acceptable alternative may consist of additional identification at selected locations.		P
	For safety reasons, the colour GREEN or the colour YELLOW should not be used where there is a possibility of confusion with the bicolour combination GREEN-AND-YELLOW.	No colour Green or Yellow conductor were found during inspection.	N/A
	Colour identification using combinations of those colours listed above may be used provided there can be no confusion and that GREEN or YELLOW is not used except in the bicolour combination GREEN-AND-YELLOW.		P
14.2.2	Identification of the protective conductor		
	The protective conductor shall be readily distinguishable by shape, location, marking, or colour.	Distinguishable by marking and colour	P
	When identification is by colour alone, the bicolour combination GREEN-AND-YELLOW shall be used throughout the length of the conductor.		P
	This colour identification is strictly reserved for the protective conductor.		P
	For insulated conductors, the bicolour combination GREEN-AND-YELLOW shall be such that on any 15 mm length one of the colours covers at least 30% and not more than 70% of the surface of the conductor, the other colour covering the remainder of the surface.		P
	Where the protective conductor can be easily identified by its shape, position, or construction, or where the insulated conductor is not readily accessible, colour coding throughout its length is not necessary but the ends or accessible positions shall be clearly identified by the graphical symbol or by the bicolour combination GREEN-AND-YELLOW.		P
14.2.3	Identification of the neutral conductor		
	Where a circuit includes a neutral conductor identified by colour, the colour shall be LIGHT BLUE.	No neutral conductor	N/A
	LIGHT BLUE shall not be used for identifying any other conductor where confusion is possible.		P
	Where identification by colour is used, bare conductor used as neutral conductors shall be either coloured by a LIGHT BLUE stripe, 15 mm to 100 mm wide in each compartment or unit or at each accessible position, or coloured LIGHT BLUE throughout their length.		P

14.2.4	Identification of other conductors		
	Identification of other conductors shall be by colour (either solid or with one or more stripes) number, alphanumeric, or a combination of colour and numbers or alphanumeric.	By numbers or alphanumerics	P
	When numbers are used, they shall be Arabic; letters shall be Roman (either upper or lower case).	Numbers are in Arabic, letters are in Roman characters.	P
	It is recommended that insulated conductors be colour-coded as follows:		
	- BLACK: a.c. and d.c. power circuits;		P
	- RED: a.c. control circuits;		P
	- BLUE: d.c. control circuits;		P
	- ORANGE: interlock control circuits supplied from an external power source		P
	Exceptions: to the above are permitted where:		
	- individual devices are purchased complete with internal wiring;		N/A
	- insulation is used that is not available in the colours required; or		P
	- multiconductor cable is used, but not the bicolour combination GREEN-AND-YELLOW.		P
14.3	Wiring inside enclosures		
	Panel conductors shall be supported where necessary to keep them in place.	Appropriate supporting devices have been provided.	P
	Non-metallic ducts shall be permitted only when they are made with a flame-retardant insulating material		P
	It is recommended that electrical equipment mounted inside enclosures be designed and constructed in such a way as to permit modification of the wiring from the front of the enclosure.		P
	Where that is not possible and control devices are connected from the rear of the enclosure, access doors or swingout panels shall be provided.		N/A
	Connections to devices mounted on doors or to other movable parts shall be made using flexible conductors in accordance with 13.2 to allow for the frequent movement of the part.		P
	The conductors shall be anchored to the fixed part and to the movable part independently of the electrical connection		P
	Conductors and cables that do not run in ducts shall be adequately supported.		P
	Terminal blocks or plug/socket combinations shall be used for control wiring that extends beyond the enclosure.		N/A
	Power cables and cables of measuring circuits may be directly connected to the terminals of the devices for which the connections were intended.		P
14.4	Wiring outside enclosures		
14.4.1	General requirements		
	The means of introduction of cables or ducts with their individual glands, bushings, etc., into an enclosure shall ensure that the degree of protection is not reduced.		P
14.4.2	External ducts		

	Conductors and their connections external to the electrical equipment enclosure(s) shall be enclosed in suitable ducts as described in 14.5 except for suitably protected cables that may be installed without ducts and with or without the use of open cable trays or cable support means.	It is in compliance with this requirement.	P
	Fittings used with ducts or multiconductor cable shall be suitable for the physical environment.		P
	Flexible conduit or flexible multiconductor cable shall be used where it is necessary to employ flexible connections to pendant push-button stations.	No this situation	N/A
	The weight of the pendant stations shall be supported by means other than the flexible conduit or the flexible multiconductor cable, except where the conduit or cable is specifically designed for that purpose.		N/A
	Flexible conduit or flexible multiconductor cable shall be used for connections involving small or infrequent movements.		P
	They shall also be permitted to complete the connection to normally stationary motors, to position switches, and to other externally mounted devices.		P
	Where prewired devices are supplied, the integral cable need not be enclosed in a duct.		P
14.4.3	Connection to moving elements of the machine		
	Connections to frequently moving parts shall be made using conductors in accordance with 13.2.	No this situation	N/A
	Flexible cable and flexible conduit shall be so installed as to avoid excessive flexing and straining, particularly at the fittings.	No this situation	N/A
	Cables subject to movement shall be supported in such a way that there is no mechanical strain on the connection points nor any sharp flexing.	No this situation	N/A
	When this is achieved by the use of a loop, it shall have sufficient length to provide for a bending radius of the cable of at least 10 times the diameter of the cable.	No this situation	N/A
	Flexible cables of machines shall be so installed or protected as to minimize the possibility of external damage due to factors that include the following cable use or potential abuse:	No this situation	N/A
	- being run over by the machine itself;	No this situation	N/A
	- being run over by vehicles or other machines;	No this situation	N/A
	- coming into contact with the machine structure during movements;	No this situation	N/A
	- running in and out on cable baskets, or on or off cable drums;		N/A
	- acceleration forces and wind forces on festoon systems or suspended cables;		N/A
	- excessive rubbing by cable collector;		N/A
	- exposure to excessive radiated heat.		N/A
	The cable sheath shall be resistant to the normal wear that can be expected from movement and to the effects of atmospheric contaminants.		N/A
	Where cables subject to movement are close to moving parts, precautions shall be taken to		N/A

	maintain a space of at least 25 mm between the moving parts and the cables.		
	Where that distance is not practicable, fixed barriers shall be provided between the cables and the moving parts.		N/A
	The cable handling system shall be so designed that lateral cable angles do not exceed 5°, avoiding torsion in the cable when:	No this situation	N/A
	- being wound on and off cable drums; and		N/A
	- approaching and leaving cable guidance devices.		N/A
	In order to prevent confusion of conduits with oil, air, or water piping, it is recommended that the onduits be either physically separated or suitably identified.		N/A
	Ducts and cable trays shall be rigidly supported and positioned at a sufficient distance from moving parts and in such a manner so as to minimize the possibility of damage or wear.		N/A
	In areas where human passage is required, the ducts and cable trays shall be mounted at least 2 m above the working surface.		N/A
	Ducts shall be provided only for mechanical protection (see 8.2.3 for requirements for connection to the protective bonding circuit).		N/A
	Cable trays that are partially covered should not be considered to be ducts or cable trunking systems, and the cables used shall be suitable for installation on cable trays.		N/A
14.5.2	Percentage fill of ducts		
	Consideration on the percentage fill of ducts should be based on the straightness and length of the duct and the flexibility of the conductors.		P
	It is recommended that the dimensions and arrangement of the ducts be such as to facilitate the insertion of the conductors and cables.		P
14.5.3	Rigid metal conduit and fittings		
	Rigid metal conduit and fittings shall be of galvanized steel or of a corrosion-resistant material suitable for the conditions.	No any metal conduit is used.	P
	The use of dissimilar metals in contact that can cause galvanic action should be avoided.	No any metal conduit is used.	N/A
	Conduits shall be securely held in place and supported at each end.	No any metal conduit is used.	N/A
	Fittings shall be compatible with the conduit and appropriate for the application.	No any metal conduit is used.	N/A
	Fittings shall be threaded unless structural difficulties prevent assembly.	No any metal conduit is used.	N/A
	Where threadless fittings are used, the conduit shall be securely fastened to the equipment.		N/A
	Conduit bends shall be made in such a manner that the conduit shall not be damaged and the internal diameter of the conduit shall not be effectively reduced.		N/A
14.5.4	Flexible metal conduit and fittings		
	A flexible metal conduit shall consist of a flexible metal tubing or woven wire armour.	No any flexible metallic conduit	N/A

		is used.	
	It shall be suitable for the expected physical environment.		N/A
	Fittings shall be compatible with the conduit and appropriate for the application.		N/A
14.5.5	Flexible non-metallic conduit and fittings		
	A flexible non-metallic conduit shall be resistant to kinking and shall have physical characteristics similar to those of the sheath of multiconductor cables.	Flexible non-metallic conduits are in compliance with this requirement.	P
	The conduit shall be suitable for use in the expected physical environment.	They are in compliance with this requirement.	P
	Fittings shall be compatible with the conduit and appropriate for the application.	They are in compliance with this requirement.	P
14.5.6	Cable trunking systems		
	Cable trunking systems external to enclosures shall be rigidly supported and clear of all moving or contaminating portions of the machine.	No any cable trunking system is used for this machine.	N/A
	Covers shall be shaped to overlap the sides; gaskets shall be permitted.		P
14.5.7	Machine compartments and cable trunking systems		
	The use of compartments or cable trunking systems within the column or base of a machine to enclose conductors shall be permitted provided the compartments, or		N/A
	Cable trunking systems are isolated from coolant or oil reservoirs and are entirely enclosed		N/A
	Conductors run in enclosed compartments and cable trunking systems shall be so secured and arranged that they are not subject to damage.		N/A
14.5.8	Connection boxes and other boxes		
	Connection boxes and other boxes used for wiring purposes shall be readily accessible for maintenance.	The connection boxes are readily accessible for maintenance.	P
	Those boxes shall provide protection against the ingress of solid bodies and liquids, taking into account the external influences under which the machine is intended to operate		P
	Those boxes shall not have opened but unused knockouts nor any other openings and shall be so constructed as to exclude materials such as dust, flyings, oil, and coolant	They have no unnecessary openings.	P
14.5.9	Motor connection boxes		
	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices.		P
15	**ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT**		
15.1	General requirements		
	Electric motors should conform to the requirements of IEC 60034-1.	They are in conformity with IEC 60034-1.	P
	The protection requirements for motors and associated equipment are given in 7.2 for overcurrent protection, in 7.3 for overload protection, and in 7.6 for overspeed protection.		P
	As many controllers do not switch off the supply to a motor when it is at rest, care shall be taken		P

	to ensure compliance with the requirements of 5.3, 5.4, 5.5, 7.5, 7.6 and 9.4.		
	Motor control equipment shall be located and mounted in accordance with clause 12.		P
15.2	Motor enclosures		
	It is recommended that motor enclosures be chosen from those included in IEC 60034-5.		P
	The degree of protection shall be at least IP23 for all motors.		P
	More stringent requirements may be needed depending on the application and the physical environment.		P
	Motors incorporated as an integral part of the machine shall be so mounted that they are adequately protected from mechanical damage.	There is adequate protection Against mechanical damage for motor.	P
15.3	Motor dimensions		
	As far as is practicable, the dimensions of motors shall conform to those given in IEC 60072-1 and IEC 60072-2.		P
15.4	Motor mounting and compartments		
	Each motor and its associated couplings, belts and pulleys, or chains, shall be so mounted that they are adequately protected and are easily accessible for inspection, maintenance, adjustment and alignment, lubrication, and replacement.		N/A
	The motor mounting arrangement shall be such that all motor hold-down means can be removed and all terminal boxes are accessible		P
	Motors shall be so mounted that proper cooling is ensured and the temperature rise remains within the limits of the insulation class.	(see IEC 60034-1)	P
	Where possible, motor compartments should be clean and dry, and when required, shall be ventilated directly to the exterior of the machine.		P
	The vents shall be such that ingress of swarf, dust, or water spray is at an acceptable level.		P
	There shall be no opening between the motor compartment and any other compartment that does not meet the motor compartment requirements.		P
	Where a conduit or pipe is run into the motor compartment from another compartment not meeting the motor compartment requirements, any clearance around the conduit or pipe shall be sealed.		P
15.5	Criteria for motor selection		
	The characteristics of motors and associated equipment shall be selected in accordance with the anticipated service and physical environmental conditions		P
	In this respect, the points that shall be considered include:		
	- type of motor;		P
	- type of duty cycle (see IEC 60034-1);		P
	- fixed speed or variable speed operation, (and the consequent variable influence of the ventilation);		P
	- mechanical vibration;		P
	- type of convertor for motor speed control	see IEC 60146-1-1);	N/A

	- influence of the harmonic spectrum of the voltage and/or current feeding the motor (when it is supplied from a static convertor) on the temperature rise;		P
	- method of starting and the possible influence of the inrush current on the operation of other users, taking also into account possible special considerations stipulated by the supply authority;		P
	- variation of counter torque load with time and speed;		N/A
	- influence of loads with large inertia;		P
	- influence of constant torque or constant power operation;		P
	- possible need of inductive reactors between motor and converter.		N/A
15.6	Protective devices for mechanical brakes		
	Operation of the overload and overcurrent protective devices for mechanical brake actuators shall initiate the simultaneous de-energization (release) of the associated machine actuators.		P
16	**ACCESSORIES AND LIGHTING**		
16.1	Accessories		
	Where the machine or its associated equipment is provided with socket-outlets that are to be used for accessory equipment, the following apply:		
	- the socket-outlets should conform to IEC 60309-1.		
	Where that is not possible, they should be clearly marked with the voltage and current ratings		N/A
	- the continuity of the protective bonding circuit to the socket-outlet shall be ensured;	(exception: see 6.4)	N/A
	- all unearthed conductors connected to the socket-outlet shall be protected against overcurrent		N/A
	When required, against overload in accordance with 7.2 and 7.3 separately from the protection of other circuits;		N/A
	- where the power supply to the socket-outlet is not disconnected by the supply disconnecting device for the machine or the section of the machine, the requirements of 5.3.5 apply.		N/A
16.2	Local lighting of the machine and equipment	No local lighting	N/A
16.2.1	General		
	Connections to the protective bonding circuit shall be in accordance with 8.2.2.		N/A
	The ON-OFF switch shall not be incorporated in the lampholder or in the flexible connecting cords.		N/A
	Stroboscopic effects from lights shall be avoided by the use of appropriate luminaires.		N/A
	Where fixed lighting is provided in an enclosure, electromagnetic compatibility should be taken into account using the principles outlined in 4.4.2.		N/A
16.2.2	Supply		
	It is recommended that the nominal voltage of the local lighting circuit should not exceed 50 V	No local lighting circuits is used	N/A

	between conductors.	on this machine.	
	Where a higher voltage is used, that value shall not exceed 250 V between conductors.		P
	Lighting circuits shall be supplied from one of the following sources:		
	- a dedicated isolating transformer connected to the load side of the supply disconnecting device.		N/A
	Overcurrent protection shall be provided in the secondary circuit;		N/A
	- a dedicated isolating transformer connected to the line side of the supply disconnecting device.		N/A
	That source shall be permitted for maintenance lighting circuits in control enclosures only.		N/A
	Overcurrent protection shall be provided in the secondary circuit (see also 5.3.5 and 14.1.3);		N/A
	- a machine circuit with dedicated overcurrent protection;		N/A
	- an isolating transformer connected to the line side of the supply disconnecting device when a dedicated primary disconnecting means (see 5.3.5) and		N/A
	secondary overcurrent protection are provided and mounted within the control enclosure adjacent to the supply disconnecting device (see also 14.1.3);		N/A
	- an externally supplied lighting circuit.		N/A
	This shall be permitted in control enclosures only, and for the machine work light(s) where the total power rating is not more than 3 kW.		N/A
	Exception: where fixed lighting is out of reach of operators during normal operations, the provisions of this subclause do not apply.		P
16.2.3	Protection		
	Local lighting circuits shall be protected in accordance with 7.2.6.		P
16.2.4	Fittings		
	Adjustable lighting fittings shall be suitable for the physical environment.		P
	The lampholders shall be:		
	- in accordance with the relevant IEC publication;		P
	- constructed with an insulating material protecting the lamp cap so as to prevent unintentional contact.		N/A
	Reflectors shall be supported by a bracket and not by the lampholder.		N/A
	Exception: where fixed lighting is out of reach of operators during normal operation, the provisions of this subclause do not apply.		P
17	**MARKING, WARNING SIGNS AND REFERENCE DESIGNATIONS**		
17.1	General		
	The electrical equipment shall be marked with the supplier’s name, trade mark, or other identifying symbol and, when required, with a certification mark.	The suppliers identification mark is found on the machine.	P
	Warning signs, nameplates, markings, and identification plates shall be of sufficient durability to withstand the physical environment involved.	They are durable.	P
17.2	Warning signs		

	Enclosures that do not otherwise clearly show that they contain electrical devices shall be marked with a black lightning flash on a yellow background within a black triangle.		P
	The warning sign shall be plainly visible on the enclosure door or cover.		P
	The warning sign may be omitted for:		
	- an enclosure equipped with a supply disconnecting device;		P
	- an operator-machine interface or control station;		P
	- a single device with its own enclosure.		P
17.3	Functional identification		
	Control devices, visual indicators, and displays used in the man-machine interface shall be clearly and durably marked with regard to their functions either on or adjacent to the item.		P
	Such markings may be as agreed between the user and the supplier of the equipment (see Annex B).		P
	Preference should be given to the use of standard symbols given in IEC 60417 and ISO 7000.		P
17.4	Marking of control equipment		
	Control equipment (e.g. controlgear assemblies) shall be legibly and durably marked in a way that is plainly visible after the equipment is installed.		P
	Wherever possible, a nameplate giving the following information shall be attached to the enclosure:		
	- name or trade mark of supplier;		P
	- certification mark, when required;		P
	- serial number, where applicable;		P
	- rated voltage, number of phases and frequency, and full-load current for each supply (see IEC61082);		P
	- short-circuit interrupting capacity of the machine overcurrent protective device where furnished as part of the equipment;		P
	- the electrical diagram number(s) or the number of the index to the electrical drawings.		N/A
	The full-load current shown on the nameplate shall be not less than the combined full-load currents for all motors and other equipment that can be in operation at the same time under normal conditions of use.		P
	Where there are unusual loads or duty cycles, the thermal equivalent current (see C.2) shall be included in the full-load current specified on the nameplate.		P
	Where only a single motor controller is used, that information may instead be provided on the machine nameplate where it is plainly visible.		N/A
17.5	Reference designations		
	All enclosures, assemblies, control devices, and components shall be plainly identified with the same reference designation as shown in the technical documentation		P

	Where size or location preclude the use of an individual reference designation, group reference designation shall be used.		P
	Exception: the requirements of this subclause may not apply to machines on which the equipment comprises only a single motor, motorcontroller, push-button station(s), and worklight(s).		P
18	**TECHNICAL DOCUMENTATION**		
18.1	General		
	The information necessary for installation, operation, and maintenance of the electrical equipment of a machine shall be supplied in the form of drawings, diagrams, charts, tables, and instructions.	Required information is Included in the technical documentation	P
	The information shall be in an agreed language.	English	P
	The information provided may vary with the complexity of the electrical equipment.		P
	The supplier shall ensure that the technical documentation specified in this clause is provided with each machine.		P
18.2	Information to be provided		
	The information provided with the electrical equipment shall include:		
	a) a clear, comprehensive description of the equipment, installation and mounting, and the connection to the electrical supply(ies);		P
	b) electrical supply(ies) requirements;		P
	c) information on the physical environment (e.g. lighting, vibration, noise levels, atmospheric contaminants) where appropriate;		P
	d) overview (block) diagram(s) where appropriate;		N/A
	e) circuit diagram(s);		P
	f) information (where appropriate) on:		
	1) programming;		N/A
	2) sequence of operation(s);		P
	3) frequency of inspection;		P
	4) frequency and method of functional testing;		N/A
	5) guidance on the adjustment, maintenance, and repair, particularly of the protective devices and circuits, and		P
	6) parts list and recommended spare parts list.		N/A
	g) a description (including interconnection diagrams) of the safeguards, interlocking functions, and interlocking of guards for potentially hazardous motions, particularly for machines operating in a co-ordinated manner;		P
	h) a description of the safeguarding and of the means provided where it is necessary to suspend the safeguarding.		P
18.3	Requirements applicable to all documentation		
	The documents shall be prepared in accordance with the requirements of 18.4 to 18.10 and the relevant parts of IEC 61082.		P
	The reference designation system shall be in accordance with IEC 61346-1.		P
	For referencing of the different documents, the supplier shall select one of the following methods:		
	- each of the documents shall carry as a		N/A

	crossreference the document numbers of all other documents belonging to the electrical equipment; or		
	- all documents shall be listed with document numbers and titles in a drawing or document list.		P
	The first method shall be used only where the documentation consists of a small number of documents.		N/A
18.4	Basic information		
	The technical documentation shall contain, as a minimum, information on the following:	Included in the instruction book	P
	- normal operating conditions of the electrical equipment including the expected conditions of the electrical supply, and where appropriate, the physical environment;	Included in the instruction book	P
	- handling, transportation and storage;		P
	- inappropriate use(s) of the equipment.		P
	That information may be presented as a separate document or as part of the installation or operation documentation.		P
	The documentation should also contain, where appropriate, information regarding load currents, peak starting currents and permitted voltage drops.		P
	That information should be contained in either the system or circuit diagram(s).		P
18.5	Installation diagram		
	The installation diagram shall give all information necessary for the preliminary work of setting up the machine.		P
	In complex cases, it may be necessary to refer to the assembly drawings for details.		P
	The recommended position, type, and crosssectional areas of the supply cables to be installed on site shall be clearly indicated.		P
	The data necessary for choosing the type, characteristics, rated currents, and setting of the overcurrent protective device(s) for the supply conductors to the electrical equipment of the machine shall be stated.		P
	Where necessary, the size, purpose, and location of any ducts in the foundation that are to be provided by the user shall be detailed.		P
	The size, type, and purpose of ducts, cable trays, or cable supports between the machine and the associated equipment that are to be provided by the user shall be detailed.		P
	Where necessary, the diagram shall indicate where space is required for the removal or servicing of the electrical equipment.		P
	Where it is appropriate an interconnection diagram or table shall be provided.		P
	That diagram or table shall give full information about all external connections.		P
	Where the electrical equipment is intended to be operated from more than one source of electrical supply, the interconnection diagram or table shall indicate the modifications or interconnections required for the use of each supply.		P
18.6	Block (system) diagrams and function diagrams		

	Where it is necessary to facilitate the understanding of the principles of operation, a block (system) diagram shall be provided.		N/A
	A block (system) diagram symbolically represents the electrical equipment together with its functional interrelationships without necessarily showing all of the interconnections.		N/A
	Function diagrams may be used as either part of, or in addition to, the block (system) diagram		N/A
18.7	Circuit diagrams		
	Where a block (system) diagram does not sufficiently detail the elements of the electrical equipment, a circuit diagram(s) shall be furnished.		P
	Those diagrams shall show the electrical circuits on the machine and its associated electrical equipment.		P
	Any graphical symbol not shown in IEC 60617 shall be separately shown and described on the diagrams or supporting documents.		P
	The symbols and identification of components and devices shall be consistent throughout all documents and on the machine.		P
	Where appropriate, a diagram showing the terminals for interface connections shall be provided.		P
	That diagram may be used in conjunction with the circuit diagram(s) for simplification.		P
	The diagram should contain a reference to the detailed circuit diagram of each unit shown.		P
	Switch symbols shall be shown on the electromechanical diagrams with all supplies turned off and with the machine and its electrical equipment in the normal starting condition.		P
	Conductors shall be identified in accordance with 14.2.		P
	Circuits shall be shown in such a way as to facilitate the understanding of their function as well as maintenance and fault location.		P
	Characteristics relating to the function of the control devices and components which are not evident from their symbolic representation shall be included on the diagrams adjacent to the symbol or referenced to a footnote.		P
18.8	Operating manual		
	The technical documentation shall contain an operating manual detailing proper procedures for set-up and use of the equipment.		P
	Particular attention should be given to the safety measures provided and to the improper methods of operation that are anticipated.		P
	Where the operation of the equipment can be programmed, detailed information on methods of programming, equipment required, program verification, and additional safety procedures (where required) shall be provided.		P
18.9	Maintenance manual		
	The technical documentation shall contain a maintenance manual detailing proper procedures for adjustment, servicing and preventive inspection, and repair.		P

	Recommendations on maintenance/service records should be part of that manual.		P
	Where methods for the verification of proper operation are provided (e.g. software testing programs), the use of those methods shall be detailed.		P
18.10	Parts list		
	The parts list shall comprise, as a minimum, information necessary for ordering spare or replacement parts required for preventive or corrective maintenance including those that are recommended to be carried in stock by the user of the equipment		P
	The parts list shall show for each item:		
	- the reference designation used in the documentation;		P
	- its type designation;		P
	- the supplier and alternative sources where available;		P
	- its general characteristics where appropriate.		P
19	**TESTING AND VERIFICATION**		
19.1	General		
	Where there is no dedicated product standard for the machine, the appropriate tests may include one or more of the following but shall always include the verification of the continuity of the protective bonding circuit (see 19.2):		P
	- verification that the electrical equipment is in compliance with the technical documentation;		P
	- continuity of the protective bonding circuit (see19.2)		P
	- insulation resistance tests (see 19.3);		P
	- voltage tests (see 19.4);		P
	- protection against residual voltages (see 19.5);		P
	- functional tests (see 19.6).		P
	When the electrical equipment is modified, the requirements stated in 19.7 shall apply.		P
19.2	Continuity of the protective bonding circuit		
	When the machine is installed and the electrical connections are complete, including those to the power supply, the continuity of the protective bonding circuit can be verified by a loop impedance test in accordance with 612.6.3 of IEC 60364-6-61.		P
	For small machines, pre-manufactured machines or parts of machines with protective bonding loops not exceeding approximately 30 m, and where the machine cannot be connected to the power supply for the loop impedance test, the following method may be appropriate:		
	- verify the continuity of the protective bonding circuit by injecting a current of at least 10 A at 50 Hz or 60 Hz derived from a PELV source.		P
	- the measured voltage between the PE terminal and the points of test is not to exceed the values given in Table 9 (see 8.2.2).		P
19.3	Insulation resistance tests		
	The insulation resistance measured at 500 V d.c. between the power circuit conductors and the protective bonding circuit is to be not less than 1 M.	500VDC	P

	For certain parts of electrical equipment, incorporating for example busbars, collector wire or collector bar systems or slip-ring assemblies, a lower minimum value shall permitted, but that value is not to be less than 50 k.	550MΩ	P
19.4	Voltage tests		
	The electrical equipment shall withstand a test voltage applied for a period of at least one second between the conductors of all circuits and the protective bonding circuit, except for those circuits intended to operate at or below PELV voltages.		P
19.5	Protection against residual voltages		
	Tests are performed to ensure compliance with 6.2.4.		P
19.6	Functional tests		
	The functions of electrical equipment shall be tested, particularly those related to safety and safeguarding.		P
19.7	Retesting		
	Where a portion of the machine and its associated equipment is changed or modified, that portion shall be reverified and retested, as is appropriate		P

Annex A

18.2.2 Test current: 10A, 30s, max actual voltage drop:

Parts tested	Cross-sectional area of the branch protective conductor under test mm²	Actual voltage drop V	Max. measured voltage drop V
Machine metal enclosure-PE	1.0 mm²	0.079V	3.3V
3-phase asynchronous motor enclosure- PE	1.0 mm²	0.052V	3.3V
enclosure- PE	1.0 mm²	0.021V	3.3V

1. Risk assessment

This risk assessment report is based on the methods in the EN ISO 12100:2010 and EN ISO 14121-2 standards, and the 4 factors S-A-G-W have been used for evaluating the level of risks.

S：Severity of possible harm

- S1：Slight（normally reversible）
- S2：Serious（normally irreversible）
- S3：Cause a few men die
- S4：Calamity or cause many men die

A：Frequency any duration of exposure

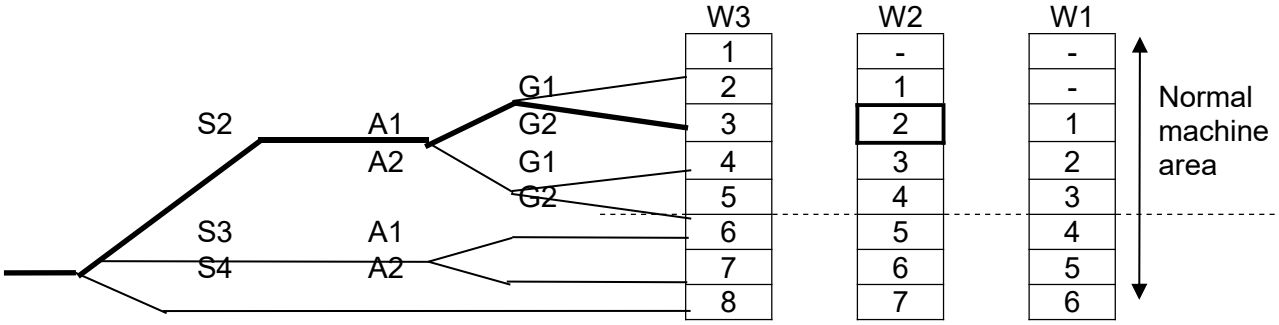
- A1：Seldom to very often
- A2：Frequent to continuous

G：Possibilities of avoidance

- G1：Possible
- G2：Impossible

W：Probability of occurrence of harm

- W1：Low
- W2：Medium
- W3：High



Solutions for the level of hazards

1：Protected by warning sign
2：Protected by guard and warning sign
3：Consider the other design, choose the best one, add both guard and warning sign
4：Consider another two design, choose the best one, add both guard and warning sign
5：Consider another three design, choose the best one, add both guard and warning sign

NO.	Hazards source	S	A	G	W	Level
	Mechanical hazards					
1.0-1	Mechanical hazards due to machine parts or work pieces					
1.0-2	Mechanical hazards due to accumulation of energy inside the machinery					
1.1	Crushing	***1***	***1***	***1***	***1***	**-**
1.2	Shearing					
1.3	Cutting or severing					
1.4	Entanglement	***1***	***1***	***1***	***1***	**-**
1.5	Drawing-in or trapping	***1***	***1***	***1***	***1***	**-**
1.6	Impact	***1***	***1***	***1***	***1***	**-**
1.7	Stabbing or puncture					
1.8	Friction or abrasion					
1.9	High pressure fluid injection or ejection					

Electrical hazards						
2.1	Contact with live parts	***2***	***1***	***1***	***1***	***1***
2.2	Contact with parts which have become live under faulty conditions	***2***	***1***	***1***	***1***	***1***
2.3	Approach to live part under high voltage					
2.4	Electrostatic phenomena					
2.5	Thermal radiation or other phenomena such as projection of molten particles and chemical effects form short-circuits, overloads etc.					
Thermal hazards						
3.1	Burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by the radiation of heat sources					
3.2	Damage to health by hot or cold working environment					
Hazards generated by noise						
4.1	Hearing loss (deafness), other physiological disorders	***1***	***1***	***1***	***1***	**-**
4.2	Interference with speech communication, acoustic signals, etc.	***1***	***1***	***1***	***1***	**-**
Hazards generated by vibration						
5.1	Use of hand-help machines resulting in a variety of neurological and vascular disorder					
5.2	Whole body vibration, particular when combined with poor postures					
Hazards generated by radiation						
6.1	Low frequency, radio frequency radiation, microwaves					
6.2	Infrared, visible and ultraviolet light					
6.3	X and gamma rays					
6.4	Alpha, beta rays, electron or ion beams, neutrons					
6.5	Lasers					
Hazards generated by materials and substances processed or used by the machinery						
7.1	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts					
7.2	Fire and explosion hazard					
7.3	Biological and micro-biological (viral or bacterial) hazards					
Hazards generated by neglecting ergonomic principles in machine design						
8.1	Unhealthy postures or excessive effort					
8.2	Inadequate consideration of hand-arm or foot-leg anatomy					
8.3	Neglected use of personal protection equipment					
8.4	Inadequate local lighting					
8.5	Mental overload or underload, stress					
8.6	Human error, human behavior	***1***	***1***	***1***	***1***	**-**
8.7	Inadequate design, location or identification of manual controls					
Combination of hazards						
9	Combination of hazards					
Unexpected start-up, unexpected overrun/over-speed						
10.1	Failure/disorder of the control system	***1***	***1***	***1***	***1***	**-**
10.2	Restoration of energy on supply after an interruption					
10.3	External influences on electrical equipment					
10.4	Other external influences (gravity, wind, etc.)					
10.5	Errors in the software					
10.6	Error made by the operator (due to mismatch of machinery with human characteristics and abilities, see 8.6)					
Impossibility of stopping the machine in the best possible conditions						
11	Impossibility of stopping the machine in the best possible conditions					

Variations in the rotational speed of tools						
12	Variations in the rotational speed of tools					
Failure of the power supply						
13	Failure of the power supply					
Failure of the control circuit						
14	Failure of the control circuit	***1***	***1***	***1***	***1***	**-**
Errors of fitting						
15	Errors of fitting	***1***	***1***	***1***	***1***	**-**
Break-up during operation						
16	Break-up during operation					
Falling or ejected objects or fluids						
17	Falling or ejected objects or fluids					
Loss of stability / overturning of machinery						
18	Loss of stability / overturning of machinery					
Slip, trip and fall of persons (related to machinery)						
19	Slip, trip and fall of persons(related to machinery)					
Additional hazards, hazardous situations and hazardous events due to mobility						
20	Relating to the traveling function					
20.1	Movement when starting the engine					
20.2	Movement without a driver at the driving position					
20.3	Movement without all parts in a safe position					
20.4	Excessive speed of pedestrian controlled machinery					
20.5	Excessive oscillations when moving					
20.6	Insufficient ability of machinery to be slowed down, stopped and immobilisated					
Linked to the work position (including driving station) on the machine						
21.1	Fall of persons during access to (or at/from) the work position					
21.2	Exhaust gases/lack of oxygen at the work position					
21.3	Fire（flammability of the cab, lack of extinguishing means）					
21.4	Mechanical hazards at the work position： contact with the wheels； rollover； fall of objects, penetration by objects； break-up of parts rotation at high speed； contact of persons with machine parts or tools（pedestrian controlled machines）					
21.5	Insufficient visibility form the work positions					
21.6	Inadequate lighting					
21.7	Inadequate seating					
21.8	Noise at the work position					
21.9	Vibration at the work position					
21.10	Insufficient means for evacuation/emergency exit					
Due to the control system						
22.1	Inadequate location of manual controls					
22.2	Inadequate design of manual controls and their mode of operation					
Form handling the machine（lack of stability）						
23	Form handling the machine（lack of stability）					
Due to the power source and to the transmission of power						
24.1	Hazards form the engine and the batteries					
24.2	Hazards form the transmission of power between machines					
24.3	Hazards form coupling and towing					

Form/to third persons						
25.1	Unauthorized start-up/use					
25.2	Drift of a part away from its stopping position					
25.3	Lack or inadequacy of visual or acoustic warning means					
Insufficient instructions for the driver/operator						
26	Insufficient instructions for the driver/operator					
Additional hazards, hazardous situations and hazardous events due to lifting						
27	Mechanical hazards and hazardous events					
27.1	Form load falls, collisions, machine tipping caused by：					
27.1.1	Lack of stability					
27.1.2	Uncontrolled loading-overloading-overturning moments exceeded					
27.1.3	Uncontrolled amplitude of movements					
27.1.4	Unexpected/unintended movement of loads					
27.1.5	Inadequate holding devices/accessories					
27.1.6	Collision of more then one machine					
27.2	Form access of persons to load support					
27.3	Form derailment					
27.4	Form insufficient mechanical strength of parts					
27.5	Form inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine					
27.6	Form inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine					
27.7	Form lowering of the load under the control of friction brake					
27.8	Form abnormal conditions of assembly/testing/use/maintenance					
27.9	Form the effect of load on persons（impact by load or counterweight）					
Electrical hazards						
28.1	Form lightning					
Hazards generated by neglecting ergonomic principles						
29.1	Insufficient visibility from the driving position					
Additional hazards, hazardous and situations and hazardous events due to underground work						
30	Mechanical hazards and hazardous events due to:					
30.1	Lack of stability of powered roof supports					
30.2	Failing accelerator or brake control of machinery running on rails					
30.3	Failing or lack of dead man’s control of machinery running on rails					
31	Restricted movement of persons					
32	Fire and explosion					
33	Emission of dust, gases etc.					
Additional hazards, hazardous situations and hazardous events due to the lifting or moving of persons						
34	Mechanical hazards and hazardous events due to:					
34.1	Inadequate mechanical strength-inadequate working coefficients					
34.2	Failing of loading control					
34.3	Failing of controls in person carrier (function, priority)					
34.4	Over speed of person carrier					
35	Falling of person from person carrier					
36	Falling or overturning of person carrier					
37	Human error, human behavior					

NO.	Hazards source	S	A	G	W	Level
1.1	Crushing	***1***	***1***	***1***	***1***	**-**
Where	Near machine					
When	*loading/unloading,maintenance*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. Affixing suitable warning signs. *2. Only operation by training/authorized persons.* *3. Operation of the machine shall conform to the instructions of the instruction manual.* *4. Check and inspection according to the specified durations of the instruction manual.* *5. Provide guards.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
1.4	Entanglement	***1***	***1***	***1***	***1***	**-**
Where	Contact with roller of the machine					
When	*during operation, inspection and maintenance of machine*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. Affixing suitable warning signs. *2. Only operation by training/authorized persons.* *3. Operation of the machine shall conform to the instructions of the instruction manual.* *4. Check and inspection according to the specified durations of the instruction manual.* *5. Provide guards.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
1.5	Drawing-in or trapping	***1***	***1***	***1***	***1***	-
Where	Contact with the conveyor of the machine					
When	*during operation, inspection and maintenance of machine*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. Affixing suitable warning signs. *2. Only operation by training/authorized persons.* *3. Operation of the machine shall conform to the instructions of the instruction manual.* *4. Check and inspection according to the specified durations of the instruction manual.* *5. Provide guards.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
1.6	Impact	***1***	***1***	***1***	***1***	**-**
Where	*moving/rotating tool*					
When	*during operation, inspection and maintenance of machine*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. Affixing suitable warning signs. *2. Only operation by training/authorized persons.* *3. Operation of the machine shall conform to the instructions of the instruction manual.* *4. Check and inspection according to the specified durations of the instruction manual.* *5. Provide guards.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
2.1	Contact with live parts	***2***	***1***	***1***	***1***	***1***
Where	*contact with live parts or connections*					
When	*During commissioning,maintenance*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. Only operation by training/authorized persons. *2. Operation of the machine shall conform to the instructions of the instruction manual.* *3. Check and inspection according to the specified durations of the instruction manual.* *4. Using safety components in accordance with those relevant international standards.* 5. *Use of warning label.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
2.2	Contact with parts which have become live under faulty conditions	***2***	***1***	***1***	***1***	***1***
Where	*contact with live parts or connections*					
When	*during operation, inspection and maintenance of machine*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. *Only operation by training/authorized persons.* *2. Operation of the machine shall conform to the instructions of the instruction manual.* *3. Check and inspection according to the specified durations of the instruction manual.* *4. Using safety components in accordance with those relevant international standards.* *5.Use of warning label.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
4.1	Hearing loss (deafness), other physiological disorders	***1***	***1***	***1***	***1***	**-**
Where	*Near machine*					
When	*during operation, inspection and maintenance of machine*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. *Only operation by training/authorized persons.* *2. Operation of the machine shall conform to the instructions of the instruction manual.* *3. Check and inspection according to the specified durations of the instruction manual.* *4. Using safety components in accordance with those relevant international standards.* *5.Use of warning label.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
4.2	Interference with speech communication, acoustic signals, etc.	***1***	***1***	***1***	***1***	**-**
Where	*Near machine*					
When	*during operation, inspection and maintenance of machine*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. *Only operation by training/authorized persons.* *2.Use of warning label.* *3.Use the PPE.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
8.6	Human error, human behavior	***1***	***1***	***1***	***1***	**-**
Where	*At load/unload, tool mounting positions*					
When	*Reasonably foreseeable misuse, inadvertent operation of controls, incorrect work material and cutter handling and setting during loading/ unloading, process control, tool handling.*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1.Only authorized person can use the machine. *2.Training before using this machine.* *3.Make reference to the instruction manual before using this machine.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
10.1	Failure/disorder of the control system	***1***	***1***	***1***	***1***	**-**
Where	*the control system of the machine*					
When	*Mechanical hazards associated with selected machine movement during setting, cleaning*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. Only authorized person can use the machine. *2. Make reference to the instruction manual before using this machine.* *3. Check before operation.* 4. *Periodic maintenance.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
14	Failure of the control circuit	***1***	***1***	***1***	***1***	**-**
Where	*In the wireway*					
When	*Unexpected movements of machine during setting, cleaning or maintenance*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. Checking before operation. *2. Make reference to the instruction manual before operate this machine.* 3. *Daily/periodic inspection and maintenance.*		***1***	***1***	***1***	***1***	**-**

NO.	Hazards source	S	A	G	W	Level
15	Errors of fitting	***1***	***1***	***1***	***1***	**-**
Where	*At machine*					
When	*machine elements fail or swing unexpectedly during process control, tool mounting, maintenance*					
Improvement result						
Method		**S**	**A**	**G**	**W**	**Level**
1. Only authorized person can use the machine. *2.Make reference to the instruction manual before using this machine.* *3.Check before operation.* *4. Periodic maintenance.*		***1***	***1***	***1***	***1***	**-**

2 Emission Test Results

2.1 Conducted Emissions Mains Terminals, 150kHz to 30MHz

Test Requirement:	EN 61000-3-2:2014；EN 61000-3-3:2013
Test Method:	Based on EN 61000-3-2:2014；EN 61000-3-3:2013;
Test Date:	May 12, 2019
Frequency Range:	150kHz to 30MHz
Class / Severity:	Table 1, Columns 2 & 3 (AC Terminals)
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)
	Quasi-Peak & Average if maximised peak within 6dB of limit

2.1.1 E.U.T. Operation

Operating Environment:

Temperature: 24.0 ◦C Humidity: 61 % RH Atmospheric Pressure: 1012 mbar

EUT Operation:

Perform a pre-test on the EUT in On Mode varying voltages +/- 10% in order to find the worse case.

Test the EUT in On Mode for both models at DC AC for the compliance test as no worse case was found.

TEST PROCEDURES

Procedure of Preliminary Test

The EUT and Support equipment, if needed, was set up as per the test configuration to simulate typical usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per EN 55022 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor standing equipment, it is placed on the ground plane, which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.

All I/O cables were positioned to simulate typical actual usage as per EN 55022.

The test equipment EUT installed received AC main power, through a Line Impedance Stabilization Network (LISN), which supplied power source and was grounded to the ground plane.

All support equipment power received from a second LISN.

The EUT test program was started. Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.

The Receiver scanned from 150kHz to 30MHz for emissions in each of the test modes.

During the above scans, the emissions were maximized by cable manipulation.

The test mode(s) described in Item 4.1 were scanned during the preliminary test.

After the preliminary scan, we found the test mode described in Item 4.1 producing the highest emission level.

The EUT configuration and cable configuration of the above highest emission levels were recorded for reference of the final test.

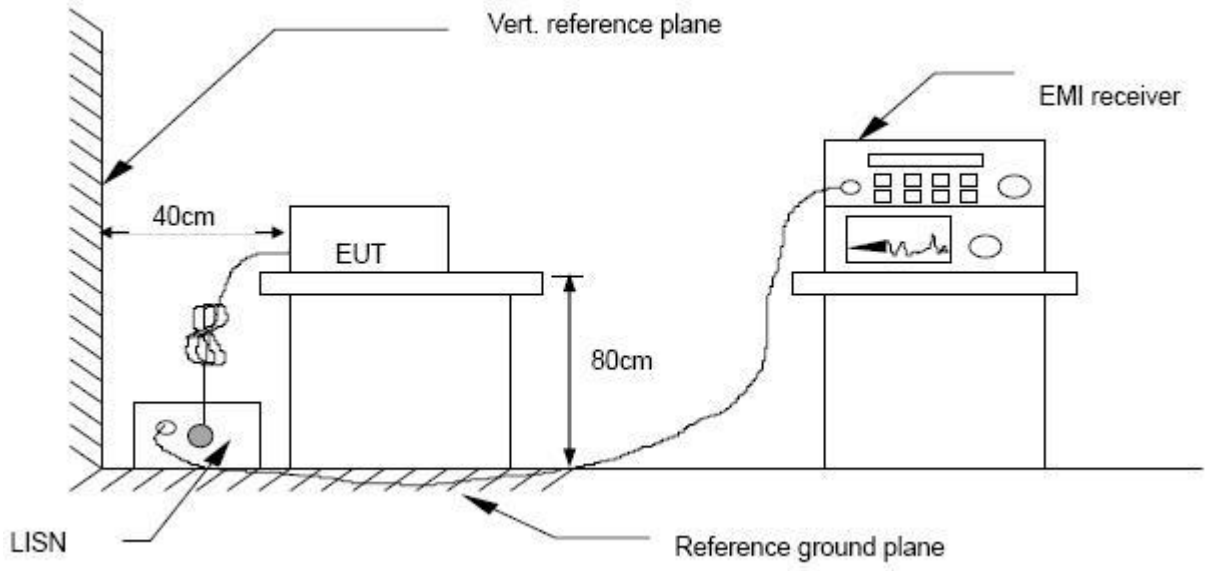
Procedure of Final Test

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test.

A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit.

The test data of the worst-case condition(s) was recorded.

TEST SETUP



2.1.2 Measurement Data

An initial pre-scan was performed on the live and neutral lines in On Mode at 7,5V.

No further Quasi-peak & average measurements were performed since no peak emissions were detected within 6dB of the average limit line.

Please see the attached peak measurement data for reference.

The following peak measurements were performed on the EUT on May 21th, 2018

Data Sample:

Freq. (MHz)	Q.P. Raw (dBuV)	Average Raw (dBuV)	Q.P. Limit (dBuV)	Average Limit (dBuV)	Q.P. Margin (dB)	Average Margin (dB)	Note
x.xx	34.44	27.28	60.00	50.00	-25.56	-22.72	L1

Freq. = Emission frequency in MHz

Raw dBuV = Uncorrected Analyzer/Receiver reading + Insertion loss of LISN, if it > 0.5 dB

Limit dBuV = Limit stated in standard

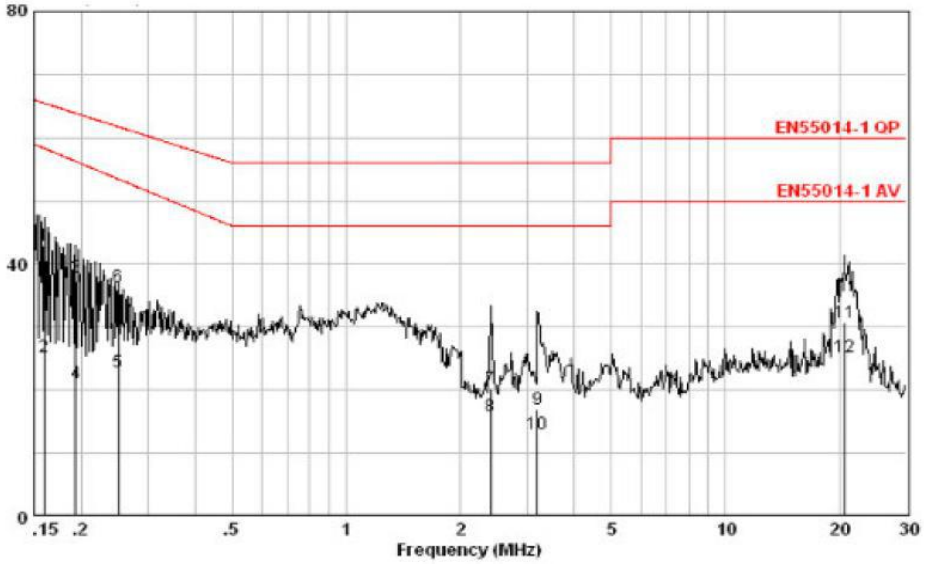
Margin dB = RAW (dBuV) – Limit (dBuV)

Note = Current carrying line of reading

Q. P.: =Quasi-Peak

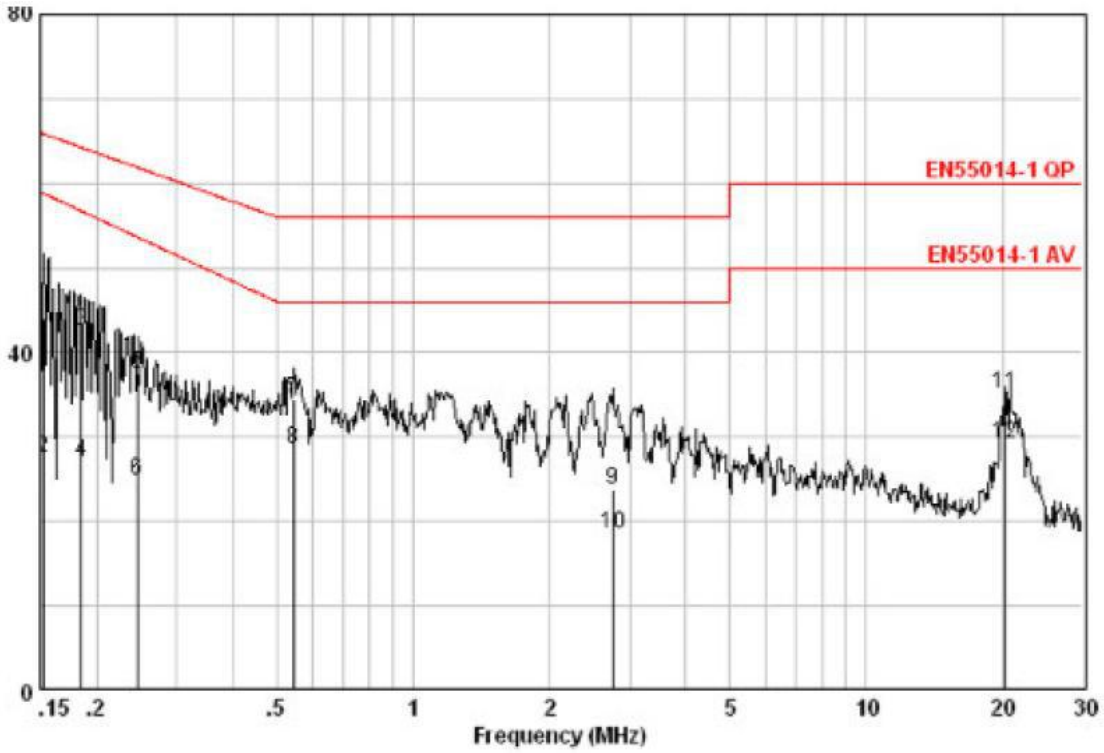
Live Line--QP

148,5kHz-30MHz:



Netural Line-QP

148,5kHz-30MHz:


80
40
0
EN55014-1 QP
EN55014-1 AV
.15
.2
.5
1
2
5
10
20
30
Frequency (MHz)

2.2 Radiated Power: 30MHz to 300MHz

Test Requirement:	EN 61000-6-3:2007
Test Method:	Based on EN 61000-6-3:2007
Test Date:	May 13, 2019
Frequency Range:	30MHz to 300MHz
Class / Severity:	Table 2, Columns 2 & 3
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)
	Quasi-Peak & Average if pre-scan peak within 15dB of average limit.

2.2.1 E.U.T. Operation

Operating Environment:

Temperature: 24.0◦C Humidity: 61% RH Atmospheric Pressure: 1012 Mbar

EUT Operation:

Perform a pre-test on the EUT in On Mode varying voltages +/- 10% in order to find the worse case.

Test the EUT in On Mode for both models at 250V AC for the compliance test as no worse case was found.

If any maximised peak emissions are detected within 15dB of the average limit line, then:

Perform Quasi-Peak and Average (if Quasi-Peak is within 15dB of Average Limit) measurement with the clamp next to the EUT (i.e. zero position). If both Quasi-Peak and Average measurement are greater than 15dB below the respective limit, then the test is terminated.

If either the Quasi-Peak and Average measurement are within 15dB of the respective limit, then extend the lead to 6m length.

Maximised all Quasi-Peak and Average measurement by moving clamp along cable.

2.2.2 Measurement Data

Peak Scan was performed on the AC mains cable, no further Quasi-peak & average measurements were performed for the EUT since no peak emissions were detected within 15dB of the average limit line

No further Quasi-peak & average measurements were performed since no peak emissions were detected within 6 dB of the average limit line.

Please see the attached peak measurement data for reference.

Procedure of Preliminary Test

The equipment was set up as per the test configuration to simulate typical usage per the user's manual. When the EUT is a tabletop system, a wooden turntable with a height of 0.8 meters is used which is placed on the ground plane. When the EUT is a floor standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.

Support equipment, if needed, was placed as per EN 55022.

All I/O cables were positioned to simulate typical usage as per EN 55022.

The EUT received AC power source from the outlet socket under the turntable. All support equipment power received from another socket under the turntable.

Mains cables, telephone lines or other connections to auxiliary equipment located outside the test are shall drape to the floor, be fitted with ferrite clamps or ferrite tubes placed on the floor at the point where the cable reaches the floor and then routed to the place where they leave the turntable. No extension cords shall be used to mains receptacle.

The antenna was placed at 10 meter away from the EUT as stated in EN 55022. The antenna connected to the Spectrum Analyzer via a cable and at times a pre-amplifier would be used.

The Analyzer / Receiver quickly scanned from 30MHz to 1000MHz. The EUT test program was started. Emissions were scanned and measured rotating the EUT to 360 degrees and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.

The test mode(s) described in Item 4.1 were scanned during the preliminary test:

After the preliminary scan, we found the test mode described in Item 4.1 producing the highest emission level.

The EUT and cable configuration, antenna position, polarization and turntable position of the above highest emission level were recorded for the final test.

Procedure of Final Test

EUT and support equipment were set up on the turntable as per the configuration with highest emission level in the preliminary test.

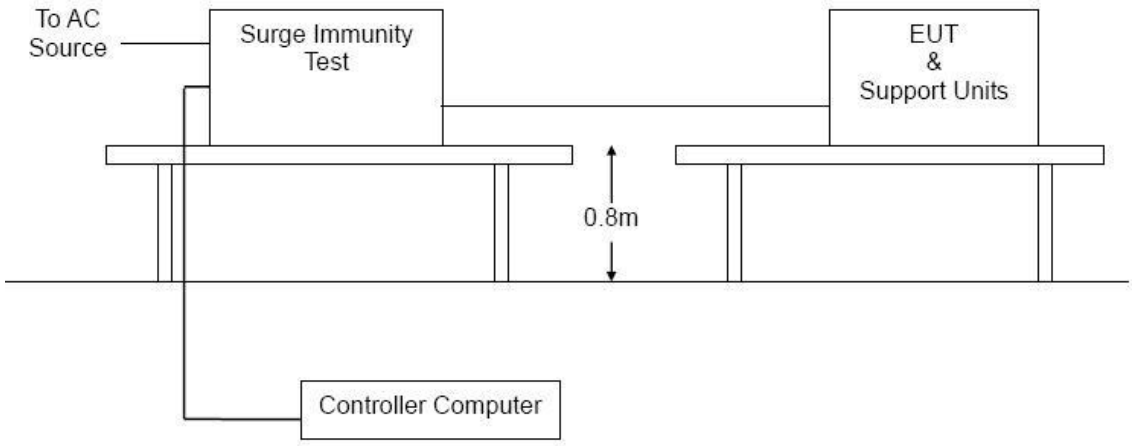
The Analyzer / Receiver scanned from 30MHz to 1000MHz. Emissions were scanned and measured rotating the EUT to 360 degrees, varying cable placement and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.

Recorded at least the six highest emissions. Emission frequency, amplitude, antenna position, polarization and turntable position were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit and only Q.P. reading is presented.

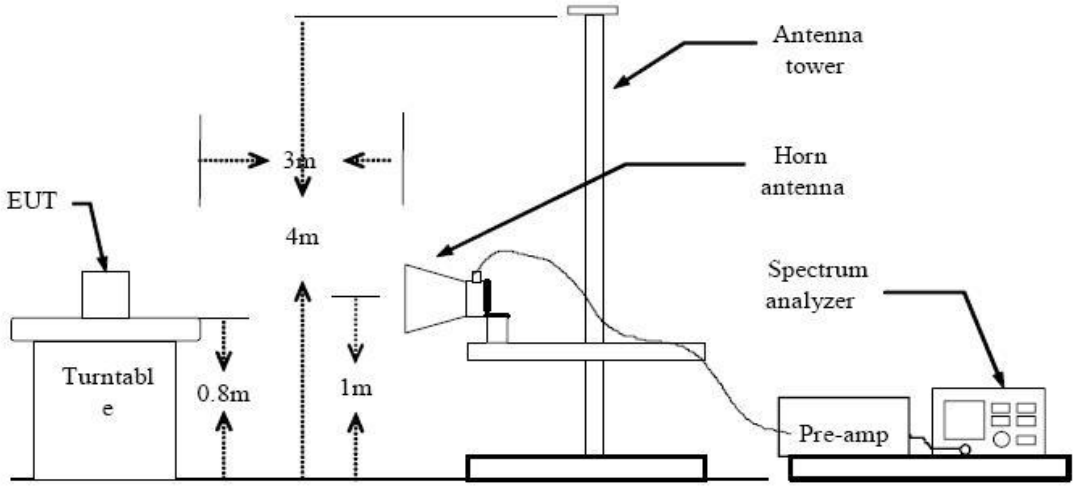
The test data of the worst-case condition(s) was recorded.

Test setup

Below 1 GHz

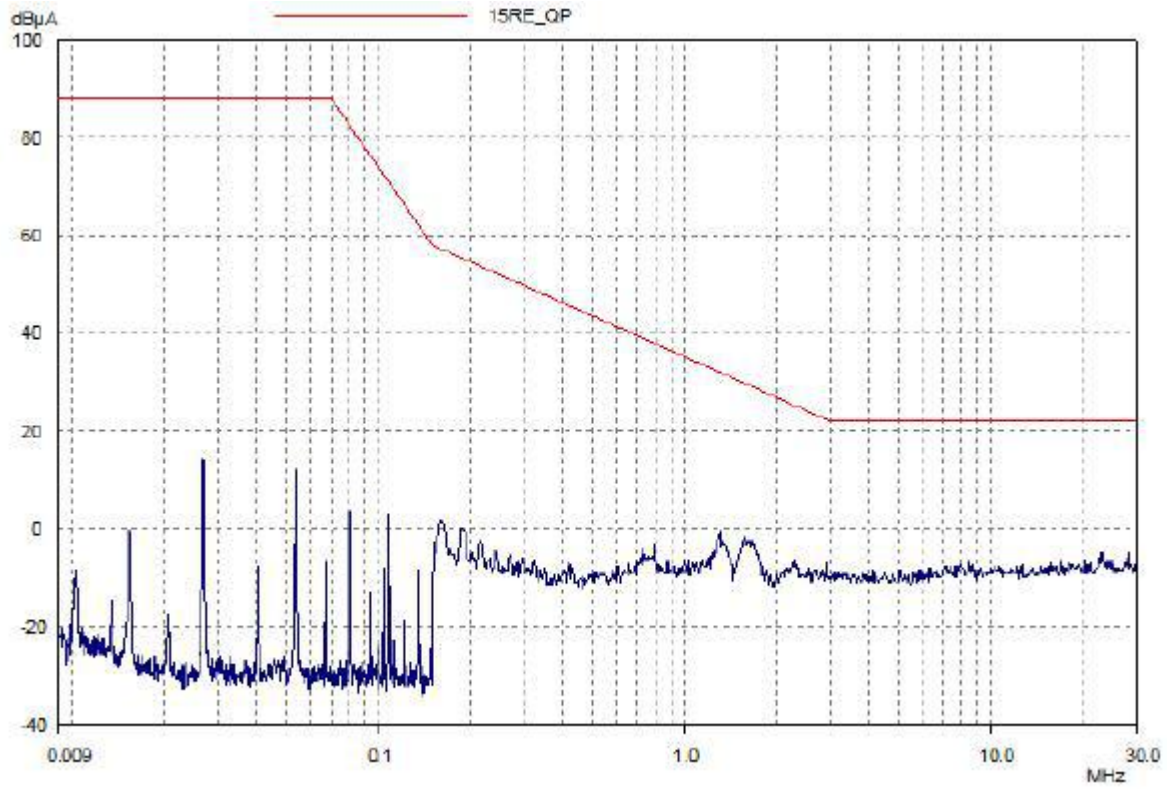


Above 1 GHz



30MHz-300Hz

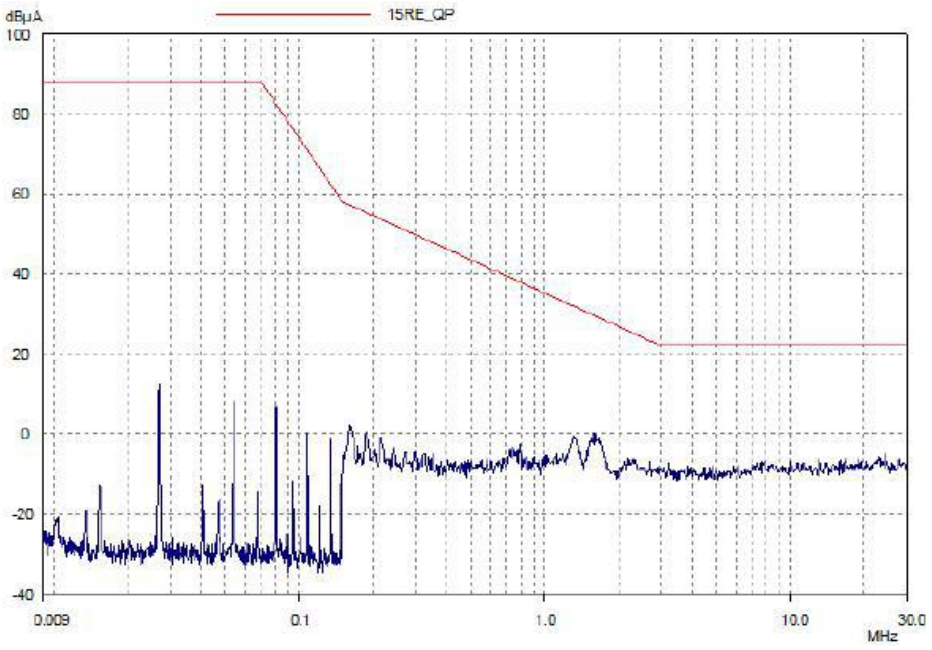
X Direction



Frequency /MHz	X direction	Quasi-peak (dBμA) Disturbance level Y direction	Z direction	Permitted limit
0.009	*	*	*	88.00
0.05	*	*	*	88.00
0.1	*	*	*	73.96
0.24	*	*	*	52.40
0.55	*	*	*	42.52
1.0	*	*	*	35.39
1.4	*	*	*	31.39
2.0	*	*	*	27.14
3.5	*	*	*	22.00
6.0	*	*	*	22.00
10.0	*	*	*	22.00
17.579	*	*	*	22.00
30.0	*	*	*	22.00

Notes: * means the disturbance level is 6dB lower than the relevant limit.

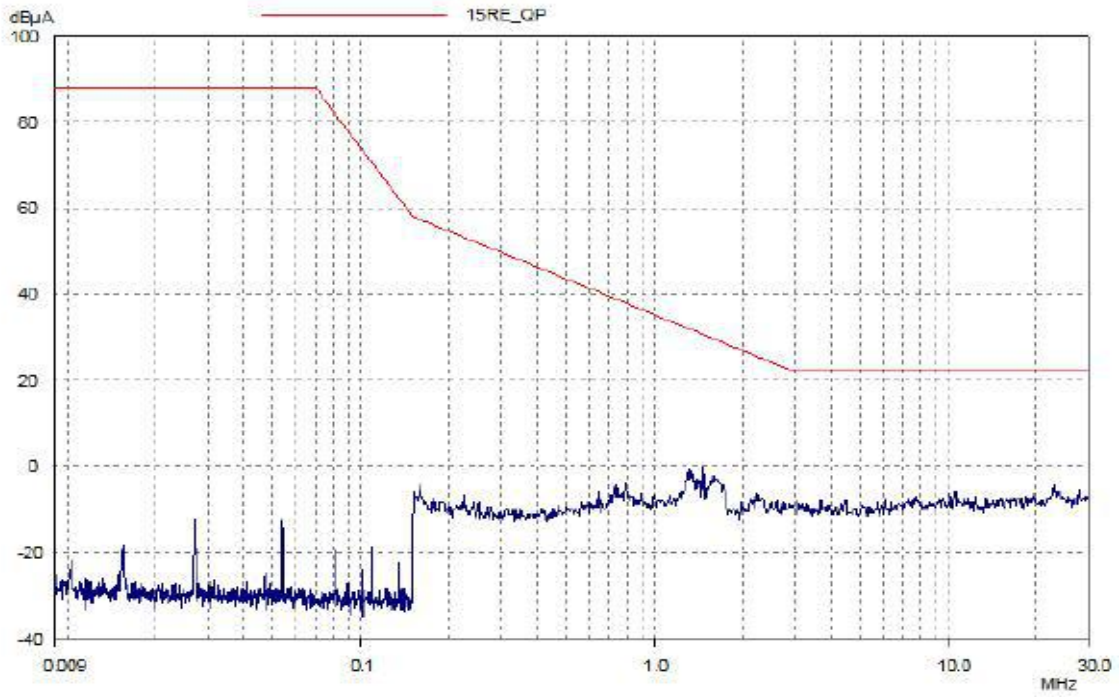
Y Direction



Frequency /MHz	X direction	Quasi-peak (dBμA) Disturbance level Y direction	Z direction	Permitted limit
0.009	*	*	*	88.00
0.05	*	*	*	88.00
0.1	*	*	*	73.96
0.24	*	*	*	52.40
0.55	*	*	*	42.52
1.0	*	*	*	35.39
1.4	*	*	*	31.39
2.0	*	*	*	27.14
3.5	*	*	*	22.00
6.0	*	*	*	22.00
10.0	*	*	*	22.00
17.579	*	*	*	22.00
30.0	*	*	*	22.00

Notes: * means the disturbance level is 6dB lower than the relevant limit.

Z Direction



Frequency /MHz	X direction	Quasi-peak (dBµA) Disturbance level Y direction	Z direction	Permitted limit
0.009	*	*	*	88.00
0.05	*	*	*	88.00
0.1	*	*	*	73.96
0.24	*	*	*	52.40
0.55	*	*	*	42.52
1.0	*	*	*	35.39
1.4	*	*	*	31.39
2.0	*	*	*	27.14
3.5	*	*	*	22.00
6.0	*	*	*	22.00
10.0	*	*	*	22.00
17.579	*	*	*	22.00
30.0	*	*	*	22.00

Notes: * means the disturbance level is 6dB lower than the relevant limit.

2.3 Harmonics Test Results

Test Requirement:	EN 61000-6-1: 2007
Test Method:	Based on EN 61000-6-1: 2007
Test Date:	May 13, 2019
Frequency Range:	100Hz to 2kHz
Measurement Time:	3 mins
Class/Severity:	Class A

2.3.1 E.U.T. Operation

Operating Environment:

Temperature: 24.0◦C Humidity: 61% RH Atmospheric Pressure: 1012 Mbar

EUT Operation:
Test the EUT in on mode for both models with the maximum. power at 240V ~ 50Hz Hair-Removing Appliances with transformer.

Test procedure

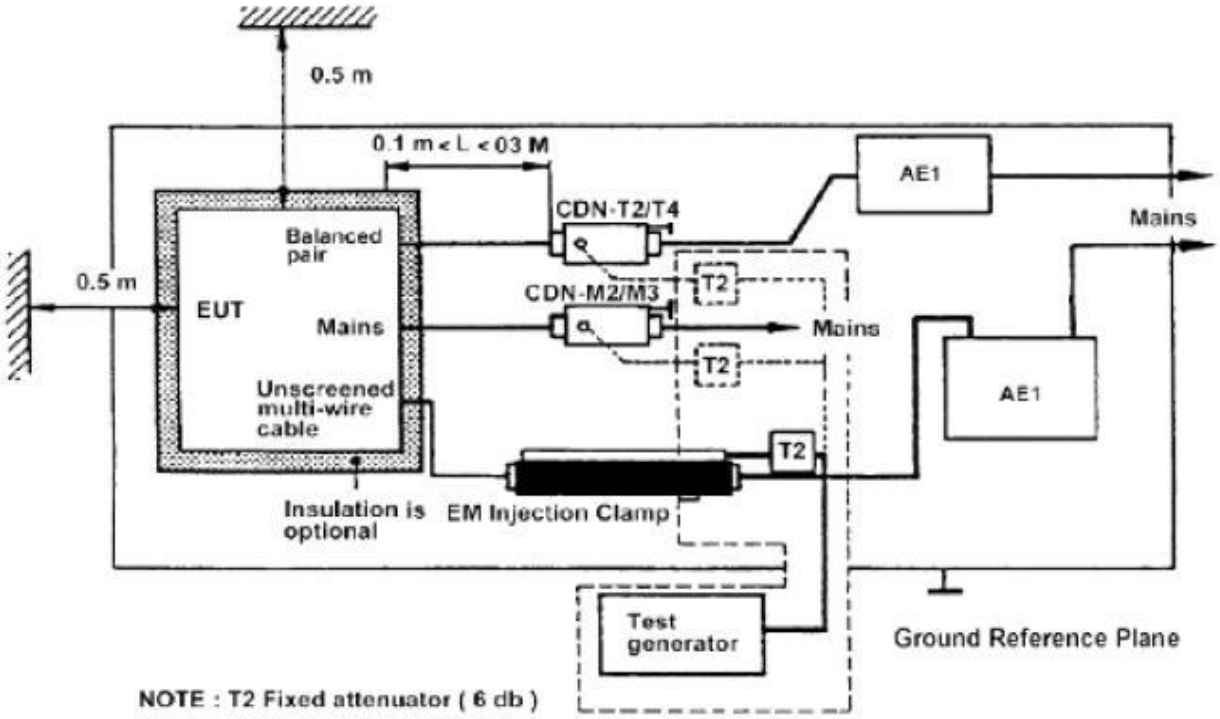
The EUT shall be tested within its intended operating and climatic conditions.

The test shell performed with the test generator connected to each of the coupling and Maroupling devices in turn, while the other non-excited RF input ports of the coupling devices are terminated by a 50-ohm load resistor.

The frequency range was swept from 150 kHz to 80 MHz, using the signal level established during the setting process and with a disturbance signal of 80 % amplitude. The signal was modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or the switch coupling devices as necessary. The sweep rate was 1.5 x 10-3 Marades/s. Where the frequency range is swept incrementally, the step size was 1 % of preceding frequency value from 150 kHz to 80 MHz.

The dwell time at each frequency was less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies such as clock frequency(ies) and harmonics or frequencies of dominant interest, was analyzed separately.

Attempts was made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.



Test procedure

The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the maximum harmonic components under normal operating conditions for each successive harmonic component in turn.

The classification of EUT is according to section 5 of EN 61000-3-2.

The EUT is classified as follows:

Class A: Balanced three-phase equipment, Household appliances excluding equipment as Class D, Tools excluding portable tools, Dimmers for incandescent lamps, audio equipment, equipment not specified in one of the three other classes.

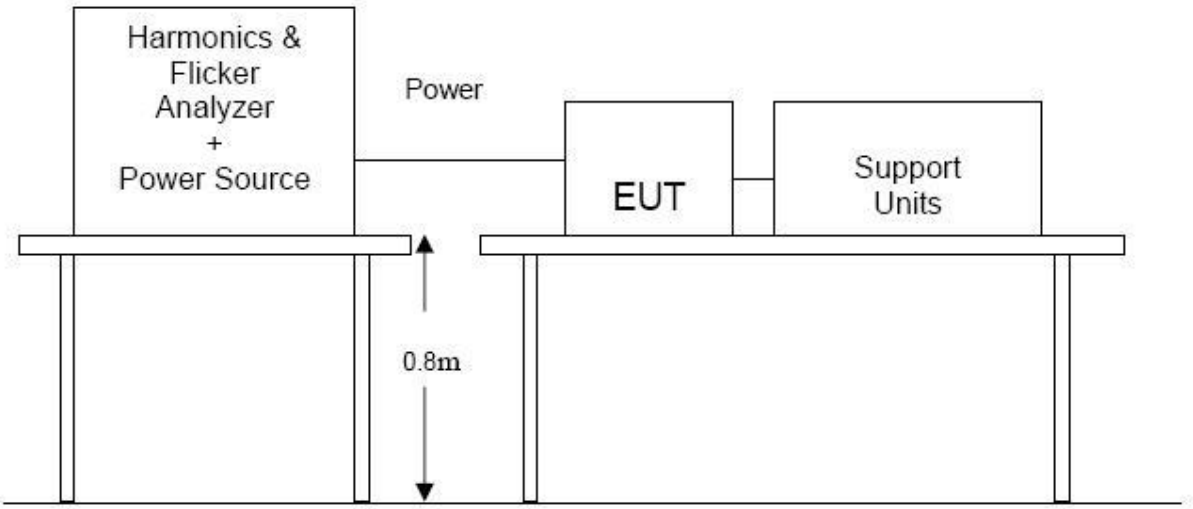
Class B: Portable tools; Arc welding equipment which is not professional equipment.

Class C: Lighting equipment.

Class D: Equipment having a specified power less than or equal to 600 W of the following types: Personal computers and personal computer monitors and television receivers.

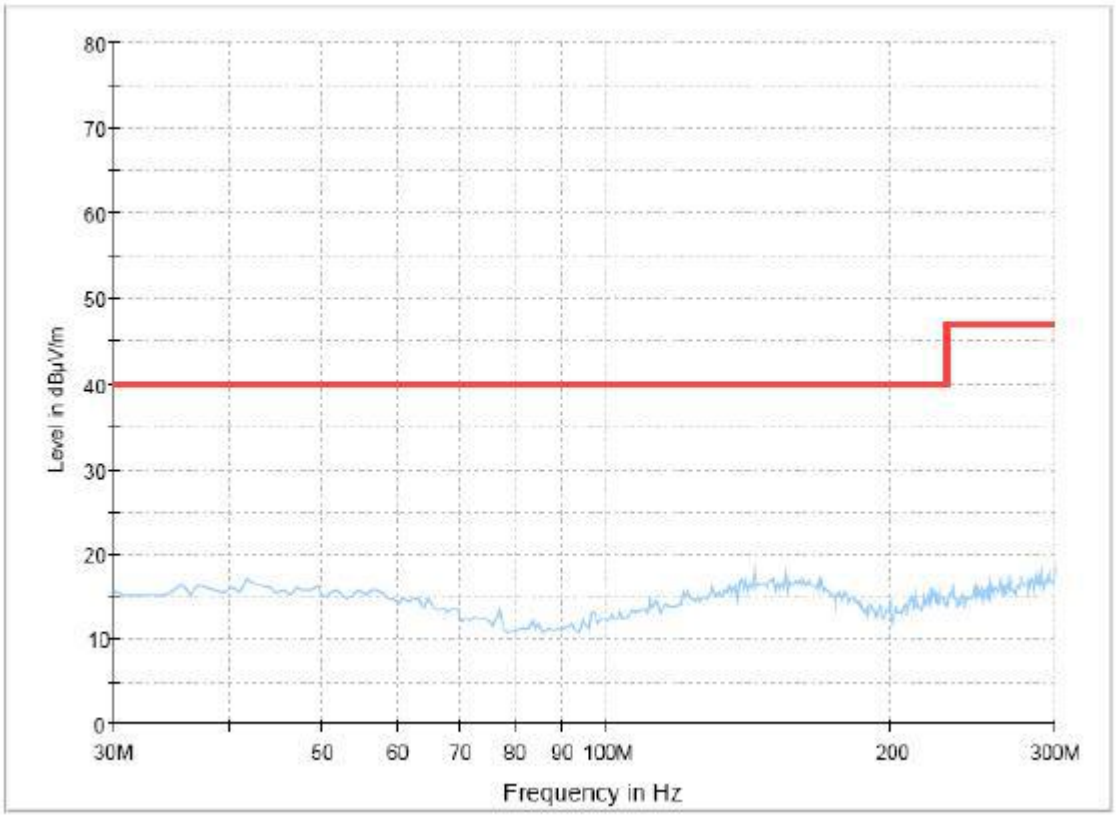
The correspondent test program of test instrument to measure the current harmonics emanated from EUT is chosen. The measure time shall be not less than the time necessary for the EUT to be exercised.

TEST SETUP



2.3.2 Measurement Data

Horizontal:

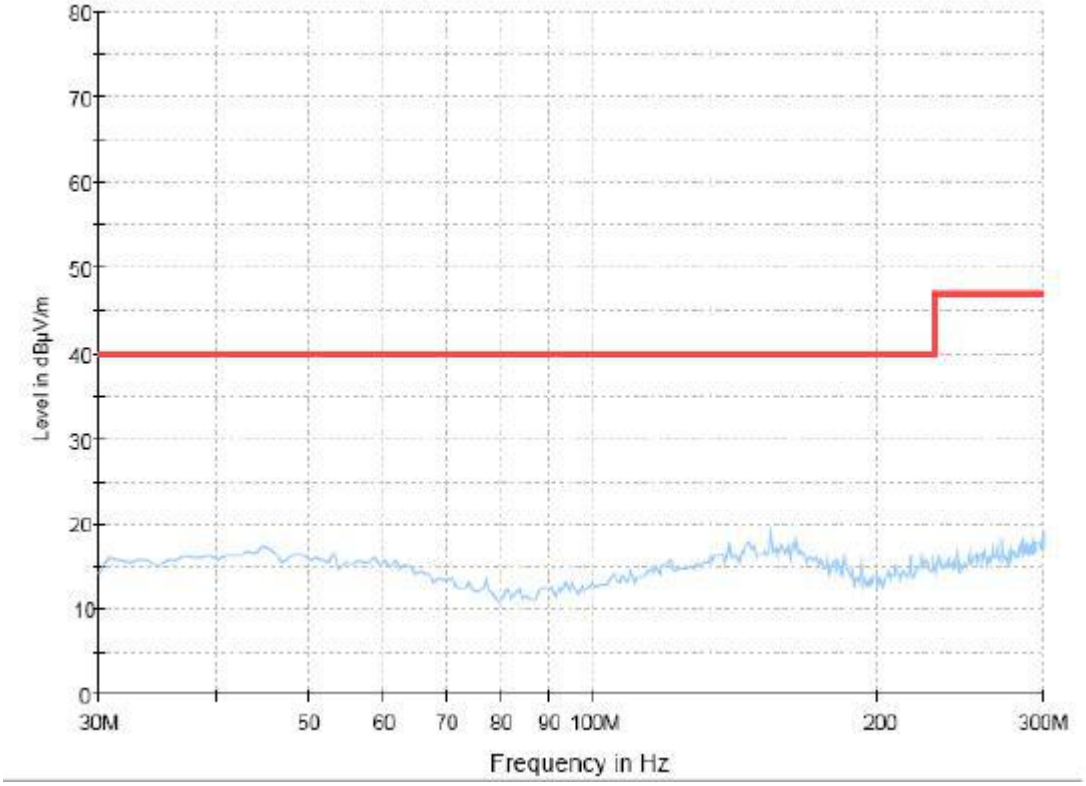


Frequency	Receiver QP Level	Limit	Margin
(MHz)	(dBuV/m)	(dBuV/m)	(dB)
30.00	*	40.00	*
40.00	*	40.00	*

50.00	*	40.00	*
100.00	*	40.00	*
150.00	*	40.00	*
200.00	*	40.00	*
250.00	*	47.00	*
300.00	*	47.00	*

“*” means the emission level is 6dB lower than the relevant limit.

Vertical



Frequency (MHz)	Receiver QP Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.00	*	40.00	*
40.00	*	40.00	*
50.00	*	40.00	*
100.00	*	40.00	*
150.00	*	40.00	*
200.00	*	40.00	*
250.00	*	47.00	*
300.00	*	47.00	*

“*” means the emission level is 6dB lower than the relevant limit .

2.4 Flicker Test Result

Test Requirement:	EN 61000-3-2: 2014
Test Method:	EN 61000-3-2: 2014
Test Date:	May 13, 2019
Measurement Time:	10 mins

2.4.1 E.U.T. Operation

Operating Environment:

Temperature: 24.0◦C Humidity: 61% RH Atmospheric Pressure: 1012 Mbar

EUT Operation:

Test the EUT in Operation Mode with once stop/run operation.

2.4.2 Measurement Data

No test required.

Remark: only require to evaluate dmax, dc, dt. The Pst and Plt shall not be evaluated.

Since the EUT does not meet the limits of the standard EN 61000-3-3: 2013 when tested or evaluated with reference Zref, the another standard EN 61000-3-2: 2014 is applicable to this EUT which is, therefore, subject to conditional connection

According to EN 61000-3-2: 2014

The limits for motor (air compressor) : Pst=1.0; Plt=0.65; d(t)=500ms; dc=3.3%; dmax=7%

For testing using Zref

Ra=0.24 ohm Xa=j0.15 ohm at 50Hz; Rn=0.16 ohm Xn= j0.10 ohm at 50Hz

The Zref = 0.472 ohm

Result: : the max. data Dmax=6.330%, Dc=0.900%,Dt=120ms

According to EN6100-3-11: 2000 clause 6.2.2 to calculation of the maximum permissible system impedance:

The maximum permissible system impedance **Zmax= 0.520 ohm**

According to sub-clause 4 of the standard EN 61000-3-2: 2014, the applicant, therefore, may choose to Marlare that the EUT complies the standard EN 61000-3-2: 2014 provided that the EUT is connected only to a supply of impedance equal to or less than the Zmax calculated above. The Zmax values shall be Marlared in the equipment instruction manual, which shall also instruct to determine in consultation with the supply authority if necessary

3 Immunity Test Results

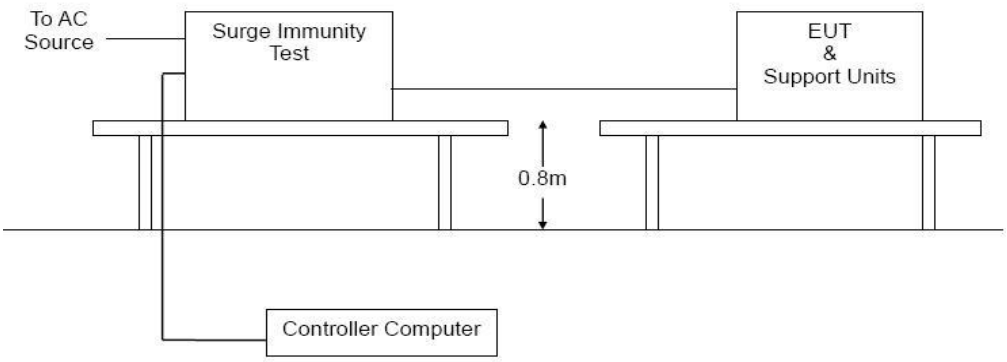
3.1 Performance Criteria Description in Clause 6 of EN 55014-2

Criterion A: The apparatus shall continue to operate as intended during the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.

Criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended. During the test, degradation of performance is allowed, however. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation and from what the user may reasonably expect from the apparatus if used as intended.

Criterion C: Temporary loss of function is allowed, provided the function is self recoverable or can be restored by the operation of the controls, or by any operation specified in the instructions for use.

TEST SETUP



3.2 ESD

Performance Criterion:	C	
Discharge Impedance:	330 W / 150 pF	
Discharge Voltage:	Air Discharge:	8 kV
	Contact Discharge:	4 kV
	VCP/HCP:	4 kV
Polarity:	Positive & Negative	
Number of Discharge:	Minimum 10 times at each test point	
Discharge Mode:	Single Discharge	
Discharge Period:	1 second minimum	

3.2.1 Test Results

Direct Application Test Results

Observations: Test Point:

1. All insulated enclosure and seams.
2. All accessible metal parts of the enclosure.

Direct Application			Test	Results
Discharge Level (kV)	Polarity (+/-)	Test Point	Contact Discharge	Air Discharge
8	+/-	1	N/A	A
4	+/-	2	A	N/A

Indirect Application Test Results

Observations: Test Point: 1. All sides.

Test points:

Indirect Application			Test	Results
Discharge Level (kV)	Polarity (+/-)	Test Point	Horizontal Coupling	Vertical Coupling
4	+/-	1	N/A	A

Results: A: No degradation in the performance of the EUT was observed. N/A: Not applicable (floor mounted EUT or not requested by Standard)

Equipment sheet of electrical safety test

No.	Name	Type	Serial No.	Valid calibration date	Used
1	Vernier callipers	0~150mm	KJ050	2018-08-21~2019-08-20	√
2	Test finger	---	KS048	2018-09-14~2019-09-13	√
3	Micrometer callipers	25~50mm	MJ003	2019-03-23~2020-03-22	√
4	Digital multimeter	1587(Fluke)	MJ035	2018-08-21~2019-08-20	√
5	Grounding resistance measurement instrument	PC39A	KJ065	2018-05-21~2019-05-20	√
6	High voltage withstand tester	CS2672B	KJ054	2018-08-09~2019-08-08	√

Photos

(1)

(2)