REPORT

EN 61800-5-1:2007

Adjustable speed electrical power drive systems — Part 5-1: Safety requirements — Electrical, thermal and energy

Report	
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Testing laboratory	
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Address ..... :	No.45 Wenming Dong Road Longquanyi Chengdu 610100. China
Testing location ..... :	Same as above
Client	
Name .....:	STARMATRIX GROUP INC.
Address.....:	NO.59,ZHONGSHAN WEST ROAD,ZHENJIANG, JIANGSU, CHINA
Test specification	
Standard..... :	EN 61800-5-1:2007
Test procedure ..... :	LVD
Test report form/blank test report	
Test report form No. ..... :	SCC61800
TRF modified by..... :	CHINA CEPREI (SICHUAN) LABORATORY
Master TRF ..... :	Reference No.61800, dated 01
Copyright blank test report..... :	Copyright reserved to the bodies participating in the IECEE CB and/or the bodies participating in the CENELEC Certification Agreement（CCA）
Test item	
Type of test object .....:	CLEVER-POOL ENERGY SAVER
Trademark .....:	/
Model and/or type reference.....:	**CLEVER-POOL/220V**
Manufacturer.....:	STARMATRIX GROUP INC.
Rating(s) .....:	Input : AC 1~230V 50/60Hz Output AC 1~230V 50/60Hz Max: 2HP, 12A

Equipment mobility……...:	Stationary
Operating condition……..:	Continuous
Tested for IT power systems……:	N.A
Mass of equipment (kg) ……:	/
Protection against ingress of water…….. .....:	IP65

Possible test case verdicts

Test case does not apply to the test object ..... : N(.A.)

Test object does meet the requirement ..... : P(ass)

Test object does not meet the requirement ..... : F(ail)

General remarks

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

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

"(See remark #)" refers to a remark appended to the report.

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

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

Brief description of the tested sample(s):

Ambient temperature: 24℃ humidity:65%

Complete test was conducted on **CLEVER-POOL/220V.**

CLEVER-POOL/220V、**CLEVER-POOLM/220V** are series products.

The difference see **Appendix A**

Clause	Requirement-Test	Result-Remark	Verdict
4	**Protection against electric shock, thermal, and energy hazards**		**P**
4.1	General		P
	This Clause 4 defines the minimum requirements for the design and construction of a PDS, to ensure its safety during installation, normal operating conditions and maintenance for the expected lifetime of the PDS. Consideration is also given to minimising hazards resulting from reasonably foreseeable misuse.	Pass muster	P
4.2	Fault conditions		P
	PDS shall be designed to avoid operating modes or sequences that can cause a fault condition or component failure leading to a hazard, unless other measures to prevent the hazard are provided by the installation.	Pass muster	P
4.3	Protection against electric shock		P
4.3.1	Decisive voltage classification		P
4.3.1.1	Use of decisive voltage class (DVC)		P
	Protective measures against electric shock depend on the decisive voltage classification of the circuit according to Table 3, which correlates the limits of the working voltage within the circuit with the DVC. The DVC in turn determines the minimum required level of protection for the circuit.	DVCB	P
4.3.1.2	Limits of DVC		P
4.3.1.3	Requirements for protection		P
	Table 4 shows the requirements for the application of basic insulation or protective separation, dependent on the DVC of the circuit under consideration and of adjacent circuits.	Comply with the requirements	P
4.3.1.4	Circuit evaluation		P
4.3.2	Protective separation		P
	Protective separation shall be achieved by application of materials resistant to degradation, as well as by special constructive measures, and	Pass muster	P
4.3.3	Protection against direct contact		P

Clause	Requirement-Test	Result-Remark	Verdict
4.3.3.1	General		P
	Protection against direct contact is employed to prevent persons from touching live parts which do not meet the requirements of 4.3.4. It shall be provided by one or more of the measures given in 4.3.3.2 and 4.3.3.3.	Comply with the requirements	P
4.3.3.2	Protection by means of insulation of live parts		P
	Live parts shall be completely surrounded with insulation if their working voltage is greater than the maximum limit of DVC A or if they do not have protective separation from adjacent circuits of DVC C or D. The insulation shall be rated according to the impulse voltage, temporary overvoltage or working voltage (see 4.3.6.2.1), whichever gives the most severe requirement. It shall not be possible to remove the insulation without the use of a tool.	Pass muster Comply with the requirements	P
4.3.3.3	Protection by means of enclosures and barriers		P
	Live parts of DVC B, C or D shall be arranged in enclosures or located behind enclosures or barriers, which meet at least the requirements of the Protective Type IPXXB according to 15.1 of IEC 60529. The top surfaces of enclosures or barriers which are accessible when the equipment is energized shall meet at least the requirements of the Protective Type IP3X with regard to vertical access only. See 5.2.2.3 for test. It shall only be possible to open enclosures or remove barriers with the use of a tool or after de-energization of these live parts.	Pass muster	P
4.3.4	Protection in case of direct contact	Not applicable	N
4.3.4.1	General		N
	Protection in case of direct contact is required to ensure that contact with live parts does not produce a shock hazard.		N
4.3.4.2	Protection using DVC A		N
	Unearthed circuits of DVC A, and earthed circuits of DVC A used within a zone of equipotential bonding (see 3.44), do not require protection in case of direct contact.		N

Clause	Requirement-Test	Result-Remark	Verdict
4.3.4.3	Protection by means of protective impedance		N
	The connection of accessible live parts to circuits of DVC B, C or D, or to earthed circuits of DVC A not used within a zone of equipotential bonding, shall only be made through protective impedances (unless 4.3.4.4 applies).		N
4.3.4.4	Protection by means of limited voltages		N
	This type of protection implies a voltage division technique from a circuit protected against direct contact, resulting in a voltage to earth not greater than that of DVC A.		N
	This type of protection shall not be used in case of protective class II, because it relies on protective earth being connected.		N
4.3.5	Protection against indirect contact		P
4.3.5.1	General		P
	Protection against indirect contact is required to prevent shock currents which can result from accessible conductive parts during an insulation failure. This protection shall comply with the requirements for protective class I, class II or class III.	Class I	P
4.3.5.2	Insulation between live parts and accessible conductive parts		P
	Accessible conductive parts of equipment shall be separated from live parts at least by basic insulation or by clearances as in 4.3.6.4.	See the rated clause	P
4.3.5.3	Protective bonding circuit		P
4.3.5.3.1	General		P
	Other than in a) or b) below, protective bonding shall be provided between accessible conductive parts of equipment and the means of connection for the protective earthing conductor:	Pass muster	P
	Metal ducts of flexible or rigid construction and metallic sheaths shall not be used as protective conductors.	Pass muster	P
4.3.5.3.2	Rating of protective bonding		P

Clause	Requirement-Test	Result-Remark	Verdict
	Protective bonding shall withstand the highest thermal and dynamic stresses that can occur to the PDS/CDM/BDM item(s) concerned when they are subjected to a fault connecting to accessible conductive parts.		P
	The protective bonding shall remain effective for as long as a fault to the accessible conductive parts persists or until an upstream protective device removes power from the part.		P
4.3.5.3.3	Protective bonding impedance	Not applicable	N
	The impedance of the protective bonding shall be sufficiently low that:		N
	- during normal operation, no voltage exceeding continuously 5 V a.c. or 12 V d.c. can persist between the accessible conductive parts and the means of connection for the protective earthing conductor,		N
	under fault conditions, no voltage exceeding AC-2 or DC-2 in Figure 7 can persist between accessible conductive parts and the means of connection for the protective earthing conductor until an upstream protective device removes power from the part. The upstream protective device considered for this requirement shall have the characteristics required by the installation manual according to 6.3.7.		N
4.3.5.4	Protective earthing conductor		
	A protective earthing conductor shall be connected at all times when power is supplied to the PDS/CDM/BDM, unless the PDS/CDM/BDM complies with the requirements of protective class II (see 4.3.5.6). Unless local wiring regulations state otherwise, the protective earthing conductor cross-sectional area shall be determined from Table 5 or by calculation according to 543.1 of IEC 60364-5-54.	Pass muster Comply with the requirements	P
4.3.5.5	Means of connection for the protective earthing conductor		P
4.3.5.5.1	General		P

Clause	Requirement-Test	Result-Remark	Verdict
	For high-voltage PDS, protective shields of high voltage cables shall have provision for connection to earth by protective bonding in accordance with IEC 60204-11 and IEC 61800-4. The protective bonding concept shall be by agreement between the supplier and user and consistent with local requirements in the area of installation.	Not applicable	N
4.3.5.5.2	Touch current in case of failure of protective earthing conductor		P
	The requirements of this subclause shall be satisfied to maintain safety in case of damage to or disconnection of the protective earthing conductor.	Pass muster	P
4.3.5.6	Special features in equipment for protective class II		P
	If equipment is designed to use double or reinforced insulation between live parts and accessible surfaces in accordance with 4.3.3.2, then the design is considered to meet protective class II, if the following also apply.	Not applicable Class I	P
4.3.6	Insulation		P
4.3.6.1	General		P
4.3.6.1.1	Influencing factors		P
	This subclause gives minimum requirements for insulation, based on the principles of IEC 60664 and IEC 60071.	Comply with the requirements	P
	Manufacturing tolerances shall be taken into account during design and installation of the PDS.		P
4.3.6.1.2	Pollution degree		P
	Insulation, especially when provided by clearances and creepage distances, is affected by pollution which occurs during the expected lifetime of the PDS. The micro-environmental conditions for insulation shall be applied according to Table 6	Pollution degree II	P
	In accordance with IEC 61800-1, IEC 61800-2 and IEC 61800-4, a standard PDS shall be designed for pollution degree 2. For safety, pollution degree 3 shall be assumed in determining the insulation. Thereby the PDS is usable for pollution degree 1, 2 and 3 environments.	Pass muster Comply with the requirements	P

Clause	Requirement-Test	Result-Remark	Verdict
4.3.6.1.3	Overvoltage category		P
	The concept of overvoltage categories (based on IEC 60364-4-44 and IEC 60664-1) is used for equipment energized from the supply mains. Four categories are considered:		P
	- category IV applies to equipment permanently connected at the origin of an installation (upstream of the main distribution board). Examples are electricity meters, primary overcurrent protection equipment and other equipment connected directly to outdoor open lines;		N
	- category III applies to equipment permanently connected in fixed installations (downstream of, and including, the main distribution board). Examples are switchgear and other equipment in an industrial installation;		N
	- category II applies to equipment not permanently connected to the fixed installation. Examples are appliances, portable tools and other plug-connected equipment;	Pass muster	P
	- category I applies to equipment connected to a circuit where measures have been taken to reduce transient overvoltages to a low level.		P
4.3.6.1.4	Supply earthing systems		P
	IEC 60364-1describes the three following basic types of earthing system.		P
	- TN system: has one point directly earthed, the accessible conductive parts of the installation being connected to that point by protective conductors. Three types of TN system, TN-C, TN-S and TN-C-S, are defined according to the arrangement of the neutral and protective conductors.	TN-S system	P
	- TT system: has one point directly earthed, the accessible conductive parts of the installation being connected to earth electrodes electrically independent of the earth electrodes of the power system.		N

Clause	Requirement-Test	Result-Remark	Verdict
	- IT system: has all live parts isolated from earth or one point connected to earth through an impedance, the accessible conductive parts of the installation being earthed independently or collectively to the earthing system.		N
4.3.6.1.5	Insulation voltages		P
	Table 7 and Table 8 use the system voltage of the circuit under consideration and overvoltage category to define the impulse voltage. The system voltage is also used to define the temporary overvoltage.	Test voltage : 2500V Pass muster	P
4.3.6.2	Insulation to the surroundings		
4.3.6.2.1	General		P
	Insulation for basic, supplementary, and reinforced insulation between a circuit and its surroundings shall be designed	Class I Basic and reinforced insulation	P
4.3.6.2.2	Circuits connected directly to the supply mains		P
	Insulation between the surroundings and circuits which are connected directly to the supply mains shall be designed according to the impulse voltage, temporary overvoltage, or working voltage, whichever gives the most severe requirement.	Comply with the requirements	P
	The requirements for double or reinforced insulation shall not be reduced when measures to reduce impulses are provided.	Pass muster	P
4.3.6.2.3	Circuits not connected directly to the supply mains		N
	Insulation between the surroundings and circuits supplied by a transformer providing galvanic isolation from the supply mains shall be designed according to: a) the impulse voltage determined using the transformer secondary voltage as the system voltage, or b) the working voltage, whichever gives the more severe requirement.		N
4.3.6.2.4	Insulation between circuits		N
	Insulation between two circuits shall be designed according to the circuit having the more severe requirement.		N
4.3.6.3	Functional insulation		P

Clause	Requirement-Test	Result-Remark	Verdict
	For parts or circuits that are not significantly affected by external transients, functional insulation shall be designed according to the working voltage across the insulation.	Pass muster	P
4.3.6.4	Clearance distances		P
4.3.6.4.1	Determination		P
	Table 9 defines the minimum clearance distances required to provide functional, basic, or supplementary insulation (see Annex C for examples of clearance distances).	Pass muster >1.5mm	P
4.3.6.4.2	Electric field homogeneity		P
	The dimensions in Table 9 correspond to the requirements of an inhomogeneous electric field distribution across the clearance, which are the conditions normally experienced in practice. If a homogeneous electric field distribution is known to exist, and the impulse voltage is equal to or greater than 6 000 V for a circuit connected directly to the supply mains or 4 000 V within a circuit, the clearance for basic or supplementary insulation may be reduced to not less than that required by Table 2 Case B of IEC 60664-1. In this case, however, the impulse voltage test of 5.2.3.1 shall be performed on the clearance.	Pass muster Comply with the requirements	P
4.3.6.4.3	Clearance to conductive enclosures		P
	The clearance between any non-insulated live part and the walls of a metal enclosure shall be in accordance with 4.3.6.4.1 following the deformation tests of 5.2.2.5.	Pass muster Comply with the requirements	P
4.3.6.5	Creepage distances		P
4.3.6.5.1	General		P
	Creepage distances shall be large enough to prevent long-term degradation of the surface of solid insulators, according to Table 10.	Pass muster >2.5mm	P
	For functional, basic and supplementary insulation, the values in Table 10 apply directly. For reinforced insulation, the distances in Table 10 shall be doubled.		P

Clause	Requirement-Test	Result-Remark	Verdict
4.3.6.5.2	Materials		P
	Insulating materials are classified into four groups corresponding to their comparative tracking index (CTI) when tested according to 6.2 of IEC 60112:		P
	- Insulating material group I CTI ≥ 600;		N
	- Insulating material group II 600 > CTI ≥ 400;		N
	- Insulating material group IIIa 400 > CTI ≥ 175;		P
	- Insulating material group IIIb 175 > CTI ≥ 100.		N
4.3.6.6	Coating		P
	A coating may be used to provide insulation, to protect a surface against pollution, and to allow a reduction in creepage and clearance distances (see 4.3.6.8.4.2 and 4.3.6.8.6).		P
4.3.6.7	PWB spacings for functional insulation		N
	Spacings for functional insulation on a PWB which do not comply with 4.3.6.4 and 4.3.6.5 are permitted when all the following are satisfied:		N
	On PWB creepage and clearance distances for functional insulation at working voltages less than 80 V (r.m.s.) or 110 V (recurring peak) are permitted to be evaluated according to pollution degree 1 if the tracks are covered with a suitable coating.		N
4.3.6.8	Solid insulation		P
4.3.6.8.1	General		P
	Materials selected for solid insulation shall be able to withstand the stresses occurring. These include mechanical, electrical, thermal and climatic stresses which are to be expected in normal use. Insulation materials shall also be resistant to ageing during the expected lifetime of the PDS.	Pass muster Comply with the requirements	P
	Tests shall be performed on components and subassemblies using solid insulation, in order to ensure that the insulation performance has not been compromised by the design or manufacturing process.	Pass muster	P
4.3.6.8.2	Requirements for electrical withstand capability		P

Clause	Requirement-Test	Result-Remark	Verdict
4.3.6.8.2.1	Basic or supplementary insulation:		P
4.3.6.8.2.2	Double and reinforced insulation:		P
4.3.6.8.2.3	Functional insulation		P
	Functional insulation shall comply with the requirements of 4.3.6.3. Testing is not required, except where the circuit analysis required by 4.2 shows that failure of the insulation could result in a hazard. In these cases, the insulation shall meet the requirements and tests for basic insulation.	Pass muster Comply with the requirements	P
4.3.6.8.3	Thin sheet or tape material	No such sheet or tape material	N
4.3.6.8.3.1	General		N
	Subclause 4.3.6.8.3 applies to the use of thin sheet or tape materials in assemblies such as wound components and bus-bars.		N
	Insulation consisting of thin (less than 0,75 mm) sheet or tape materials is permitted, provided that it is protected from damage and is not subject to mechanical stress under normal use.		N
	Where more than one layer of insulation is used, there is no requirement for all layers to be of the same material.		N
4.3.6.8.3.2	Material thickness not less than 0,2 mm		N
4.3.6.8.3.3	Material thickness less than 0,2 mm		N
4.3.6.8.3.4	Compliance		N
	Compliance is checked by the tests described in 5.2.3.1 to 5.2.3.3.		N
	When a component or sub-assembly makes use of thin sheet insulating materials, it is permitted to perform the tests on the component rather than on the material.		N
4.3.6.8.4	Printed wiring boards (PWBs)		P
4.3.6.8.4.1	General		P

Clause	Requirement-Test	Result-Remark	Verdict
	Insulation between conductor layers in double-sided single-layer PWBs, multi-layer PWBs and metal core PWBs, shall meet the requirements of 4.3.6.8.1. Basic, supplementary, double and reinforced insulation shall meet the appropriate requirements of 4.3.6.8.2.1 or 4.3.6.8.2.2. Functional insulation in PWBs shall meet the requirements of 4.3.6.8.2.3.	Pass muster Comply with the requirements	P
4.3.6.8.4.2	Use of coating materials		P
	A coating material used to provide functional, basic, supplementary and reinforced insulation shall meet the requirement as specified below.		P
	Type 1 protection (as defined in IEC 60664-3) improves the microenvironment of the parts under protection. The clearance and creepage distance of Table 9 and Table 10 for pollution degree 1 apply under the protection. Between two conductive parts, it is a requirement that one or both conductive parts, together with all the spacing between them, are covered by the protection.	Pass muster Comply with the requirements	P
	Type 2 protection is considered to be similar to solid insulation. Under the protection, the requirements for solid insulation specified in 4.3.6.8 are applicable and spacings shall not be less than those specified in Table 1 of IEC 60664-3. The requirements for clearance and creepage in Table 9 and Table 10 do not apply. Between two conductive parts, it is a requirement that both conductive parts, together with the spacing between them, are covered by the protection so that no airgap exists between the protective material, the conductive parts and the printed boards.	Pass muster Comply with the requirements	P
4.3.6.8.5	Wound components		P
	Varnish or enamel insulation of wires shall not be used for basic, supplementary, double or reinforced insulation.		P

Clause	Requirement-Test	Result-Remark	Verdict
	The component itself shall pass the requirements given in 4.3.6.8.1 and 4.3.6.8.2. If the component has reinforced or double insulation, the voltage test of 5.2.3.2 shall be performed as a routine test.		P
4.3.6.8.6	Potting materials		P
	A potting material may be used to provide solid insulation or to act as a coating to protect against pollution. If used as solid insulation, it shall comply with the requirements of 4.3.6.8.1 and 4.3.6.8.2. If used to protect against pollution, the requirements for Type 1 protection in 4.3.6.8.4.2 apply.	Pass muster Comply with the requirements	P
4.3.6.9	Insulation requirements above 30 kHz	Not applicable	N
	Where voltages across insulation have fundamental frequencies greater than 30 kHz, further considerations apply. For low-voltage circuits, guidance is provided in IEC 60664-4.		N
4.3.7	Enclosures		P
4.3.7.1	General		P
	Metal enclosures shall comply with the deflection test of 5.2.2.5.2 or have a thickness as specified in 4.3.7.2 or 4.3.7.3.	Pass muster Comply with the requirements	P
	Polymeric enclosures or polymeric parts, relied on to complete and maintain the integrity of an electrical enclosure, shall comply with the flammability requirements of 4.4.3 and the impact test in 5.2.2.5.3.	Pass muster Comply with the requirements	P
	Enclosures shall be suitable for use in their intended environments. The manufacturer shall specify the intended environment (see 6.3.3) and the IP rating of the enclosure (see 5.2.2.4 for test).		P
4.3.7.2	Cast metal		P
	Die-cast metal, except at threaded holes for conduit, where a minimum of 6,4 mm is required, shall be:		P
	Malleable iron or permanent-mould cast aluminium, brass, bronze, or zinc, except at threaded holes for conduit, where a minimum of 6,4 mm is required, shall be:		P

Clause	Requirement-Test	Result-Remark	Verdict
	- at least 2,4 mm thick for an area greater than 155 cm^2 or having any dimension more than 150 mm;		N
	- at least 1,5 mm thick for an area of 155 cm^2 or less having no dimension more than 150 mm.		P
	A sand-cast metal enclosure shall be a minimum of 3,0 mm thick except at locations for threaded holes for conduit, where a minimum of 6,4 mm is required.		N
4.3.7.3	Sheet metal	No such sheet metal	N
	The thickness of a sheet-metal enclosure at points to which a wiring system is to be connected shall be not less than 0,8 mm thick for uncoated steel, 0,9 mm thick for zinc-coated steel, and 1,2 mm thick for non-ferrous metal.		N
	Enclosure thickness at points other than where a wiring system is to be connected shall be not less than that specified in Table 11 or Table 12.		N
4.3.8	Wiring and connections		P
4.3.8.1	General		P
	The wiring and connections between parts of the equipment and within each part shall be protected from mechanical damage during installation. The insulation, conductors and routing of all wires of the equipment shall be suitable for the electrical, mechanical, thermal and environmental conditions of use. Conductors which are able to contact each other shall be provided with insulation rated for the DVC requirements of the relevant circuits.	Pass muster Comply with the requirements	P
	The compliance with 4.3.8.2 to 4.3.8.8 shall be checked by visual inspection (see 5.2.1) of the overall construction and datasheets if applicable.		P
4.3.8.2	Routing		P
	A hole through which insulated wires pass in a sheet metal wall within the enclosure of the equipment shall be provided with a smooth, well-rounded bushing or grommet or shall have smooth, well-rounded surfaces upon which the wires bear to reduce the risk of abrasion of the insulation.	Pass muster Comply with the requirements	P

Clause	Requirement-Test	Result-Remark	Verdict
	Wires shall be routed away from sharp edges, screw threads, burrs, fins, moving parts, drawers, and similar parts, which abrade the wire insulation. The minimum bend radius specified by the wire manufacturer shall not be violated.	Pass muster	P
4.3.8.3	Colour coding		P
	Insulated conductors, other than those which are integral to ribbon cable or multi-cord signal cable, identified by the colour green with or without one or more yellow stripes shall not be used other than for protective bonding.	Pass muster Green/yellow	P
4.3.8.4	Splices and connections		P
	All splices and connections shall be mechanically secure and shall provide electrical continuity.		P
	Electrical connections shall be soldered, welded, crimped, or otherwise securely connected. A soldered joint, other than a component on a PWB, shall additionally be mechanically secured.	Pass muster Comply with the requirements	P
4.3.8.5	Accessible connections		P
	In addition to measures given in 4.3.4.1 to 4.3.4.3 it shall be ensured that neither insertion error nor polarity reversal of connectors can lead to a voltage on an accessible connection higher than the maximum of DVC A. This applies for example to plug-in sub-assemblies or other plug-in devices which can be plugged in without the use of a tool (key) or which are accessible without the use of a tool. This does not apply to equipment intended to be installed in closed electrical operating areas.	Pass muster Comply with the requirements	P
4.3.8.6	Interconnections between parts of the PDS		N
	In addition to complying with the requirements given in 4.3.8.1 to 4.3.8.5, the means provided for the interconnection between parts of the PDS shall comply with the following requirements or those of 4.3.8.7.		N

Clause	Requirement-Test	Result-Remark	Verdict
	Cable assemblies and flexible cords provided for interconnection between sections of equipment or between units of a system shall be suitable for the service or use involved. Cables shall be protected from physical damage as they leave the enclosure and shall be provided with mechanical strain relief.		N
	When external interconnecting cables terminate in a plug which mates with a receptacle on the external surface of an enclosure, no risk of electric shock shall exist at accessible contacts of either the plug or receptacle when disconnected.		N
4.3.8.7	Supply connections		P
	A PDS intended for permanent connection to the power supply shall have provision for connection to the applicable wiring system in accordance with the requirements where it is being installed. The connection points provided shall be of appropriate construction to preclude the possibility of loose strands reducing the spacing between conductors when careful attention is paid to installation.	Pass muster	P
4.3.8.8	Terminals		P
4.3.8.8.1	Construction requirements		P
	All parts of terminals which maintain contact and carry current shall be of metal having adequate mechanical strength.	Adequate mechanical strength	P
	Terminal connections shall be such that the conductors can be connected by means of screws, springs or other equivalent means so as to ensure that the necessary contact pressure is maintained.		P
	Terminals shall not allow the conductors to be displaced or be displaced themselves in a manner detrimental to the operation of equipment and the insulation shall not be reduced below the rated values.		P
4.3.8.8.2	Connecting capacity		P

Clause	Requirement-Test	Result-Remark	Verdict
	Terminals shall be provided which accommodate the conductors specified in the installation and maintenance manuals (see 6.3.6.4) and cables in accordance with the wiring rules applicable at the installation. The terminals shall meet the temperature rise test of 5.2.3.8. The terminals shall also be suitable for conductors of the same type at least two sizes smaller, as given in the appropriate column of Table F.1.	Pass muster Comply with the requirements	P
4.3.8.8.3	Connection		P
	Terminals for connection to external conductors shall be readily accessible during installation.		P
	Clamping screws and nuts shall not serve to fix any other component although they may hold the terminals in place or prevent them from turning.		P
4.3.8.8.4	Wire bending space for wires 10 mm2 and greater		P
	For low-voltage PDS, the distance between a terminal for connection to the main supply, or between major parts of the PDS (for example, motor, transformer, CDM/BDM), and an obstruction toward which the wire is directed upon leaving the terminal shall be at least that specified in Table 13.		P
4.3.9	Output short-circuit requirements		P
	The PDS shall not present a thermal hazard, electric shock or energy hazard under shortcircuit conditions at any output that is capable of providing power. In some cases, short-circuit protection may be provided by external measures, the characteristics of which shall be specified by the manufacturer.	Pass muster Comply with the requirements	P
4.3.10	Residual current-operated protective (RCD) or monitoring (RCM) device compatibility		N
	RCD and RCM are used to provide protection against insulation faults in some domestic and industrial installations, additional to that provided by the installed equipment.		N
4.3.11	Capacitor discharge		P

Clause	Requirement-Test	Result-Remark	Verdict
	Capacitors within a PDS shall be discharged to a voltage less than 60 V, or to a residual charge less than 50 µC, within 5 s after the removal of power from the PDS. If this requirement is not achievable for functional or		P
4.3.12	Access conditions for high-voltage PDS		N
	The high voltage sections (transformer, converter, motor, etc.) shall be protected by an appropriate housing enclosure according to IEC 60204-11 with respect to personnel safety.		N
	a) Operating conditions Interlocking doors shall prevent any access inside the enclosure of the high voltage converter section when main circuit breaker(s) providing the high voltage to the circuit are on, and if live parts have not been earthed (see 0).		N
	b) Access for maintenance – earthing instructions The earthing operation is performed after the normal discharge time stated by the converter manufacturer. Care shall be taken to ensure that this operation is safe even in case of failure of the discharge circuit. Care shall also be taken that on the input and output side the stray capacitance of cables, motor and/or transformer shall be discharged before possible access to live parts. The requirements of 4.3.11 apply.		N
4.4	Protection against thermal hazards		P
4.4.1	Minimizing the risk of ignition		P
	The risk of ignition due to high temperature shall be minimized by the appropriate selection and use of components and by suitable construction.		P
	Electrical components shall be used in such a way that their maximum working temperature under normal load conditions is less than that necessary to cause ignition of the surrounding materials with which they are likely to come into contact. The limits in Table 15 shall not be exceeded for the surrounding material.		P
4.4.2	Insulating materials		P

Clause	Requirement-Test	Result-Remark	Verdict
4.4.2.1	General		P
	A material which is used for the direct support of an uninsulated live part shall comply with the following requirements.		P
	The insulating material shall be suitable for the maximum temperature it attains as determined by the temperature rise test of 5.2.3.8. Consideration shall be given as to whether or not the insulating material additionally provides mechanical strength and whether or not the part can be subject to impact during use.	Pass muster Comply with the requirements	P
4.4.2.2	Material requirements		P
	The insulating material shall have a CTI of 100 or greater.		P
	The manufacturer may provide data from the insulating material supplier to demonstrate compliance with the above requirements. In this case, no further testing is required.		P
4.4.3	Flammability of enclosure materials		P
	Materials used for enclosures of PDS shall meet the test requirements of 5.2.5.4.		P
	Metals, ceramic materials, and glass which is heat-resistant tempered, wired or laminated, are considered to comply without test.		P
	Materials are considered to comply without test if, in the minimum thickness used, the material is of flammability class 5VA, according to IEC 60695-11-20.	Pass muster Comply with the requirements	P
	The manufacturer may provide data from the insulating material supplier to demonstrate compliance with the above requirements. In this case, no further testing is required.		P
4.4.4	Temperature limits		P
4.4.4.1	Internal parts		P
	Equipment and its component parts shall not attain temperatures in excess of those in Table 15 when tested in accordance with the ratings of the equipment	Class B Pass muster	P

Clause	Requirement-Test	Result-Remark	Verdict
4.4.4.2	External parts of CDM		N
	The maximum temperature for accessible exterior parts of the CDM shall be in compliance with Table 16. It is permitted that parts have temperatures exceeding these values, but they shall then be marked with a warning statement as given in 6.4.3.4. Under no circumstances shall the temperature of accessible parts exceed 150 ° C.		N
4.4.5	Specific requirements for liquid cooled PDS	Not applicable	N
4.4.5.1	Coolant		N
	The specified coolant (see 6.2) shall be suitable for the anticipated ambient temperatures. Coolant temperature in operation shall not exceed the limit specified in Table 15.		N
4.4.5.2	Design requirements		N
4.4.5.2.1	Corrosion resistance		N
	All cooling system components shall be suitable for use with the specified coolant. They shall be corrosion resistant and shall not corrode as a result of electrolytic action or prolonged exposure to the coolant and/or air.		N
4.4.5.2.2	Tubing, joints and seals		N
	Cooling system tubing, joints and seals shall be designed to prevent leakage during excursions of pressure over the life of the equipment. The entire cooling system including tubing shall satisfy the requirements of the Hydrostatic pressure test of 5.2.7.		N
4.4.5.2.3	Provision for condensation		N
	Where internal condensation occurs during normal operation or maintenance, measures shall be taken to prevent degradation of insulation. In those areas where such condensation is expected, clearance and creepage distances shall be evaluated at least for a pollution degree 3 environment (see Table 6), and provision shall be made to prevent accumulation of water (for example by providing a drain).		N
4.4.5.2.4	Leakage of coolant		N

Clause	Requirement-Test	Result-Remark	Verdict
	Measures shall be taken to prevent leakage of coolant onto live parts as a result of normal operation, servicing, or loosening of hoses or other cooling system parts during the expected lifetime. If a pressure relief mechanism is provided, this shall be located so that there shall be no leakage of coolant onto live components when it is activated.		N
4.4.5.2.5	Loss of coolant		N
	Loss of coolant from the cooling system shall not result in thermal hazards, explosion, or shock hazard. The requirements of the Loss of coolant test of 5.2.4.5.4 shall be satisfied.		N
4.4.5.2.6	Conductivity of coolant		N
	When the coolant is intentionally in contact with live parts (for example non-earthed heatsinks), the conductivity of the coolant shall be continuously monitored and controlled, in order to avoid hazardous current flow through the coolant.		N
4.4.5.2.7	Insulation requirements for coolant hoses		N
	When the coolant is intentionally in contact with live parts (for example non-earthed heatsinks), the coolant hoses form a part of the insulation system. Depending on the location of the hoses, the requirements of 4.3.6 for functional or basic insulation or protective separation shall be applied where relevant.		N
4.5	Protection against energy hazards		P
4.5.1	Electrical energy hazards		P
	Failure of any component within the PDS shall not release sufficient energy to lead to a hazard, for example, expulsion of material into an area occupied by personnel.		P
	Where appropriate, the possibility should be considered of energy transfer from the PDS motor to the CDM/BDM when the driven equipment over-runs the CDM/BDM control.		P
4.5.2	Mechanical energy hazards		P

Clause	Requirement-Test	Result-Remark	Verdict
4.5.2.1	General		P
	Mechanical failure due to critical speed considerations or torsional problems can create a hazard to operating personnel. These considerations are applicable to all PDS, although they are increasingly significant with increased equipment size, such as with high-voltage PDS. As these subjects are application-dependent, it is not possible to include specific requirements in this standard.	Pass muster Comply with the requirements	P
4.5.2.2	Critical torsional speed		P
	Where appropriate, communication should be established between PDS/CDM/BDM supplier, driven equipment supplier, installer, and user with respect to any anticipated critical torsional speed considerations.		P
4.5.2.3	Transient torque analysis		N
	Transient torque analysis is an important design tool for PDS to check torsional stresses in the whole mechanical string. For example, the following operating conditions are areas of concern.		N
	Where appropriate, communication should be established with the driven equipment supplier and the information required by 6.3.5.4 provided.		N
4.5.3	Acoustic noise emission		P
	Under consideration. Requirements for acoustic noise emission are often present in local regulations. In the absence of such regulations, it is recommended that the limits of IEC 60034-9 should be applied.	Pass muster Comply with the requirements	P
4.6	Protection against environmental stresses		P
	The PDS/CDM/BDM shall not present any hazards as a result of specified environmental stresses. As a minimum, the PDS/CDM/BDM shall satisfy the environmental endurance tests of 5.2.6. More demanding requirements may be specified by the manufacturer, in which case less demanding tests of this standard do not need to be performed.	Pass muster Comply with the requirements	P

Clause	Requirement-Test	Result-Remark	Verdict
5	**Test requirements**		**P**
5.1	General		P
5.1.1	Test objectives and classification		P
	Testing, as defined in this Clause 5, is required to demonstrate that PDS is fully in accordance with the requirements of this part of IEC 61800. Testing may be waived if permitted by the relevant requirements subclause of Clause 4.		P
	The manufacturer and/or test house shall ensure that the specified maximum and/or minimum environment (or test) values are imposed, taking tolerances and measurement uncertainties fully into account.		P
	Warning ! These tests can result in hazardous situations. Suitable precautions shall be taken to avoid injury.	Pass muster	P
5.1.2	Selection of test samples		P
	When testing a range or series of similar products, it may not be necessary to test all models in the range. Each test should be performed on a model or models having mechanical and electrical characteristics that adequately represent the entire range for that particular test.	Pass muster	P
5.1.3	Sequence of tests		P
	In general, there is no requirement for tests to be performed in a set sequence, nor is it required that they are all performed on the same sample of equipment. However, the pass criteria for some of the tests require that they are followed by one or more further tests.	Pass muster Comply with the requirements	P
5.1.4	Earthing conditions		P
	The manufacturer shall state the acceptable earthing systems (see 4.3.6.1.4) for the PDS. Test requirements shall be determined using the worst-case (most stressful) earthing system allowed by the manufacturer. Earthing systems may include:	Pass muster	P
5.1.5	Compliance		P

Clause	Requirement-Test	Result-Remark	Verdict
	Compliance with this part of IEC 61800 shall be verified by carrying out the appropriate tests specified in this Clause 5.	Comply with the requirements	P
	Compliance with construction requirements and information to be provided by the manufacturer shall be verified by suitable examination, visual inspection, and/or measurement.	Pass muster	P
5.1.6	Test overview		P
	Table 17 provides an overview of the type, routine and sample testing of electronic components, devices and PDS/CDM/BDM.	Comply with the requirements	P
5.2	Test specifications		P
5.2.1	Visual inspections (type test, sample test and routine test)		P
	Visual inspections shall be made:		P
	- as routine tests, to check features such as adequacy of labelling, warnings and other safety aspects.	Pass muster	P
	- as acceptance criteria of individual type tests, sample tests or routine tests, to verify that the requirements of this standard have been met	Comply with the requirements	P
	Routine inspections may be part of the production or assembly process.		P
5.2.2	Mechanical tests		P
5.2.2.1	Clearances and creepage distances (type test)		P
	It shall be verified by measurement or visual inspection that the clearance and creepage distances comply with Table 9 and Table 10. See Annex C for measurement examples. Where this verification is impossible to perform, an impulse voltage test (see 5.2.3.1) shall be performed between the considered circuits.	Pass muster See the rated clause	P
5.2.2.2	PWB short-circuit test (type test)		P
	On PWBs, functional insulation provided by spacings which are less than those specified in Table 9 and Table 10 (see 4.3.6.7) shall be type tested as described below.		P

Clause	Requirement-Test	Result-Remark	Verdict
	Surgical cotton shall be placed at all openings, handles, flanges, joints and similar locations on the outside of the enclosure, and the wire mesh cage (if used), in a manner which will not significantly affect the cooling.		P
	The decreased spacings shall be short-circuited one at a time, on representative samples, and the short-circuit shall be maintained until no further damage occurs		P
	As a result of the PWB short-circuit test, the PDS/CDM/BDM shall comply with the following:		P
	- there shall be no emission of flame or molten metal;		P
	- the surgical cotton indicator shall not have ignited	Pass muster	P
	- the earth connection shall not have opened;	Pass muster	P
	- the door or cover shall not have blown open;	Pass muster	P
	- during and after the test, accessible SELV and PELV circuits shall not exhibit voltages greater than the time dependent voltages of Figure 7;		N
	- during and after the test, live parts at voltages greater than decisive voltage class A shall not become accessible.	Pass muster	P
5.2.2.3	Non-accessibility test (type test)		P
	This test is intended to show that live parts, protected by means of enclosures and barriers in compliance with 4.3.3.3, are not accessible.		P
	This test shall be performed as a type test of the enclosure of a PDS as specified in IEC 60529 for the enclosure classification for protection against access to hazardous parts. Exception:	Pass muster Comply with the requirements	P
5.2.2.4	Enclosure integrity test (type test)		P
	The claimed IP rating of the enclosure shall be verified. This test shall be performed as a type test of the enclosure of a PDS as specified in IEC 60529 for the enclosure classification.		P
5.2.2.5	Deformation tests		P
5.2.2.5.1	General		P

Clause	Requirement-Test	Result-Remark	Verdict
	The Deflection and Impact tests apply to PDS, and to enclosed CDM/BDM where they are intended for operation without a further enclosure to which access is restricted to trained maintenance staff. After completion of the Deflection test (see 5.2.2.5.2) for metallic enclosures and the Impact test (see 5.2.2.5.3) for polymeric enclosures, the PDS/CDM/BDM shall pass the tests of 5.2.3.1 and 5.2.3.2 and shall be inspected to check that:	Pass muster Comply with the requirements	P
	The Deflection and Impact tests shall be performed at the worst case point on representative accessible face(s) of the enclosure.		P
5.2.2.5.2	Deflection test (type test)		P
	The enclosure shall be held firmly against a rigid support and subjected to a steady force of 250 N applied for 5 s through the end of a rod having a 12,7 mm by 12,7 mm square, flat steel face.	Comply with the requirements	P
	Damage to the finish, small dents and small chips which do not adversely affect the protection against electric shock or moisture, may be ignored.	Pass muster	P
5.2.2.5.3	Impact test (type test)		P
	A sample consisting of the enclosure or a portion thereof representing the largest nonreinforced area shall be supported in its normal position. A solid smooth steel sphere, approximately 50 mm in diameter and with a mass of 500 g ± 25 g, shall be permitted to fall freely from rest through a vertical distance of 1 300 mm onto the sample. (Vertical surfaces are exempt from this test.)	Comply with the requirements	P
	If the pendulum test is inconvenient, it is permitted to simulate horizontal impacts on vertical or sloping surfaces by mounting the sample at 90° to its normal position and applying the vertical impact test instead of the pendulum test.		P
5.2.3	Electrical tests		
5.2.3.1	Impulse voltage test (type test and sample test)		

Clause	Requirement-Test	Result-Remark	Verdict
	The impulse voltage test is performed with a voltage having a 1,2/50 μs waveform (see Figure 6 of IEC 60060-1) and is intended to simulate overvoltages of atmospheric origin. It also covers overvoltages due to switching of equipment. See Table 18 for conditions of the impulse voltage test.	Test voltage : 2500V Pass muster	P
	Tests on clearances smaller than required by Table 9 and on solid insulation are performed as type tests using appropriate voltages from Table 19 or Table 20.		P
	If it is necessary to test a clearance that has been designed for altitudes between 2 000 m and 20 000 m (using Table A.2 of IEC 60664-1), the appropriate test voltage may be determined from the clearance distance, using Table 9 in reverse.		P
5.2.3.2	A.C. or d.c. voltage test (type test and routine test)		P
5.2.3.2.1	Purpose of test		P
	The test is used to verify that the clearances and solid insulation of components and of assembled PDS/CDM/BDM has adequate dielectric strength to resist overvoltage conditions.	Pass muster	P
5.2.3.2.2	Value and type of test voltage		P
	The values of the test voltage are determined from column 2 or 3 ofTable 21, Table 22, or Table 23, depending upon whether the circuit under test is connected to low voltage mains, high voltage mains, or not mains connected.	Comply with the requirements	P
	Between circuits with protective separation (double or reinforced insulation), the test voltage of column 3 shall be applied for type tests. For routine tests between circuits with protective separation the values from column 2 shall be applied to prevent damage to the solid insulation by partial discharge.		P
	The voltage test shall be performed with a sinusoidal voltage at 50 Hz or 60 Hz. If the circuit contains capacitors the test may be performed with a d.c. voltage of a value equal to the peak value of the specified a.c. voltage.		P

Clause	Requirement-Test	Result-Remark	Verdict
5.2.3.2.3	Performing the voltage test		P
	The test shall be applied as follows, according to Figure 8.		P
	a) Test (1) between accessible conductive part (connected to earth) and each circuit sequentially (except DVC A circuits). Test voltage according to, Table 22, or Table 23, column 2, corresponding to voltage of considered circuit under test.	Comply with the requirements	P
	b) Test between each considered circuit sequentially and the other adjacent circuits connected together. Test voltage according to Table 21, Table 22, or Table 23, column 2, corresponding to voltage of considered circuit under test.	Comply with the requirements	P
	c) Test between DVC A circuit and each adjacent circuit sequentially. Test voltage according to Table 21, Table 22, or Table 23, column 3 (for type test) or column 2 (for routine test), corresponding to the circuit with the higher voltage. Either the adjacent circuit or the DVC A circuit may be earthed for this test. It is necessary to test basic insulation between PELV and SELV circuits, but it is not necessary to test functional insulation between adjacent PELV or adjacent SELV circuits.	Not applicable	N
	In the case of high-voltage PDS, the voltage shall be applied using a ramp of up to 5 s in duration. Also, for high-voltage PDS, if the test is required or requested to be repeated, the voltage shall be de-rated to 80 % of the original test voltage.		N
5.2.3.2.4	Duration of the a.c. or d.c. voltage test		P
	The duration of the test shall be at least 5 s for the type test and 1 s for the routine test. The test voltage may be applied with increasing and/or decreasing ramp voltage but the full voltage shall be maintained for 5 s and 1 s respectively for type and routine tests.	Comply with the requirements	P
5.2.3.2.5	Verification of the a.c. or d.c. voltage test		P
	The test is successfully passed if no electrical breakdown occurs during the test.		P

Clause	Requirement-Test	Result-Remark	Verdict
5.2.3.3	Partial discharge test (type test, sample test)		N
	The partial discharge test (see Table 24) shall confirm that the solid insulation (see 4.3.6.8) used in components and subassemblies for protective separation of electrical circuits remains partial-discharge-free within the specified voltage range (see Table 24).		N
	This test shall be performed as a type test and a sample test. It may be deleted for insulating materials which are not degraded by partial discharge, for example ceramics.		N
5.2.3.4	Protective impedance (type test and routine test)		P
	A type test shall be performed to verify that the current through a protective impedance under normal operating conditions does not exceed the values given in 4.3.4.3. The test shall be performed using the circuit of IEC 60990, Figure 4.	Pass muster Comply with the requirements	P
5.2.3.5	Touch current measurement (type test)		
	The touch current shall be measured to determine if the measures of protection need not be taken (see 4.3.5.5.2). The test may be used for a BDM, but in that case the BDM shall be connected to a motor. The motor may be unloaded, but the length and the type of the motor cable indicated by the manufacturer shall be used.	Pass muster	
5.2.3.6	Short-circuit test and Breakdown of components test (type tests)		
5.2.3.6.1	General		
	Protection against risk of thermal, electric shock and energy hazards in case of short circuit or breakdown of a component for a CDM/BDM or for a PDS in combination with its installation shall be evaluated by:		P
	a) tests defined in 5.2.3.6.3 and 5.2.3.6.4,		P

Clause	Requirement-Test	Result-Remark	Verdict
	b) calculation or simulation based on tests as defined in 5.2.3.6.3 and 5.2.3.6.4 on a representative model of PDS/CDM/BDM, where no damage other than opening of fuses or tripping of circuit breakers has occurred to the test sample,		P
	c) for high-voltage PDS: calculation or simulation based on tests of elements that adequately represent those used in the PDS. The elements, tests and test conditions shall be selected so that there is sufficient confidence in the test results for them to be transferred (for example, by scaling from lower to higher power) to the PDS/CDM/BDM under consideration,		N
	d) for custom *PDS*: risk and hazard analysis of the intended application, and analysis of the construction characteristics. See 6.3.9 for commissioning information requirements.		P
5.2.3.6.2	Test configuration		P
	In the case of a PDS/CDM/BDM supplied without an enclosure, a wire mesh cage which is 1,5 times the individual linear dimensions of the PDS/CDM/BDM part under study shall be used to simulate the intended enclosure.	Pass muster	P
	Surgical cotton shall be placed at all openings, handles, flanges, joints, and similar locations on the outside of the enclosure or around the wire mesh cage (if used).	Pass muster	P
	Where the PDS under test is specified in its installation manual to require external means of protection against faults, these specific means shall be provided for the test.		P
5.2.3.6.2.1	Supply voltage and current		P
	PDS rated for d.c. input shall be tested using a d.c. source. PDS rated for a.c input shall be tested at their rated input frequency.		N

Clause	Requirement-Test	Result-Remark	Verdict
	The open-circuit voltage of the supply shall be 100 % - 105 % of the rated input voltage. The open-circuit voltage may exceed 105 % of the rated input voltage at the request of the manufacturer.	Pass muster	P
	For the Short-circuit test, the supply shall be capable of delivering the specified prospective short-circuit current (see 4.3.9) at the connection to the PDS, unless circuit analysis demonstrates that a lesser value may be used.		P
	For the Breakdown of components test, the supply shall be capable of delivering a prospective short-circuit current of between 1 kA and 5 kA, unless the analysis of 4.2 shows that a different value is required.	Pass muster	P
5.2.3.6.3	Short-circuit test		N
5.2.3.6.3.1	Load conditions		N
	The short circuit test shall be performed with the CDM/BDM at full load or light load whichever creates the more severe condition.		N
5.2.3.6.3.2	Location of short-circuit		N
	Power outputs shall be provided with cable of a cross-section appropriate to the rated current available at the output. The length of each loop shall be approximately 2 m, unless the size of the PDS requires a greater length, in which case the length shall be as short as practical to perform the test.		N
	All output terminals of each power output tested shall be simultaneously connected together, using an appropriate switching device.		N
5.2.3.6.4	Breakdown of components test		N
5.2.3.6.4.1	Load conditions		N
	The breakdown of a component, identified as a result of the circuit analysis of 4.2, shall be tested with the CDM/BDM at full load or light load whichever creates the more severe condition.		N
5.2.3.6.4.2	Application of short-circuit or open-circuit		N

Clause	Requirement-Test	Result-Remark	Verdict
	The short circuit or open circuit shall be applied with cable of a cross-section of minimum 2,5 mm2 and an appropriate switching device. The length of the loop shall be as short as practical to perform the test.		N
5.2.3.6.5	Test sequence		P
	The PDS shall be powered, with its output(s) operating.		P
	- For the Short-circuit test, a short-circuit shall be introduced at the output under test.		P
	- For the Breakdown of components test, identified components shall be short-circuited or open-circuited, whichever creates the worse hazard, one at a time.		P
	The PDS shall be operated until one or more of the following ultimate results are obtained:		P
	- the operation of electronic short-circuit protection circuitry, or		P
	- the opening of a short-circuit protection device, or		P
	- a steady state temperature is attained after a minimum of 10 min.		P
5.2.3.6.6	Pass criteria		P
	As a result of the Short-circuit test and the Breakdown of components test, the PDS/CDM/BDM shall comply with the following:		P
	- there shall be no emission of flame or molten metal;		P
	- the surgical cotton indicator shall not have ignited;		P
	- the earth connection shall not have opened;		P
	- the door or cover shall not have blown open;		P
	- during and after the test, accessible SELV and PELV circuits shall not exhibit voltages greater than the time dependent voltages of Figure 7;		N
	- during and after the test, live parts at voltages greater than decisive voltage class A shall not become accessible.		P
5.2.3.7	Capacitor discharge (type test)		P

Clause	Requirement-Test	Result-Remark	Verdict
	Verification of the capacitor discharge time as required by 4.3.11 may be done by a type test and/or by calculation.	Pass muster	P
5.2.3.8	Temperature rise test (type test)		P
	The test is intended to ensure that parts and accessible surfaces of the PDS do not exceed the temperature limits specified in 4.4 and that the manufacturer's temperature limits of safetyrelevant parts are not exceeded.	Pass muster	P
	If this is not possible, it is permitted to simulate the temperature rise, if the validity of the simulation can be demonstrated by tests at lower power levels.		N
	The test shall be maintained until thermal stabilization has been reached. That is, when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test and not less than 10 minute intervals, indicate no change in temperature, defined as ± 1 °C between any of the three successive readings, with respect to the ambient temperature.	Pass muster Comply with the requirements	P
	The maximum temperature of electrical insulation (other than that of windings), the failure of which could cause a hazard, is measured on the surface of the insulation at a point close to the heat source.		P
	No corrected temperature shall exceed the rated temperature of the material or component measured.	Pass muster	P
5.2.3.9	Protective bonding (type test and routine test)		P
	The impedance of each protective bonding circuit between the PE terminal and relevant points that are part of each protective bonding circuit shall be measured with a current of at least 10 A derived from a supply source, the output of which is not earthed, having a maximum no-load voltage of 24 V.	Pass muster	P
	When the protective bonding has been designed using the cross-section rules of 4.3.5.4, the impedance shall not exceed 0,02	0.007	P
5.2.4	Abnormal operation tests		P

Clause	Requirement-Test	Result-Remark	Verdict
5.2.4.1	General		P
	Before all operation tests, the test sample shall be mounted, connected, and operated as described in the temperature rise test		P
	In the case of a CDM/BDM supplied without an enclosure, a wire mesh cage which is 1,5 times the individual linear dimensions of the CDM/BDM part under study shall be used to simulate the intended enclosure.		P
	Surgical cotton shall be placed at all openings, handles, flanges, joints and similar locations on the outside of the enclosure, and the wire mesh cage (if used), in a manner which will not significantly affect the cooling.	No applicable	N
5.2.4.2	Test duration		P
	The individual tests shall be performed until terminated by a protective device or mechanism (internal or external), a component failure occurs, or the temperature stabilizes.	Comply with the requirements	P
5.2.4.3	Pass criteria		P
	As a result of the Abnormal operation tests, the PDS/CDM/BDM shall comply with the following:		P
	- there shall be no emission of flame or molten metal;		P
	the surgical cotton indicator shall not have ignited		P
	the earth connection shall not have opened;		P
	the door or cover shall not have blown open;		P
	- during and after the test, accessible SELV and PELV circuits shall not exhibit voltages greater than the time dependent voltages of Figure 7;		N
	during and after the test, live parts at voltages greater than decisive voltage class A shall not become accessible.		P
5.2.4.4	Loss of phase (type test)		N

Clause	Requirement-Test	Result-Remark	Verdict
	A multi-phase PDS shall be operated with each line (including neutral, if used) disconnected in turn at the input. The test shall be performed by disconnecting one line with the power conversion equipment operating at its maximum normal load (this particular requirement does not apply to high-voltage PDS and may be simulated for low-voltage PDS with rated input current greater than 500 A) and shall be repeated by initially energizing the device with one lead disconnected.		N
5.2.4.5	Cooling failure tests (type tests)		N
5.2.4.5.1	General		N
	For PDS having a combination of cooling mechanisms, all relevant tests shall be performed. It is not necessary to perform the tests simultaneously.		N
5.2.4.5.2	Inoperative blower motor		N
	A PDS having forced ventilation shall be operated at rated load with blower motor or motors made inoperative, singly or in combination from a single fault, by physically preventing their rotation		N
5.2.4.5.3	Clogged filter		N
	Enclosed PDS/CDM/BDM having filtered ventilation openings shall be operated with the openings blocked to represent clogged filters. The test shall be performed initially with the ventilation openings blocked 50 %. The test shall be repeated under a full blocked condition.		N
5.2.4.5.4	Loss of coolant		N
	A liquid cooled PDS shall be operated at rated load. Loss of coolant shall be simulated by blocking the flow or disabling the system coolant pump. The a.c. or d.c. voltage test 5.2.3.2 shall be performed after termination of the Loss of coolant test.		N
5.2.5	Material tests		P
5.2.5.1	High current arcing ignition test (type test)		P

Clause	Requirement-Test	Result-Remark	Verdict
	Five samples of each insulating material (see 4.4.2) to be tested are used. The samples are 130 mm long minimum by 13 mm wide and of uniform thickness representing the thinnest section of the part. Edges shall be free from burrs, fins, etc.	Pass muster	P
	The test is continued until ignition of the sample occurs, a hole is burned through the sample or a total of 200 arcs have elapsed.		P
	The average number of arcs to ignition of the specimens tested shall be not less than 15 for V-0 class materials and not less than 30 for other materials.		P
5.2.5.2	Glow-wire test (type test)		P
	The glow-wire test shall be made under the conditions specified in 4.4.2 according to IEC 60695-2-10 and IEC 60695-2-13.	Pass muster Comply with the requirements	P
5.2.5.3	Hot wire ignition test (type test – alternative to Glow-wire test)		N
	Five samples of each insulating material (see 4.4.2) are tested. The samples are 130 mm long minimum by 13 mm wide and of a uniform thickness representing the thinnest section of the part. Edges shall be free from burrs, fins, etc.		N
	The wrapped sample is supported in a horizontal position (see Figure 10) and the ends of the wire connected to the variable power source, which is again adjusted to generate (0,25 ± 0,01) W/mm in the wire.		N
	The average ignition time of the specimens tested shall not be less than 15 s.		N
5.2.5.4	Flammability test (type test)		P

Clause	Requirement-Test	Result-Remark	Verdict
	Three samples of the complete equipment or three test specimens of the enclosure thereof (see 4.4.3) shall be subjected to this test. Consideration shall be given to leaving in place components and other parts that might influence the performance. The test samples shall be conditioned in a full draft circulating air oven for seven days at 10 °C greater than the maximum use temperature but not less than 70 °C in any case	Pass muster Comply with the requirements	P
	The flame shall be applied for 5 s and removed for 5 s. The operation shall be repeated until the specimen has been subjected to five applications of the test flame.	Pass muster	P
5.2.6	Environmental tests (type tests)		P
5.2.6.1	General		P
	Environmental testing is required to establish the safety of the PDS at the extremes of the environmental classification to which it will be subjected.		P
	If size or power considerations prevent the performance of these tests on the complete PDS, it is permitted to test individual parts that are considered to be relevant to the safety of the PDS.		P
5.2.6.2	Acceptance criteria		P
	The following acceptance criteria shall be satisfied:		P
	no degradation of any safety-relevant component of the PDSICDMIBDM;		P
	no potentially hazardous behaviour of the PDSICDMIBDM during the test;		P
	no sign of component overheating;		P
	no live part shall become accessible;		P
	no cracks in the enclosure and no damaged or loose insulators;		P
	pass routine a.c. or d.c. voltage test 5.2.3.2;		P
	pass Protective bonding test 5.2.3.9;		P
	no potentially hazardous behaviour when the PDSICDMIBDM is operated following the test.		P

Clause	Requirement-Test	Result-Remark	Verdict
5.2.6.3	Climatic tests		P
5.2.6.3.1	Dry heat test (steady state)		P
	The Dry heat (steady state) test shall be performed according to Table 25.		P
5.2.6.3.2	Damp heat test (steady state)		P
	To prove the resistance to humidity, the CDM shall be subjected to a Damp heat test (steady state) according to Table 26.	Temperature : 40℃ Humidity : 90%	P
5.2.6.4	Vibration test (type test)		P
	To verify the mechanical strength, a vibration test shall be performed according to Table 27 as a type test using a sliding frequency.		P
5.2.7	Hydrostatic pressure (type test and routine test)		N
	For type tests, the pressure inside the cooling system of a liquid cooled PDS (see 4.4.5.2.2) shall be increased at a gradual rate until a pressure relief mechanism (if provided) operates, or until a pressure of twice the operating value or 1,5 times the maximum pressure rating of the system is achieved, whichever is the greater.		N
	For routine tests, the pressure shall be increased to its operating value.		N
	There shall be no thermal, shock, or other hazard resulting from the test. There shall be no significant leakage of coolant or loss of pressure during the test, other than from a pressure relief mechanism during a type test.		N

6	**Information and marking requirements**		**P**
6.1	General		P
	The purpose of this Clause 6 is to define the information necessary for the safe selection, installation and commissioning, operation, and maintenance of PDS/CDM/BDM. It is presented as Table 28, showing where the information shall be provided, followed by explanatory subclauses.	Comply with the requirements	P

Clause	Requirement-Test	Result-Remark	Verdict
	The requirements of this Clause 6 apply to all PDS/CDM/BDM, unless otherwise stated.		P
	All information shall be in an appropriate language, and documents shall have identification references. Drawing symbols shall conform to IEC 60417 or IEC 60617 as appropriate. Symbols not shown in IEC 60417 or IEC 60617 shall be identified where used.	Comply with the requirements	P
6.2	Information for selection		P
	Each part of a PDS that is supplied as a separate product shall be provided with information relating to its function, electrical characteristics, and intended environment, so that its fitness for purpose and compatibility with other parts of the PDS can be determined. For CDM/BDM, this information includes, but is not limited to:		P
	- the name or trademark of the manufacturer, supplier or importer;	STARMATRIX GROUP INC.	P
	- catalogue number or equivalent;		P
	- input and output voltage range, current, and power rating information, including: – number of phases; – frequency range;	Input : AC 1~230V 50/60Hz Output : AC 1~230V 50/60Hz 2HP	P
	- protective class;	Class I	P
	- the type of electrical supply system (e.g. TN, IT, etc.) to which the PDS/CDM/BDM may be connected;	TN	P
	- prospective short-circuit current rating(s) and protective device characteristics		P
	- field supply requirements (if any);		P
	- coolant type and design pressure for liquid cooled product;		P
	- IP rating;		P
	- operating and storage environment;		P
	- reference(s) to relevant international standard(s) for manufacture, test, or use;		P
	- date code, or serial number from which the date of manufacture can be determined;		P

Clause	Requirement-Test	Result-Remark	Verdict
	- reference to instructions for installation, use and maintenance.		P
6.3	Information for installation and commissioning		P
6.3.1	General		P
	Safe and reliable installation is the responsibility of the installer, machine builder, and/or user. The manufacturer of any part of the PDS shall provide information to support this task. This information shall be unambiguous, and may be in diagrammatic form.	Pass muster	P
6.3.2	Mechanical considerations		P
	The following drawings shall be prepared by the manufacturer:		P
	- dimensional drawing, including mass information;		P
	- mounting drawing.		P
6.3.3	Environment		P
	The following environmental conditions shall be specified, for operation, transportation and storage:		P
	- climatic (temperature, humidity, altitude, pollution, ultra-violet light, etc.);		P
	- mechanical;		P
	- electrical.		P
6.3.4	Handling and mounting		P
	In order to prevent injury or damage, the installation documents shall include warnings of any hazards which can be experienced during installation. Where necessary, instructions shall be provided for:		P
	packing and unpacking;		P
	- moving;		P
	- lifting;		P
	- strength and rigidity of mounting surface;		P
	- fastening;		P
	- provision of adequate access for operation, adjustment and maintenance.		P
6.3.5	Motor and driven equipment		P

Clause	Requirement-Test	Result-Remark	Verdict
6.3.5.1	Motor selection		P
	Where necessary for CDM/BDM, information on suitable motor specifications (for example, based on IEC 60034-1) shall be provided. The possible influence on motor insulation of reflections of the PWM output waveform shall be taken into consideration.	Pass muster Comply with the requirements	P
6.3.5.2	Motor integrated sensors		P
	Insulation requirements shall be identified (see 4.3.5 and 4.3.6).		P
6.3.5.3	Critical torsional speeds		P
	When required, the PDS supplier shall provide all relevant motor information to enable critical torsional speeds to be identified (see 4.5.2.2).		P
6.3.5.4	Transient torque analysis		P
	When required, the PDS supplier shall provide all relevant electrical and mechanical information to enable transient torque analysis to be performed (see 4.5.2.3).		P
6.3.6	Connections		P
6.3.6.1	General		P
	Information shall be provided to enable the installer to make safe electrical connection to the PDS. This shall include information for protection against hazards (for example, electric shock or availability of energy) that may be encountered during installation, operation or maintenance.	Pass muster	P
6.3.6.2	Interconnection and wiring diagrams		P
	The installation and maintenance manuals shall include details of all necessary connections, together with a suggested interconnection diagram.		P
6.3.6.3	Conductor (cable) selection		P

Clause	Requirement-Test	Result-Remark	Verdict
	The Installation manual shall define the voltage and current levels for all connections to the PDS/CDM/BDM, together with cable insulation requirements. These shall be worst-case values, taking into account overcurrent and overload conditions and the possible effects of nonsinusoidal currents.	Pass muster	P
6.3.6.4	Terminal capacity and identification		P
	The installation and maintenance manuals shall indicate the range of acceptable conductor sizes and types (solid or stranded) for all terminals, and also the maximum number of conductors which can simultaneously be connected. For user terminals, the manuals shall specify the requirements for tightening torque values and also the insulation temperature rating requirements for the conductor or cable.	Pass muster	P
	The identification of all user terminals shall be marked on the PDS/CDM/BDM, either directly or by a label attached close to the terminals.		P
6.3.6.5	Protection requirements		P
	The installation, users and maintenance manuals shall identify any accessible parts at voltages greater than ELV, and shall describe the insulation and separation provisions required for protection. Accessible ELV parts of a PDS/CDM/BDM which are of protective class 0 shall be clearly identified, and instructions provided in the installation manual to increase the protection against indirect contact.		P
	The manuals shall also indicate the precautions to be taken to ensure that the safety of ELV connections is maintained during installation.		P
	The manuals shall provide instructions for the use of PELV circuits within a zone of equipotential bonding.		N
	The installation, users, and maintenance manuals shall identify all external terminals relating to circuits protected by one of the methods of 4.3.4.2 to 4.3.4.4.		P

Clause	Requirement-Test	Result-Remark	Verdict
6.3.6.6	Earthing		P
	The installation manual shall specify requirements for safe earthing of the PDS/CDM/BDM.		P
	The installation and maintenance manuals for high-voltage PDS shall provide instructions for the use of an earthing switch to ensure safe access during maintenance.		P
	Equipment of protective class II shall be marked with symbol IEC 60417-5172 (2003-02) (see Annex H). Where such equipment has provision for the connection of an earthing conductor for functional reasons (see 4.3.5.6) it shall be marked with symbol IEC 60417-5018 (2006-10) (see Annex H).	Pass muster Comply with the requirements	P
6.3.6.7	Protective earthing conductor current		P
	Where the touch current in the protective earthing conductor (see 4.3.5.5.2) exceeds 3,5 mA a.c. or 10 mA d.c., this shall be stated in the installation and maintenance manuals. In addition, a caution symbol ISO 7000-0434 (2004-01) (see Annex H) shall be placed on the product, and a notice shall be provided in the installation manual to instruct the user that the minimum size of the protective earthing conductor shall comply with the local safety regulations for high protective earthing conductor current equipment.	Pass muster Comply with the requirements	P
6.3.6.8	Special requirements		P
	Any particular cable and connection requirements shall be identified in the installation and maintenance manuals.		P
6.3.7	Overcurrent or short-circuit protection		P
	Where external devices are necessary to protect against overcurrent or short-circuit, the installation manual shall specify the required characteristics (see also 5.2.2.2, 5.2.3.6.2, 5.2.4.2).	Pass muster Comply with the requirements	P
6.3.8	Motor overload protection		P

Clause	Requirement-Test	Result-Remark	Verdict
	The installation and maintenance manuals of CDM/BDM incorporating internal overload protection for the motor shall indicate the overload protection provided in percent of full-load current and duration. If the protection is adjustable, the manuals shall include instructions for adjustment.	Pass muster Comply with the requirements	P
6.3.9	Commissioning		P
	If commissioning tests are necessary to ensure the electrical and thermal safety of a PDS, information to support these tests shall be provided for each part of the PDS. This information can depend on the specific installation, and close cooperation between manufacturer, installer, and user can be required.		P
6.4	Information for use		P
6.4.1	General		P
	The user's manual shall include all information regarding the safe operation of the PDS/CDM/BDM. In particular, it shall identify any hazardous materials and risks of electrical shock, overheating, explosion, excessive acoustic noise, etc.		P
6.4.2	Adjustment		P
	The user's manual shall give details of all safety-relevant adjustments intended for the user. The identification or function of each control or indicating device and fuse shall be marked adjacent to the item. Where it is not possible to do this on the product, the information shall be provided pictorially in the manual.	Pass muster Comply with the requirements	P
	Maintenance adjustments may also be described in this manual, but it shall be made clear that they should only be made by qualified personnel.		P
6.4.3	Labels, signs and signals		P
6.4.3.1	General		P
	Labelling shall be in accordance with good ergonomic principles so that notices, controls, indications, test facilities, fuses, etc., are sensibly placed and logically grouped to facilitate correct and unambiguous identification.	Pass muster	P

Clause	Requirement-Test	Result-Remark	Verdict
	All safety related equipment labels shall be located so as to be visible after installation or readily visible by opening a door or removing a cover.		P
6.4.3.2	Isolators		P
	Where an isolating device is not intended to interrupt load current, a warning shall state: DO NOT OPEN UNDER LOAD.	Pass muster	P
6.4.3.3	Visual and audible signals		P
	Visual signals such as flashing lights, and audible signals such as sirens, may be used to warn of an impending hazardous event such as the driven equipment start-up and shall be identified.		P
6.4.3.4	Hot surfaces		P
	Surfaces which can exceed the temperature limits of Table 16 shall be marked with the warning symbol IEC 60417-5041 (2002-10) (see Annex H). The user's manual shall also contain this information.	Pass muster Comply with the requirements	P
6.4.3.5	Equipment marking		P
	The identification of each control or indicating device and fuse shall be marked adjacent to the item. Replaceable fuses shall be marked with their rating and time characteristics. Where it is not possible to do this on the product, the information shall be provided pictorially in the manual.	Pass muster Comply with the requirements	P
	Appropriate identification shall be marked on or adjacent to each movable connector.		P
	The polarity of any polarized devices shall be marked adjacent to the device.		P
	The diagram reference and if possible the function shall be marked adjacent to each pre-set control in a position where it is clearly visible while the adjustment is being made.		P
6.5	Information for maintenance		P
6.5.1	General		P
	Safety information shall be provided in the maintenance manual including, as appropriate, the following:		P

Clause	Requirement-Test	Result-Remark	Verdict
	-preventive maintenance procedures and schedules;		P
	-safety precautions during maintenance (for example, the use of earthing switches for highvoltage PDS);	Pass muster	P
	- location of live parts that can be accessible during maintenance (for example, when covers are removed);		P
	- adjustment procedures;		P
	-subassembly and component repair and replacement procedures;		P
	- any other relevant information.		P
6.5.2	Capacitor discharge		P
	When the requirements of the first sentence of 4.3.11 are not met, the warning symbol IEC 6041-5036 (2002-10) 7 (see Annex H) and an indication of the discharge time (for example, 45 s, 5 min) shall be placed in a clearly visible position on the enclosure, the capacitor protective barrier, or at a point close to the capacitor(s) concerned (depending on the construction). The symbol shall be explained and the time required for the capacitors to discharge after the removal of power from the PDS shall be stated in the installation and maintenance manuals.	Pass muster Comply with the requirements	P
6.5.3	Auto restart/bypass connection		P
	If a CDM/BDM can be configured to provide automatic restart or bypass connection, the installation, user and maintenance manuals shall contain appropriate warning statements.		P
6.5.4	PT/CT connection		N

Clause	Requirement-Test	Result-Remark	Verdict
	A PDS which has monitoring or control functions using a potential transformer (PT) supplied from high voltage, or a current transformer (CT) supplied from a high current connection, shall be clearly marked to show the possible hazards of voltage transients upon disconnection of the secondary circuit. The hazards shall also be described in the installation and maintenance manuals.		N
6.5.5	Other hazards		P
	The manufacturer shall identify any components and materials of a PDS which require special procedures to prevent hazards.		P

Appendix A

CLEVER-POOL series of various types of difference

1 the power is not the same as:

1) CLEVER-POOL/220V -1500W power 1500W.

2) CLEVER-POOLM/220V /2.2KW power 2200W.

2 the input voltage is the same

CLEVER-POOL/220V -1500W and CLEVER-POOLM/220V /2.2KW are single 220V input.

3 the output voltage is the same as

1) the output of CLEVER-POOL /220V -1500W single phase 220V.

2) CLEVER-POOLM/220V /2.2KW output three-phase 220V.

Photos of the sample

Picture 1

Picture 2

Photos of the sample

Picture 3

Notice

1. This test report shall be invalidation without the cachet of the testing laboratory.
2. This copied report shall be invalidation without sealed the cachet of the testing laboratory.
3. This report shall be invalidation without tester signature, reviewer signature and approver signature.
4. This altered report shall be invalidation.
5. Client shall put forward demurrer within 15days after received report. The testing laboratory shall refuse disposal if exceeded the time limit.
6. The test results presented in this report relate only to the object tested.

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