4.9.2.2.2 Fixed installations

Fixed *installations* of *BDM/CDM/PDS* shall be placed on a rigid mounting which does not seriously interfere with the ventilation or cooling system.

Experience shows that equipment meeting the vibration test from 5.4.7.5 or the shock test from 5.4.7.6 is suitable for industrial use in fixed *installations*.

Vibration shall remain within the limits of Table 16 which is considered normal for stationary equipment.

	IEC 60721-3-3:1994 and IEC 60721-3- 3:1994/AMD1:1995, AMD2:1996 and IEC 60721-3- 4:1995 and IEC 60721-3-4:1995/,AMD1:1996 3M1 and 4M1		
Frequency	Amplitude Acceleratio		
Hz	mm	m/s ²	
9 ≤ <i>f</i> < 200	frequency dependent	1	
NOTE The frequency range 2 Hz to 9 Hz covers earthquake, but this not covered by this document. Earthquake can be specified. IEC 60721-2-6 provides more details.			

 Table 16 – Environmental vibration limits for fixed installation

Vibration beyond these limits and use on non-stationary equipment are considered unusual mechanical conditions.

Compliance is checked by test of 5.4.7.5 which is an accelerating test to demonstrate the ability of the *BDM/CDM* to withstand the mechanical stress during the estimated lifetime.

If shock has to be taken into account the values shall remain within the limits of Table 17.

Table 17 – Environmental shock limits for fixed installation

Shock	IEC 60721-3-3:1994 and IEC 60721-3- 3:1994/AMD1:1995, AMD2:1996 and IEC 60721-3- 4:1995 and IEC 60721-3-4:1995/AMD1:1996 3M1 and 4M1
Peak acceleration	40 m/s ²
Duration	22 ms

Compliance is checked by test with increased values of 5.4.7.6.

4.9.2.2.3 Fixed *installations* as part of stationary machine

If the *BDM/CDM/PDS* is part of a stationary machine which create vibrations and shock during operation, the mechanical stress can be higher than shown in Table 16 and Table 17. If these values are known, the *manufacturer* shall use them for testing.

The shock test is recommended, if the *BDM/CDM/PDS* is part of a stationary machine.

If the mechanical stress exceeds the test values in 5.4.7.5 and 5.4.7.6, the values shall be specified by the *customer*, and the *manufacturer* shall use them for testing taking into account a margin.

4.9.2.3 Unusual environmental service conditions

The use of *BDM/CDM/PDS* under conditions exceeding the specified conditions listed 4.9.2.1 and 4.9.2.2 shall be considered unusual.

Unusual service conditions may require special optional construction or protective features.

Examples to consider:

- a) exposure to damaging fumes;
- b) exposure to excessive moisture (relative humidity greater than specified);
- c) exposure to excessive dust;
- d) exposure to abrasive dust;
- e) exposure to steam or water condensation;
- f) exposure to oil vapour;
- g) exposure to abnormal vibration, shock or tilting;
- h) exposure to unusual transportation or storage conditions exceeding the values from Table 18;
- i) exposure to extreme or sudden changes in temperature;
- j) unusual mounting space limitations;
- k) cooling water containing acid or impurities which cause excessive scale, sludge, electrolysis or corrosion;
- I) unusually high nuclear radiation;
- m) altitude for thermal consideration, if rated for operation above 1 000 m;
- n) altitude for insulation coordination if rated for operation above 2 000 m (see IEC 61800-5-1);
- o) long periods not energized, specified by the supplier;
- p) severe restriction on audible noise.
- q) exposure to explosive mixtures of dust or gases;
- r) exposure to salt air;
- s) outdoor equipment.

The unusual service conditions shall be specified by the *customer* in agreement with the *manufacturer*.

4.9.2.4 The act of installing, commissioning and operation

The act of installing, commissioning, and operation have the same normal and unusual service conditions.

4.9.2.5 Sonic pressure and sound level

Equipment with the *BDM/CDM/PDS* has the potential for increased noise emissions based on a variety of reasons.

Air cooled equipment can have increased noise emissions due to the sound created by the fans and motors cooling the equipment.

Transformers and reactors can have increased noise emission due to the sound created by non-sinusoidal currents.

Motors can have increase noise emissions due to bearing wear and other mechanical friction.

Water cooled equipment can have increased noise emissions due to the motor and pump provided for cooling.

Regardless, these all have a weighted effect on the overall noise created by the system. This is an important consideration in system design for performance, functionality, and safety.

For safety associated with sonic pressure and sound level, see IEC 61800-5-1 for *BDM/CDM/PDS*, IEC 60076-1 for transformers, and refer to IEC 60034-9 and IEC 60034-25 for *DC motors*.

The information associated with sonic pressure and sound level can be obtained from the *manufacturers* of the various equipment used to create the *PDS*. This then can be used to create an estimation of the effect this new equipment will have on the existing sound levels at the site of installation. However, the best result is to measure the sonic pressure and sound level after the equipment is installed to make a final determination on how to follow local laws and ensure the usage of the correct personal protective equipment (PPE), if required.

For compliance see 5.4.2.8.3.

4.9.3 Storage and transport of equipment

4.9.3.1 Climatic conditions

The *BDM/CDM/PDS* shall be placed under adequate cover according to the limits in Table 18, immediately upon receipt, if packing coverings are not generally suitable for outdoor or unprotected storage.

	Storage according to IEC 60721-3-1:1997Transport according to IEC 60721-3-2:1997in product packaging up to 6 monthsin shipping packaging for than 6 months		
Climatic class	1K4	2K4	
Ambient temperature ^c Min	−25 °C	-40 °C	
Мах	55 °C	70 °C	
Biological environmental condition	ns 1B1 ^a	2B1 ª	
Chemically active environmental conditions	1C2	2C2	
Maximum permitted temperature changes	0,5 K/min as average value over 5 min; equivalent to 30 K/h	Direct change in air/air: −40 °C to 30 °C at 95 %	
Relative/absolute air humidity ^d	1K3 (5 % R.H to 95 % R.H.)	2K4 (5 % R.H to 95 % R.H.)	
Rain	Not permitted	6 mm/min ^b	
Water, but not rain	Not permitted	1 m/s and wet loading surfaces ^b	
Air pressure Min	Above 70 kPa or below	3 000 m above sea level	
Мах	Below 106 kPa o	r above sea level.	
Condensation, spray water and ic	Permitted		
Salt spray	Permitted		
Solar radiation	1 120	1 120 W/m ²	
Vibration	1M2	2M3	

Table 18 – Storage and transport limits

- ^a Mould, fungus, rodents, termites and other animal vermin not permitted.
- ^b In sea- and weather-resistant *shipping packaging* (container).
- ^c Temperature limits refer to the ambient temperature immediately surrounding the equipment (for example, inside a container).

Lower limits for the highest temperature are possible, provided a warning is given.

These limits apply with cooling liquid removed

^d Some combinations of temperature and humidity may cause condensation.

4.9.3.2 Unusual climatic conditions

Where transportation temperatures are below the *manufacturer*'s recommendation, the use of heated transport, or special thermic protection, or the removal of selected low temperature sensitive components may be required.

4.9.4 Mechanical conditions

Equipment should be able to be transported, in the *product packaging* and *shipping packaging*, within the limits of IEC 60721-3-2:1997 class 2M1, or within limits specified by the *manufacturer*.

This includes the following: vibration in Table 19 and free fall in Table 20.

Frequency	Amplitude	Acceleration	
Hz	mm	m/s²	
2 ≤ <i>f</i> < 9	3,5	frequency dependent	
9 ≤ <i>f</i> < 200	frequency dependent	10	
200 ≤ <i>f</i> < 500	frequency dependent	15	

 Table 19 – Transportation vibration limits

Table 20 – Transportation limits of free fall

Shipping weight with packaging	Random free-fall drop height mm IEC 60721-3-2:1997 (2M1)		Number of falls
кg			
	With product packaging	With shipping packaging	
w < 20	250		5
$20 \le w < 100$	250		5
w ≥ 100	100		5
NOTE More severe requirement can be found in IEC 61131-2.			

If a free fall and vibration environment beyond those limits is anticipated, special packaging or transport is required.

If a less damaging environment is known to exist, packaging may reflect reduced requirements.

The main transformer (if any) and the motor should comply with their applicable product standards. (IEC 60076 series and IEC 60034 series, respectively, or a nationally recognized equivalent.)

4.9.5 Specific storage hazards

The following require particular attention:

- a) water except for equipment specifically designed for outdoor installation: equipment should be protected from rain, snow, sleet, etc.;
- b) condensation sudden changes in temperature and humidity should be avoided;
- c) corrosive materials equipment should be protected from salt spray, hazardous gases, corrosive liquids, etc.;
- d) time the above specifications apply to shipping and storage with a total duration of up to six months; longer storage times may require special consideration (i.e. reduced ambient temperature range such as in class 1K3 of IEC 60721-3-1);
- e) rodents and fungi when storage conditions are likely to involve rodent or fungus attack, equipment specifications should include protective items:
 - 1) rodents materials on the outside of the equipment and the size of apertures for cooling, connection, etc. should be specified such as to discourage rodent attack or entry;
 - 2) fungi materials should be specified for a degree of fungus resistance suitable for the storage and operating environments.

4.9.6 Environmental service tests (type test)

Environmental service testing may be required to demonstrate the function of the *BDM/CDM/PDS* at the extremes of the environmental classification in Table 21 to which it will be subjected.

If size or power considerations prevent the performance of these tests on the complete *BDM/CDM/PDS*, it is permitted to test individual parts that are considered to be relevant to the function of the *BDM/CDM/PDS*.

When testing components or sub-assemblies separately, the temperature during the dry-heat test shall be chosen as to simulate actual use in the end-product. The component or sub-assembly shall be energized simulating the same conditions as in the end-product.

Table 21 shows the standard tests to be performed for the different environmental service conditions.

Product standard committees for the relevant parts of the IEC 61800 series or the *manufacturer* shall select the relevant tests.

Compliance is shown by conducting tests of 5.4.7.3 to 5.4.7.11 according to as applicable for the environmental service conditions specified by the *manufacturer*.

Where the *BDM/CDM/PDS* is required to operate in conditions outside the range of values given in this document, then the test conditions shall be specified, as defined in the particular individual enquiry or purchasing specification. In any case, the test requirements shall not be less demanding than the operating conditions specified.

Test condition	Indoor conditioned	Indoor unconditioned	Outdoor unconditioned	
	IEC 60721-3-3:1996	IEC 60721-3-3:1996	IEC 60721-3-4:1995 and IEC 60721-3-4:1995/ AMD1:1996	
Climatic	Temperature (see 5.4.7.3)	Temperature (see 5.4.7.3)	Temperature (see 5.4.7.3)	
	Damp heat (see 5.4.7.4)	Damp heat (see 5.4.7.4)	Damp heat (see 5.4.7.4)	
Chemically active substances	-	-	Salt mist ^a (see 5.4.7.7)	
Water	-	Water test (see 5.4.7.10)	Water test (see 5.4.7.10)	
Mechanically active substances	-	Dust (see 5.4.7.8)	Dust and sand (see 5.4.7.8, and 5.4.7.9)	
Mechanical	Vibration (see 5.4.7.5)	Vibration (see 5.4.7.5)	Vibration (see 5.4.7.5)	
	Shock (see 5.4.7.6)	Shock (see 5.4.7.6)	Shock (see 5.4.7.6)	
Biological	-	-	-	
^a Where it is ensured that condition, the <i>manufac</i>	at the equipment will not be use turer may choose to rate the equ	ed in a salt mist atmosphere upment for a less severe co	, water wet or saltwater wet ndition. For information. see	

Table 21 – Environmental service tests

When special environmental conditions are specified, additional tests (e.g. for chemically active substances) shall be considered.

For *integrated PDS*, the test conditions shall comply with the most severe tests from Table 19 or with those of the relevant standard for the *motor* from the IEC 60034 series.

4.10 Types of load duty profiles

6.2.

The general performance features of the *CDM* are specified in 4.4, which covers the most common applications.

For special applications where other load profiles are requested the IEC TR 61800-6 provides further information about the current rating of the *CDM* for different kinds of load profiles covering equipment, assemblies and system aspects.

This included load profiles like:

- uniform load profiles;
- intermittent peak load profiles;
- intermittent load duty;
- intermittent load duty with no-load intervals;
- repetitive load duty;
- non-repetitive load duty.

IEC TR 61800-6 also specifies duty classes for non-repetitive industrial classes (IG to VG).

Compliance with special duty cycles according to IEC 60034-1 (S1 to S10) for rotating machines may be specified by the *manufacturer* following the guidance of IEC TR 61800-6.

4.11 Generic interface and use of profiles for PDS

BDM/CDM/PDS's used in industrial applications typically interface with one or more external control systems which coordinate operation of several *PDS*.

Often the control system is separate from the drive and may consist of

- one or more PLCs (programmable logic controllers), and/or
- a DCS (distributed control system), and/or
- a process controller.

NOTE 1 The control system software can be partially or entirely embedded in the BDM/CDM/PDS.

IEC 61800-7 (all parts) define a means to access functions and data in a *BDM/CDM/PDS* by providing a series of well-defined communication profiles and interfaces. The objective is a common drive model with generic functions and objects suitable to be mapped into different communication interfaces/*ports*.

From the perspective of control software, the communication and control functions of a *BDM/CDM/PDS* may be characterized by profiles. A *BDM/CDM/PDS* device profile is a representation of the parameters and behaviour of the *BDM/CDM/PDS* which may be used to facilitate control of the *BDM/CDM/PDS*. This device profile can then be mapped onto different network technologies (e.g. "communication profiles" of the IEC 61158 fieldbus series) to facilitate control of a *BDM/CDM/PDS* over a network.

IEC 61800-7 (all parts) defines a generic interface and profiles for *BDM/CDM/PDS* to be used with a control system and consists of the following parts;

- IEC 61800-7-1 defines requirements for a generic interface with the control software;
- IEC 61800-7-2xx specify different drive profiles;
- IEC 61800-7-3xx specify mappings of the device profiles onto various network technologies.

The relationship of IEC 61800-7 (all parts) to control system software and the *BDM/CDM/PDS* is represented in Figure 15 below.



Figure 15 – Example of relationship of IEC 61800-7 (all parts) to control system software and the *BDM/CDM/PDS*

NOTE 2 Other network technologies can be applicable (e.g. EN 50325-4 or other).

For compliance, see 5.4.8.

4.12 Voltage on power interface

The voltage interface between the *CDM* and the *motor* is a topic which might require special consideration, to ensure compatibility between *CDM* and *motor*.

For applications where the voltage interface is of importance, the IEC TS 61800-8 can provide further information about the determination of voltages on the *power interface*.

For compliance, see 5.4.2.8.5.

4.13 Explosive environment

PDS's may be used in applications involving explosive atmospheres. Considerations include whether the *BDM/CDM* and/or *motor* are located in the explosive atmosphere, and whether the *BDM/CDM* provides a safety control system associated with a hazard related to the explosive atmosphere.

Requirements to achieve the necessary level of safety have been defined in IEC 60079 (all parts).

NOTE 1 The draft of the future IEC 60079-42 provides more information regarding the minimum requirements for safety devices required for the safe functioning of equipment with respect to explosion risks.

NOTE 2 The 2nd edition of IEC 61800-5-2 no longer implements appropriate information about *PDS* used in safety systems related to explosive atmospheres. All this information is now considered in different parts of IEC 60079 series in revision.

5 Test

5.1 General

Subclauses 5.2 to 5.4 provide guidance for the test to show compliance with the requirement of Clause 4 as agreed between *manufacturer* and *customer* or specified by product standard committees.

5.2 **Performance of tests**

5.2.1 General conditions

It is advisable to restrict the performance of costly tests to those which are necessary.

This recommendation is therefore outlined so that testing can normally be limited to the tests in *manufacturer's* works on the *BDM/CDM/PDS* and separate components.

When the customer or its representative desires to witness factory tests, it shall be specified from a particular agreement between parties. The system supplier shall not proceed beyond any witness test without the customer's or his representative's acceptance of the tests or his waiver.

Tests shall be performed by the *manufacturer* prior to shipment, unless otherwise agreed.

5.2.2 Supply system earthing conditions

Type tests shall be performed to verify complete *BDM/CDM* performance with the acceptable earthing systems. These may include:

- neutral to earth;
- line to earth;
- neutral to earth through high impedance;
- isolated neutral (not earthed).

NOTE Refer to IEC 60364-1 supply earthing systems.

For information, see 6.3.

5.3 Standard tests for *BDM/CDM/PDS*

5.3.1 General

Table 22 provides an overview over applicable test which may be chosen to show compliance with the requirement in Clause 4.

Test	Туре	Routine	Sample	Requirement(s)	Specification
Visual inspections	Х	Х	Х	4.1	5.4.1
Ratings	Х			4.3	5.4.2
Input ratings				4.3.2	5.4.2.4
Input voltage and frequency	Х			4.3.2.1	5.4.2.4.2
Input currents	Х			4.3.2.2	5.4.2.4.3
Output ratings	Х			4.3.3	5.4.2.5
Continuous output ratings	х			4.3.3.2	5.4.2.5.3
					5.4.2.5.4
Overcurrent and torque capability	Х			4.3.3.3	5.4.2.5.5
		_			
Operating quadrants				4.3.4	
Operation in II and IV quadrants	Х			4.3.4.2	5.4.2.5.6
		_			
Additional test for special ratings				4.3.6	5.4.2.7
Power factor measurement	Х				5.4.2.7.2
Current sharing	Х				5.4.2.7.3
Voltage division					5.4.2.7.4
Checking of auxiliary devices	Х	Х			5.4.2.7.5
Checking of protective measures	Х				5.4.2.7.6
Functionalities under unusual service conditions	Х				5.4.2.7.7
				1	
Additional test (effect on motor) for special rating				4.3.6	5.4.2.8
<i>Motor</i> vibration	х				5.4.2.8.2
Sonic pressure and sound level	х			4.9.2.5	5.4.2.8.3
Bearing current	Х				5.4.2.8.4
<i>Motor</i> insulation	Х				5.4.2.8.5
Spark test					5.4.1
Steady state performance	Х			4.4.1.2	5.4.2.9
		-			
Dynamic performance and ratings				4.4.1.3	5.4.2.10
Current limit and current loop	Х				5.4.2.10.2
Speed loop	Х				5.4.2.10.3
Torque pulsation	Х				5.4.2.10.4
Automatic restart	Х			4.4.1	5.4.2.10.5
Fault supervision	Х			4.4.2	5.4.2.11
I/O devices	Х			4.4.4	5.4.2.12
		1		1	1
General safety	Х	Х	Х	4.5	5.4.3
Functional safety	Х			4.6	5.4.4

Table 22 – Tests overview