INTERPLANT STANDARD — STEEL INDUSTRY

IPSS

GUIDE FOR TESTS FOR HARDWARE AND ENCLOSURES FOR DIFFERENT ENVIRONMENTS

IPSS : 2-07-001-87

CORRESPONDING INDIAN STANDARD DOES NOT EXIST

0. Foreword

0.1 Interplant standardization activity in steel industry is being pursued under the aegis of the Bureau by Indian Standards (BIS) and the Steel Authority of India Limited (SAIL). This Interplant Standard, prepared by the Standards Committee on Computerization and Automation, IPSS 2 : 7 with the active participation of the representatives of the steel plants, established manufacturers of computers and instruments, reputed consulting organizations, was adopted by the Approval Committee on Design Parameters, IPSS 2, on 25 May 1987.

0.2 Interplant Standards on design parameters primarily aim at achieving rationalization and unification of parts and assemblies of process and auxiliary equipment used in steel plants and these are intended to provide guidance to the steel plant engineers, consultants and manufacturers in their design activities.

0.3 Careful planning of all constructional and technical requirements is a pre-requisite for trouble free installation and operation of systems.

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1. Scope — This standard provides the guidelines for tests for hardware and enclosures for different environment for electronic and electrical equipment to be used in the computerization and automation fields in steel plants.

2. Terminology — For the purpose of this standard, the terms and definitions given in IS : 1885 (Part 39)-1979 'Electrotechnical vocabulary: Part 39 Reliability of electronic and electrical items (*first revision*)' shall apply for general terms and reliability definitions as per IS : 7690-1975 'Specification for mathematical guide to the terms and definitions for reliability of electronic equipment and components (or parts) used therein.' For electrical equipment and power supply equipment, the standard terms and definitions as given in IS : 7204 (Part 1)-1974 'Specification for stabilized power suppliers, dc output: Part 1 Terms and definitions' shall apply.

3. General Guidelines — This standard gives the general guidelines to be followed for all the equipment. The equipment is classified as per environmental stresses to be encountered by them in different areas of the environment. For each environment class, the values are given for the operating range and the degree of severity to be adopted during tests. The various tests indicated shall conform to IS : 9000 (Part 2/Sec 1 to 4)-1977 'Basic environmental testing procedure for electronic and electrical items: Part 2 Cold test' and shall be conducted as per the guidelines given in IS : 9001 (Part 2)-1977 'Guidance for environmental testing: Part 2 Cold and dry heat tests' with the equipment specified for enviornmental tests as per IS : 9002 (Part 3)-1979 'Equipment for environmental tests for electronic and electrical items: Part 3 Humidity chamber'. Alternatively the equipment testing can be done as per equivalent internationally recognized standards. In case any equipment does not fall under the classification required, the degrees of severity are to be mentioned in the relevant specification for each item. The reliability factor given is for the reliability of the equipment mentioned.

4. Safety Requirements — The equipment shall conform to the applicable safety requirements of IS : 616-1981 'Specification for safety requirements for mains operated electronic and related apparatus for household and similar general use (*first revision*)'. The special care shall be taken to avoid any possibility of shock from any accessible points.

5. Burning-in of Components and PC Boards — Subject to the PCB and Modules used in the equipment to 100 percent static burn-in for 168 hours including dynamic burn-in for 48 hours for screening out components prone to infant mortality.

Amendments Issued (*to be filled up by the user department*):

No.	Date of Issue	No.	Date of Issue
1		3	
2		4	

UDC 621·38·038+621·31 : 620·193·669·18·013·5·681·3

6. Environmental — All the equipments are classified under the following environmental classes:

Environmental Class	*Environment for Application*
A	To be installed in controlled environment
B	To be installed in partially controlled environment
C	To be installed in covered areas (uncontrolled areas in shops)
D	To be installed in covered areas but nearer to hot substances/equipment (severe conditions)
E	To be installed in open areas (uncontrolled open spaces)

6.1 A suggested list of equipment falling under the application classes is given in Appendix A for each class.

7. Quality Assurance

7.1 The supplier shall show to the purchaser or his representatives the quality assurance programmes that are being followed in his manufacturing facility.

7.2 The tests to be shown shall include the environmental tests and operational tests that are being conducted on PCBs and systems as given in Appendix B and Appendix C.

8. Tests During Inspection by Purchaser at Supplier's/Manufacturer's Premises — The equipment shall be assembled and installed in the supplier's/manufacturer's premises for demonstration of integrated test with hardware and software. The following tests shall be carried out.

8.1 *Visual Inspection* — All the equipment shall be subjected to visual inspection to detect any visible defects before putting power on. Tests shall be conducted under simulated test conditions.

8.2 *Individual Equipment Test* — The individual pieces of equipment like memory devices, peripherals and VDU's shall be tested for functioning as per specification. The supplier shall provide the necessary test facilities, signal generators, test tools and equipment and system software wherever needed.

8.3 *Integrated Software Test* — After the above two tests, modules of the application software as agreed in the system design document shall be tested individually and in integrated mode in the system for demonstrating performance according to the specification. Simulators and signal generators shall be provided by the supplier wherever necessary.

8.4 *Diagnostic Tests* — For testing of the diagnostic software all the modules of the software shall be run and tested under simulated failure conditions.

9. Packing — After satisfactory test of the equipment as indicated in **8**, the equipment shall be dismantled and suitably packed for despatch depending on the mode of transport. Where specified the packages shall have necessary indications for slinging, direction of storage (indication of top and bottom of the packs). The packages shall have mechanical indicators to indicate the amount of shock and tilt experienced by the package during transport. These indicators shall warn the purchasers at his premises suitably before the actual opening of the box so that necessary claims can be lodged and also care can be taken while opening.

10. Storage Conditions

10.1 Irrespective of the class of the application, the equipment shall withstand the following environmental conditions during long storage before installation and after installation while not in operation. Temperature up to 55 °C, relative humidity 0 to 95 percent.

10.2 Equipment shall also be suitably tested to withstand transport stresses as per IS : 9001 before transport.

11. Tests After Installation of the Equipment but Before Commissioning — All the tests indicated in **8** shall be repeated under actual conditions after installation of the equipment at site but before commissioning. After successful completion of these no load tests, the Computer Automation equipment shall be put in-line with the process and the demonstration of working of this equipment (both hardware and software) in order to meet the process requirements shall be done. The integrated operation of the hardware and software in giving the specified response times and as per the process requirements shall be demonstrated over a period agreed mutually.

12. MTBF and MTTR — The MTBF and the MTTR to be assured by the supplier shall be within limits for achieving the production capacities of the process which is controlled by this equipment. The supplier shall produce necessary certificates to this effect from either independent bodies or from his other user base.

13. Acceptance Tests

13.1 Acceptance tests are carried out to check the reliability of hardware and make sure the availability of the software features as asked for and supplied.

13.2 *Minimum Configuration* - To calculate the uptime, it is required to determine the minimum configuration

- CPU
- Minimum workable memory boards
- Minimum number of disk drives
- One line printer
- One console
- Minimum number of terminals
- One floppy drive
- One tape drive

13.3 *Acceptance Test Period* — The period of acceptance test should be determined depending upon

- Micro system, or
- Mini system, or
- Mainframe system

Environmental non-availability shall be taken as null time. Hardware/software breakdown (other than operational error) shall necessitate to conduct the A/T from the beginning for continuous period as decided

13.4 The various physical tests shall be as follows.

13.4.1 *Physical examination*

- PCB condition should be good
- Mother board connectors connections
- Contacts should be good
- Ruggedness
- Integrity tests

13.4.2 A certificate from manufacturer is required and if possible the tests may be conducted for the following:

- Voltage tolerance test
- Temperature tolerance test
- Electro magnetic interference
- Humidity variation
- Vibration test
- Burn test

13.4.3 *Physical memory*

13.4.4 *Extension slots*

13.4.5 *Disk drives*

- Maximum number of drives/controller
- Maximum number of controller/slots

13.4.6 *Tape drives*

- Maximum number of drives/controller
- Tape recording density

13.4.7 *Line printer*

- Type of line printer band
- Character set

13.4.8 *VDU*

- Number of terminal ports
- Number of function keys on key boards
- List of programmable function keys

13.4.9 *Communication*

- Ports available for communications

13.4.10 *Magnetic heads on floppy and tape drives*

- Media verify programme

13.5 The hardware diagnostics shall be as follows.

13.5.1 *CPU* — Frequent system boosting test. Extensive CPU diagnostics for complete set of instructions in all possible formats and data types. Including multiprocessing capabilities, testing I/O ports, interrupt priority checking, exception conditions (simulated) handling, effectiveness and memory protection circuitery.

13.5.2 *Memory* — Write-read and verify of specific information in various locations.

13.5.3 *Hard disk* — The diagnostic could include incremental seek, oscillating seek, and random seek with write-read and verify operations. Also seek/access timing checks should be done. A system file logging all soft and hard errors encountered during actual usage under operating system should be available.

13.5.4 *Line printer*

- Self check
- Printer diagnostic
- Print quality
- On-line printer test

13.5.5 *Floppy drive*

- Media check
- Speed check
- Diagnostic check

13.5.6 *Terminals and console*

- Self test
- An interactive key board test for verifying all key operations

13.5.7 *Tape drive* — A write-read verify type of test with record by record (start/stop mode) forward and backward motion may be done. Also BOT, EOT sensing, file marks sensing may be done

13.5.8 *Communication hardware* — This should be done with the help or communication software.

13.6 The software tests shall be as follows.

13.6.1 *Operating system*

- Single user/multiuser
- Bootable from disk/tape/floppy
- Security (O. S. and system files deletion security)
- Memory management features
- Task management features
- System generation (installation of system through tape/floppy)
- Disk certification
- Identify bad blocks
- Prohibiting the allocation of bad blocks to files
- File management features
- Device management
- Spooler features
- Communication features
- Cost capabilities
- Job accounting features
- System error logging
- Compiler testing

13.6.2 *Data base package testing*

13.6.3 *Application packages testing*

13.6.4 *System utilities testing*

APPENDIX A

(*Clause* 6.1)

LIST OF ITEMS UNDER CLASS A

(To be Installed in Controlled Environment)

1. CPUs of business computer systems, controllers, memory devices, I/O channel
2. High speed printers
3. Exchangeable disk drives
4. Spool type tape drives
5. Plotters and video copiers
6. Communication controllers
7. Winchester disc drives

LIST OF ITEMS UNDER CLASS B

(To be Installed in Partially Controlled Environment)

1. Process control computer CPUs
2. PLCs
3. DPUs
4. MPUs
5. Distributed control systems
6. Cassette tape drives
7. Winchester disk drives
8. Laser printers
9. CRT terminals
10. Operator consoles
11. Graphic terminals
12. CCTV equipment
13. Voice communication equipment
14. Data highway controllers
15. Process I/O interface
16. Marshalling racks and terminal racks
17. Weighing and batching systems
18. Floppy drives
19. Indicating and recording instruments

LIST OF ITEMS UNDER CLASS C

(To be Installed in Covered Areas, Uncontrolled Areas in Shops)

1. Transmitters
2. Switches (pressure, flow, level, temperature, etc)
3. Hot metal detectors
4. Cold metal detectors
5. Convertors
6. Photo cell banks
7. Proximity switches/limit switches
8. Load cells
9. Position encoders/tachos
10. Radiation pyrometers and other instrumentation systems
11. CCTV cameras
12. Actuators

LIST OF ITEMS UNDER CLASS D

(To be Installed in Covered Areas but Nearer to Hot Substances/Equipment – Severe Conditions)

1. Transmitters
2. Switches (pressure, flow, level, temperature, etc)
3. Hot metal detectors
4. Cold metal detectors
5. Convertors
6. Photo cell banks
7. Proximity switches/limit switches
8. Load cells
9. Position encoders/tachos
10. Radiation pyrometers and other instrumentation systems
11. CCTV cameras
12. Actuators

LIST OF ITEMS UNDER CLASS E

(To be Installed in Open Areas — Uncontrolled Open Spaces)

1. Transmitters
2. Switches (pressure, flow, level, temperature, etc)
3. Hot metal detectors
4. Cold metal detectors
5. Convertors
6. Photo cell banks
7. Proximity switches/limit switches
8. Load cells
9. Position encoders/tachos
10. Radiation pyrometers and other instrumentation systems
11. CCTV cameras
12. Actuators

Note — A suitable enclosure shall be provided in case the hardware cannot sustain the environment specified for respective classes.

APPENDIX B

(*Clause* 7.2)

COMMON TESTS REQUIRED FOR ITEMS UNDER CLASSES A, B, C, D AND E

B-1. Vibration — The equipment shall be monitored to a vibration test at a frequency of 10-55 Hz and acceleration 2 g for 1 hour 45 minutes.

B-2. Interference — The operational environment should consider RFI/EMI as per international standards.

B-3. Power Supply — The equipment should be designed to operate with a specified ac voltage ±10 percent −15 percent at 48 to 50·5 cycles/second.

B-4. Reliability — The equipment shall be guaranteed for a reliability of 90 percent during integrated functional operation for one year. The supplier shall devise a test which can be conducted in the factory for a period of 48 hours to demonstrate the equipment availability as guaranteed. The test shall be conducted in presence of the purchaser. The statistical data regarding MTBF and MTTR and third party test certificates for the same shall be provided to the purchaser.

APPENDIX C

(*Clause* 7.2)

SPECIFIC TESTS REQUIRED FOR ITEMS UNDER CLASSES A, B, C, D AND E

C-1. Items under class A (to be installed in controlled environment).

C-2. Environmental Test

C-2.1 *Temperature* — The operating temperature of this equipment shall be 24 ± 4 C. The equipment shall be subjected to a dry heat test of severity 55 C for 16 hours in accordance with IS : 9000 (Part 3/Sec 1 to 5)-1977 'Part 3 Dry heat test'. The equipment shall be subjected to a cold test of sevirity −10 °C for 4 hours carried out in accordance with IS : 9000 (Part 2 Sec 1 to 4)-1977.

C-2.2 *Humidity* — The equipment shall be operated in an environment with humidity ranging from 40 to 70 percent. It will be subjected to a damp heat cyclic test at a temperature of 55 °C for two cycles carried out in accordance with IS : 9000 (Part 5/Sec 1 and 2)-1981 'Part 5 Damp heat (cyclic) test'.

C-3. Enclosures — The equipment should be enclosed as per IP 40.

C-4. Items under class B (to be installed in partially controlled environment).

C-5. Environmental Test

C-5.1 *Temperature* — The operating temperature of this equipment will be −5 to 55 °C. The equipment shall be subjected to a dry heat test of severity +85 °C for 16 hours in accordance with IS : 9000 (Part 3/Sec 1 to 5)-1977. The equipment shall be subjected to a cold test of severity 10 °C for 2 hours carried out in accordance with IS : 9000 (Part 2/Sec 1 to 4)-1977.

C-5.2 *Humidity* — The equipment shall be operated in an environment with humidity ranging from 5 to 95 percent. It will be subjected to a damp heat cyclic test at a temperature of 55 °C for six cycles carried out in accordance with IS : 9000 (Part 5/Sec 1 and 2)-1981.

C-6. Enclosures — The equipment shall be enclosed as per IP 51.

C-7. Items under class C (to be installed in severe conditions).

C-8. Environmental Test

C-8.1 *Temperature* — The operating temperature of this equipment shall be 0 to 100 °C. The equipment shall be subjected to a dry heat test of severity 85 °C for 16 hours in accordance with IS : 9000 (Part 3 Sec 5). The equipment will be subjected to a cold test of severity −10 °C for 4 hours carried out in accordance with IS : 9000 (Part 2/Sec 1 to 4)-1977.

C-8.2 *Humidity* — The equipment shall be operated in an environment with humidity ranging from 0 to 100 percent. It will be subjected to a damp heat cyclic test at a temperature of 55 °C for six cycles carried out in accordance with IS : 9000 (Part 5/Sec 1 and 2)-1981.

C-9. Enclosures — The equipment shall be enclosed as per IP 54.

C-10. Items under class D (to be installed in uncontrolled areas in shops).

C-11. Environmental Test

C-11.1 *Temperature* — The operating temperature of this equipment shall be 0 to 55 °C. The equipment shall be subjected to a dry heat test of severity 100 °C for 4 hours in accordance with IS : 9000 (Part 3/Sec 1 to 5)-1977. The equipment shall be subjected to a cold test of severity −10 °C for 4 hours carried out in accordance with IS : 9000 (Part 2/Sec 1 to 4)-1977.

C-11.2 *Humidity* — The equipment shall be operated in an environment with humidity ranging from 5 to 95 percent. It shall be subjected to a damp heat cyclic test at a temperature of 55 °C for six cycles carried out in accordance with IS : 9000 (Part 5/Sec 1 and 2)-1981.

C-12. Enclosures — The equipment shall be enclosed as per IP 65.

C-13. Items under class E (to be installed in uncontrolled open spaces).

C-14. Environmental Test

C-14.1 *Temperature* — The operating temperature of this equipment shall be 0 to 80 °C. The equipment shall be subjected to a dry heat test of severity 100 °C for 4 hours in accordance with IS : 9000 (Part 3/Sec 1 to 5)-1977. The equipment shall be subjected to a cold test of severity −10 °C for 4 hours carried out in accordance with IS : 9000 (Part 2/Sec 1 to 4)-1977.

C-14.2 *Humidity* — The equipment shall be operated in an environment with humidity ranging from 0 to 100 percent. It shall be subjected to a damp heat cyclic test at a temperature of 55 °C for six cycles carried out in accordance with IS : 9000 (Part 5/Sec 1 and 2)-1981.

C-15. Enclosures — The equipment shall be enclosed as per IP 67.

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