

MATERIAL STANDARD

FOR

CONTROL PANELS AND SYSTEM CABINETS

CONTENTS :
PAGE No.

1. SCOPE	3
2. REFERENCES	3
3. UNITS	4
4. GENERAL	4
5. LABELLING AND NAMEPLATES	6
6. CONTROL PANELS.....	6
7. CONSOLE TYPE PANELS	6
8. INSTRUMENT PANELS - MIMIC PROCESS FLOW DIAGRAMS.....	7
9. PAINTING OF INSTRUMENTS AND PANELS.....	8
10. PANEL CONSTRUCTION.....	8
11. ENCLOSED PANELS FOR HAZARDOUS AND NON-HAZARDOUS AREA CLASSIFICATIONS OUTDOOR & INDOOR LOCATIONS.....	9
12. ELECTRICAL INSTALLATION.....	9
13. AIR SUPPLY TO PNEUMATIC PANELS.....	11
14. SYSTEM CABINET ARRANGEMENT (ELECTRONIC AUXILIARY ENCLOSURES).....	12
14.1 General	12
14.2 Enclosure.....	12
14.3 Circuitry	14
14.4 Card Frames	15
14.5 Internal Wiring.....	15
14.6 Wiring Techniques.....	16
14.7 Earthing	17
14.8 Instrument Electricity Supply.....	18
14.9 Identification.....	19
15. SYSTEM PERFORMANCE	20
15.1 Burn-in Period	20
15.2 Reliability	20
15.3 Type Test	20
16. FACTORY INSPECTION AND TESTING.....	22
17. PACKAGING AND TRANSPORTATION.....	23
18. GUARANTEE	24

19. PURCHASING PROCEDURES.....	24
19.1 Extent of Supply.....	24
19.2 Quotation	24
19.3 Documentation	25
19.4 Time Schedule.....	26

APPENDICES:

APPENDIX A ELECTRICITY SUPPLY CONDITIONS FOR INSTRUMENT SYSTEMS.....	27
APPENDIX B INITIATING CIRCUIT DIAGRAMS	28

1. SCOPE

This Standard covers the general requirements for the material of control panels and system cabinets to be used in oil, gas, and petrochemical industries.

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Contractor:

ISA (INSTRUMENT SOCIETY OF AMERICA)

ANSI/ISA S 71-04 "Environmental Conditions"

IEC (INTERNATIONAL ELECTROTECHNICAL COMMISSION)

IEC 68 "Basic Environmental Testing Procedures"

PART 2 TESTS

68-2-1 (1974) Test A: "Cold"

68-2-2 (1974) Test B: "Dry"

68-2-3 (1969) Test Ca: "Damp Heat and Steady State"

68-2-42 (1982) Test Kc: "Sulfur Dioxide Tests for Contacts and Connections"

68-2-43 (1976) Test Kd: "Hydrogen Sulphide Tests for Contacts Connections"

IEC 79-11 (1984) "Construction and Test of Intrinsically Safe and Associated Apparatus"

IEC 529 (1976) "Classification of Degrees of Protection Provided by Enclosures"

IEC 605 "Equipment Reliability Testing"

605-1 (1978) Part 1 "General Requirements"

605-5 (1982) Part 5 "Compliance Test Plans for Success Ratio"

605-7 (1978) Part 7 "Compliance Test Plans for Failure Rate and Mean Time Between Failures Assuming Constant Failure Rate"

IEC 641 "Specification for Pressboard and Presspaper for Electrical Purposes"

641-1 (1979) Part 1 "Definitions and General Requirements"

IEC 654 "Operating Conditions for Industrial Process Measurement and Control Equipment"

654-1 (1979) Part 1 "Temperature, Humidity and Barometric Pressure"

654-3 (1983) Part 3 "Mechanical Influences"

654-4 (1987) Part 4 "Corrosive and Erosive Influences"

IEC 801 "Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment"

801-3 (1984) Part 3 "Radiated Electromagnetic Field"

BSI (BRITISH STANDARD INSTITUTION)

BS 381C -1988 "Specification for Colors for Identification, Coding and Special Purposes"

IPS (IRANIAN PETROLEUM STANDARDS)

M-IN-100/1	"General-Factory Inspection and Testing of Instruments and Instrument Systems"
M-IN-100/2	"General-Name Plates"
M-IN-120	"Temperature Instruments"
E-IN-180	"Electrical Power Supply & Distribution System"
E-IN-190	"Transmission Systems"
E-IN-200	"Instrument Air System"
E-EL-200	"Lighting and Wiring"
G-IN-220	"Control Centers"

3. UNITS

This Standard is based on International System of Units (SI), except where otherwise is specified.

4. GENERAL

4.1 Each panel section shall be constructed as a self-contained unit so that after testing at the manufacturers works the least number of connections are disturbed when the panel is sectioned for shipment to site. Design details, layout and shape of panels shall be discussed and agreed with the Purchaser before drawings are submitted.

4.2 The panel layout shall be designed to follow the actual physical arrangement of the unit as closely as possible:

a) Instruments shall be mounted in logical groupings according to their position in the process units, i.e., instruments needed for the area of control exercised by process operators shall be grouped together. A clear demarcation shall be made on the panel between process units. Each unit shall be identified by a nameplate mounted in the top section of the panel.

b) As a secondary criterion instruments shall occupy relative positions in accordance with the natural expectations of the operator, i.e., related variables shall be adjacent, e.g. cascade controllers. Expected sequences as of process items or of position within a process item, should be adjacent.

c) Panel mounted multipoint temperature indicators shall be mounted on a vertical section of the main panel. In general one shall be provided for each process unit.

4.3 An identification system, such as name-plates, color codes or symbols, which will enable an operator to quickly identify any particular equipment shall be used in the mimic panel layout.

4.4 The space behind and at each end of a free-standing panel assembly shall form an unobstructed passageway of 1500 mm taking into account any equipment mounted on the back wall. Similarly the walkway inside a walk-through type of panel shall be not less than 1200 mm wide.

4.5 The instrument arrangement and mounting heights on the panel shall be subject to the Purchaser approval.

4.6 In general the maximum and minimum instrument mounting heights shall be as follows:

a) Minimum: To centerline of instrument requiring operation or manipulation (e.g., pushbuttons or controllers) 685 mm.

b) Maximum: To centerline of instruments requiring operation or manipulation (e.g., pushbuttons or controllers) 1600 mm.

c) Maximum: To centerline of instruments requiring inspection but not operation in normal use (i.e., Receiver gages) 1980 mm.

4.7 Items such as annunciators may be mounted above other instruments, but care must be taken that legends on annunciators are clearly readable in spite of their mounting height. In any case test acknowledgment buttons for annunciators are subject to the same mounting height rules as for instruments requiring manipulation during normal plant operation.

4.8 Panels should normally be free standing and console type may be used with prior consent of the user. In all cases they shall conform to the purchaser standard drawings.

4.9 The control panel shall be facia type with miniature or large case instruments, or both, mounted in horizontal and vertical rows.

4.10 The distance between rows of instruments will depend upon the types of instrument and the accessibility for maintenance and adjustment. See IPS-E-IN-220, Fig. 3.

4.11 The individual indicating lights, annunciator systems and miscellaneous indicators shall be mounted above the top row of the instruments and shall conform to the Purchaser standard drawings:

a) The alarm indicators shall be located in the panel section containing the associated instrumentation. They shall be mounted above the process instruments in a matrix array, but no single array should exceed seven indicators in any horizontal row or five indicators in any vertical row.

b) Indicating lights not associated with process alarms shall be segregated from process alarms.

4.12 Mimic presentation, (semigraphic) of the main process flow diagrams is acceptable, but full graphic presentation is not recommended.

Note:

Where a graphic display is required, the execution may be such that the layout can be easily modified on the site, i.e. by means of small removable and replaceable building blocks. The detailed execution shall be as indicated in the requisition and the drawings attached or referred there to.

4.13 The total width of the panel shall be determined by the type and number of instruments used. Groups of panels shall present a smooth unbroken surface.

4.14 On new process plant installations, at least 20% usable spare panel space shall be provided. This spare space should normally be distributed over the panel. In some cases it may be logical to provide spare blank panel space at the end of the group of panels.

4.15 Free space shall be available, at the back of the spare blank panel for future expansion.

4.16 Auxiliary equipment installed in prewired and prepiped panels shall be accessible for maintenance and adjustments.

4.17 All wiring, piping, etc. shall be adequately marked, coded or colored so that it can be easily identified.

4.18 All instruments on the face of the control panel shall be flush-mounted. When a cascade system is specified, the primary and secondary controller shall be mounted with the primary immediately above the secondary where possible.

4.19 ESD switches shall be guarded from accidental operation.

4.20 Illumination levels on control panels, and desks, shall be in accordance with electrical part of IPS standards IPS-E-EL-200 "Lighting and Wiring". Adequate illumination shall be provided at the rear of the panel. See also: IPS-G-IN-220, para. 6.2.3.

4.21 Panels that are totally enclosed shall have access doors with quick release fastenings.

4.22 The panel assemblies shall be tested before erection wherever possible. See sections 15 & 16.

4.23 Console type panels will normally be free standing cabinet type enclosures, incorporating a desk or sloping area on the front of the cabinets.

4.24 Instruments on consoles shall be prewired and piped and shall be completely enclosed.

4.25 If maximum ambient temperature conditions are such that apparatus manufacturer's recommended operating temperatures could be exceeded, provisions for environmental control shall be agreed with the purchaser.

5. LABELLING AND NAMEPLATES

5.1 Panels shall be clearly labelled with plant instrument numbers and duties at the front and rear.

5.2 Labels shall be transparent plastic material and engraved on reverse side. The engraving to be filled in either black or white depending on which is most legible. Provision shall be made in the panel mounted instruments, for insertion and removal of meter constant cards and control valve action.

5.3 The material for name-plates should normally be a laminated bicolor plastic, which when engraved, the top layer is cut through allowing the letter to show in the second color.

5.4 Continuous panels for control of a number of process units, as in the case of integrated plant, shall have the panel sections clearly defined by arrow-headed lines and labelled with the plant designation at the top of the panel.

5.5 Reference to be made to: IPS-M-IN-100/2 "General-Name Plates".

6. CONTROL PANELS

6.1 Panel lay-out for control houses shall permit the operator or operators to observe the functioning of all instruments from a central control point.

6.2 It is desirable that each operator be provided with a strategically positioned writing desk.

6.3 Instruments which are required for assessment of plant behavior shall be mounted in such a manner as to be readable from the control desk. Presentation may be in digital or analogue form.

6.4 Consideration may be given to providing common recording points with facilities for connection to a range of instruments measuring process variables. These systems, when connected into controller transmission loops, must be designed so that the reliability of the controller is not affected, and affects from switching transients are avoided.

6.5 Instruments shall, in general, be of the "miniature" type, ("Miniature" applies to instruments approximately (144 mm × 144 mm) or smaller.

6.6 Panels shall be assembled from manufacturers' standard units.

6.7 The height from the floor to top of the highest control or recording instrument and to the top of the lowest instrument, shall be in accordance with the Purchaser standard drawings No. IPS-D-IN-116.

7. CONSOLE TYPE PANELS

7.1 Instruments shall be grouped on inclined and/or vertical panels. A desk shall be provided as an integral part of the panel structure.

7.2 The detailed design and quality of the consoles shall be such that they can withstand normal handling during transport.

7.3 Sectional construction should be selected to facilitate manufacturing, handling and transportation.

7.4 Openings such as tube connections etc. shall be covered to avoid entry of dust.

7.5 To enable easy reassembling of the sections on site, the wiring and the tubing to be reconnected shall be properly identified. All instruments and components packed separately from the console shall also be properly identified.

7.6 A small quantity of components e.g., ferrules nuts, tubing, terminals wire shall be supplied with the console, for on site assembling and small modifications.

8. INSTRUMENT PANELS - MIMIC PROCESS FLOW DIAGRAMS

8.1 Mimic diagrams, either draughted or built-up, shall be mounted immediately above conventional and freestanding panels and may be inclined forward at an angle of 15 degrees, if specified in data sheet.

8.2 A semi-graphic representation shall be provided in accordance with plant process and utilities flow. Main process lines shall be 5 mm and instrument lines shall be 3 mm.

8.3 Generally fabrication by means of tiles for indoor panels are in preference as rearrangement and modification can be more conveniently carried out.

8.4 Towers, drums, vessels and similar major items of equipment shall be included in the diagram. Pumps, compressors, heat exchangers and other such items of equipment shall only be shown when control or measuring instruments are directly connected to them or to improve understanding of the process.

8.5 Constructional details of towers, vessels and heaters shall not be shown unless required for location of instrument connections.

8.6 Major equipment symbols shall be scaled from actual dimensions where possible.

8.7 Instrument symbols shall be mounted external to process lines and vessels, and as far as possible, in the same relative position as their associated panel mounted instruments.

8.8 Instrument symbols shall be shown connected with all relevant instrument measurement, transmission, and control lines.

8.9 Where process lines cross, the horizontal line shall be continuous, and the vertical line broken. In all cases instrument lines shall be broken where they cross a process line.

8.10 Equipment symbols shall be marked with both name and number.

8.11 Instrument symbols shall be marked with the process instrument number.

8.12 Plant feed and products lines shall be provided with in-line labels marked with the name of the process fluid.

8.13 Process lines shall be provided with arrow heads to depict direction of flow.

8.14 Instrument lines shall, where necessary, be provided with arrow heads to illustrate cascade connections.

8.15 Equipment and instrument symbols, lines, and nameplates, shall be manufactured from materials which will ensure freedom from buckling with temperature changes.

8.16 Symbols, lines and labels shall be fixed to the panel by means of an adhesive which will allow for their removal with or without the application of a solvent and without damaging the painted surface of the main panel.

8.17 Mimic diagrams shall be coloured in accordance with the following color code:

- a)** Main panel-semi-matt admiralty Grey to BS. 381C-Shade 697.
- b)** Equipment symbols, towers, vessels, etc., -semi-matt Dark Grey to BS. 381C-Shade 632.
- c)** Instrument symbols, and control valves-semi-matt Black.

- d) Instrument measurement, transmission and control lines-semi-matt Black.
- e) Water-matt pale rounded Blue to BS-381C-Shade 172.
- f) Steam-semi-matt signal Red to BS. 381C-Shade 537.
- g) Process Air-semi-matt White.
- h) Hydrocarbon vapor and gas-semi-matt Lemon to BS. 381C-Shade 355.
- i) Hydrocarbon liquids-Light buff to BS. 381C-Shade 358, Traffic yellow-Shade 386 and Golden Brown -shade 414; to distinguish, respectively, light medium and heavy streams.
- j) Chemicals and corrosive fluids-semi-matt Light Brunswick Green to BS. 381C-Shade 225.

8.18 A color code key shall be shown at one end of the mimic diagram panel.

9. PAINTING OF INSTRUMENTS AND PANELS

9.1 The surface of panels except the inner surfaces, for which items c, d and e (noted under) are not required, shall be prepared and painted with air-drying materials in accordance with the following procedure:

- a) Surfaces of the finished panel shall be blast cleaned and given one coat of etch primer, except that zinc coated sheet shall be degreased and not blast cleaned.
- b) One coat of gray primer shall be applied.
- c) Any indentations shall be filled with quick drying putty in thin layers.
- d) Two coats of quick drying knifing filler shall be applied and allowed to dry overnight before flatting.
- e) The undercoat shall consist of one coat of synthetic enamel groundcoat, color BS. 381C-217.
- f) The finish shall be one coat of synthetic enamel, semi-matt or eggshell, color BS. 381C-217, Sea Green except that mimic diagram panels shall be Admiralty Gray to BS. 381C-697 semi-matt or eggshell.

9.2 Instruments shall be painted light Brunswick green to BS. 381C-Shade 225.

9.3 Any deviation from the colors of panels and instruments shall be subject to the user approval.

10. PANEL CONSTRUCTION

10.1 Fabricate the control panel from 4 mm (minimum) cold rolled steel formed members except for the 100 mm channel base frame.

10.2 Panel structure shall be entirely self-supporting by the use of 50 mm structural angle iron frame. Framing and brackets shall be as necessary to achieve a rugged design and to insure a smooth, flat surface with a maximum deflection of 4 mm over total surface of panel after installation of all instruments and accessory equipment. Design and fabricate panel lengths from a smooth, continuous panel surface. Provide holes at panel joints complete with bolts, nuts, and washers for panel assembly, shop-assemble the entire unit and check for accurate alignment and surface matching.

- Provide removable end side plates.
- Bottom and rear of the panel shall be easily accessible.

10.3 The top section of the panel board shall be a medium density semi-graphic display for each panel unit.

10.4 For handling purposes, each shipping section shall be provided with removable lifting lugs designed for lifting without deforming the panel.

10.5 Cutouts for instruments must be within the tolerances as specified by their manufacturer.

10.6 Where cutouts are specified for future instruments they shall be covered by 3 mm steel removable plates, finished and painted the same as the front of the panel.

10.7 All burrs produced around cutouts or bolt hole drillings must be ground smooth.

10.8 The rear panel area shall not be obstructed by conduits, ducts, raceways, stiffeners, etc.

10.9 Filler panels, when specified, shall be designed and furnished for bolting to the panel. They shall be fabricated from 3-4 millimeters cold-rolled steel plate with 50 mm turn back, corners arcwelded and ground smooth. The filler panels shall be finished to match the panel color.

11. ENCLOSED PANELS FOR HAZARDOUS AND NON-HAZARDOUS AREA CLASSIFICATIONS OUTDOOR & INDOOR LOCATIONS

11.1 Construction Panel shall be fully enclosed. Face plate shall be 4 mm (minimum) steel with remaining general structure 3 mm steel. The base shall consist of 100 mm high channel iron. Doors and access plates shall be 1 mm steel minimum. Doors shall be flush, fully gasketed, full height and width of the panel, with louvers at the top and bottom of the doors provided for air circulation and heat removal. Stainless steel piano type hinges, T-handles and rust and corrosion resistant latches shall be provided. For out door service a 500 mm deep removable canopy shall be provided .

11.2 Painting and nameplates shall be as mentioned before (see: para. 9).

12. ELECTRICAL INSTALLATION

12.1 The panel board will be installed in an air-conditioned pressurized control house classed as nonhazardous, suitable for general purpose electrical devices and wiring. All components and wiring must conform to the requirements of the Electrical codes. Ratings, construction and testing to be in accordance with the applicable standards of ANSI, NEMA, etc. All devices must be approved by UL, or other equivalent establishments except those categories for which no approval list has been established and these must be approved by the Purchaser. The edition of codes, standards and approval lists, current at the time when specification is issued for purchase, shall be applicable.

12.2 Fabricator shall provide the wiring for all internal wiring of the panel.

12.3 Vertical raceways preferably shall be 100 mm. Separate raceways shall be provided within the panel for isolation of each of the following types of instruments wiring systems:

- a)** Thermocouple extension wire.
- b)** d.c signals (4 - 20 mA).
- c)** a.c power and control wiring, with more than 24 V d.c.
- d)** Pulse signals.

12.4 When common terminal boxes are used, these terminal boxes shall be divided into sections separated by a metal barrier so as to segregate the following types of signals:

- a)** 4-20 mA d.c. instruments signals.
- b)** Thermocouple signals.
- c)** a.c power and control system wiring, with more than 24 V d.c.
- d)** Pulse signals.

12.5 Terminal blocks for instruments and control wiring shall be medium duty, 300 to 600 volt rating, barrier type, of non-hygroscopic material. Terminal blocks to be approved by the Purchaser.

12.6 Terminal blocks shall be mounted on channels with a minimum of 25 mm spacers between the channel and the mounting surface. Separation between the rows of terminal blocks shall be a minimum of 80 mm for terminal blocks up to 600 mm long. Separation shall be 150 mm for longer rows.

12.7 Each terminal on panel mounted electrical devices (such as push-button switches, indicating lights, relays, ammeters, etc.) shall be wired to a terminal block by the panel fabricator. These terminal blocks shall be provided with protective covers.

12.8 All panel board wiring (with the exception of thermocouple extension wire shall be terminated with lugs at both ends). These lugs shall be crimp-on, vinyl self-insulating, locking type. All wires shall be identified with instrument 28 tag number and terminal designation at both ends with heat shrink markers.

12.9 Terminal block spare terminals shall be provided according to the following:

<u>REQUIRED TERMINALS</u>	<u>ADDITIONAL SPARES</u>
2-4	2
5-10	4
11-20	8
21-30	10
31-40	12
41-60	18

For more than 60, 20% spare shall be provided.

12.10 Terminal blocks shall be provided on panels and subassemblies for power supply wiring, alarm system wiring, and electrical transmission lines. Non terminal blocks are permitted for neither thermocouple extension wiring, nor for analytical instruments signal lines. The signal lines for these instruments shall be directly connected to the receiving instrument. The terminal blocks shall be clearly identified with engraved or embossed numbers.

12.11 The terminal blocks shall be of the enclosed type. The open type terminal blocks may be used in enclosed panels such as consoles or cubicles.

12.12 The electrical supply to the instrument panel shall be 24 V d.c, or 110 volts 50 Hz two wire, grounded, single phase, for other power supplies (see Appendix A).

12.13 Normally PVC trunk type or sheet metal wire ways, rigid or flexible conduit, or combination of these should be used. When area classification permits PVC insulated wires on adequate trays may be used.

12.14 Disconnect switches shall be provided for servicing requirements of all panel instruments. One disconnect switch may be used to serve as many as six chart drives. For electronic instruments, cabinet type annunciators multiple alarm units, potentiometers and emergency shut down solenoid valves and relays. One disconnect switch shall be used per instrument. Each disconnect switch shall be clearly labeled to identify the particular instruments or alarm units served by that switch. See also for more details: IPS-E-IN-180, "Electrical Power Supply & Distribution System"

12.15 Isolation possibilities for supplies to individual instruments shall be available, e.g., by means of dedicated power distribution fuse/socket boxes or fused terminals.

12.16 Low Voltage d.c Wiring

a) Control and alarm wiring shall be 1.5 mm², stranded tinned copper, twisted paired, color coded. Installation shall be in separate conduit or slotted plastic duct with 30% spare space provided.

b) Selector switches shall be identified by permanent front nameplates indicating their service position and tag number.

12.17 a.c. Wiring

a.c. wiring shall be 2.5 mm², stranded tinned copper, twisted paired, color coded, and 600 volt rating insulation.

13. AIR SUPPLY TO PNEUMATIC PANELS

13.1 The instrument air header shall run the full length of the panel, and shall be constructed of brass pipe and fittings, cadmium plated. Brass unions shall be supplied between panel sections.

13.2 The dual-air regulator filter station shall be supplied with 3-way brass cocks connected to allow either regulator and filter to be used to supply air to the header. These stations shall be such as to permit removal of the filter cartridges without disassembly of piping, and to permit dis-assembly of either regulator/filter without interfering with the operation of the other unit. provide cock handles attached to the cocks. For more information, reference to be made to: IPS-E-IN-200 "Instrument Air System".

13.3 Where each panel instrument has its own pressure reducing regulator and filter set, the header shall be of galvanized steel pipe.

13.4 For future expansion, spare valved take-off connections shall be provided on the air header. The spare connections shall not be less than 20% of the existing take-offs.

13.5 For long curved panels, in order to facilitate field connection, the header shall be joined between panel sections with a flange or union type connection.

13.6 A valved drain shall be provided at the bottom end of the header, farthest from the air supply source.

13.7 Control and transmission lines and interconnecting lines between panels and subassemblies shall be brought to bulkhead fittings. The bulkhead fittings shall be installed on top of the panel. The bulkhead fittings shall be adequate for connecting the tubing from the field.

13.8 When PVC multitubing is used for connecting field instruments to the control instruments, the bulkhead fitting shall be mounted vertically and housed in a detachable enclosed junction box. The junction box shall be freely installed on top of panel.

13.9 When copper tubing is used for connecting field instruments to the control room instruments the bulkhead fittings shall be mounted vertically.

13.10 Each bulkhead connection shall be clearly labeled with the designation of the particular instrument or connection it serves.

13.11 Testing of the air supply header and signal tubing shall be accomplished with air. Each joint shall be tested with a soap and water solution and shall be absolutely tight. Instruments shall be also tested in the manner prescribed by their manufacturer. For testing refer to IPS-M-IN-100/1, "General-Factory Inspection and Testing of Instruments and Instrument Systems".

13.12 The relief valve and pressure gage on the air header shall be constructed of brass, bronze, or stainless steel. The relief valve shall be minimum 1 inch inlet size, set to relieve at 1.7 bar (g) and shall be supplied with a lifting lever.

13.13 Unless otherwise shown on the panel drawings, all pneumatic tubing shall be copper, PVC coated, ¼" O.D. by 0.8 mm wall, thickness, as minimum.

13.14 Tubing fittings shall be compression type of purchaser approved manufacturer.

13.15 All tubing shall be clamped or supported from the panel frame-work as required to prevent sagging. No clamps or supports shall be attached to the instruments.

13.16 Tubing runs shall be horizontal or vertical with each bend 90. Tubing bends shall be rigidly held to limit the tubing bending radius to 15 mm min.

13.17 Tubing runs shall be arranged so that visual tracing is possible, and finger tracing will not be required.

13.18 The panel fabricator shall supply a bulkhead plate as shown on the panel drawings, fitted with bulkhead fittings, 10 spare bulkhead fittings and locations shall be provided. Fittings shall be suitable for connection of copper tubing of panel to plastic tubing of field incoming tubes.

13.19 Tubing shall be installed separately from wiring, in PVC ducting with a cover.

14. SYSTEM CABINET ARRANGEMENT (ELECTRONIC AUXILIARY ENCLOSURES)

14.1 General

14.1.1 The system cabinet typically consists of an enclosure containing:

- Circuitry (14.3).
- Internal wiring (14.6).
- Terminals and sockets for external wiring (14.6).
- Accessories, such as electricity supply units (14.8) and relays for operating howlers.

14.1.2 The total capacity of the cabinet shall include 10% for contingencies, i.e., to cover changes in the project scope which may occur during the engineering phase, plus 20% for future use.

14.1.3 Cabinets should be delivered with all slots wired to proper sockets/terminations/wrapping boards, to allow expansion of the system to maximum cabinet capacity, by card/module insertion only.

14.2 The Enclosure

14.2.1 System cabinets should be of the type and manufacture as specified by the Purchaser in the Data Sheets. Cabinets to manufacturer/supplier's own standards require the approval of the Purchaser in writing.

Note:

The enclosure shall be constructed in sheet steel, be suitable for indoor use and meet the requirements of IP 51 of IEC 529, unless otherwise specified.

14.2.2 The finish and color of the enclosure shall be as per Section 9, unless otherwise specified in data sheet. A small quantity of touch-up paint, say 0.25 L, shall be supplied with each cabinet.

14.2.3 The cabinet shall be fitted with removable eyebolts for lifting purposes.

14.2.4 The temperature inside the cabinet shall not exceed 10°C above the maximum control room temperature when all internal equipment and external loads are energized.

Note:

Cabinets will generally be installed in an environment with a temperature limit between 22 and 26°C with humidity between 40 and 50%.

14.2.5 The limits shall be as stated in the data sheets, and it shall be ensured that the maximum allowable temperature inside the cabinet is not exceeded.

14.2.6 For temperature and humidity limits during storage and transportation, class C 1 of IEC 654-1 shall apply, and for mechanical vibration and shock, class VSI of IEC 654-3.

14.2.7 The allowance for air contaminants shall be as specified in the data sheets. ISA-S71 04, or the final edition of IEC 654-4, should be used as a guide for specifying environmental conditions.

14.2.8 Two options are available for cooling the cabinet internals depending on the amount of the heat generated inside:

- a) Natural ventilation by means of screened and louvered openings in the doors and in the top of the cabinet.
- b) Forced ventilation by means of openings in the doors fitted with dust filters and with extraction fans mounted in the top of the cabinet fitted with fingerguards.

14.2.9 The manufacturer shall provide a calculation of heat generated under the worst possible conditions, i.e., with all loads energized, at the maximum ambient temperature.

14.2.10 The type of ventilation selected for the cabinet, based on the heat calculation provided by the manufacturer, shall be indicated in the data sheets. If the temperature under the conditions as specified, will remain within 10°C above the maximum ambient temperature, natural ventilation shall be applied. Otherwise forced ventilation will be required to limit the temperature rise inside the cabinet to within 10°C.

14.2.11 Side panels shall not be considered to give cooling effects.

Note:

When cabinets are bolted together with the side plates removed, it shall be ensured that the cooling airflow remains effective for all critical internal components.

14.2.12 A fan-failure alarm shall be provided for cabinets with forced ventilation. The alarm shall be available, either as potential free contacts on dedicated terminals in the cabinet, or as a dedicated socket, connected to the door of the cabinet and on the operating control desk.

14.2.13 Dust filters shall be of the replaceable or cleanable type, and this action shall be possible without disturbing the functioning of the cabinet.

14.2.14 Unless otherwise specified in the data sheets:

- Fans should be connected to an a.c interruptible, maintained supply (14.9).
- The cabinet shall be free standing with front and back doors, thus providing access to equipment, wiring and terminations.

14.2.15 If wall-mounted cabinets or back-to-back mounted cabinets are specified in the data sheets, all equipment, wiring and terminations shall be accessible from the front.

14.2.16 The side panels shall be removable so that it is possible to mount the cabinets side by side and properly connect them together. Therefore the sidewalks shall not be used for cable entry or ventilation openings, etc.

14.2.17 The application of swing out frames requires the written approval of the Purchaser.

Note:

The application of swing out frames should be avoided wherever possible. They shall not be applied in cabinets for safeguarding equipment.

14.2.18 If swing-out frames are specified in the data sheets, special attention shall be given to the maximum weight of equipment allowed on the frame in the swung out position. The connecting wire "bundle" to the equipment on the swing out frame shall be adequately protected. Doorstops and swing-frame stops shall be provided.

14.2.19 The size of the cabinet shall be stated in the data sheets and should be selected from the following sizes:

HEIGHT	DEPTH	WIDTH
2100	600	600
2100	600	800
2100	600	1200

14.2.20 The height indicated above may be included a plinth for door clearance, etc. All dimensions given are in millimeters.

14.2.21 The size of cabinets, i.e., height and depth, should be consistent within the same control or auxiliary room.

14.2.22 For enclosures having a width of 600 mm maximum, one door is acceptable, for wider enclosures two doors should be provided. Doors and side panels shall be easily removable.

Note:

Single doors of 800 mm may be applied provided escape routes allow for such doors. Regulations for escape routes shall be adhered to.

14.2.23 For those systems where observation of the equipment by operating or electrical maintenance personnel is required without opening the doors, clear acrylic windows or laminated glass windows shall be specified in the data sheets.

14.2.24 Each cabinet should be provided with either a separate handle and lock or with a lock insert in the handle. Unless otherwise specified in the data sheets, the locking arrangement shall be to manufacturer's standards, each lock shall be identical for all cabinets provided by the same supplier and these cabinets shall have 2 keys.

14.2.25 For extensions to existing plants, the locks and handles should preferably match those of the existing cabinets.

14.2.26 Cable entry shall be in the bottom of the cabinet unless otherwise specified by the Purchaser. Sufficient freely accessible space shall be available for accommodating and terminating all cables, the cabinet shall be provided with properly designed cable clamps and cable support rails in order not to exert any undue force on terminations.

14.2.27 Unless ventilation is required through the bottom of the cabinet, all holes remaining after entry of the cables shall be properly sealed against the entry of dust. The dust seal shall be such that it is easily removed for the entry of other cables.

14.3 The Circuitry

The power and output circuits shall be rated for simultaneously energizing the complete system. All output circuits shall be short-circuit proof, and the shorting of one output circuit shall not effect other circuits.

Note:

To avoid the interactions indicated, individual fusing of the output circuits or current limiting devices should be employed.

14.3.1 Initiating circuits (field instruments)

14.3.1.1 General

Initiating circuits do not form part of this Standard; however it shall be ensured that the specifications of the initiating circuits are compatible with those of the system cabinet circuitry as appropriate.

14.3.1.2 Contacts

The system circuitry shall be capable of operating with initiating devices which are free from earth, potential-free, and of the snap-acting type, with the contacts closed in the normal condition and open in abnormal conditions. Typical electrical characteristics for initiating contacts are given in Appendix B. For initiating devices other than contacts, the electrical characteristics shall be as specified in the appropriate data sheet.

Notes:

- 1) The current passing thorough the initiating contacts shall be at least 1 mA d.c and energy needed for initiating a change in system status shall be at least 10 mW.
- 2) The initiating devices may be located in a hazardous area, in which case the type of protection shall be suitable for those areas.

14.4 Card Frames

- a) The circuit cards shall be mounted vertically in card frames which are securely fixed to standard 480 mm (19 inch) racks in the enclosure. The height of the racks shall be to the approved manufacturer's standard.
- b) The card frames shall be provided with connectors and card guides enabling the correct insertion of the circuit cards, and providing adequate separation, both electrically and mechanically, between them.
- c) Each card frame and the card which will be inserted, shall be marked for identification, either by consecutive numbering and type, or if agreed by the user, by the manufacturer's standard code.
- d) Spare positions shall be fitted with edge connectors and blanking plates.

14.4.1 Mounting plates

When a cabinet is used for housing a variety of discrete components, either rack-mounted or individually on a mounting plate, the following constructional details shall be taken into account:

- a) Earthing of the mounting of the mounting plate;
- b) provision of sufficient space for the removal of covers and for testing;
- c) building of a dedicated tester/adjuster as appropriate if the cabinet contains many similar items;
- d) equipment removal from the front without disturbing other equipment;
- e) accessibility of all wiring and terminations from the front;
- f) cable entry, which shall be in accordance with (14.2).

14.5 Internal Wiring

14.5.1 The internal wiring shall be adequately sized for the required voltages and currents. The conductor cross-section shall be such that the voltage drop is less than 2%.

14.5.2 When a large number of wires are laid together in ducting or in a bundle a current derating of 50% of the nominal rating should be applied.

14.5.3 All wires in screw type terminals shall be provided with wire markers.

14.5.4 Unless otherwise specified in the requisition, or agreed by the user, the coding of wires shall be as follows:

1. Power 24 V d.c positive	- Red
2. Negative	- Black
3. V Phase	- Brown
4. Neutral	- Light Blue
5. Input and output signals	- White (or blue if a color is to be used to indicate intrinsically safe signals)
6. Safety earth	- Green/Yellow
7. Signal earth	- Green
8. Thermo-Couple ext. wires	- As specified in the data sheets, which is to be based on IPS-M-IN-120 "Temperature Instruments"

Notes:

1) Signal wiring from internal supply with a voltage higher than 50 V and signal wiring from external supply sources with a voltage higher than 50 V may be suitably colored to provide an additional warning. The colors Orange and Orange/White should be used respectively, if not otherwise specified in the requisition.

2) Care shall be taken that interference susceptible signal lines are not affected by high current carrying lines. Refer to IPS-E-IN-190 transmission systems.

14.5.5 All wiring should be laid in PVC ducting with a removable cover. Intrinsically safe wiring shall be contained in separate ducting and if a color coding is applied to identify the contents, the cover of this ducting should be colored blue.

14.5.6 For new projects, at least 20% spare capacity shall be available in the ducting when all wiring is complete.

14.5.7 Spare wires shall not be left loose in the ducting, they shall be properly terminated.

14.5.8 Interconnections shall not be made in the ducting.

14.5.9 Wires and cable in the ducting shall not have excessive spare length.

14.5.10 Wiring shall lie neatly in the ducting even when the covers are removed.

14.5.11 The socket-boards shall be mounted in the cabinet such that:

- a)** The plugs can be easily inserted or withdrawn, sufficient space shall be available for the plugs and the cable loops.
- b)** The loops shall be arranged such, that force is not exerted on the plug/socket assembly.
- c)** The sockets-boards can be reached for fault finding or adding wiring for new circuits, with the wiring technique as selected from (14.6.1).
- d)** Sufficient access and space should therefore be available.

14.5.12 Plugs and sockets shall have a polarizing code such that interchanging between different types of voltages are not possible. Signal segregation for IS signals shall be in accordance with the requirements of IEC 79-11.

14.5.13 All terminations using screw type terminals shall be straight through, non-pinching and spring backed to hold the wire, with only one wire in each terminal. The type and manufacturer of the terminals shall be specified in the data sheets.

14.6 Wiring Techniques

14.6.1 The following techniques should be applied for the termination of internal wiring:

a) Crimped-on contacts and pins:

- 1) For stranded flexible wire of minimum size 1.5 mm^2 , voltage rating 250 V and with insulation suitable for temperatures up to 80°C .
- 2) The manufacturers recommendations shall be followed for the size of the crimp pins and contacts and for the type and correct application of crimping tools to produce high quality connections consistently.

Notes:

- 1) The crimping tools shall be checked for wear at regular intervals and be replaced when manufacturers tolerances have been exceeded.
- 2) The tools shall have a single torque value and be of the non-return type until the crimp has been made.
- 3) Crimp connections shall not be made on solid wires (solid wires shall be used only for thermo-couple extension wires)

b) Wire wrap connections, the modified version, minimum wire size 0.2 mm^2 . This technique is used with small wire sizes. The application of this method shall be approved by the Purchaser.

14.6.2 The wiring for power supply units shall have terminal connections with the rating adequate for the load.

14.6.3 The selected wiring technique shall be as stated in the requisition. The terminations and wire sizes may be to manufacturer's standards, but only with the approval of the Purchaser.

Note:

Soldered connections shall not be used for internal wiring.

14.6.4 Quality control procedures for the proposed wiring technique shall be submitted to the Purchaser for approval.

14.6.5 A set of crimping/wrapping tools together with a quantity of the required wire and crimp pins etc. shall be supplied with the cabinet(s), to facilitate any modifications that may be necessary during commissioning.

14.7 Earthing

14.7.1 A safety-earth connection shall be provided for every cabinet. Conducting parts such as doors and frames, etc., which are not permanently connected to safety-earth, shall be connected to the cabinet frame with flexible braided earthing strips of 6 mm^2 minimum.

14.7.2 Safety-earthing shall be connected to a dedicated earth-bolt of M8 minimum size, provided with an earth-symbol marker.

14.7.3 Where local regulations are more stringent than the above requirements, this shall be indicated in the requisition and they shall be complied with.

14.7.4 Each cabinet shall have a tinned copper earth-bar for signal earth connections and sufficient screws shall be available for making the connections. The signal earth-bar shall be insulated from the cabinet frame. Earth connections shall be as short as possible and of adequate cross sectional area.

14.7.5 To avoid flash-over between signal earth and safety earth, over-voltage protection devices should be applied, limiting the voltage difference to 65 volts approximately.

14.7.6 For additional lightning protection requirements, see the standard of transmission systems, IPS-E-IN-190.

Note:

If the equipment installed in the cabinet requires the connection of signal-earth to the cabinet frame because it is the manufacturer's standard, then the cabinet shall be mounted such that it is insulated from safety earth and the building structure.

14.7.7 Earthing details of cabinets shall be shown on separate drawings as part of the complete set of drawings for earthing details.

14.8 Instrument Electricity Supply

14.8.1 General requirements

14.8.1.1 The system shall be suitable for operating from a supply as defined in Appendix A the selection shall be indicated in the requisition. Without considering redundancy, a spare capacity of 25% of the maximum allowable load shall be available.

14.8.1.2 The power sources shall be of a design to suit the requirements of the system. The manufacturer shall ensure the power sources do not introduce interference into the system.

Notes:

- 1) Power supply units shall be of the simplest design to fulfil the requirements of the system.**
- 2) Inrush currents and short circuit currents shall be limited, to avoid damage to the power supply units.**

14.8.1.3 A fuse/circuit breaker schematic diagram shall be prepared for each system cabinet, together with calculations indicating power distribution, fuse ratings, fuse types (size and current-time characteristics), terminations and total worst-case power consumption.

Note:

The information shall be available at an early stage of the project and be updated regularly, to enable Electrical Engineering to selectively size the fuses in their supplies.

14.8.1.4 The data sheet shall indicate if the supply for the circuitry in the cabinet will be floating or earthed on one side.

Notes:

- 1) The earth systems, has common zero and earthing on one side. The written approval of the user shall be obtained in these cases.**
- 2) Floating supplies are applied in order to obtain a high integrity of the system and to enable an early detection of a fault or start of a fault by means of earth leakage detection.**
- 3) Special attention shall be paid to all inputs and outputs to and from cabinets with a floating supply, and to interconnections with other systems in order to ensure that the earth-fault detection can function properly, i.e., circuits fed from supply with earth-leakage detection shall be completely separated from those fed by some other supply by means of potential-free contacts or by galvanic isolation circuits.**

14.8.1.5 Earth leakage monitoring shall be provided in the electrical distribution board, i.e., for the floating d.c supply system, and should form part of the system cabinet power supply arrangement.

14.8.1.6 Potential free contacts shall be available for alarm on the operators panel, for earth leakage detection system.

14.8.1.7 If the intention is to provide an uninterruptible power supply, maintenance of the supply or supply units in the system cabinets, shall be possible without disturbing the supply.

Notes:

- 1) Details of the required power supply arrangement given in the requisition, shall also indicate the amount of redundancy and the maintenance facilities required, such as indications for overvoltage, undervoltage, overload and isolation of incoming power.**

2) With built-in power supply units, due attention shall be given to the wiring and terminations, with respect to on-line servicing possibilities.

3) Power supply units should be located in the top of the cabinet to avoid unnecessary heating of the cabinet internals.

4) The supply arrangement inside the cabinet should include protection against polarity reversal.

14.8.1.8 Power supply terminations shall be clearly identified and numbered and wiring shall be kept separate from interference susceptible wiring.

14.8.1.9 Power supply group numbers and distribution board numbers shall be clearly identified inside the system cabinets.

14.8.2 Batteries inside cabinets

The application of batteries inside cabinets requires the written approval of the user. All such batteries shall be clearly identified and the following minimum requirements shall be adhered to:

- Sealed batteries shall be applied, otherwise agreed in writing by the user.
- The temperature shall be kept below 30°C for efficient use of the battery.
- Facilities for on-line replacement and checking shall be provided.
- Full documentation, such as maintenance instructions, area classification and expected lifetime shall be supplied.
- The batteries shall be tested for capacity during commissioning on site according to the battery manufacturers instructions. If the capacity is less than 80% of the rating they shall be replaced.
- Small, low cost batteries for memory protection etc. shall be renewed without testing.
- All batteries in the cabinet shall be clearly identified, e.g. on the inside of the door stating type, function, date fitted, date checked date of renewal etc.

14.9 Identification

14.9.1 Each cabinet shall have a nameplate of corrosion resistant material fixed on to the front of the cabinet, with screws, and giving the following information:

- Name of purchaser,
- Serial number of the unit,
- Rating in watt,
- Voltage and frequency,
- Purchase order number,
- Year of manufacture.

14.9.2 Live parts of equipment and terminations carrying voltages above 50 volt shall be covered with a transparent insulation plate, bearing the warning text: DANGER.

14.9.3 All equipment, relays, sockets, wiring, terminals, etc. shall be clearly identified by nameplate in accordance with the relevant drawings included in the data sheet.

14.9.4 These nameplates shall be properly fixed using a 2 component epoxy resin cement near to the equipment on non-removable parts of the cabinet.

14.9.5 Nameplates shall be prepared in accordance with the requirements of nameplates standard, IPS-M-IN-100/2.

15. SYSTEM PERFORMANCE

15.1 Burn-in Period

15.1.1 When specified in the data sheet each system cabinet containing active elements, shall be completely assembled and subjected to a 100 hours burn-in period at elevated temperature and with all loads energized.

15.1.2 After the burn-in period the system shall comply with the performance requirements and successfully pass the other tests indicated in this section.

15.1.3 Detailed procedures for the burn-in period and the other tests indicated in this section, shall be submitted to the user together with the proposed dates for the tests, in order that they may be witnessed by the Purchaser.

15.1.4 A record shall be prepared during burn-in and testing, indicating failures and replacements or repairs of any components, the record shall include data such as temperature and humidity etc., with reference to the applicable environmental specification. This record shall be regularly updated and be available for review by the purchaser or his representative, at any time during the tests.

15.2 Reliability

15.2.1 When specified in the requisition, the reliability shall be stated by the manufacturer/supplier for the system cabinet which he will supply. The figures to be provided should be; mean time between failure for both nuisance and serious failure with an assumed mean time to repair of 8 hours.

15.2.2 To determine the definition of failure for the system to be supplied, advice shall be obtained from the purchaser's specialist.

15.2.3 Data and calculations shall be provided to substantiate the figures quoted for the system cabinet:

Note:

Typically, the reliability should be determined in accordance with the requirements of IEC 605-1, 605-5, 605-7 and a detailed test specification should be prepared by the manufacturer or an independent third party.

15.2.4 The test specification and the independent third party to be involved in the testing shall be subject to the approval of the Purchaser.

15.2.5 Unless otherwise specified by the Purchaser the failure reporting shall be in accordance with the IEC publications referred to above.

15.3 Type Test

15.3.1 General

To ensure that the design of the system cabinet complies with the requirements intended by the Purchaser, at least one system cabinet of each design should be subjected to, and successfully pass the type tests defined below. However, some of the tests indicated in this section may be waived with the written agreement of the Purchaser.

15.3.2 Bench tests

The supplier shall indicate in the quotation, to which severity the equipment and the circuitry may be tested.

15.3.2.1 Interference rejection

The system shall respond within the specified tolerances, when using the initiating devices as specified to carry out the following tests:

- Series Mode

Using the circuit of Fig. 2 of Appendix B, an interfering signal of 1 volt a.c (rms) at mains frequency, shall be applied from a source with an output resistance of 30 ohms.

- Common Mode

With reference to Fig. 3 of Appendix B, a signal of 100 volt a.c (rms), shall be applied to the initiating circuit with respect to the earth.

Note:

Where applicable, other voltage values may be proposed by the supplier.

15.3.2.2 Electricity supply tolerances

The system shall function, within the specified tolerances, when the electricity supply is varied within the allowed tolerances for the selected type of supply, see Appendix A.

15.3.2.3 Electricity supply transients

The system shall function, within the specified tolerances, when the following pulses are superimposed on the supply voltage for the durations indicated:

OVERVOLTAGE OF NOMINAL	PULSE DURATION % IN ms
100	10
200	1
300	0.02
500	0.005

15.3.2.4 Radio-frequency interference (Refer IEC 801-3)

The system shall be subjected to an interference test at radio frequencies, by operating a portable transmitter/receiver at a distance of one metre from the cabinet, with the doors open and the maintenance extender circuit card(s) installed. The electric field strength measured at the cabinet shall not exceed 5 v/m.

Notes:

1) As an alternative to measuring, the electric field strength may be calculated using the following formula:

$$E = (1.6 \sqrt{P})/d$$

Where:

- E** is the electric field strength in v/m;
- P** is the rated power of the portable transmitter/receiver in watts, and
- d** is the distance between the transmitter/receiver and the cabinet in metres.

The portable transmitter/receiver shall be fully charged and the condition shall be in accordance with the manufacturers specification.

2) The distance shall never be less than that indicated in Fig. A4 of IEC-801-3 for far fields.

The test shall be carried out at frequencies of 70-170 MHz, 460 MHz. During the test, digital signals shall not change status, and analogue signals shall not change by more than 0.5% of the span.

The requisition shall indicate the frequency of any portable transmitters used at the site of destination. This frequency shall be specifically checked during the test. Any deviations from the above procedure shall be approved by the Purchaser in writing.

15.3.2.5 Short-circuiting of output terminals

15.3.2.6 Earthing of input terminals

The supplier shall indicate, in his quotation, if these tests are possible with the equipment to be supplied.

15.3.3 Climatic and environmental tests

15.3.3.1 General

When carrying out any of the following tests, the cabinet shall be completely assembled, mounted and enclosed as for the actual installation. Functional checks shall be made before, during and after each test.

As agreed with the Purchaser a number of tests shall be selected with severities as specified and related to the environment in which the cabinet will operate.

TEST	METHOD REFERENCE
Dry heat	IEC 68-2-2
Cold	IEC 68-2-1
Damp heat	IEC 68-2-3 Part 2 Test Ca
Vibration	IEC 68-2-3 Part 2 Test Fc
Impact	As specified
Corrosion SO ₂	IEC 68-2-42 Part 2 Test Kc
Corrosion H ₂ O	IEC 68-2-43 Part 2 Test Kd

16. FACTORY INSPECTION AND TESTING

16.1 Unless otherwise specified in the requisition, all system cabinets and panels shall be inspected by the user's nominated inspector before leaving the factory. The inspection shall be carried out in accordance with the requirements of factory inspection and testing of instruments and instrument system standard, IPS-M-IN-100.

16.2 Inspection shall take place after all work has been completed, including the factory burn-in (15.1) and testing by the manufacturer as appropriate. The user shall be informed at least ten working days in advance of when the inspection can be made.

Note:

If for any reason the user waives inspection, this shall not relieve the manufacturer/supplier of the responsibility to repair, at his cost, any defects found later.

16.3 The manufacturer shall provide free of charge simulation and test apparatus, together with personnel for carrying out the tests indicated in this specification, the data sheets and the inspection plan.

16.4 If simulation and test equipment is part of the order, this equipment shall be used during the inspection and testing.

16.5 Any defects found by the purchaser's inspector shall be rectified in his presence. Where this is not possible, check lists shall be prepared stating all pending items for signature by the purchaser's inspector. Copies of these lists shall be sent to the equipment's destination for their subsequent checking.

16.6 The equipment shall not be shipped before all discovered defects have been corrected and satisfactorily retested.

16.7 Re-testing of the related systems after correction of the defects, shall be carried out as indicated by the purchaser's inspector.

16.8 The inspection outlined above is considered only as an agreement for shipping the equipment, it shall not be considered as a formal acceptance of the equipment by the Purchaser.

17. PACKAGING AND TRANSPORTATION

17.1 The manufacturer/supplier shall remove all slide mounted instruments and ship them separately from the cabinet(s) and panel(s).

17.2 Prior to packing, all open ended pipes shall be adequately sealed to prevent ingress of dust and moisture. All loose pipes, cable looms, etc., which are disconnected for ease of shipment, shall be secured and identified.

17.3 The manufacturer/supplier shall inspect and approve the loading and bracing to ensure that damage will not occur during transit.

17.4 All sensitive meters such as millivolt and millimeters shall be "jumpered" on the input to give damping against mechanical shock.

17.5 Prior to packing, all cabinets should be mounted on a suitable skid and coated with a strip-off lacquer.

17.6 If cabinets and panels are subjected to overseas transit and exposed to storage under adverse conditions, the following minimum specification is given as a guide to the degree of protection required:

- The units shall be sealed in suitable plastic envelopes, humidity indicators fitted and sufficient dessicant for 12 months storage enclosed.
- Cabinets and panels shall be bolted to the base of the packing case with interposed shock proof mountings, and cushioned with an adequate thickness of packing material on sides, ends and the lid.
- The framed base, sides and ends of the packing case shall be constructed of 22 mm thick tongued and grooved close boarding and lined with reinforced waterproof paper.
- The lid shall be lined with roofing felt backed by 3 mm plywood.

17.7 The manufacturer's/supplier's final packaging specification is subject to the purchaser's approval.

17.8 The shipping mark, Purchase Order Number and any other particulars as requested in the requisition, shall be stencilled on each separate package and/or on the outside of each wooden case or crate.

17.9 The cabinet and panel manufacturer/supplier shall inform the Purchaser of the estimated total weight and dimensions of each shipping section of the cabinet and its termination rack, within four weeks of the acknowledgment of the Purchase Order.

18. GUARANTEE

18.1 The manufacturer/supplier shall guarantee all work and material in his supply against defect, poor workmanship, improper design, improper packaging and/or failure in normal use for 12 months after the system has been placed in service but not exceeding 18 months after date of despatch.

18.2 The manufacturer/supplier shall repair or replace within one week, without any charge to the Purchaser, the parts found defective within the time specified above. In no event will this guarantee cover defects due to normal wear and tear or due to disregard of manufacturer/supplier's operating instructions.

18.3 The guarantee period shall be extended by any period(s) equal to the period(s) during which the system has been out of operation as a result of a defect covered by this guarantee.

18.4 Fresh guarantee periods equal to those specified above shall apply to replacement parts or repaired parts.

18.5 The manufacturer/supplier shall guarantee at least (15) years spare parts supply.

19. PURCHASING PROCEDURES

In addition to general purchasing conditions, the following requirements shall also apply when supplying system cabinets and control panels.

19.1 Extent of Supply

19.1.1 Each system cabinet and control panel shall be as specified in this Standard, the data sheets and the documents listed therein. In case of a conflict between these documents, the order of priority shall be as follows:

- The Purchase Order.
- The data sheets.
- The documents listed in the data sheets.
- This Standard.

19.1.2 Each system shall be supplied with an adequate number of special tools if applicable, e.g., for the mounting and/or removal of lamps or switches.

19.1.3 The cabinet or/and control panel shall be delivered completely assembled for erection at site, except for those parts removed for packing, without further preparation.

19.2 Quotation

19.2.1 Quotation shall be submitted in two forms, one with prices (commercial quotation), and the second without prices (technical quotation).

19.2.2 The following information shall be included in the quotation:

a) The price for the complete system cabinet or/and control panel as specified by the purchaser, together with the price for:

- Witnessed testing of the system;
- furnishing of drawings;
- compilation of spare parts data (if any);
- furnishing of installation and maintenance data;
- provisions for transport, including packaging;
- transport charges to the delivery point mentioned in the enquiry;
- turnover tax, if any.

- b)** A copy of the certificate of intrinsic safety (if applicable).
- c)** Current rating of contacts used to energize external devices.
- d)** Dimensional outline drawing showing the position of the equipment in the cabinet or/and control panel.
- e)** Typical internal arrangements drawing showing the position of the equipment in each cabinet control or/and panel.
- f)** Other details as requested in this standard and the data sheets.
- g)** Items on which the equipment offered deviates from the purchaser's specifications.
- h)** A statement that the equipment offered satisfies the type tests specified in (14.4) and/or detailed listings of items which do not comply with the specified performance criteria.
- i)** A proposal for erection/commissioning assistance (hourly rate plus expenses).
- k)** Proposal for site modifications (hourly rate plus expenses).
- l)** A provisional time schedule for meeting the delivery date indicated in the data sheets detailing activities such as preparation of drawings, requisitioning of material, start of fabrication, ready for inspection and ready for shipping.

Note:

Items a, i, and k are applicable for commercial quotation only.

19.3 Documentation

19.3.1 In the event of an order being placed, the number of copies and/or transparencies of the preliminary documents and drawings to be sent for approval and the final as built document and drawings to be supplied, will be specified in the purchase order.

19.3.2 At least 1 set of reproducible drawings shall be available at the site when the cabinet or/and control panel arrives.

19.3.3 The documents and drawings which shall be prepared includes but is not restricted to the following:

- Outline drawing showing dimensions in (mm) and mass of cabinets, or/and control panels.
- Installation and maintenance instructions.
- Description of operation.
- Electricity consumption with all loads energized.
- Schematic wiring and cable connection diagrams of the complete system.
- Terminal arrangements.
- Description of test procedures.
- Earthing arrangement.
- Power distribution with fuse ratings/types.
- Internal wiring diagrams or lists.

Note:

In order to be able to prepare and execute future modifications efficiently, internal wiring shall be clearly identified on drawings or schedules such that the routing of every wire can be derived from it.

- Detailed information on all items bought in by the Manufacturer.

Note:

The System Cabinet and control panel supplier is responsible for the supply of drawings and documents of free issue equipment fitted by him in the cabinet or/and control panel in the quantities stated in the Purchase Order.

19.3.4 Format, layout and contents of all documents and drawings shall be approved by the Purchaser at an early stage in the project. Standard forms and examples of typical forms will be supplied to the manufacturer with the requisition as appropriate.

19.3.5 SPIR (Spare Parts Interchangeability Record) shall be completed for the initial and normal operation of the cabinet, for all cabinet, and panel mounted components including bought-out items, within six weeks after receipt of the Purchase Order. This should ensure the timely purchase and shipment of initial spare parts.

19.3.6 The Manufacturer/Supplier shall clearly mark the spare parts interchangeability lists with the Purchaser Order reference and item number, unit type indication and serial number.

19.3.7 Spare parts list shall show for each part:

- Description;
- drawing/part number;
- identification number;
- interchangeability of the parts;
- quantity per unit;
- material specification;
- interchangeability of the parts;
- unit price ex-works;
- any other useful information.

Note:

Illustrated spare parts are preferred.

19.3.8 In the case of "bought-out items" the Supplier shall, in addition, specify:

- The drawing and part number of the original manufacturer.
- Where two or more parts can be supplied only as an 'assembly' the drawing/part number shall be given for the assembly.
- Spare parts lists shall illustrate the various parts with identification numbers and should include sectional drawings/parts list.

19.3.9 Initial Spare Parts shall mean the parts required to safeguard the operation of equipment during the running-in and starting-in periods including the first year of operation. These parts shall therefore be available on site prior to plant start-up.

19.3.10 Normal operational spare parts

Spare parts for normal operation should adequately cover the requirements of day to day maintenance for a period of two years operation following the initial operation (running-in and starting up periods and the first year of operation).

19.3.11 The English language shall be used on all documents.

19.3.12 Each document shall contain the purchase order number, item number, and year of manufacture.

19.4 Time Schedule

The provisional time schedule (19.2) shall be finalized and dates for start of work, inspection and delivery shall be indicated.

APPENDICES

APPENDIX A

A.1 ELECTRICITY SUPPLY CONDITIONS FOR INSTRUMENT SYSTEMS

The following types of supply are defined:

A.1.1 AC uninterruptible maintained

An uninterruptible two feeder AC supply of a quality suitable for the feeding of microprocessor based and computer systems.

A.1.2 This supply will be maintained typically for 30 minutes for process units and one hour for utilities unless otherwise specified. This type of supply should be applied for systems such as fire and gas detection, control and telecommunication, with back-up times as specified.

A.1.3 AC interruptible maintained

An AC supply with a two feeder arrangement backed up with an emergency supply, which may have an interrupt time of up to 10 seconds.

Note:

Unless additional measures are taken, the electrical characteristics of this supply are the same as for the mains supply. additional measures could involve line conditioners and special transformers to stabilize voltage and reduce mains interference.

A.1.4 AC interruptible not maintained

As A.1.3, but without back-up from an emergency power source.

A.1.5 DC uninterruptible maintained

A supply as specified in electrical power supply and distribution system standard IPS-E-IN-180, and maintained for a prolonged period such as for A.1.1 above.

(to be continued)

APPENDIX A-(continued)

A.2 SPECIFICATION FOR THE TYPES OF ELECTRICITY SUPPLY

TABLE 1 - TYPES OF SUPPLY

DESCRIPTION	(1.1)*	(1.3)*	(1.4)*	(1.5)*
Voltage (Note 1)	110	110	110	24
Voltage Tolerance (+% max.)	5	5 (Note 2)	5 (Note 2)	10
Frequency (Hz)	50	50	50	—
Frequency Tolerance (+%max.)	2	5	5	—
Harmonic (%max.)	5 Total	—	—	—
Content (Note 4)	2 Each	—	—	—
Ripple (%max.) (Note 3)	—	—	—	2
Interrupt Time	10 ms	10 s	—	10 ms
Crest Factor (max.) (Note 4)	3	—	—	—
In-Rush Current (Note 5)	—	—	—	—

* See the previous page

Notes:

1) Voltage and frequency to suit local conditions, will be confirmed together with phase required, for each particular case (by electrical Engineering).

2) As mains supply (statistical information, if required, shall be provided by Electrical Engineering).

3) Defined as root means square value of AC components/nominal DC voltage.

4) Defined as $I(\text{peak}) / I(\text{root mean square})$. Additional harmonics may be generated by the non-linear load, total should not exceed 5% and 2% for each component.

5) Defined as number of times the nominal current will be drawn during a difined time. Typical figure could be:

$20 \times I(\text{nominal})$ during 10 ms the figure to be confirmed for each particular case.

APPENDIX B INITIATING CIRCUIT DIAGRAMS

