ENGINEERING STANDARD

FOR

GENERAL INSTRUMENTATION

SECOND EDITION

FEBRUARY 2016

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FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPANY:

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery and Distribution Company.

PURCHASER:

Means the “Company" where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR:

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR:

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

0. INTRODUCTION

This Engineering Standard covers the minimum requirements of all engineering aspects of instrumentation which are common to various instruments. The Standard is contained in four parts as listed below:

Part One: Hazardous Area Classification and Methods of Safeguarding

Part Two: The Division of Responsibilities between Instrument and Engineering Disciplines

Part Three: Instrument Engineering Procedures

Part Four: Instrument Documents and Drawings

PART I

HAZARDOUS AREA CLASSIFICATION

AND

METHODS OF SAFEGUARDING

CONTENTS: PAGE No.

1. SCOPE

This Standard provides general guidance for the safe installation of electrical instruments using appropriate means to prevent ignition of flammable gasses and vapors mixed with air under normal atmospheric conditions.

Note 1:

This is a revised version of this standard, which is issued as Revision (2)-2016. Revision (1)-2005 of the said standard specification is withdrawn.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the company and the vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

IEC (INTERNATIONAL ELECTROTECHNICAL COMMISSIONS)

60079-0 "Explosive atmospheres - Part 0: Equipment – General requirements"

60079-2 "Explosive atmospheres - Part 2: Equipment protection by pressurized enclosure “p”"

60079-10-1 "Explosive atmospheres - Part 10-1: Classification of areas – Explosive gas atmospheres"

60079-10-2 "Explosive atmospheres - Part 10-2: Classification of areas – Combustible dust atmospheres"

60079-13 "Explosive atmospheres - Part 13: Equipment protection by pressurized room “p”"

BSI (BRITISH STANDARDS INSTITUTION)

BS 2000 Part 1 "Methods of Test for Petroleum and its Products - Part 1: Determination of Acidity, Neutralization Value - Colour Indicator Titration Method (Identical with IP 1/94)"

BS 2000 Part 2 "Methods of Test for Petroleum and its Products - Part 2: Determination of Aniline Point and Mixed Aniline Point (Identical with IP 2/98)"

BS 2000 Part 15 "Methods of Test for Petroleum and its Products - Part 15: Petroleum Products - Determination of Pour Point (Identical with IP 15/95)"

API (AMERICAN PETROLEUM INSTITUTE)

API RP 500 "Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2"

ISA INSTRUMENT SOCIETY OF AMERICA)

ANSI/ISA 12.01.01 "Definitions and Information Pertaining to Electrical Equipment in Hazardous (Classified) Locations"

ANSI/ISA 60079-11 "Explosive Atmospheres - Part 11: Equipment protection by intrinsic safety “i”"

ANSI/ISA 60079-25 "Explosive Atmospheres - Part 25: Intrinsically safe electrical systems"

ANSI/ISA 60079-27	"Fieldbus Intrinsically Safe Concept (FISCO) and Fieldbus Non-Incendive Concept (FNICO)"
ISA RP12.06.01	"Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

NFPA 70	"National Electrical Code"
NFPA 496	"Standard for Purged and Pressurized Enclosures for Electrical quipment"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-I-IN-100	"Inspection Standard for General Instrument Systems"
IPS-G-IN-200	"General Standard for Instruments Air System"
IPS-G-IN-230	"General Standard for On-Line Analyzers"
IPS-E-EL-110	"Engineering Standard for Hazardous Area"
IPS-E-SF-100	"Engineering Standard for Classification of Fires and Fire Hazard Properties"

SECTION ONE

HAZARDOUS AREA CLASSIFICATION

3. GENERAL CONSIDERATIONS

3.1 Electrical equipment in petroleum industries require special precautions to prevent or contain safely any explosion caused by ignition of vapors which have penetrated from outside into the equipment housing.

3.2 For electric instrumentation, the problem is aggravated because measuring elements containing flammable process fluids are often located in the housing for the electric components, a typical example is a pressure switch. Failure of the measuring element may mean an explosion, unless the electric components have been selected to prevent this.

3.3 Allowable techniques for coping with the above hazards, such as application of intrinsically safe circuits, flameproof housings etc., depend on the area classification, as will further detailed in the following chapters.

3.4 For recommendation on area classification in Petroleum Industries or applications, reference should be made to the IPS-E-EL-110 and IPS-E-SF-100.

3.6 For each project, an area classification drawing which is made by the relevant specialists shall form the basis for considering instrumentation-aspects.

3.7 The area classification drawing will only indicate the conditions around the instruments, but the situation inside the instrument housing may be more dangerous in case of failure of the measuring element. Either of two classifications rated as more dangerous case should determine the appropriate execution.

4. AREA CLASSIFICATION OF PETROLEUM INSTALLATIONS FOR THE SELECTION OF ELECTRICAL EQUIPMENT

The following section outlines the procedures for the classification of areas for the selection and installation of electrical equipment. Unprotected electrical equipment would be a potential ignition hazard in certain areas of the installation. For the selection of appropriate and safe electrical equipment, and its sitting in any oil facility, control is exercised by means of ‘Area Classification’, a procedure whereby the different zones of an installation or plant are set out in accordance with the International Electrotechnical Commission nomenclature, IEC 60079-10. The definition of hazardous area in this context, and its converse, is as follows:

4.1 Hazardous Area

An area in which flammable gas or vapour or mist are, or may be expected to be, present in quantities such as to require special precautions for the construction and use of electrical apparatus.

4.2 Non-Hazardous Area

An area in which flammable gas or vapour or mist are not expected to be present in quantities such as to require special precautions for the construction and use of electrical apparatus.

4.3 Condition of Explosions

For an explosion to occur the following conditions must co-exist:

4.3.1 A flammable gas or vapor mixed with air in the proportions required to produce an explosive gas-air mixture.

4.3.2 The source of ignition

Only the source of ignition related to electrical apparatus are taken into consideration. These are arcs or sparks or surfaces at a temperature sufficient to ignite the mixture.

5. CLASSIFICATION OF HAZARDOUS AREAS

In order to facilitate the selection of appropriate electrical apparatus, hazardous areas are divided into classified Zones.

5.1 Zones (Classification by IEC)

Hazardous areas are classified in zones based upon the frequency of the appearance and the duration of an explosive gas atmosphere as follows:

5.1.1 Zone 0

An area in which an flammable gas-air mixture is present continuously or is present for long periods.

The vapor space of a closed process vessel or storage tank or above an oil-water separator basin is an example of this Zone.

5.1.2 Zone 1

An area in which a flammable gas-air mixture is likely to occur in normal operation.

The vicinity surrounding vents and gaging openings on a fixed-roof tank containing Class I petroleum products is an example of this category.

5.1.3 Zone 2

An area in which a flammable gas-air mixture is not likely to occur in normal operation and if it does occur, it will only exist for a short period.

An example is the whole area inside the bund wall of a fixed or floating-roof tank containing Class I petroleum products, and to the height of the bund wall.

Because of the lower probability of a Zone 2 occurrence, less stringent protection will be required for electrical equipment suitable for Zone 2 installation.

5.1.4 Area classification procedure

The area classification should be carried out by those who understand the relevance and significance of properties of flammable materials and those who are familiar with the process and the equipment along with safety, electrical, mechanical and other qualified engineering personnel.

Area classification procedure is given in IPS-E-SF-100.

5.2 Divisions (Classification by NFPA)

The classification of hazardous areas in accordance to NFPA 70 Standards are as follows:

5.2.1 Division 1

The criterion for these locations is that; hazardous concentration of flammable gases or vapors continuously or frequently present under normal operating conditions.

5.2.2 Division 2

The criterion for these locations is that; volatile flammable liquids or flammable gases present, but normally confined within closed containers or system from which they can escape only under abnormal operating or fault conditions.

SECTION TWO

METHODS OF SAFEGUARDING

Methods of safeguarding are the subject of Part 2 of IPS-E-EL-110 which is referred for detailed consideration. However the most applicable safeguarding methods used in instrumentation will be considered in clauses 6, 7 and 8.

6. INTRINSIC SAFETY

6.1 An Intrinsically Safe (IS) instrument or circuit is an arrangement of instruments and wiring incapable (under normal or abnormal conditions) of releasing sufficient energy to cause ignition of a specific hazardous mixture in its most easily ignited form at atmospheric pressure.

6.2 Only those instruments shall be used, which carry a certificate of intrinsic safety for the type of gas to be expected in its intended location. Moreover, it must be ensured that this certificate has been (or will be) accepted by the Company regulations

6.3 For process instrumentation, the certificate of intrinsic safety shall be valid for field mounted instruments and the related circuits extending to the control centers at safe areas.

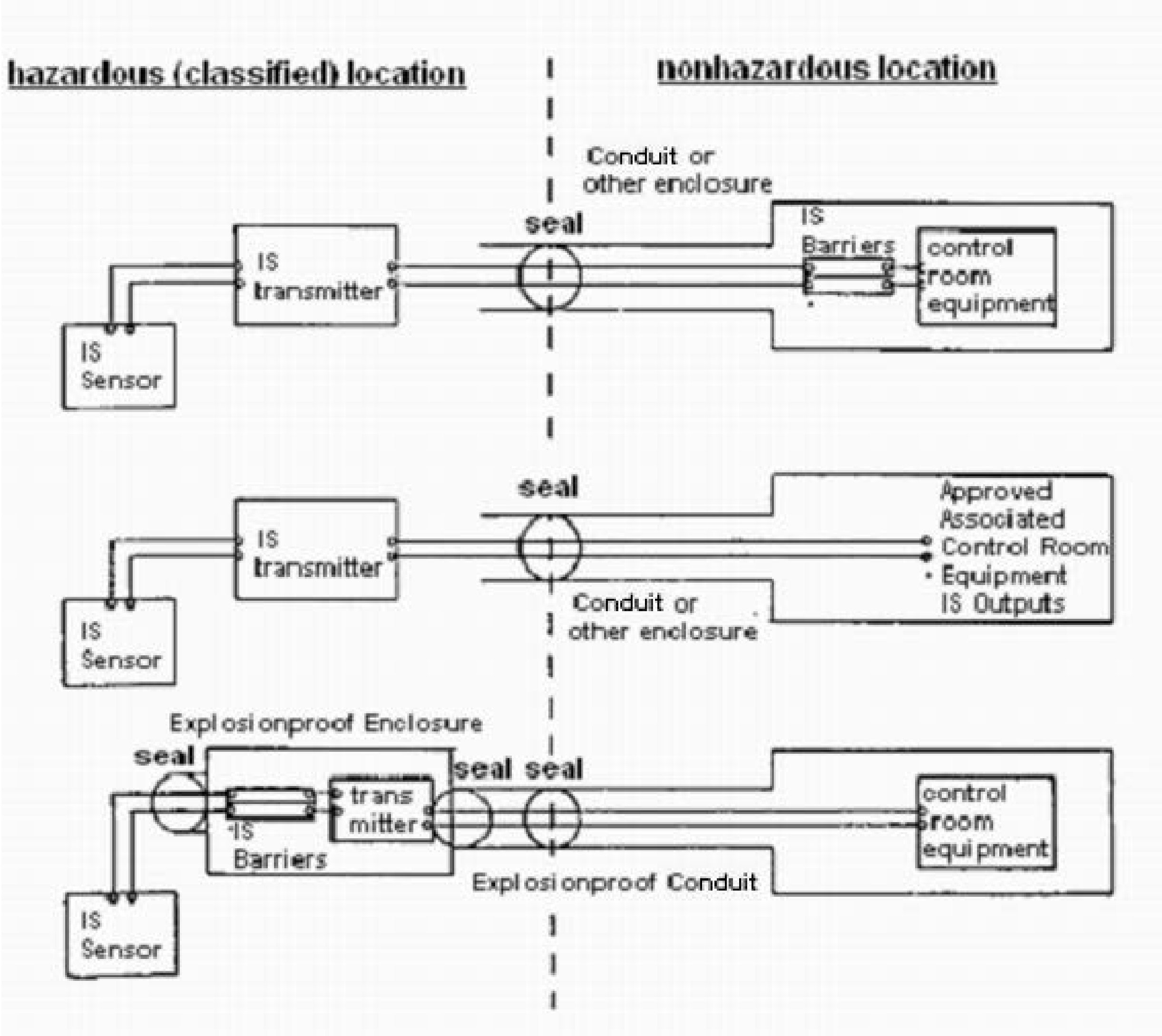
6.4 When instruments, data loggers, computers, etc., are to be connected to IS instrumentation in hazardous areas, application of safety-barriers (with valid certificate) shall be considered to make the external circuit intrinsically safe.

These safety-barriers restrict the maximum possible spark-energy, and consequently have more in-line resistance for higher operating voltages.

Shunt-diode barriers are therefore only suitable for low-level signals, e.g., thermocouples, or electric signals in the milliamp, range for electronic instrumentation. Where switches mounted in hazardous areas are required to control higher power, e.g., for operating relays in non-IS alarm and control systems, the use of other safety barriers, such as interposing relays with IS, certificate shall be considered.

6.5 The housing of IS field-mounted instruments, components, and the associated cable gland(s) shall be weather-proof and (where necessary) water-tight.

6.6 Some examples of the various configurations of intrinsically safe systems are given in Fig. 1.

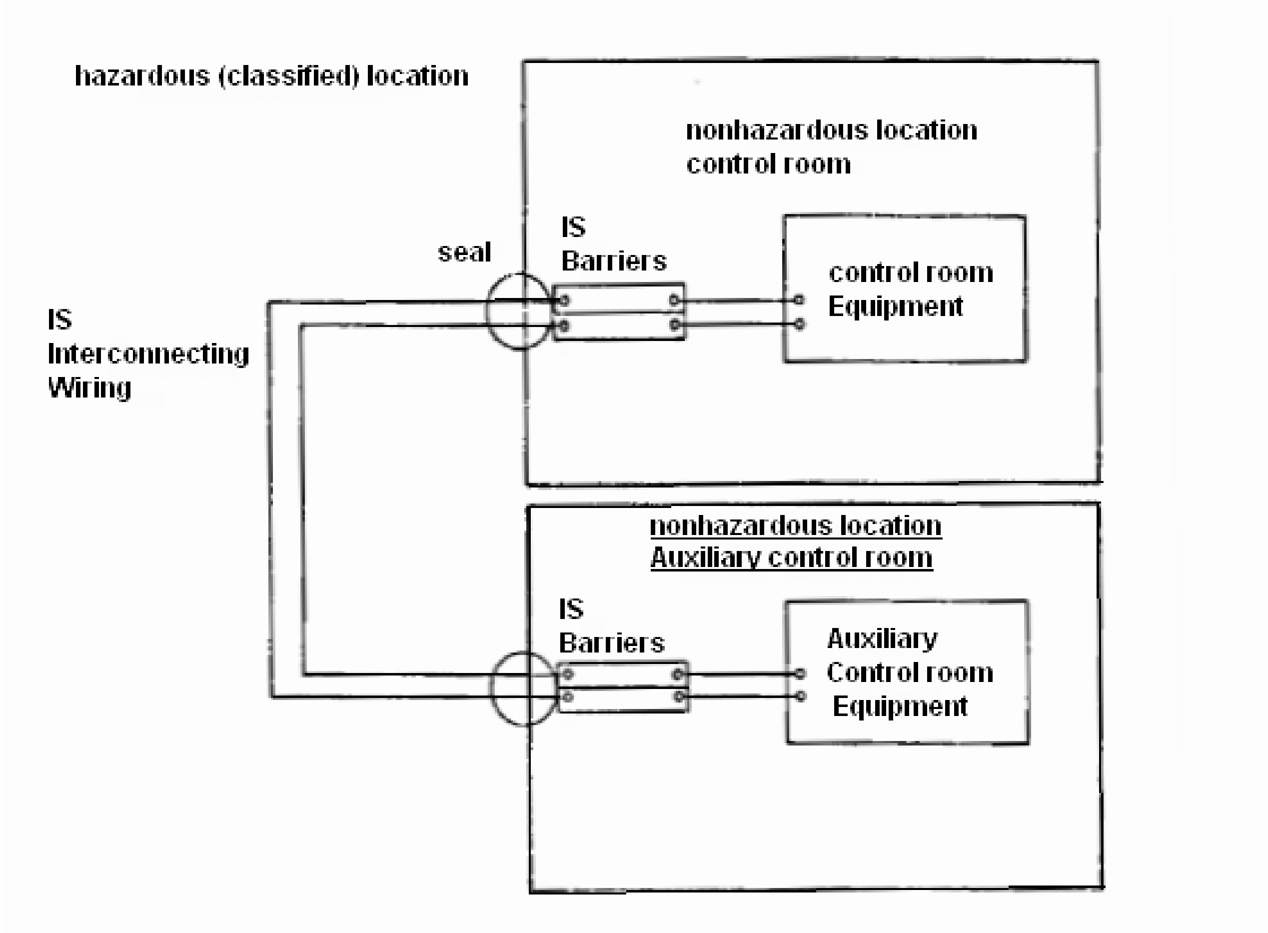


VARIOUS CONFIGURATIONS OF INTRINSICALLY SAFE SYSTEMS

Fig. 1 (to be continued)

*** IS Intrinsically Safe terminals.**

**** Other enclosure may be shielded cable, metal-clad cable, or any mechanical or electrical protection that enforces separation of intrinsically safe circuits from circuits that are not intrinsically safe.**



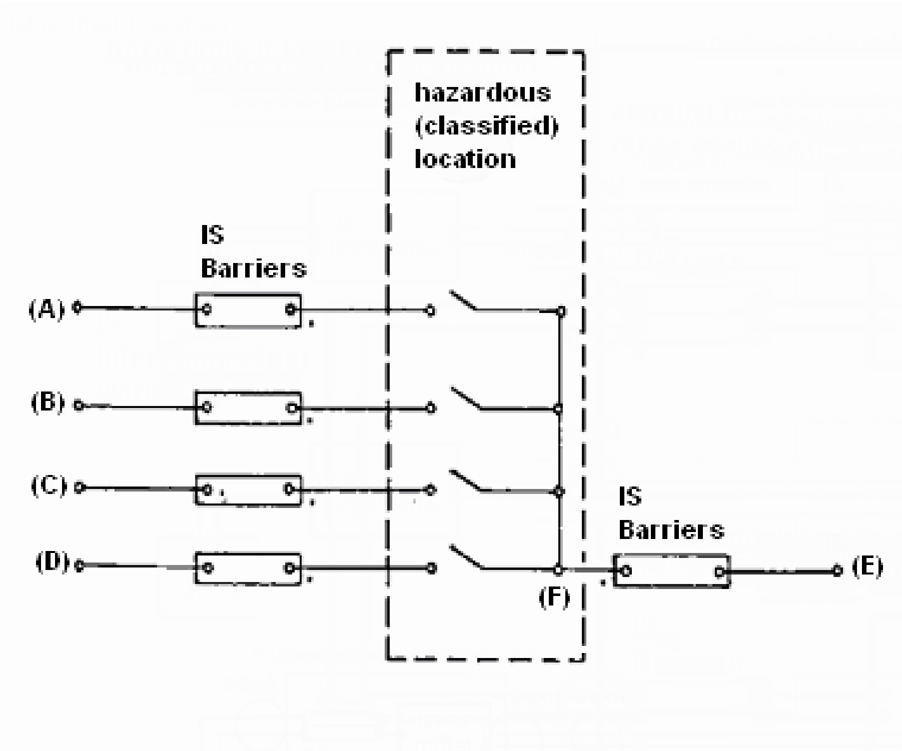
*** IS Terminals.**

VARIOUS CONFIGURATIONS OF INTRINSICALLY SAFE SYSTEMS

Fig. 1 (continued)

6.7 Hazardous (Classified) Location Apparatus

6.7.1 A switching device is shown in Fig. 2. If a common fault voltage occurs at Terminals A, B, C, and D when all the switch contacts are closed and if a simultaneous fault to ground occurs at point F, it is possible to get five times the maximum current of any one barrier. Unless the barrier control drawing permits five barriers to be paralleled, this circuit configuration is not acceptable.



BINARY CODED DECIMAL SWITCHING DEVICE

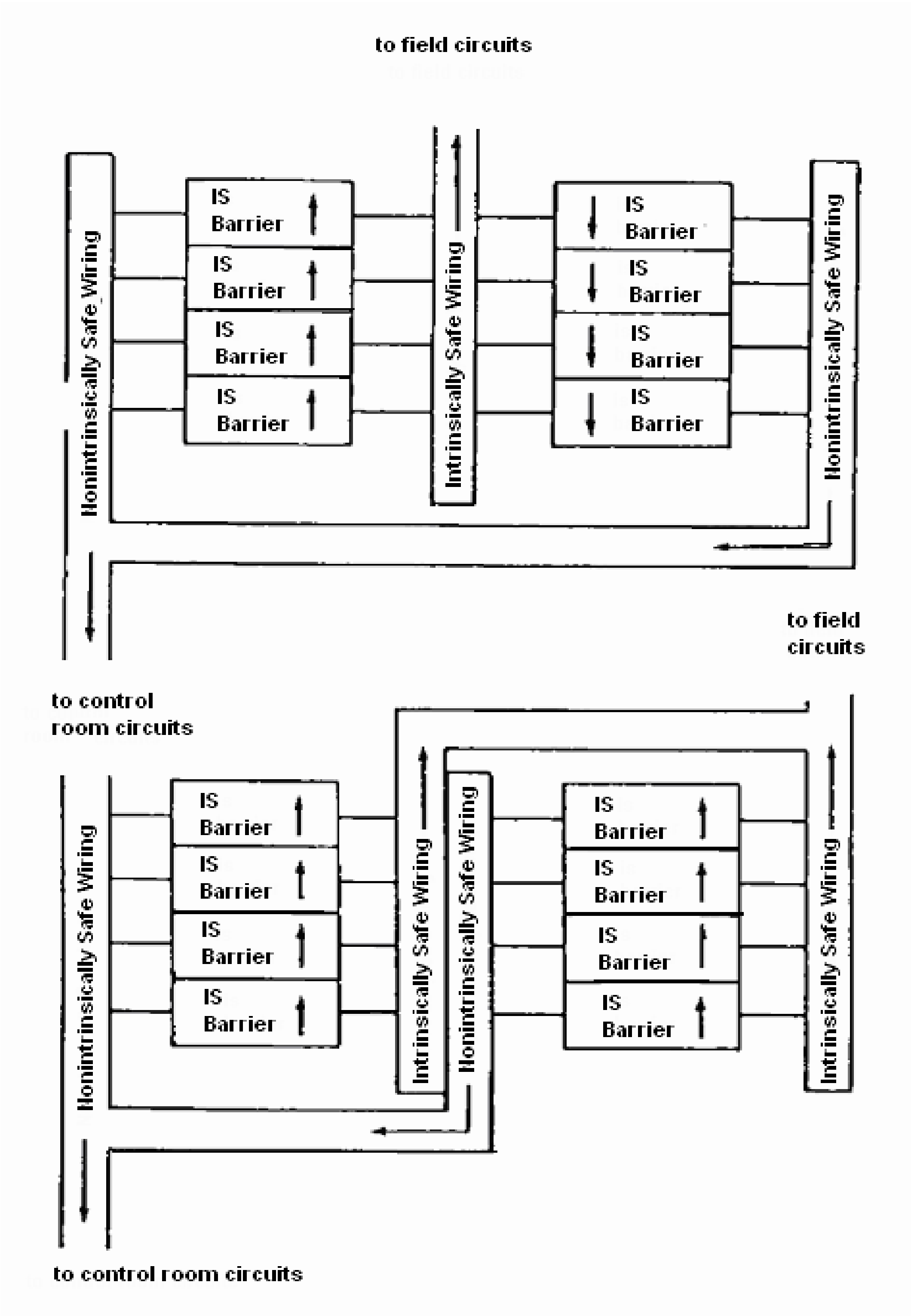
Fig. 2

*** IS Terminals.**

6.8 Nonhazardous Location Wiring of Intrinsically Safe Circuits

6.8.1 Where intrinsically safe wiring may be exposed to disturbing magnetic or electric fields, it shall be twisted, shielded, or other suitable methods implemented to prevent the energy level of the intrinsically safe wiring from becoming ignition-capable.

6.8.2 When several devices having both intrinsically safe and nonintrinsically safe terminals are mounted in the same enclosure, attention must be given to the separation of circuits. An acceptable method of separation is shown in Fig. 3. Separate raceways are often used to provide greater assurance that separation of wiring will be maintained. Wire lacing, wire ties, or equivalent fasteners are also acceptable methods of separating wiring.



SUGGESTED PANEL ARRANGEMENT USING SEPARATE WIREWAYS
Fig. 3

7. FLAME-PROOF HOUSINGS

7.1 A flame-proof housing for electrical apparatus will withstand, without injury, any explosion of the prescribed flammable gas or vapor that may occur within it, and will prevent the transmission of flame that ignite the prescribed flammable gas or vapor which may be present in the surrounding atmosphere.

7.2 Flame-proof certificates are issued for separate groups of gases, according to the grade of risk. For segregation of groups refer to Appendix A.

In general apparatus certified for the higher group will cover situations where gases from the lower groups are present.

7.3 Flame-proof housings have been carefully designed for pressure release and flame-quenching openings, and consequently these housings are usually not weather-proof. Where weather-proofing is required for protection of the internals, this shall not interfere with the basic features. The use of gaskets is permissible only where these are applied to a joint additional to the flame-proof joint and do not interfere with its function.

A suitably constructed weather shield is usually the best solution.

7.4 All flame-proof housings shall be properly earthed.

8. PURGING FOR REDUCTION OF HAZARDOUS AREA CLASSIFICATION

The addition of air or inert gas (such as nitrogen) into the enclosure around the electrical equipment at sufficient flow to remove any hazardous vapors present and sufficient pressure to prevent their re-entry, shall be considered for hazardous area classification reduction.

Protection by pressurization is subdivided into three Levels of Protection (“pxb”, “pyb” and “pzc”) which are selected based upon the Equipment Protection Level required (Mb, Gb, Db, Gc or Dc), whether there is the potential for an internal release, and whether the equipment within the pressurized enclosure is ignition-capable (see Table 1 of IEC 60079-2 (2014)). The Level of Protection then defines design criteria for the pressurized enclosure and the pressurization system (see Table 2 of IEC 60079-2 (2014)).

APPENDICES

APPENDIX A

GROUPING AND CLASSIFICATION OF ELECTRICAL APPARATUS IN DIFFERENT COUNTRIES

CENELEC IEC EN 60079	IEC 60079	USA NATIONAL ELECTRICAL CODE (Class 1) GROUP	TYPICAL GASES AND VAPORS
IIA	IIA	D	ETHANE,PROPANE, BUTANE,PENTANE, HEXANE, HEPTANE OCTANE,NONANE, DECANE,ACETIC ACID, ACETONE, METHANOL, TOLUENE, ETHYLACETATE
IIB	IIB	C	ETHYLENE,COKE OVEN GAS DIMETHYL ETHER, DIETHY-LETHER ETHYLENE OXIDE
IIC	IIC	B	HYDROGEN
			CARBON DISULPHIDE
		A	ACETYLENE
			ETHYL NITRATE

Note:

Groupings in different countries may slightly differ. The above table is for rough comparisons only and reference should be made to the relevant standard to ascertain the grouping for a particular gas.

PART II

THE DIVISION OF RESPONSIBILITIES

BETWEEN

INSTRUMENT AND ENGINEERING DISCIPLINES

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APPENDICES:

1. SCOPE

This Standard defines the division of responsibilities between instrument and engineering disciplines and gives guidance for working at the interface between them.

2. GENERAL

In order to define the instrument and electrical interface clearly, the division of responsibilities should be based upon identified areas of responsibility for each discipline.

2.1 Objectives for Defining the Division of Responsibilities

A carefully defined division of responsibility for the instrument and the electrical disciplines is considered necessary in order to:

2.1.1 Achieve a clearly defined interface, without overlaps or gaps.

2.1.2 Ensure compatibility of equipment at the interface.

2.1.3 Minimize a duplication of expertise (specialist know-how) in two ‘adjacent’ disciplines.

2.1.4 Minimize personnel of different disciplines working on the same equipment.

2.1.5 Promote uniformity in the field of experience and training.

2.1.6 Enable each engineering discipline to be directly and singularly for matters assigned where qualifications of competence are required by authorities. Furthermore, the demarcation lines should be such that future developments can be easily adapted on either side.

2.2 Status for the Division of Responsibilities

By its very nature, this Standard can never be so complete as to cover all possible situations. Those not covered should be decided upon in line with the general objectives as stated above and with the principles as defined in the following sections.

It is highly desirable that the division of responsibilities as defined in this Standard is adopted for use by users for all instrument and electrical engineering activities.

2.3 Principles for Defining the Division of Responsibilities

In order to make areas of responsibility easily identifiable they are based upon a system division as opposed to an equipment division, the guiding principles being:

2.3.1 Instrument engineering shall be responsible for measurement and control systems of the operating variables in processing units, related utilities and facilities.

This shall include signal transmission systems, computer systems for process monitoring and control, and the related peripherals, e.g. data-loggers, DCS, etc.

2.3.2 Electrical engineering will be responsible for electrical power systems and their rotating equipment systems.

Note:

Rotating equipment systems in the context of this Standard refer only to electric-motor-driven equipment and to power generation equipment.

Typical examples of areas of responsibilities for instrument and electrical engineering are given in Appendix A.

3. THE INSTRUMENT AND ELECTRICAL INTERFACE

3.1 General

The interface between equipment forming part of instrument engineering (usually located in the plant control room) and equipment forming part of electrical engineering (usually located in a switch house or in the plant) is normally a matter of defining the demarcation lines for the interconnecting cabling. In other situations, the demarcation lines are not so straightforward. For some typical cases demarcation lines have been defined in more detail.

3.2 Interface in Control and Signal Cabling

In order to achieve a well-defined interface in control and signal cabling between electrical and instrument engineering, an interface box shall normally be provided. The box shall contain an interface terminal strip-for instrument cable connections at one side and for electrical cable connections at the other side.

The interface box shall form part of instrument engineering, but shall be accessible to both instrument and electrical engineering disciplines.

The interface box shall be located adjacent to the relevant switch room, however, subject to the geographical lay-out of the plant, it maybe located in other locations, e.g., control room basement, instrument auxiliary room, or close to the relevant equipment as agreed between instrument and electrical engineering.

The area in which the interface box is located may contain instrument equipment/facilities for instrument signal conversion/condition and routing to and from the control center. The interposing relays which form part of instrument engineering may be included in the interface box.

Terminals accommodating on-off signal/command lines, or analogue instrument signal lines shall be fitted with isolating facilities.

Note:

The interface termination between instrument and electrical signal lines is normally the only area where the two disciplines shall work on the same item of equipment.

3.3 Electrical Equipment

The interface with instrument engineering for e.g., remote control shall be as described in 3.2. For motor-operated valves see 3.7.

3.4 Materials Handling Systems

3.4.1 General

In the context of this Standard, materials handling comprises:

- The filling of cans, bins, pails, bottles, drums, etc., with product (fluids, chemicals).

- The transportation of solid products (powder, nibs, flakes, lumps, bales) and associated filling of bags, drums, etc.

- The transportation of solid products on conveyers with hoisting and lifting equipment, in packing machines, palletizers, shrink wrapping machines, etc., including storage and dispatch.

- The handling with, e.g., conveyer bulk materials, catalysts, etc. Equipment for these systems is often supplied as an approved package unit complete with inherent controls.

Remote control with associated signal transmission to the control room is not normally required for this type of equipment.

Where remote monitoring and control is required the measuring and control signals shall be routed via an interface box (see 3.2). The interface box should form part of the package.

3.4.2 The division of responsibilities

The division of responsibilities between instrument and electrical engineering for these systems shall be as follows:

3.4.2.1 Instrument engineering shall be responsible for:

- Overall system coordination of the automated materials handling systems;

- All equipment which has a measurement function (mass, volume, throughput);

- Process-integrated automation systems by computer of conventional controls.

3.4.2.2 Electrical engineering should be responsible for:

- All non-process-integrated individual power consumers for transport and handling, such as cranes, elevators, 'stand alone' packaged units, etc.

- Electric consumers (e.g. electric motors, heaters), control gear but excluding small drives (e.g. control drives, chart drives) for systems which are part of instrument engineering.

3.5 Signal Converters for Power Systems

Where electrical AC parameters such as current, power or power factor have to be presented in the control room as a process variable, these parameters shall be converted into a standard transmission signals or data in accordance with IPS-E-IN-190 such as 4-20 mA DC or serial link. These converters should form part of electrical engineering responsibilities and shall be installed in the electrical switch room. Attention shall be given to the provision of adequate isolation between input and output and to the arrangements for electricity supply; some types require an AC supply (from switch room) but others operate on a two-wire (24-V DC) system as is usual for other transmitters and signal converters. To avoid complications in further data handling, cable screening, etc., preference should be given to converters operating from an external 24-V DC supply, which will then form part of instrument engineering and be supplied via the interface strip.

The interconnecting cabling between converters and the interface box shall form part of electrical engineering.

3.6 Instrument Electricity Supply

3.6.1 General

Instrument engineering shall specify the basic requirements for instrument electricity supply, such as:

- Required AC and DC voltages

- Estimated consumption

- Quality of supply

- Allowable interruption time (if any)

- Required back-up time in the case of power failure

Note:

The power requirements for air-conditioning systems to protect the instrument equipment, will be specified via air conditioning engineering.

The division of responsibilities between instrument and electrical engineering shall be as defined in 3.6.2 and 3.6.3.

3.6.2 AC-powered instrument systems

Electrical engineering shall be responsible for the AC powering of instrument systems, such as main power, back-up and the distribution network.

From take-off points of this network, instrument engineering shall arrange for the connections to the various instrument systems and racks located in a control room, basement or auxiliary room.

The AC supply for plant-mounted instruments or instrument racks form part of electrical engineering up to the AC termination point in the instrument or rack.

Instrument engineering shall be responsible for power conditioners and back-up arrangements as required for the individual instrument systems and racks, which form an integral part of the instrument or instrument system.

3.6.3 DC-powered instrument systems

Electrical engineering shall be responsible for powering the complete DC instrument systems of a plant, up to and including the DC power distribution board. The instrument-electrical interface shall lie at the DC terminal strip in the distribution board.

Instrument engineering shall be responsible for power supplies of equipment, control systems, or rack-dedicated AC/DC systems (with battery back-up as required).

3.7 The Motor-Operated Valve (MOV)

The engineering of motor-operated valves (MOVs) requires an input from mechanical, instrument and electrical engineering as follows:

3.7.1 Mechanical engineering shall have responsibility for the MOV to specify the details for the valve body.

3.7.2 Instrument engineering will decide in consultation with mechanical and electrical engineering whether the valve shall be electrically, pneumatically or hydraulically actuated.

Instrument engineering in cooperation with process engineering shall indicate the requirements for the associated measuring and control features of the valve and actuator.

3.7.3 Electrical engineering shall specify the motor for MOVs based on process design data (closing time, size of the valve, etc.) and the required measuring and control features advised by instrument engineering.

The interface between instrument and electrical engineering for the electric-operated actuator shall lie in an interface box, see 3.2.

3.8 Ignition Burners

Instrument engineering shall be responsible for the flame rod amplifier.

Electrical engineering will specify, install and maintain the HT transformer, if required.

Mechanical engineering shall be responsible for the ordering of the ignition burner package.

3.9 Soot Blower Control

A schematic control arrangement with interface lines for a soot blower system is given in Appendix B.

4. THE INSTRUMENT AND ICT INTERFACE

4.1 General

The interface between equipment forming part of instrument engineering (usually located in the plant control room) and equipment forming part of ICT (Information Communication Technology) engineering (usually located in control room or ICT center or radio technical room) is normally a matter of defining the demarcation lines for the interconnecting cabling. In other situations, the demarcation lines are not so straightforward.

4.2 Interface in Radio Communication

Instrument engineering shall specify the radio parameter for data transfer from radio to control system or other devices equipment and vice versa.

Instrument engineering shall specify the media between radio and control devices.

ICT engineering shall specify the basic requirements for radio communications between two or more radios.

ICT engineering shall specify radio hardware such as radio type, antenna and antenna cable.

4.3 Interface in Network Communication

Instrument engineering shall specify the basic requirements for all network communication in control system.

ICT engineering shall specify network interface between control system and any monitoring system (SCADA) out of plant.

5. THE INSTRUMENT AND MECHANICAL INTERFACE

5.1 The following items form part of mechanical engineering activities for which the relevant engineering information shall be supplied by instrument engineering:

- Orifice flanges, orifice meter runs (made in accordance with Standard Drawings);

- Level gage glasses;

- Safety/relief valves;

- Instrument air supply system including compressors, coolers, dryers, buffer vessels and instrument air supply piping larger than ½ inches;

- Instrument nozzles on mechanical equipments and piping.

5.2 Mechanical Equipment (Drives, lube oil systems, cooling water systems, etc.)

The measurements, protection and controls, including systems for speed control (up to speed governor) and machine monitoring (bearing temperatures, vibration), etc., are part of instrument engineering.

APPENDICES

APPENDIX A

TYPICAL ACTIVITIES OF INSTRUMENT AND ELECTRICAL ENGINEERING

A.1 Instrument Engineering

Instrument Engineering Consists of activities necessary for the specification, design, construction, testing, inspection, quality control, installation and maintenance of equipment and systems for the measurement and control of operating variables in processing units related utilities and facilities.

The equipment involved in instrument engineering activities comprises, but is not limited to:

- Measurement and control systems including analogue, digital, sequential, supervisory controls, DCS and PLC systems.

- Machine monitoring systems (vibration, displacement, torque, speed) and associated actuation of machine protection systems.

- Alarm annunciation and safeguarding systems.

- Detection systems and associated alarms for flammable and toxic gases, including those for buildings.

- Pollution detection systems and associated control systems including those for buildings.

- Instrument power supply incorporated in instrument systems.

- The selection of the type of actuator for control valves and remote operated on/off valves.

- Remote control and status signaling for pneumatically or hydraulically-operated valve actuators.

- Integrated electrical protection devices for instrument circuits.

A.2 Electrical Engineering

Electrical engineering consists of activities necessary for the specification, design, construction, installation, maintenance, measuring, protection and safeguarding, testing, inspection and quality control of electric power systems and electrical rotating equipment systems. Operation of electric power systems forms part of electrical engineering.

The equipment involved in electrical engineering activities comprises, but is not limited to:

- Generation, transmission and distribution of electric power.

- Conversion of electric energy (e.g. transformers, frequency-converters, rectifiers, inverters).

- Electric drives (e.g. motors, variable-speed drives, constant-torque drives).

- Electric heating (e.g. process heating, compensation heating).

(to be continued)

APPENDIX A (continued)

- Electric heat tracing.

- Lighting including dimmer equipment.

- Electrostatic filters, desalters, etc.

- Equipment for electrolysis.

- Electrical motor for MOVs

- Instrument electricity supply systems up to the point where instrument engineering takes over.

- Safety circuits for personnel protection (e.g. emergency stops, pull chains, work safety switches).

- Earthing and bonding systems for electrical system earthing, protection against electrostatic charges, personnel protection.

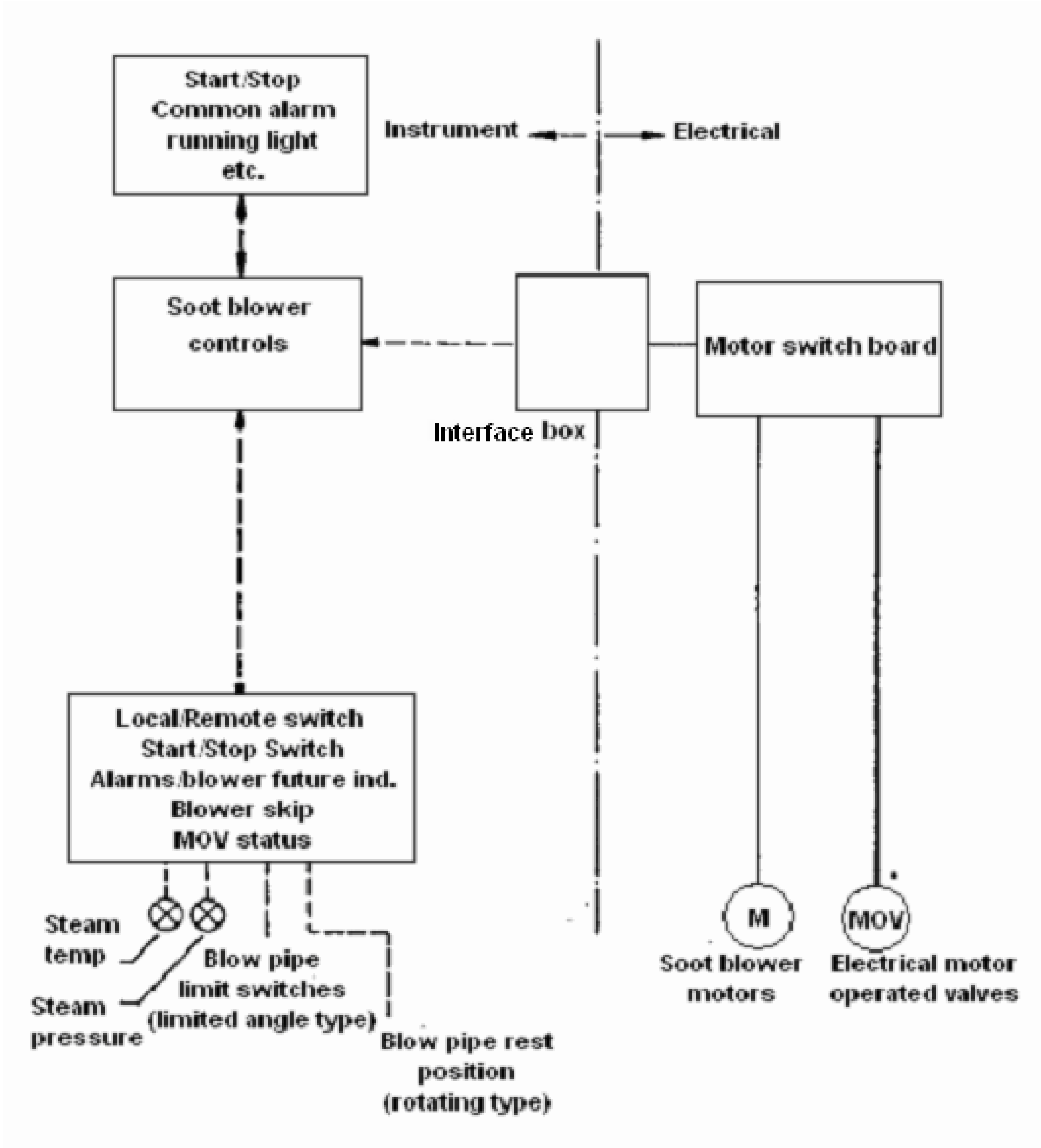
- Clean earth provisions for instrument systems.

- Lightning protection systems.

- Measurement and control systems, including inherent alarm annunciation and safeguarding systems for protection of electrical equipment.

APPENDIX B

INSTRUMENT-ELECTRICAL INTERFACE FOR A TYPICAL SOOT BLOWER SYSTEM



------------- **Electrical Signal Lines.**

------------ **Instrument Signal Lines.**

PART III

INSTRUMENT ENGINEERING PROCEDURES

CONTENTS: PAGE No.

APPENDICES:

1. SCOPE

This Standard describes instrument project engineering procedures for the design, requisition, test and inspection of instruments.

2. GENERAL

2.1 Instrument Engineering Activities

Unless otherwise specified, Instrument Engineering shall be responsible for carrying out the activities as mentioned hereafter. These activities comprise at least the following:

1) Planning and scheduling of the instrumentation work for the project within the overall project plan.

2) Review of Process Flow Diagrams (PFD), Utility Flow Diagrams (UFD), functional logic diagrams and flow charts (functional description).

3) Checking of Piping and Instrument Diagrams (P&IDs).

4) Preparing and updating instrument data sheets.

5) Calculations for flow measuring instruments and control valves and checking of safety/relief valves sizing.

6) Preparation of inquiries for all instruments, control systems, accessories and installation materials.

7) Technical evaluation of quotations, selection of suppliers from the list of approved manufacturers, checking copies of orders and suppliers data/drawings/documents.

8) Inspection and test of instrumentation and control system.

9) Advising and assisting in the lay-out of instrument panels, operator consoles, control rooms, auxiliary instrument rooms, computer rooms and analyzer houses.

10) The design and engineering of alarm and trip systems.

11) The configuration of process control system.

12) The preparation of detailed documents and drawings for the ordering and installation of the instruments and control systems, etc.

13) The checking of plant models, for instrument accessibility and location purposes.

14) Follow-up and progress control on all matters relating to instrument engineering.

15) The preparation and obtaining the necessary approvals of ’as-built’ drawings.

The Designer shall be responsible for all instrumentation and related activities, and for the satisfactory design and correct implementation of instruments and control systems in accordance with Company’s specifications.

For "split-phase" projects, responsibility shall be in accordance with the relevant section of the project specification.

2.2 Demarcations for Instrument Engineering

The interface between Instrument and other Engineering disciplines is given in Part 2 of this Standard IPS-E-IN-100.

2.3 Design Data for Instrument Engineering

2.3.1 All instrument engineering shall be based on the design data given in Instrument data sheets, process and utility flow diagrams (PFD & UFD) and P&ID. Where necessary, additional information shall be provided in cooperation with relevant disciplines to explain such plant operational requirements as:

- Functional logic diagrams for (complicated) safeguarding systems;
- flow charts (functional description) for sequence control systems;
- functional diagrams for 'advanced' control.

2.3.2 The Designer (contractor / consultant) shall continuously update the instrument data sheets if necessary and submit these at defined intervals for the Company's approval.

2.3.3 In addition to the instrumentation listed during the detailed engineering phase, all other instrumentation, such as those for equipment packages, shall be included in the instrument data sheets and engineering flow diagrams. Where these are not practicable, the additional instrumentation shall be shown on separate engineering flow diagrams and instrument data sheets.

Notes:

1) All process data shall be approved by the responsible process engineer before being used for instrument engineering.

2) The preliminary instrument data sheets as prepared in the basic design phase, shall minimally show the process data.
Additional data shall be stated in a later revision by the Designer.

2.4 The Basis for Instrument Engineering

2.4.1 All instrument engineering activities shall be based on the requirements given in the latest revision of design package and amendments. In case of conflict between the design package and the amendments, the amendment shall be followed.

2.4.2 The Designer shall obtain the Company's written agreement for all deviations from the Project Specification, prior to carrying out the related engineering work.

2.4.3 Government and local authority requirements, laws and customs shall prevail if these are more stringent than those specified in the Project Specifications.

2.4.4 It is the Designer's responsibility that all the local legal obligations related to the scope of work and applicable to the realization of the project are complied with.

2.4.5 The Designer shall inform the user immediately of any such local requirements which are not covered by the specifications indicated above.

2.4.6 Should doubt arise in the interpretation of rules given in the design package referred to above, the Company shall be consulted.

2.4.7 Compliance with the requirements of this specification shall not relieve the Designer of his obligation to follow sound and safe engineering practice throughout.

2.4.8 If changes in the design are considered necessary by the Designer tractor for economic, safety, ease of operation, or other reasons they shall only be carried out after obtaining the Company's approval in writing.

2.5 Instrumentation of Equipment Packages

2.5.1 In general the instruments for equipment packages, such as boilers, incinerators, refrigeration equipment, compressors, etc., should be of exactly the same make and type as those used for the process units as far as possible.

2.5.2 The Equipment Package supplier shall be informed of the selected types and manufacturers of the preferred instruments.

3. TIME SCHEDULE

3.1 All phases of instrument engineering work shall be planned in detail and in accordance with the overall time schedule for the project. Special attention shall be given to the timing of the following:

- "Preparing the summary of instrumentation documents and drawings".

- "Preparing the summary of instrumentation inquiries".

- "The summary of instrument engineering activities".

These summaries shall indicate all expected engineering documents, drawings, inquiries and activities together with the expected date, duration and sequence of them. The documents will then be used as the basis for the detailed instrument engineering planning. The list of documents will be given in part IV of this standard.

- Required on site date, for equipment, documents and drawings etc.

- The finalization of input data for all calculations. This data shall be available at specified time before the planned date of plant commissioning.

- Third party data and documents which are required for ESD, PCS and FGS systems implementation.

4. PREPARATION OF INQUIRIES

4.1 General

4.1.1 The inquiries of all instruments, control systems, auxiliary equipment, installation materials, etc. shall be based on the relevant data sheets, specification and drawings.

4.1.2 The inquiries shall be prepared separately for 'in line' instruments which have a pressure rating of various classes. They shall be segregated from inquiries which contain instruments of a lower pressure rating.

4.2 Inquiries Procedures

4.2.1 Inquiries shall be prepared for the purchase of all instruments shown in the P&IDs and instrument list and relevant data sheets, including all auxiliary equipment and installation materials. These inquiries shall clearly state date and all the requirements necessary for the supply of correct purchased items.

4.2.2 The types of equipment specified on any inquiries should 'preferably' be limited to those which can all be supplied by the same manufacturer.

4.2.3 The PCS, SIS and FGS systems inquiries shall be prepared based on following procedure.

4.3 Information in Inquiries

4.3.1 The inquiries shall only carry the information necessary for ensuring the proper supply of the equipment and/or services required.

4.3.2 When required, in addition to the operating conditions specified on the inquiry, the instrument engineer shall also state requirements such as vacuum service, high pressure, low and high temperature, oxygen service, strongly varying process conditions, corrosive and abrasive conditions.

4.3.3 Furthermore, the specific requirements given in the Project Specification shall be stated on the inquiries and special attention shall be given to the following:

- Material certification of instruments and related components for pressure retaining parts, including the bolting of pressure retaining parts.

- Special testing and/or treatment of materials, e.g. leak, dye penetration, ultrasonic, magnetic particle, hardness, heat treatment, stress relieving, annealing/pickling, etc., shall be in accordance with the requirements given for the piping system or equipment in which the instruments are to be installed, and/or the Project Specification.

Note:

Pressure testing is mandatory for all pressure retaining instruments and/or installation materials.

- Requirements for the maximum allowable noise level, e.g. for control valves, control room equipment, etc.

- The 'NACE Requirements' for 'in line' instruments used in sour service.

4.3.5 Complete tag numbers shall be stated on the inquiry for identifying instruments and accessories during installation.

This is not necessary for installation materials which are identified, stored and used by indent/item numbers.

4.4 Comment/Approval by the Company

4.4.1 The instrument engineer shall carefully check the supplier's information to ensure the correct supply of equipment and/or services.

4.4.2 When the Designer (may be consultant) is requested by the Company to submit inquiries for comments and/or approval, the relevant up-to-date instrument data sheets and other relevant documents e.g. control valve calculation sheets shall be issued prior to, or simultaneously with the inquiry.

4.4.3 Quotations for approval shall be submitted with all relevant documents included, such as catalogues, intermediate correspondence and drawings, etc.

4.5 Project Spare Parts (Capital Spares)

4.5.1 The inquiries, especially initial inquiries, should include an amount of certain extra equipment/parts as 'project spares' to allow for losses of installation materials, or for late changes at site.

4.5.2 The Designer (consultant/contractor) shall propose for each of the (initial) inquiries an amount of project spares. The amount of these spares requires the written approval of the Company.

4.6 Free Issue Items

If the inquiries for the main equipment contains free issue items, cross references shall be made between the inquiries for main equipment and free issue items, giving the inquiry number, make and type of instrument/equipment and quantities.

4.7 Preliminary Inquiries

4.7.1 To ensure timely delivery, preliminary inquiries shall be issued for certain equipments at an early stage of the detailed engineering, to allow the manufacturers to reserve manufacturing capacity and to order sub-assemblies and parts.

Such equipments may be:

- Control valves with components made from non-standard/special materials or Distributed Control Systems, etc.;

- Panel instruments and flow transmitters when required in large quantities (with estimated quantities).

They shall be followed by updated revised inquiries at a later stage.

4.7.2 Initial inquiries for installation materials and cables should be issued with estimated quantities and average lengths of cable required for each instrument. The inquiries shall be revised and re-issued at a later date when final quantities and lengths are known, together with and approved amount of project spares materials and cables.

4.8 Factory Testing

Inquiries for equipment of ’Category B’ and ’Category C’, (see Clause 6), shall carry a note that the equipment will be inspected after factory-testing and before shipment.

4.9 Erection/Commissioning Assistance

Inquiries for factory assembled systems shall specify whether erection and/or commissioning assistance and/or a 6 months or 1 year maintenance contract is required from the supplier, or as otherwise stated in the Project Specification.

5. COMPOSITE MANUALS

The engineering designer shall ensure that manufacturers/suppliers are instructed to supply to site, either by direct dispatch or via the designer’s office in accordance with the Project specification, complete sets of all instrument installation, commissioning, operating, maintenance manuals and QC documents, applicable to each type of equipment in their supply. Where practicable, these sets shall be assembled in loose-leaf binders.

For the larger systems, provided by the same supplier, the sets shall include all details of all the types of instruments supplied, e.g. for Distributed Control System, blender, metering station, etc.

6. FACTORY INSPECTION

6.1 Decision for Inspection

6.1.1 To facilitate the requirements for factory inspection, the instrumentation shall be separated into "Category A", "Category B" or "Category C" Items as appropriate, see Appendix A.

6.1.2 Equipment in Category A will not normally require a factory inspection.

Equipment in Category B shall be subjected to factory inspection.

Equipment in Category C should be subjected to factory inspection.

Note:

The need for inspection of items in Category C shall be indicated.

6.1.3 Material in Category A, which forms an integral part of the equipment of Category B, will be inspected against the relevant requirements during the inspection of Category B material, e.g. controllers and recorders in a control desk will be checked against the requisition in the panel shop, during the acceptance test of the control desk. The requirements for factory inspection shall be clearly indicated in the inquiry for the particular equipment.

Factory inspection shall be carried out by:

- The Company or his representative; for non-turnkey projects.

- The Designer; for turnkey projects, accompanied by a representative of Company.

6.2 Inspection Procedures

6.2.1 Prior to factory inspection by or on behalf of company the manufacturer shall carry out tests and if necessary take corrective measures, with the approval of company, in order to ensure that all equipment fulfills the requirements stated in the inquiry. This shall include equipment which is supplied with equipment packages or as free issue items.

The factory inspection, by or on behalf of company, shall include full loop and function tests for which floor space, simulation equipment and manpower assistance shall be provided by manufacturer. The inspection date shall be fixed at least four weeks in advance.

6.2.2 One set of approved, up-to-date vendors drawings, including test procedures, shall be supplied to the Company before the inspection is carried out.

6.3 Inspection Documents

For turnkey projects, the Designer shall establish, document and maintain, an effective quality assurance system to demonstrate compliance with the requirements for services and manufactured products, in accordance with the relevant section of the Project Specification.

7. DOCUMENTS AND DRAWINGS

For guidance as to which instruments and drawings should be made in the engineering stage, refer to IPS-E-IN-100 Part IV (Instrument Document and Drawings).

The engineering documents and drawings shall be processed and submitted to the Company in logical sequence for comments, or released in accordance with the requirements of the Project Specification, to ensure proper coordination of responsibilities and activities. If available, the Designer may use his own computerized system for handling documents and drawings, having first obtained the Company's approval in writing.

APPENDICES

APPENDIX A

INSPECTION REQUIREMENTS

A.1 Equipment Categories

A.1.1 Category A

Comprising individual items of equipment and separately mounted instruments. Typical items in this category are:

- transmitters
- recorders
- standalone controllers (including indicating controllers)
- pressure/draught/receiving/temperature gages
- installation materials (except for impulse lines containing valves)
- solenoid valves
- plant mounted terminal/junction boxes
- switches (manual/receiver and process)
- push buttons
- cables
- variable-area meters (except for process applications)
- indicators
- diaphragm/chemical seals
- pulse counters
- alarm light units
- computing/selecting/limiting/boosting/time relays
- air filter-reducers
- thermocouple assemblies
- resistance thermometer elements/RTD's
- detectors
- tank gages
- gage glasses
- signal converters

- volume boosters
- load cells
- lock-up/quick exhaust devices
- control drives for dampers
- valve actuators/positioners.

A.1.2 Category B

Comprising instruments and equipment of a more complex nature, custom-built systems or equipment packages. Typical items of equipment in this category are:

1) Field equipment and Packages such as:

- local panels
- metering station
- meter provers
- remote I/Os
- remote terminal unit (RTU)
- well head panels
- high integrity pressure protection systems (HIPPS)
- pressure regulators
- self acting temperature regulators

2) Analytical equipment such as:

- sampling systems for process stream analyzers
- process stream analyzers.

3) Piped and/or wired system cabinets or racks for:

- receiver devices
- signal converters
- signal amplifiers
- miscellaneous/auxiliary components.

4) Control room equipment such as:

- control desks
- alarm systems/alarm service units
- safeguarding systems

- interlock systems
- sequential control systems
- relay systems
- process control systems (PCS)
- multiplexers
- operator consoles
- programmable logic controllers (PLC)
- SCADA systems
- mimic panels
- interface systems
- tank gaging systems
- interposing cabinets
- monitoring systems
- fire and gas systems (FGS)
- patch panels
- weighing systems
- dosing systems
- blending systems
- sequential event recorder
- multi point paperless indicating systems
- batch control units
- counters
- flow computers.
- machine monitoring systems (MMS)
- leak detection systems (LDS)
- control valves/safety valves

A.1.3 Category C

Comprising in-line mounted instruments and items for instrument impulse lines. Typical items of equipment in this category are:

1) In line mounted instruments such as:

- orifice plates/restriction orifices
- variable area meters
- special meter runs. (e.g. for custody transfer)
- turbine/PD meters (including all accessories)
- venturi/dall/pitot tubes
- electromagnetic/vortex/impact/ultrasonic flow meters
- flow straighteners
- flow nozzles
- displacer level instruments
- probe-type level instruments

2) Installation materials (for impulse lines) such as:

- manifold valves

Note:

All instruments installation materials in Category C which are to be inspected shall be examined by a mechanical specialist to ensure compliance with the piping specification.

PART IV

INSTRUMENT DOCUMENTS AND DRAWINGS

CONTENTS: PAGE No.

1. SCOPE

This Part of IPS-E-IN-100 gives minimum requirements for instrumentation documents and drawings which shall be prepared/completed during the basic design and detailed engineering stage of a project. In addition the requirements for documents and drawings in the "As Built" condition are given in Clause 3.

It is intended for use in Petroleum Industries. Where cross-references are made, the numbers of the section of sub-sections referred to, are shown in brackets.

2. GENERAL REQUIREMENTS

2.1 General

A set of instrumentation documents and drawings shall be prepared for each project, which shall include but not necessarily be limited to those specified in this Part.

These documents and drawings shall be issued such that sufficient time is allowed for realizing the instrument installation, taking into account the procedures and the time required for review and comment by the Company.

The extent of detailing of each document and drawing shall be such that it will facilitate the procurements, installation of all instrumentation at the construction site and serve as a reference for future maintenance, changes and/or extension to the instrumentation.

The contents of these documents and drawings, the type of documents (electronic or hardcopy), the number of copies required, the need for additional documents and the procedures for commenting and/or approval, shall be in accordance with requirements which will be stated by the Company.

The use of any software by the contractor, for document and drawing production requires the written approval of the Company. If documents and drawings are provided through software system the application software and native files shall be submitted.

Notes:

1) The release (date) of the above software packages shall be listed and submitted for approval by the Company.

2) The compatibility with computer equipment used on site should be verified by the Company. If the software is not compatible, the required computer equipment should be ordered with the project.

All parts and sections of any form, sheet or other document which requires ‘filling in’ shall be completed. Where a particular part of any document is not applicable it shall be so indicated.

2.2 Identification

The identification of documents and drawings shall be based on approved project numbering procedure.

All documents and drawings should normally be provided with a registration number from the series of numbers allocated to the project, together with a code number for classification and identification. The code number should consist of a prefix, project number, group number.

All documents and drawings shall bear proper references to related project construction drawings, and indent numbers for the materials required, etc. The documents and drawings shall bear the titles as indicated in this part. In addition, all instrument related layout drawings of control rooms, auxiliary rooms and analyzer houses, etc., shall indicate the building and room number.

Where multi-sheet drawings (Clause 2.4) consist of a large number of sheets, each sheet may be revised, if required. For each revision, the cover sheet and the revision index sheet shall be re-issued together with the revised sheets. All the revised sheets shall bear the same revision letter irrespective of the last revision letter on the individual sheets, i.e., all revised sheets shall bear the same revision indicator as the cover sheet.

For multi-sheet drawings where signatures are applied for approval or checking, these shall be indicated on the cover sheet only. Where a full title block is applied this shall be used on the cover sheet only. Continuation sheets shall be sufficiently titled to link them clearly to the cover sheet and include project title, drawing title, project, drawing number and sheet number.

2.3 Drafting Techniques

The drafting techniques, drawing sizes and preparation of technical drawings shall be in accordance to the following instructions or company policy as instructed by the user. The basic format of each type of document produced by the Designer shall be submitted for review and approval by the Company. The following order of preference shall apply:

A4	297 mm × 210 mm
A3	420 mm × 297 mm
A2	594 mm × 420 mm
A1	841 mm × 594 mm
A0	1189 mm × 841 mm

Drawing size A0 may be used for instrument documents and drawings on special cases.

Special attention shall be paid by the Designer to ensure a consistent drawing and documentation package, particularly for those documents which are associated with equipment package unit, (Clause 2.8). It is not acceptable to deviate from the agreed formats and standards, and it is the Designer's responsibility to ensure rigid adherence to such procedures.

Copies of drawings issued for comments or information shall have a maximum size of A3. Consideration should be given to reducing by copying to A4 size before dispatch. Drafting techniques should then take into account clear readability of the reduced format.

For the mechanical, instrument and electrical symbols and identification systems to be used on drawings, refer to the related symbols and legend drawings of these disciplines.

2.4 Multi-Sheet Drawings

Certain 'documents' shall be made in the format of a 'drawing' with a large number of sheets, consisting typically of:

- A cover sheet.
- Index to sheets, giving the applicable revision indicator of the sheets contained in the set.
- Listing of symbols and abbreviations used.
- Listing (by item number) of materials required.
- Detail sheets (as indicated on the index sheet) giving the required information.

Note:

For a typical example, refer to the multi-sheet drawing for instrument impulse lines, given in IPS-D-IN-104.

For the preparation of such drawings, standard forms A4 and A3 size shall be used. To facilitate reproduction and filing preference is given to the use of A4 size. All sheets of a multi-sheet drawing shall have the same size, mixing of A3 and A4 sizes in one multi-sheet drawing set is not allowed.

Where the subject cannot be arranged entirely on one sheet, as may be the case with logic diagrams, relay diagrams or instrument signal diagrams, the subject shall be continued on the following sheet(s) with proper cross references at the demarcation points. The arrangement shall then be such that a continuous presentation of the subject is formed when the separate sheets are laid side by side by the user.

2.5 Construction Drawings

Where constructional details are required to ensure the proper supply of instrumentation equipment, such details shall be shown on a separate construction drawing, to which references shall be made in the requisition.

For standard equipment, such drawings are available in the form of standard installation drawing. Where these standard drawings are used in an unmodified form they can be used by referring to the standard number, revision indicator and title. When, however, for a particular application, deviations from the standard drawing are necessary, the Designer shall prepare an engineering drawing based on the standard drawing. Under no circumstances shall a standard drawing be issued in a modified form.

For non-standard equipment, dedicated engineering drawings shall be prepared showing details and all requirements.

2.6 Technical Specifications

Where comprehensive descriptions, arrangement drawings and/or construction details are necessary for ensuring the proper supply of equipment, these requirements shall take the form of a technical specification, to which references shall be made in the requisition. For certain standard equipment, these specifications are available as an IPS publication (e.g., for control valves, control panels). Where this is not the case a dedicated technical specification shall be prepared in the form of a multi-sheet specification.

2.7 Manufacturer's Documents

Drawings received from manufacturer shall be identified as engineering drawings, see (2.2), and where applicable commented upon and incorporated into the detailed engineering stage of the project.

Manufacturer's drawings shall be fully integrated into the overall project documentation package and incorporated into a dedicated 'Instrument Summary', (see 3.2.1).

In addition to identification (2.2), manufacturer's drawings shall carry a manufacturing schedule consisting of a table, listing the tag and/or equipment numbers with special requirements such as material, range, type number, labeling/ engraving adjacent to the tags. This will serve both as an acknowledgment and check on the additional requirements specified in the requisition.

Standard manufacturer's manuals/bulletins shall indicate or delete inapplicable items and details, and highlight those which are applicable by underlining or arrowing, etc.

Note:

Where applicable, the above requirements shall be clearly stated under "Documentation" in each instrument equipment requisition.

Manufacturer's drawings shall only be used to assist in the production of a comprehensive installation drawing package and shall not form a part of the installation package.

2.8 Equipment Package Drawings

Drawings of an equipment package shall be identified in accordance with Sub-clause 2.2. The drawings shall be commented upon and incorporated into the detailed engineering stage of the project. The drawings of an equipment package shall be arranged in separate sets for each equipment package unit.

3. THE PREPARATION OF INSTRUMENTATION DOCUMENTS AND DRAWINGS

3.1 As Built Requirements

The "As Built" preparation for the documents and drawings should be in accordance to the following table and categories:

- Category A Documents and drawings, should remain ‘as built’ during the life time of the plant for maintenance and safety audit purposes. After commissioning, particularly in the case of plant changes, however small, plant management is responsible for the updating of the ‘category A’ documents and drawings concerned, and this function shall be defined clearly within the plant organization.

- Category B ‘As-Built’ documents and drawings, after construction shall include all changes/additions which have been made during the construction/commissioning phase of the project.

DOCUMENT/DRAWING TITLE	'AS-BUILT' CATEGORY	CROSS REFERENCE
General Instrumentation Documents:		(3.2)
- Summaries of instrumentation documents and drawings	A	(3.2.1)
- Summary of instrumentation inquiries	B	(3.2.2)
- Instrument engineering data sheets	A	(3.2.3)
- Composite instrument manuals	B	(3.2.4)
Instrumentation General Diagrams:		(3.3.1)
- System control diagrams	A	(3.3.2)
- Instrument loop diagrams	A	(3.3.3)
- Logic diagrams including relay diagrams	A	(3.3.4)
- Function descriptions	A	(3.3.5)
- Computer diagrams	B	(3.3.6)
- Alarm and trip settings	A	(3.3.7)
- Arrangements of system cabinets/auxiliary cabinets	B	(3.3.8)
- Instrument/Electrical interface cabinet	A	(3.3.9)
- Computing relay calculations	A	(3.3.10)
- Distributed control system (DCS)	A	(3.3.11)
- Instrument utility consumption calculations	B	(3.3.12)
- Heat dissipation calculation	B	(3.3.13)
- Noise calculation (CR)	B	(3.3.14)
Analyzers and Sundry Instruments:	A	(3.4)
- On-line process stream analyzers and sample systems	A	(3.21.1)
- Layout of the analyzer house		(3.21.2)
Flow Instruments:	A	(3.5)
- Flow meter calculations	A	
- Restriction orifice calculations	B	
- Construction drawings for special flow meters	B	
- Construction drawings for restriction orifices	A	
- Flow computer calculations		
Level Instruments:	B	(3.6)
- Calculations for differential pressure instruments	B	
- Calculations for radioactive sources	B	
- Construction drawings for special level instruments		

(to be continued)

DOCUMENT/DRAWING TITLE	'AS-BUILT' CATEGORY	CROSS REFERENCE
Pressure Instruments:	B	(3.7)
- Selection of diaphragm seals	B	
- Selection of over range protection		
Temperature Instruments:	B	(3.8)
- Construction drawings for special temperature measurement devices	B	
- Construction drawings for multiple temperature measuring elements		
Final Control Elements:	B	(3.9
- Control valve sizing calculations	B	
- Control valve noise calculations	B	
- Control valve stroking time calculations		
Instrument Installation:	B	(3.10)
- Summary of instrumentation cables	B	(3.10.1)
- Summary of instrument installation materials	B	(3.10.2)
- Summary of instrument process connections	B	(3.10.3)
- Instrument tag numbers and nameplates	A	(3.10.4)
- Layout of control room	B	(3.11.1)
- Computer system drawings	A	(3.11.2)
- Layout of auxiliary room	B	(3.12.1)
- Layout of cable supports and instruments signal cables in auxiliary	B	(3.12.2)
room	B	(3.12.3)
- Instrument air/filter reducer stations in auxiliary room	B	(3.12.4)
- Arrangement for main marshaling cabinets cabinets	B	(3.12.5)
- Arrangement of instrument system earth	A	(3.12.6)
- Signal cabling diagram	A	(3.12.7)
- Layout of earthing in the auxiliary room	B	(3.13.1)
- Layout of instrument consoles	B	(3.13.2)
- Cutout dimensions for instrument consoles	A	(3.13.3)
- Construction of instrument consoles	A	(3.13.4)
- Alarm annunciator panels	A	(3.13.5)
- Fire and gas detection display panel	B	(3.14.1)
- Layout of local instrument panels	B	(3.14.2)
- Construction of local instrument panels	B	(3.15.1)
- Location of field instruments	B	(3.15.2)
- Trenches for instrument cables	A	(3.15.3)
- Layout of instrument cables in the plant	B	(3.16.1)
- Single-line diagrams for instrument power supply	B	(3.16.2)
- Layout of instrument power supply cables in the control building	B	(3.16.3)
- Layout of instrument power supply in analyzer house(s)	B	(3.17)
- Instrument air system details		(3.18)
- Instrument signal lines		
Instrument Cable Terminations:		(3.19)
- For each junction box	A	(3.19.1)
- For pneumatic tubing distribution facilities	A	(3.19.2)
- For thermocouple extension cable distribution facilities	A	(3.19.3)
- For each electric signal cable distribution cabinet	A	(3.19.4)
Instrument Impulse Lines	B	(3.20)
Critical Instruments and Systems:	A	
- Depressurizing systems		
All documents and drawings such as layouts, installation details, fire proofing, etc., which are not already covered by 'As-Built' category A requirements.		

3.2 General Instrumentation Documents

The following sub-sections indicate the type of documents and drawings generally applied and give guidance on how they should be prepared.

3.2.1 Summaries of instrumentation documents and drawings

The summary shall consists of an index sheet and separate sheets for listing engineering drawings and manufacturer's drawings respectively.

The first issue shall be prepared at specified time after award of the contract and shall contain, in numerical order, listings of all instrumentation documents and engineering drawings, complete with the planned dates for the first issue indicated in the relevant columns.

Revisions of the summary shall be issued monthly and shall then be up to date and contain all known information. Each revision issued shall contain a complete set of sheets including non-revised sheet(s), the revision indicator used on the index sheet shall also be used on the attached summary sheets and in the 'issue' column of each revised item, irrespective of the previous revision indicator(s), if any, there-on. The revision shall include manufacturer's drawings as soon as these have been received.

3.2.2 Summary of instrumentation inquiries

This summary consists of an index sheet and a list(s) of inquiries for each group of instruments. The first issue shall be prepared at specified time after award of the contract and shall contain, in numerical order, a listing of all instrumentation requisitions, complete with the planned dates for the first issue indicated in the relevant columns.

Normally one line should be used for each requisition but where the requisition covers materials which are expected to have different delivery dates, one line should be used for each group of items which have the same delivery date. Revisions of the summary shall be issued periodically and shall then be up to date and contain all known information.

3.2.3 Instrument engineering data sheets

For each processing unit and/or major equipment package unit in the project, the design and engineering information for the instrumentation shall be listed on 'standard instrument engineering data sheets'. These sheets shall carry the process data which is defined by process engineering.

Notes:

1) The Actual operating data for the processing unit and/or major equipment package unit shall be entered on the instrument engineering data sheets. However, the values given for minimum/normal/maximum of flow/level/pressure/temperature etc., shall take into account the turn-down requirements and the operating/design limits of the processing and equipment package unit.

2) In addition to the instrumentation entered by the process engineers, all other instrumentation data, such as for utilities, etc., shall be included in the data sheets.

The tag numbers on the sheets shall be in numerical sequence 'Symbols and identification system instrumentation'. These sheets shall comprise tag numbers in numerical sequence, the related process engineering (or utility) flow diagram (PFD) drawing number, and the location co-ordinates of the instrument concerned on the (PFD). Where a line has been revised the revision letter shall be placed in the left hand column.

Data sheets for each process unit and for each major equipment package shall be made up into separate sets and each set shall be supplied with a dedicated cover sheet. The set(s) of sheets of equipment package(s) shall be combined with and immediately follow the set of sheets for its associated process unit. However, the cover sheets from each set shall be placed at the front and the combined set shall be numbered accordingly. Tag numbers for a package unit shall be given in sequence and in a group.

The first issue shall be prepared at an early stage of the detailed engineering phase and shall specify the components for each instrument loop, with all additional information available at that time. During the detailed engineering period the instrument engineering data sheets shall be further completed with engineering and purchasing data. Revisions of the instrument engineering data sheets shall be issued periodically and shall then be up to date and contain all known information.

The sequence of the data sheets as an engineering document and their numbering shall be as indicated on the cover sheet. The cover sheet shall list all the sheets and give the latest revision letter.

3.2.4 Composite instrument manuals

Composite instrument manuals shall be compiled as follows, but not necessarily limited to the examples given:

- For all in-line instruments such as control valves, positive displacement/turbine meters including accessories, level displacer instruments, etc.

- Equipment packages (including skid mounted units).

- Process Control System (PCS).

- Tank gaging, blending, dosing and weighing systems, etc.

- On-line process stream analyzers and sample systems.

The Composite instrument manuals shall incorporate all manufacturer's documents for the instrumentation designed/ ordered against a particular project.

3.3 Diagrams

3.3.1 Instrumentation general diagrams

These diagrams shall be arranged as a multi-sheet 'drawing' (2.4), in one complete set for the particular project.

The diagrams shall show overall signal routing between field devices and all systems and cabinets, including the type of signal cabling, junction boxes, terminals, main distribution frame and system cabling, etc. For system cabinets, the type of power supply and the arrangement of system cabinet alarms, etc., shall be indicated. These drawings shall be in the form of block diagrams and, if applicable, detail all the battery limits delineating the scope of supply.

The diagrams shall be prepared at an early stage of the detailed engineering phase and shall be fully reviewed and approved by the Company before detailed design is started.

The instrumentation 'general' drawings shall be revised throughout the project to incorporate further requirements as they become apparent.

3.3.2 System control diagrams

These diagrams shall show in detail all active instrument components complete with instrument ranges, set points, controller settings, etc., for complicated systems such as HP/MP/LP steam systems, fuel gas systems and compressor surge control systems.

3.3.3 Instrument loop diagrams

Loop diagrams shall be arranged as a multi-sheet 'drawing' (2.4), in separate sets for each processing unit and for each major equipment package unit.

Each set of instrument loop diagrams shall have a drawing number. Where more than one processing unit and/or major equipment package unit is involved in the project, a group of consecutive drawing numbers shall be used for the various sets of diagrams.

3.3.4 Logic diagrams

Logic diagrams shall be arranged as a multi-sheet 'drawing' (2.4), in separate sets for each processing unit and for each major equipment package unit.

For binary logic functions of each system (including those in package units), a logic diagram shall be prepared by, or in close cooperation with, process design or process control engineering.

Each logic system as indicated on the process engineering (or utility), piping and instrumentation diagrams (P&IDs), shall have its own sheet or it may consist of several sheets.

The logic diagrams shall be converted into suitable operational diagrams to implement the logic such as relay diagrams, structure text (ST), function block diagram (FBD) and sequential function chart (SFC), etc. These conversions shall take into account system engineering aspects such as:

- Fail-safe provision.

- Provision for override, start-up, testing under operating conditions, etc.

- Identification of all components such as relays, circuit breakers, etc., terminals, sockets and pins, especially for incoming and outgoing signals.

The resulting diagrams shall be in such detail that proper hardware execution by the system supplier is ensured. The requisition for the system shall make reference to the applicable detailed hardware drawings, showing the position of and the interconnections between the applied modules for easy identification during installation, testing and maintenance. The format and layout of particular ‘diagrams’ shall be to requirements given by the user, and the proposed presentation shall be submitted for review and approval by the user.

Each set of logic diagrams shall have a drawing number. Where more than one processing unit and/or major equipment package unit is involved in the project, a group of consecutive drawing numbers shall be used for the various sets of logic diagrams and the converted diagrams.

3.3.5 Function descriptions

Function descriptions, including basic logic diagrams and step charts, may be made for sequence control or safeguarding systems and other complicated control systems. Function descriptions shall include test procedures for testing under operating conditions.

3.3.6 Computer diagrams

These diagrams and lists shall show all incoming and outgoing signals and control lines to computer equipment, operator consoles, interface equipment such as thermocouple selectors and signal line interconnections, junction boxes, cross boards, etc., as far as not covered in the documents and drawings for the process control system and normal instrumentation e.g. CCTV, F&G systems.

3.3.7 Alarm and trip set point list

Alarm and trip setting details shall be arranged as a multi-sheet document (2.4), in sets for each system. Each instrument having a binary logic function shall be listed on this document. The document shall be prepared in such a way that instruments forming part of a system are grouped together on one or more sheets.

The alarm and trip setting document shall be set out to requirements given by the user. The format and layout showing the intended presentation shall be submitted for review by the user.

Each set of listed alarm and trip settings shall have a document number. Where more than one set of listed alarm and trip settings is involved in the project, a group of consecutive document numbers shall be used for the various sets.

3.3.8 System cabinets/auxiliary cabinets+

Drawings for each system cabinet or auxiliary cabinet shall show:

- The arrangement of all equipment in the cabinet with their tag numbers.

- The arrangement of terminals and sockets for the outside cabling with their identification.

- Assignment of each terminal and socket pin for the outside cabling.

- Facilities for earthing, outside cable supporting, ventilation and hoisting.

- Cabinet, equipment and socket/terminal row nameplate details.

- Cabinet installation details.

For guidance in the arrangement of system/auxiliary cabinets, refer to IPS-G-IN-220 "Control Center".

3.3.9 Instrument/electrical interface cabinets

This drawing shall show the construction and the layout of the interface cabinet, complete with the interface relays and cable termination details for the signals forming part of instrument engineering, and those forming part of electrical engineering.

For the division of responsibilities between instrument and electrical engineering disciplines, refer to Part 2 of this Standard.

3.3.10 Process control system (PCS) configuration

The system shall be shown in a multi-sheet ‘drawing’ (2.4), arranged in sets for the configuration of the selected PCS.

These sets of ‘drawings’ shall give information on the layout of the console, cabinets and the software function block configuration.

The function block configuration diagrams shall provide detailed software information, including an overview of the interrelations of the functional elements which constitute the controls and the interface with input/output circuitry, man/machine interface and supervisory controls as appropriate.

During the preparation of the PCS configuration drawings, care should be taken not to include "volatile" information in the drawing, such as proportional band setting, group display layouts, pictorials, etc. This type of information tends to change continuously during the lifetime of the plant, so that the drawing never reaches the "as built" status. This information shall be depicted on a separate drawing, and not included in the composite instrument manuals.

The PCS configuration drawing package shall be completed in detail so that proper configuration execution by the system supplier is ensured.

Certain parts of the PCS configuration, such as group display layout, pictorials, historical trend, alarm group listing, etc., shall be prepared in close cooperation with, Company’s process design, process control and operation specialists.

Each set of PCS configuration drawing sheets shall have a drawing number. A group of consecutive drawing numbers shall be used for the various sets of PCS configuration ‘drawings’.

3.3.11 Instrument utility consumption calculations

For each required instrument utility, the calculation sheets shall give a detailed calculation which shall include but not necessarily be limited to:

- Instrument air, which shall consider both the base load and the maximum air consumption requirement and be ultimately based on selected equipment manufacturer’s quoted consumption rates,

- Secured air supply buffer vessel capacity/sizing,

- Nitrogen, steam, cooling water, etc. consumption, e.g., for analyzers,

- Electrical power load requirements e.g., for Distributed Control System (PCS), Safeguarding Systems, Emergency Shutdown Systems (ESD), etc.,

- Purge fluid consumption, e.g., for instrument impulse lines,

The calculation shall indicate the required and the installed capacity.

During the detailed engineering stage, the instrument utility consumption calculations shall be updated and issued at regular intervals to ensure that the requirements can be met.

3.3.12 Heat dissipation calculation

This calculation sheets shall contain a detailed heat dissipation calculation for all electrically powered instrument equipment which will be installed in the instrument auxiliary room and/or field auxiliary rooms, analyser houses (where applicable), and control room, in view of total heat load for the air-conditioning system(s). During the detailed engineering stage, the heat dissipation calculation shall be updated and issued at regular intervals to ensure that the requirements can be met.

3.3.13 Noise calculation

This ‘drawing’ shall contain a detailed noise calculation and/or spectrum for all instrument equipment which will be installed in the plant and control room and contribute to a noise level higher than the allowed limit. Typical examples are printers, cooling fans of instrument equipment, etc.

3.4 Analyzers and Sundry Instruments

Documents and drawings are concerned with the selection, specification and ordering of on-line process stream analyzers, etc., and sundry instruments. For guidance on the preparation of such documents and drawings, refer to IPS-G-IN- 230 "On-Line Analyzers".

3.5 Flow Instruments

This Sub-section concerns the documents and drawings relating to the selection, specification and ordering of flow instruments.

Typical examples are:

- Flow meter calculations.

- Restriction orifice calculations.

- Installation drawings for special flow meters.

- Construction drawings for restriction orifices.

- Flow computer specification.

- Custody transfer flow metering stations.

Flow meter and restriction orifice calculations shall be arranged as a multi-sheet ‘drawing’ (2.4), in sets for each processing unit. Each set shall have a drawing number and, where more than one processing unit is involved in the project, a group of consecutive drawing numbers shall be used for the various sets of flow meter and restriction orifice calculations.

3.6 Level Instruments

This Section concerns documents and drawings relating to the selection, specification and ordering of level instruments.

Typical examples are:

- Calculations for differential-pressure instruments.
- Calculations for radio-active sources.
- Calculations for interface measurement.
- Installation drawings for special level measurement.

Calculations for differential-pressure transmitters shall be arranged as a multi-sheet ‘drawing’ (2.4), and show in detail all the required data such as transmitter elevation, type of leg and sealing fluid (if applicable), calculations of temperature effect on the sealing medium (if applicable), calibrated range and zero elevation/suppression, etc., for each application.

3.7 Pressure Instruments

This Section comprises all documents and drawings relating to the selection, specification and ordering of pressure instruments.

Typical examples are:

- Selection of diaphragm seals.
- Selection of over-range protection devices.

3.8 Temperature Instruments

This Section comprises all documents and drawings relating to the selection, specification and ordering of temperature instruments. Typical examples are:

- Installation drawings for special temperature measurement devices.
- Installation drawings for multiple temperature measuring elements.

3.9 Final Control Elements

This Section concerns documents and drawings relating to the selection, specification and ordering of final control elements.

Typical examples are:

- Control valve sizing calculations.
- Control valve noise calculations.
- Control valve stroking time calculations.

ISA Forms to be used for this purpose. Each set of control valve sizing and noise calculations shall have a drawing number. Where more than one processing unit is involved in the project, a group of consecutive drawing numbers shall be used for the various sets of control valve sizing and noise calculations sheets.

3.10 Instrument Installation

3.10.1 Summary of instrumentation cables

The summary consists of an index sheet and separate summary sheets for electric signal and supply cables (which form part of instrument engineering), thermocouple signal cables, system cables.

The summary shall contain a listing of all instrumentation cables. The relevant sheets shall be completed at a later date, with the manufacturer's cable reel identification code.

The first issue of the summary shall be made as soon as possible after cable supplier selection, and henceforth it shall be revised at regular intervals, with the final issue at such a time that the cable deliveries are not endangered.

3.10.2 Summary of instrument installation materials

The summary consists of a table of contents and an index sheet together with sheets listing standard materials, sheets for specifying other materials and sheets for summarizing material quantities.

Revisions of the summary shall be issued at regular intervals. Each revision issued shall consist of a revised index sheet with summary sheet(s) attached.

3.10.3 Instrument tag numbers and nameplates

Details of the type of tag numbers and nameplate and the description of the instrument service, etc., shall be arranged as a multi-sheet 'drawing' (2.4).

3.11 Control Room

3.11.1 Layout of the control room

The control room drawing shall show in detail, true to scale, the general arrangement and location of instrument consoles, computer consoles, auxiliary consoles, supervision panels, printers, including console/panel numbering as applicable. It shall also show openings in the wall or floor between control room and auxiliary room, etc.

For projects where the auxiliary room and control room will be on the same elevation, the drawing shall indicate the grid of the false floor and openings required in this floor, for bottom entry into instrument consoles, etc.

3.11.2 Computer system drawings

When the project includes digital computer(s) for supervisory/maintenance/management information functions, all details of the computer system shall be clearly covered in documents and drawings as follows:

- A layout of the computer/engineering room

These drawings shall show the arrangement of computer equipment, cabinets, desks, etc., in the computer/engineering room respectively:

- Air-conditioning of computer/engineering room

This drawing shall show the layout of the air distribution ducting and the direction of the air flow,

- A layout of the false floor in the computer/engineering room

This drawing shall show the construction of the false floor, with an indication of the openings therein.

3.11.3 Fire and gas detection display panel

Drawing(s) shall show the layout (full scale) of the fire and gas detection display panel, giving main dimensions. The display shall consist of a geographical plant representation for flammable/toxic gas, fire, smoke and heat detection with indication lights for alarms, maintenance override status indication and manual call points.

For guidance in the preparation of the fire and gas detection display panel, refer to IPS-E-SF-260 and IPS-G-IN-270.

3.12 Auxiliary Room

3.12.1 Layout of the auxiliary room

The drawing of the auxiliary room shall show in detail, true to scale (using the same scale as for the control room (3.11.1)), the arrangement and identification of all equipment such as system cabinets and consoles, auxiliary, distribution and riser cabinets. This drawing shall indicate the grid of the false floor and the openings required in this floor for bottom entry into cabinets, etc.

3.12.2 Layout of supports, and instrument signal cables

This drawing shall show:

- The arrangement of all cable supports under the ceiling and false floor of the auxiliary room.

- The plant instrument signal cable entries into the auxiliary room in the correct position together with the relevant cable numbers.

- The position of the plant instrument signal cable termination facilities, with their identification, and the routing of the plant instrument signal cables to these facilities.

- The openings in the wall or floor between control room and auxiliary room.

3.12.3 Arrangement for main marshaling cabinets

Drawings for electrical instrument signal cables shall show:

- The arrangement of the terminal rows for outdoor cables, complete with row/terminal identification.

- The arrangement of the system cable termination boards for indoor cables, complete with row/terminal and socket identification.

- The arrangement of terminals rows for devices such as barriers and transducers.

- The facilities for interconnecting the cable screens.

- The facilities for earthing the armouring/lead sheathing of outdoor cables, if applicable.

- The facilities for supporting the indoor and outdoor cables.

- The facilities for routing/supporting the cross wiring.

Drawings required for thermocouple signal cables are similar to the above, but shall also include the arrangement of cold junction compensation boxes and their identification.

3.12.4 Arrangement of instrument earthing system(s)

The drawing shall show:

- The arrangement of earth bars for instrument earthing system(s) and safety earth of instrument equipment, complete with earth bar/terminal identification, choke and arrester.

- The facilities for supporting the incoming earthing cables.

3.12.5 Signal cabling diagram

This drawing shall show in diagrammatic form all signal cabling in the auxiliary room and its connection to equipment in the auxiliary room, to the consoles in the control room and to the plant. The drawing shall indicate the exact signal cabling routing, including cable crossing details, and generally follow the actual layout of equipment in the auxiliary room, but need not necessarily be true to scale.

The cable terminations shall be coded such that a clear distinction is made between cables terminating on rail-mounted terminals, plugs, and sockets, etc. The drawing shall also include the identification of the equipment, the cables, and the system cable sockets mounted in the equipment.

3.12.6 Layout of earthing in the auxiliary room

Separate drawings shall be prepared for PCS earth, computer earth, instrument system earth and safety earth of instrument equipment.

These drawings shall show in diagrammatic form all earth cabling from the system earth cabinet in the auxiliary room and its connections to equipment in the auxiliary room and consoles in the control room. They shall also include the identification of equipment and earth cables.

The drawing shall generally follow the actual layout of equipment in the auxiliary room, but need not necessarily be true to scale.

3.13 Local Panels

3.13.1 Layout of local instrument panels

Drawings shall show the layout (to scale) of each local panel, with the instruments in outline and giving the tag number for each instrument.

3.13.2 Construction drawings of local instrument panels

Construction drawings shall give all information required for manufacturing the local panels. Fully dimensioned cutouts for all instruments shall be included, either on the same drawing or presented separately.

3.14 Field Instrumentation

3.14.1 Location of field instruments

The location of instruments shall be shown, superimposed on sections of a simplified plot plan as follows:

- All field mounted instruments, including local indicators.

- All local panels.

- All field-mounted junction boxes for instrument signal cabling.

- All trunking/cable tray for instrument cabling and its riser points from (underground) trenches, complete with sizes, bends, branches and supporting points.

- All conduits between trunking and plant instruments.

- All instrument air supply piping from its demarcation points with mechanical engineering to the relevant (group of) consumers. Isolating valves, branch-off points and pipe sizes shall be clearly indicated.

Note: Air filter/regulators shall not be shown in detail on these drawings.

In general, separate drawings shall be provided for the location of instruments relating to:

- Processing units.

- Flammable gas, fire and smoke detection and deluge systems.

- Toxic gas detection.

Each drawing shall contain a list of all instruments and junction boxes. Each list shall show, in sequence of tag number, the (plant) coordinates for location of the equipment, its elevation above plant grade level and the junction box connected to.

Where instrumentation installation in structures is involved, preference shall be given to the preparation of layout drawings for different levels, e.g., for each platform, and/or drawings showing such structures in sideview (elevation) containing all the above information.

Where one drawing showing all the information would become too congested, consideration should be given to:

- Changing the scale of the drawing, or where necessary covering the processing unit on several drawings, on the same scale.

- Showing relatively small congested areas on a separate drawing to a larger scale.

- Splitting the information over two drawings, with one drawing showing instruments and junction boxes, and the other showing junction boxes, cable trunking, conduits and air supply piping, this drawing shall then have the title 'Location of Cable Trunking and Air Supply Piping'.

- Splitting the information over two drawings, with one drawing showing pneumatic and the other showing electronic instruments.

Complicated cable trunking shall also be shown in isometric form if plan/elevation drawings would not be sufficiently clear for fabrication of trunking systems.

Where the cable trunking will be of fire resistant construction, it shall be shown on detailed construction drawings.

Where the cable trunking requires special supports, these shall be shown on detailed construction drawings, and a decision shall be taken whether they can form part of the installation activities or whether they should be requisitioned separately for prefabrication.

3.14.2 Trenches for instrument cables

Drawings shall show the location of trenches superimposed on a simplified plot plan for instrument cables complete with indication of size, branch-off points, etc. Details of trench construction, methods of backfilling and trench closure shall also be indicated.

Note:

These drawings shall be prepared in close co-operation between instrument, electrical and civil engineering. The ultimate drawing(s) may form part of civil engineering, provided detailed references are made on the instrumentation drawings.

3.14.3 Layout of instrument cables in the plant

Drawings shall show the aboveground and underground routing of all instrumentation cables from their termination point in the plant to their termination point in the control building, complete with the laying pattern for cable segregation and cross sections of trenches showing the location and laying pattern of each group of cables.

Cables for similar applications, such as for fire, gas and smoke detection and deluge systems shall also be indicated on the drawings.

Special attention shall then be paid to the need for additional branches and riser points in these power cable trenches for accommodating the instrument electricity supply cables.

All riser points for instruments power cables shall also be indicated on the drawings 'Layout of instrument cables in the plant', complete with the aboveground cable routing to the individual consumers. Cross references shall then be made on both drawings.

3.15 Instrument Power Supply

3.15.1 Single-line diagram for instrument power supply

The instrument power supply shall be shown diagrammatically, from the electrical distribution switchboards to the consumers, and shall include:

- Arrangements for AC and DC supply.
- Special provisions for computer power supply.
- All instrument switchboards, switches, fuses including ratings and characteristics.
- Demarcation points at the interface between electrical engineering and instrument engineering.

For the division of responsibilities between instrument and electrical engineering disciplines, refer to Part 2, of this Standard.

3.15.2 Layout of instrument power supply cables in the control building

Drawing(s) shall show the layout of the instrument electricity supply cables, complete with the cable numbers, from the distribution board(s) forming part of electrical engineering, under the false floor and up into the system and auxiliary cabinets, and up through riser cabinets into the instrument panels of the control room, etc., and into the computer room.

3.15.3 Layout of instrument power supply in analyzer house(s)

The drawing shall show in detail, true to scale and on the same scale as 'Layout of an analyzer house', the instrument electricity supply connections for the individual consumers. Complete with de-energizing facilities for each consumer, socket outlets for electrical tools and test equipment, and the cable routing from point of entry to the consumers.

3.16 Instrument Air System

Instrument air lines shall be prepared as a multi-sheet 'drawing' (2.4), showing in detail, the arrangement of the individual air supply for each pneumatically operated instrument, using the appropriate sheets of Standard form refer to IPS-G-IN-200 "General Standard for Instrument Air System".

Dedicated instrument air line details shall be provided for instruments related to fire detection facilities and deluge systems.

3.17 Instrument Cabling Procedures

Instrument signal lines, prepared as a multi-sheet 'drawing' (2.4), shall indicate:

- Procedures for laying cables in trenches, and methods of backfill.

- Procedures for laying cables in trunking, and methods for fixing the cables, etc.

- Details/procedures for termination of cables in cable joints, if applicable.

- Details/procedures for laying cables entering the auxiliary room with respect to their termination point.

- Details for covering/sealing/fire proofing of cable entries into the auxiliary and control room.

- Details/procedures for stripping length and finishing touch of cables in particular with respect to cable glands.

- Methods for identification of wires, pairs or quads in multielement cables.

- Procedures for termination of cables in thermocouple heads, transmitters, converters, solenoid valves, manual switches junction boxes, distribution cabinets, etc.

- Construction details of signal cabling crossings (bridges).

The 'drawing' shall also give dedicated earthing principles and details for instrument equipment such as:

- Instrument earthing, for signal cable screen continuity and earthing point, system cables, reference system earth bar, etc.

- Instrument earth star point.

- Safety earthing for signal cable armouring/lead sheathing, system cabinets, frames, instrument desks/consoles, recessed floor(s), instrument cable trunking, junction boxes, local panels, power distribution boards, etc.

- Safety earth distribution.

- Earthing of safety barriers, if applicable.

3.18 Instrument Cable Terminations

Instrument cable terminations in the form of a multi-sheet 'drawing' (2.4) shall be prepared. These drawings shall be set out to the requirements given by the user. The format and layout shall be submitted for review by the user prior to full scale application. The multi-sheet 'drawing' shall indicate the requirements of the following Sub-sections:

3.18.1 For each junction box

- Junction box number.

- The actual numbering of the terminals.

- The (multi-element) signal cable(s) connected to these terminals with full identification by cable number(s), pair/ quad number, color or number coding of wires, etc.

- The connections to plant instruments specified by the tag number.

If more than one signal is related to a tag number, the following code may be added:

- TX in the case of a measured value signal.

- CV in the case of a controller output signal.

3.18.2 For each electric signal cable distribution cabinet

- The terminal rows for plant cables complete with row and terminal identification and cable numbers.

- Terminal rows for indoor cables complete with row/terminal identification.

- The cross wiring between the terminal rows.

- The direct wiring between the terminal rows for indoor cables.

3.19 Instrument Impulse Lines

Instrument impulse line details shall be prepared as a multi-sheet ‘drawing’ (2.4), in sets for each processing unit, using the appropriate ‘Standard Forms’.

Each set of instrument impulse lines shall have a drawing number. Where more than one processing unit is involved in the project, a group of consecutive drawing numbers shall be used for the various sets of instrument impulse lines.

3.20 On-Line Process Stream Analyzers

3.20.1 On-line process stream analyzers and sample systems

Documents and drawings giving details of analyzer and sampling systems, etc., shall be prepared as follows, arranged in sets for each on-line analyzer:

- The sample take-off/return assembly, preconditioning and transport system.

- Sample transport system line size calculations.

- Sample lag time calculations.

- Calculations of the ratio of the sample line flow and the normal process line flow.

- Layout drawing(s) of analyzer sample transport system ‘in isometric form’ showing the routing of the sample transport lines from the sample take-off/return points in the plant, to the sample conditioning system at the analyzer house.

- The sample conditioning system.

- Calculations of the conditions at the inlet and outlet of the sample conditioning system.

- Calculations of the percentage of normal flow in the process line which is vented (flared) or drained.

- The analyzer and related equipment such as programmers, peak pickers (peak holders), recorders, convertors, etc.

- Calculations for auxiliary equipment such as heaters, coolers, pumps, tracing/lagging, etc., to obtain the required sample inlet conditions.

For guidance in the preparation of the above documents and drawings, refer to IPS-G-IN-230 "Analytical Instruments":

- Analyzer data sheet, using Standard Form for analyzer arrangements requiring a sample conditioning system.

Note:

The range of all instruments, in the above systems shall be specified in the requisition.

The range of the instruments shall also be specified on the appropriate documents and drawings. Each set of in-line analyzer documents and drawings shall have a drawing number. Where more than one analyzer is involved in the project, a group of consecutive drawing numbers shall be used for the various sets of documents and drawings.

3.20.2 Layout of the analyzer house(s)

A drawing, true to scale and on the same scale as the drawing ‘Layout of instrument electricity supply in the analyzer house’, shall show in detail the arrangement of all equipment in and around the analyzer house.

The equipment such as sample lines and conditioning systems, drain/vent systems, air conditioning, heating/ventilation systems, analyzers and their related equipment, junction boxes, initiating elements of safeguarding systems, sink, workbench, etc., shall where applicable be identified with line and/or tag numbers, etc.

For guidance in the preparation of the layout of analyzer house(s), refer to IPS-G-IN-230 "Analytical Instruments".