

1

Control System Documentation

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1.1 Introduction

Documentation used to define control systems has evolved over the past half-century as the technology used to generate it has evolved. Information formerly stored on smudged, handwritten index cards in the maintenance shop is now more likely to be stored digitally. However, the purpose of that documentation remains unchanged: to impart information efficiently and clearly to a knowledgeable viewer. Recorded information will evolve as the facility conceptualization, design, construction, operation, and maintenance progress from conceptualization to producing a desired product.

The documents described in this chapter form a typical set used to define work to be done, whether for design, construction, or maintenance. The documents were developed over many years. They are commonly used for continuous processes, but they also work for other applications, including batch processes. The authors know of no universal “standard” for all documentation, but the ones here can be considered typical and useful. Some facilities or designs will not include all the documents described, and some designs may include documents not described, but the information provided on these documents will likely be found somewhere in any successful document suite.

All of the illustrations and many of the descriptions used in this section were published in the 2011 International Society of Automation (ISA) book *Instrumentation and Control System Documentation* by Frederick A. Meier and Clifford A. Meier [1]. That book includes many more illustrations and explanations.

In their book, the Meiers use the term *instrumentation and control* (I&C) to identify the group or discipline responsible for designing and maintaining a process control system, which also prepares and, hopefully, maintains these documents. Many terms are used to identify the people or groups responsible for a process control system; they differ by industry, company, and even region. Terms such as *control systems engineer/engineering* (CSE) and *instrumentation and electrical* (I&E) are common, and with the broadening of the term *automation*, *automation engineer/engineering* (AE) has become more common. To maintain harmony with the Meiers’ book, the term I&C is used in this chapter.

1.2 Types of Documentation

This chapter provides descriptions and typical, albeit simple, sketches for the following documents:

- Process flow diagrams (PFDs)
- Piping and instrumentation diagrams (P&IDs)
- Loop and tag numbering
- Instrument lists
- Specification forms
- Logic diagrams
- Location plans (instrument location drawings)
- Installation details

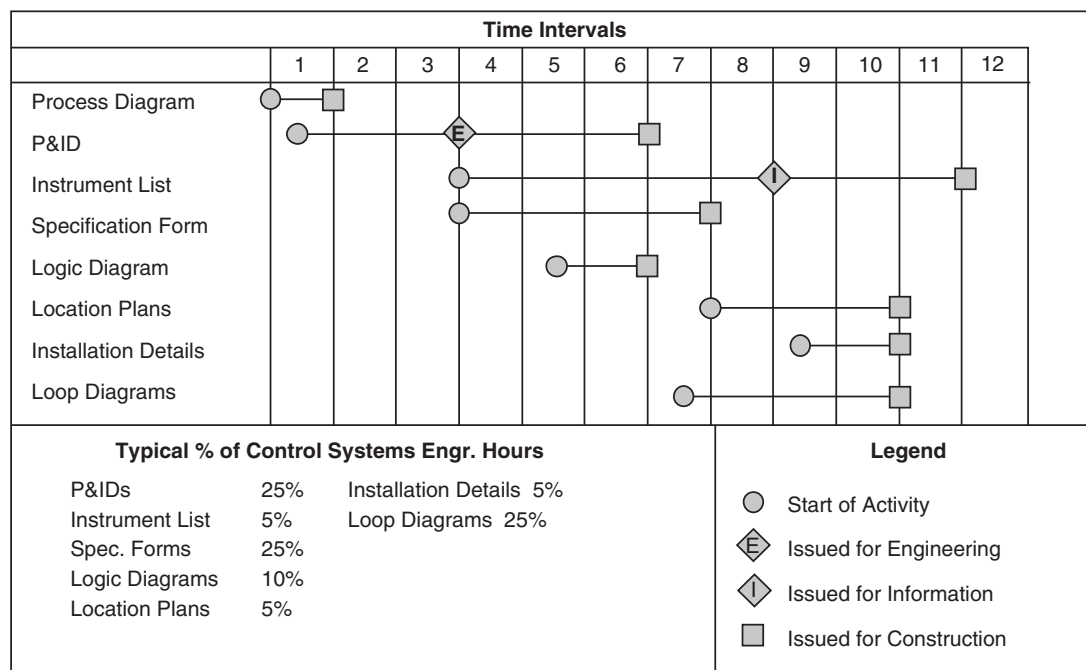


Figure 1.1 Instrumentation documentation timeline.

- Loop diagrams
- Standards and regulations
- Operating instructions

Figure 1.1 is a timeline that illustrates a sequence for document development. There are interrelationships where information developed in one document is required before a succeeding document can be completed. Data in the PFD drives the design of the P&ID. P&IDs must be essentially complete before instrument specification forms can be efficiently developed. Loop diagrams are built from most of the preceding documents in the list.

The time intervals and percentage of total effort for each task vary by industry and designer. The intervals can be days, weeks, or months, but the sequence is likely similar to that shown in the preceding list. The documents listed are not all developed or used solely by a typical I&C group. However, the I&C group contributes to and uses the information contained in them.

1.3 PFDs

A PFD is a “big-picture” schematic representation of the major features of a process. These diagrams summarize the overall intent of the process using a graphical representation of the material flow and the conversion of resources into a product. Points where resources and energy combine to produce material are identified graphically. These points are then defined in more detail in associated mass balance calculations. The PFD shows how much of each resource or product a plant might make or treat; it includes descriptions and quantities of needed raw materials and the byproducts produced. PFDs show critical process conditions – pressures, temperatures, and flows; necessary equipment; and major process piping. They differ from P&IDs, discussed later, in that they have far less detail and less ancillary information. They are, however, the source from which P&IDs grow.

Figure 1.2 shows a simple PFD of a knockout drum used to separate liquid from a wet gas stream.

Process engineers produce PFDs to depict the important aspects of a process. In a way, a PFD serves the same purpose as an abstract does for a technical paper. Only the information or major components needed to define the process are included, along with sufficient detail to describe the input and output quantities and energy required. The drawing shows the main components for storage, material conversion, and material transfer, as well as the main interconnections between components.

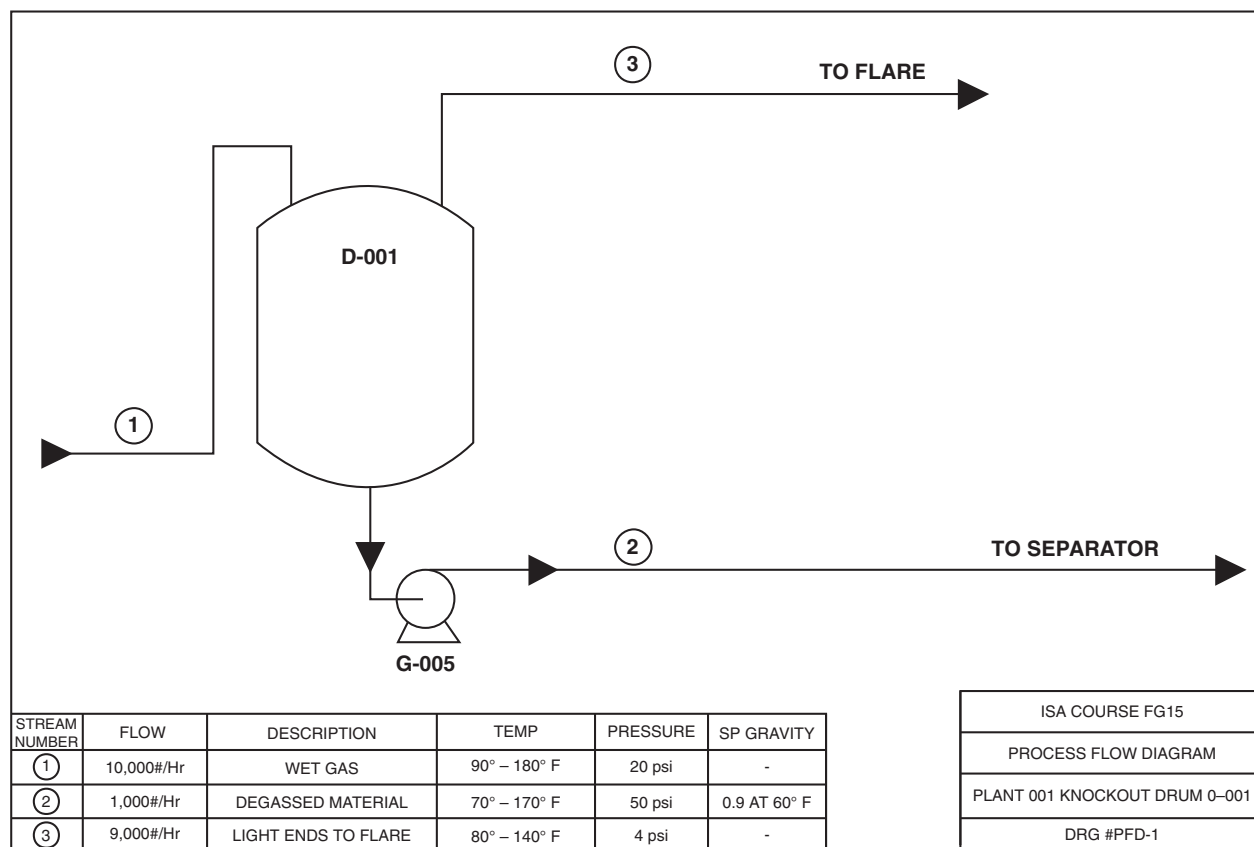


Figure 1.2 PFD.

Process streams are identified with numbers that refer to line items in a table on the drawing containing the content and conditions for the streams. This information comes from a mass and energy balance calculated by the process engineer. The mass balance is the calculation that defines what the process will accomplish. PFDs may include important or high-cost I&C components based on symbols in ANSI/ISA-5.1-2024, *Instrumentation and Control Symbols and Identification*. One purpose of a PFD is to support the preparation of the cost estimates needed to determine whether a project will be done.

As raw materials and process parameters change, batch process plants configure their equipment in various ways. Many different products are often produced in the same plant. A control recipe, or formula, is developed for each product. A PFD can be used to document the different recipes.

1.4 P&IDs

The acronym P&ID is widely understood within process industries to identify the principal document used to define the equipment, piping, and I&C components needed to implement a process. According to the ISA *Automation, Systems, and Instrumentation Dictionary* definition, P&IDs “show the interconnection of process equipment and instrumentation used to control the process” [2]. The PFD is the big picture; it illustrates what the process is intended to do. The P&ID provides the details that define how that happens.

P&IDs are developed iteratively by the various design disciplines as a project evolves. Information placed on a P&ID by one discipline is collectively used by the other disciplines as the various designs progress. It is an active shared document until completion.

The P&ID shown in Figure 1.3 was developed from the PFD in Figure 1.2. The P&ID includes the control system definition using symbols from ANSI/ISA-5.1-2024. In this example, two electronic loops are part of the shared display/shared control system: FRC-100, a flow loop with control and recording capability, and LIC-100, a level loop with control and indicating capability. There is one field-mounted pneumatic loop, PIC-100, with control and indication capability.

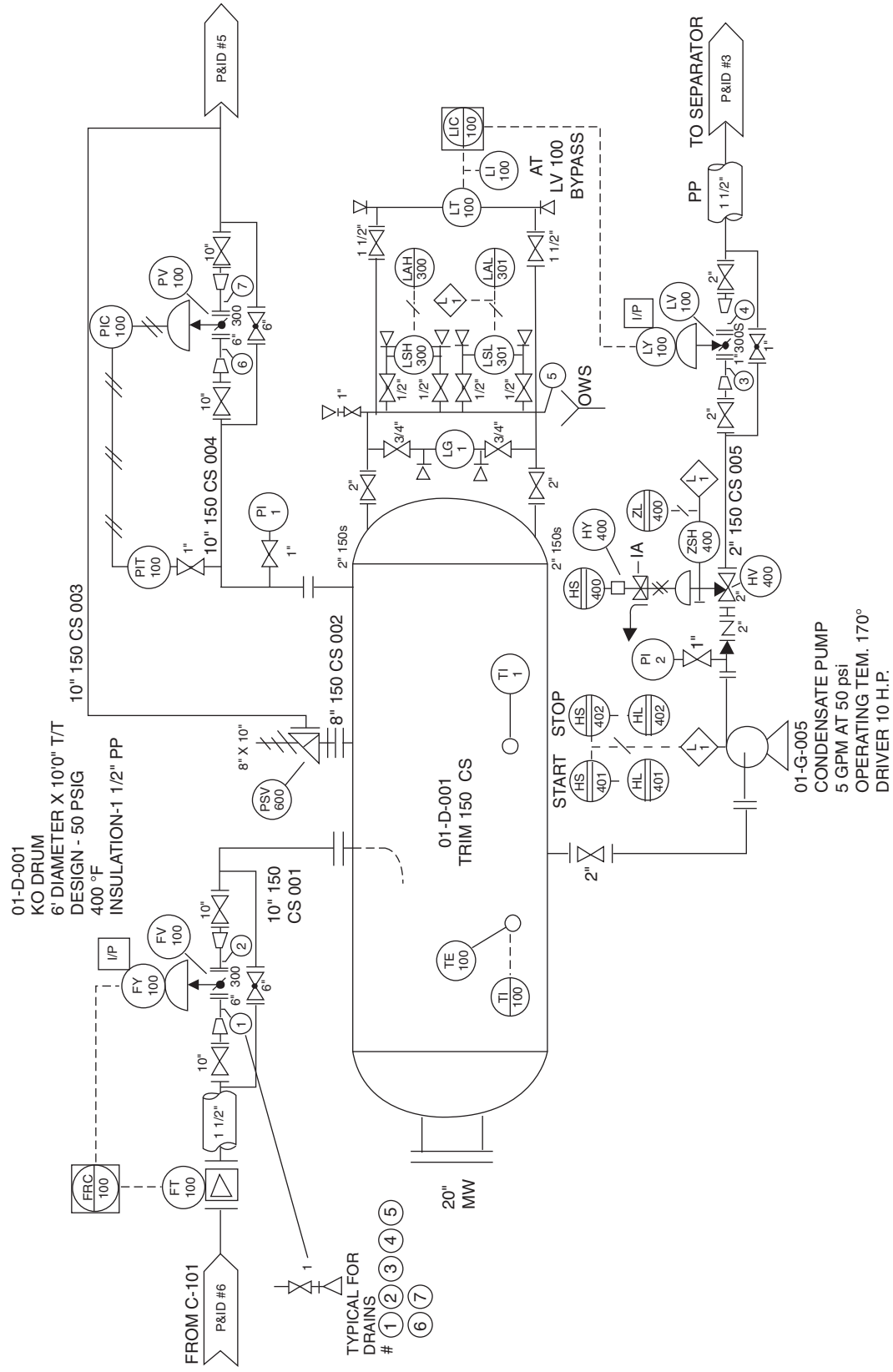


Figure 1.3 P&ID.

There are several switches and indicator lights on a local (field) mounted panel, including hand-operated switches and lights HS and ZL-400, HS and HL-401, and HS and HL-402. Other control system components are also included in the drawing.

The P&ID also includes piping and mechanical equipment details; for instance, the data string “10” 150 CS 001” associated with an interconnecting line defines it as a pipe with the following characteristics:

- 10” = nominal pipe size
- 150 = ANSI 150 Class 150 rated system
- CS = carbon steel pipe
- 001 = associated pipe is line number 1

The project standards, as defined on a legend sheet, will establish the format and terms used in the data string.

1.5 Loop and Tag Numbering

A unique loop number is used to group a set of functionally connected process control elements. Grouped elements generally include the process variable measurement, an indication or control element, and often a manipulated variable. Letters combined with the loop number comprise a tag number. Tag numbers provide unique identification for each I&C component. All the devices that make up a single process control loop have the same number but use different letter designations to define their process function. The letter string is formatted and explained on a legend sheet based on ANSI/ISA-5.1-2024, Table 1.

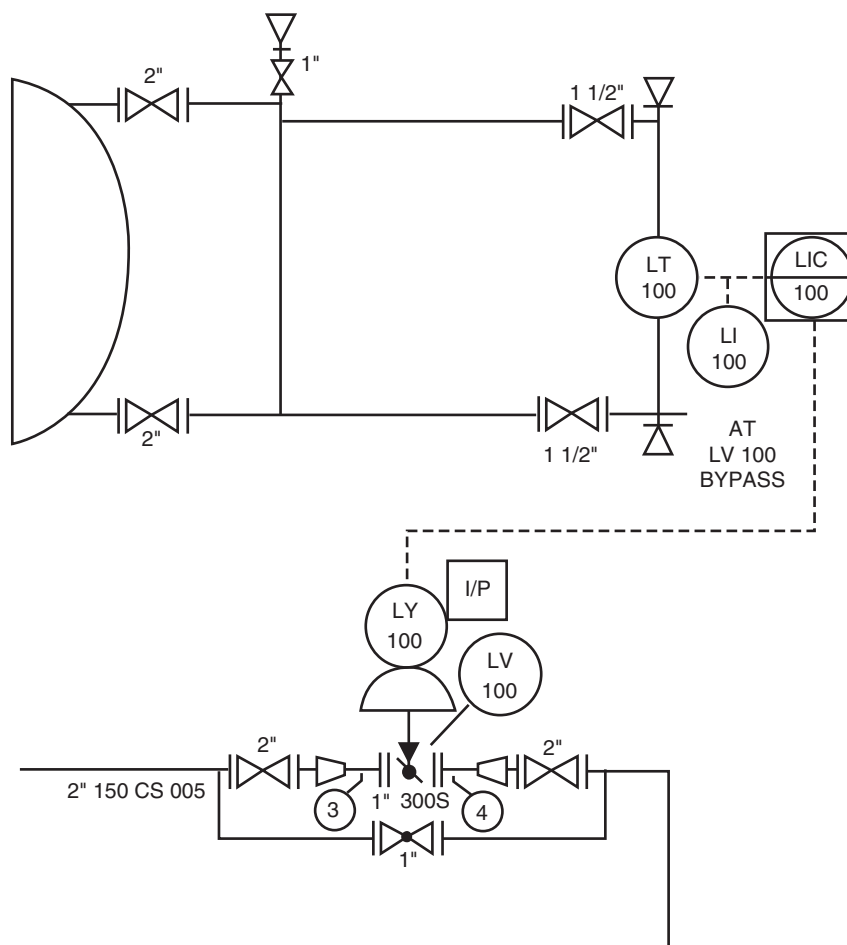


Figure 1.4 Level loop LIC-100.

Figure 1.3 illustrates a P&ID with a parallel numbering system using a single loop number (100) with multiple process variables, flow, level, and temperature. The flow loop is FRC-100, the level loop is LIC-100, and the temperature loop is TI-100.

Figure 1.4 consists of LT-100, a field-mounted electronic level transmitter; LI-100, a field-mounted electronic indicator; LIC-100, a level controller that is part of the control system; LY-100, a current-to-pneumatic (I/P) converter; and LV-100, a pneumatic butterfly control valve. In this case, loop L-100 would have some variation of the title “KO Drum 100 Level.” ISA-5.1 states that loop numbers may be parallel, using a single numeric sequence for all process variables, or serial, requiring a new number for each process variable.

A significant amount of implied information is associated with a P&ID, information that is further augmented by the project standards. For example, experienced designers will determine from the P&ID that there is a 10 hp pump to start and control. A specific number of various-sized valves, gaskets, bolts, piping, and specific vessels and associated safety relief equipment are required. Wiring to power instruments, transmit analog signals, and interconnect and display the status of switches are all defined within the information on this drawing. There are numerous lists, purchasing activities, and even equipment foundations to be prepared, all from what appears to be a moderately simple document.

1.6 Instrument Lists

The *instrument list*, also called an *instrument index*, is an alphanumeric listing of all tag-number-identified devices. The list or index provides a place to record each tag number identifier, the associated device, and relevant drawings and documents.

Table 1.1 is a partial listing that includes the level devices on the D-001 K.O. drum – LG-1, level gauge; LT-100, level transmitter; and LI-100, level indicator – all of which are shown in Figure 1.3. Note that the list includes instruments on P&IDs that were not included in the figures for this chapter. Table 1.1 has nine columns: Tag, Description, P&ID, Spec Form, Requisition, Location Plan, Installation Detail, Piping Drawing, and Loop Diagram. The I&C group develops the instrument list.

There is no ISA standard defining an instrument list; thus, the list may contain as many columns as the project design team or the owner needs to support the work, including design, procurement, maintenance, and even operation. The data in the document will have various uses during the life of the facility. In the example index, level gauges are designated as “n/a” (not applicable) in the loop drawing column because, for this facility, gauges are mechanical devices that are not wired to the control system; therefore, no loop drawings are made for them. This is a common approach, but a facility may choose to prepare and use loop diagrams for all components, even when they do not wire to anything.

1.7 Specification Forms

The I&C group defines tag-numbered physical devices on *specification forms*, also known as *data* or *spec sheets*. The forms include information required during the project design and procurement phase, enabling vendors and contractors to quote on and supply the correct devices. The forms are used to record the features and capabilities of the devices, including

Table 1.1 A typical instrument list.

Tag	Description	P&ID	Spec Form	Requisition	Location Plan	Installation Detail	Piping Drawing	Loop Diagram
LG-1	D-001-K.O. Drum	1	L-1	L-1	—	—	ISO-010	n/a
LG-2	D-001 Distil. Column	2	L-1	L-1	—	—	ISO-015	n/a
LG-3	C-002 Stripper	3	L-1	L-1	—	—	ISO-016	n/a
LT-100	D-001 K.O. Drum	1	L-100	T-1	LP-1	ID-001	ISO-010	L-100
LI-100	D-001 K.O. Drum	1	I-100	I-1	LP-1	ID-002	—	L-100
LT-101	C-001 Distil. Column	2	L-100	T-1	LP-4	ID-001	ISO-015	L-101
LT-102	C-002 Stripper	3	L-100	T-1	LP-5	ID-001	ISO-016	L-102

materials of construction, ratings, area classification, range, signal, power, and service. A specification form is completed for each component. In some cases, similar devices can all be listed on one specification form, provided the complete model number of the listed device is the same for all tag numbers listed.

Even though many operating companies, design firms, and consultants have developed their own spreadsheet-based specification forms, ISA-20-1981, *Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves*, was used for many years. However, as specification requirements and the types of devices increased with technological advances and the growth of automation, this standard was replaced with technical report ISA-TR20.00.01-2007, *Specification Forms for Process Measurement and Control Instruments – Part 1: General Considerations*. The technical report provides forms for many additional devices as well as separate forms for operating parameters (i.e., process conditions/requirements) and device specifications. The forms are also available in an editable Word format. ISA-20-1981 has been subsequently withdrawn. Operating parameter and device specification forms from the CD-ROM that would be used to specify LT-100 (depicted in Figures 1.3 and 1.4) are shown in Figures 1.5 and 1.6.

1	RESPONSIBLE ORGANIZATION		LEVEL DEVICE		6	SPECIFICATION IDENTIFICATIONS	
2			Operating Parameters		7	Document no	
8					Latest revision	Date	
9					Issue status		
10							
11	ADMINISTRATIVE IDENTIFICATIONS				43	SERVICE IDENTIFICATIONS Continued	
12	Project number	Sub project no		44	Process conn diff height		
13	Project			45	Zero datum height		
14	Enterprise			46	Turbulence intensity		
15	Site			47	Inline hazardous area cl	Div/Zone	Group
16	Area	Cell	Unit	48	Inline area min ign temp	Temp ident number	
17				49	Remote hazardous area cl	Div/Zone	Group
18	SERVICE IDENTIFICATIONS			50	Remote area min ign temp	Temp ident number	
19	Tag no/Functional ident			51			
20	Related equipment			52			
21	Service			53			
22				54	COMPONENT DESIGN CRITERIA		
23	P&ID/Reference dwg number			55	Component type		
24	Upper conn nozzle number			56	Component style		
25	Upper conn pipe spec			57	Output signal type		
26	Upper conn nominal size	Rating		58	Characteristic curve		
27	Upper conn termn type	Style		59	Compensation required		
28	Upper conn schedule no	Wall thickness		60	Type of protection		
29	Upper conn length			61	Criticality code		
30	Upper conn orientation			62	Max EMI susceptibility	Ref	
31	Upper conn material type			63	Max temperature effect	Ref	
32	Connection design code			64	Max response time		
33	Lower conn nozzle number			65	Min required accuracy	Ref	
34	Lower conn pipe spec			66	Max dead band		
35	Lower conn nominal size	Rating		67	Avail nom power supply	Number wires	
36	Lower conn termn type	Style		68	Min load capability		
37	Lower conn schedule no	Wall thickness		69	Testing/Listing agency		
38	Lower conn length			70	Test requirements		
39	Lower conn orientation			71	Supply loss failure mode		
40	Lower conn material type			72	Signal loss failure mode		
41	Device insertion length			73			
42	Vessel nominal diameter	Height		74			
75	PROCESS VARIABLES		PROCESS DESIGN CONDITIONS				
76	Condition Identification	Minimum	Normal	Maximum	Units		
77	Pressure						
78	Temperature						
79	Lower material phase type						
80	Lower material density						
81	Lower material sp gr						
82	Lower material viscosity						
83	Lower material level						
84	Upper material phase type						
85	Upper material density						
86	Upper material sp gr						
87	Upper material viscosity						
88	Upper material level						

Figure 1.5 Level device operating parameters form, ISA 20L1001, rev. 0. © International Society of Automation. Used with permission of ISA.

1	RESPONSIBLE ORGANIZATION		DISPLACER-TYPE LEVEL TRANSMITTER OR LOCAL CONTROLLER		6	SPECIFICATION IDENTIFICATIONS	
2			Device Specification		7	Document no	
3					8	Latest revision	Date
4					9	Issue status	
5					10		
11	BODY OR CAGE				60	TRANSMITTER OR CONTROLLER Continued	
12	Body/Cage type				61	Cert/Approval type	
13	Process conn nominal size	Rating			62	Mounting location/type	
14	Process conn termn type	Style			63	Span-Zero adjust lct	
15	Flange facing finish				64	Enclosure material	
16	Lower conn location	Upper			65		
17	Gage glass conn nom size	Rating			66		
18	Gage glass conn type	Style			67		
19	Vent/Drain conn nom size	Rating			68	PERFORMANCE CHARACTERISTICS	
20	Vent/Drain termn type	Style			69	Max press at design temp	At
21	Head orientation/type				70	Min working temperature	Max
22	Extension/Heat insulator				71	Accuracy rating	
23	Body/Cage material				72	Level Lower Range-Limit	URL
24	Bolting material				73	Min level span	Max
25	Gasket/O ring material				74	Min differential sp gr	
26					75	Min ambient working temp	Max
27					76	Contacts ac rating	At max
28					77	Contacts dc rating	At max
29	SENSING ELEMENT				78		
30	Sensor type				79		
31	Sp gr Lower Range-Limit	URL			80		
32	Displacer diameter	Length			81	ACCESSORIES	
33	Extension length				82	Connecting cables length	
34	Displacer material				83	Air set filter style	
35	Torque tube/Spring matl				84	Air set gauges	
36	Extension/Cable material				85	Gage glass style	
37	Trim material				86	Gage valve style	
38					87		
39					88		
40	CONNECTION HEAD				89	SPECIAL REQUIREMENTS	
41	Type				90	Custom tag	
42	Enclosure type no/class				91	Reference specification	
43	Signal termination type				92	Special preparation	
44	Cert/Approval type				93	Compliance standard	
45	Enclosure material				94	Construction code	
46					95	Software configuration	
47					96		
48					97		
49	TRANSMITTER OR CONTROLLER w/wo SWITCHES				98	PHYSICAL DATA	
50	Housing type				99	Estimated weight	
51	Output signal type				100	Overall height	
52	Enclosure type no/class				101	Removal clearance	
53	Control mode				102	Upper to lower conn lg	
54	Digital communication std				103	Lower to drain conn lg	
55	Signal power source				104	Signal conn nominal size	Style
56	Contact wiring		Quantity				

Figure 1.6 Displacer-type level transmitter or local controller specifications form, ISA 20L2121, rev. 0. © International Society of Automation. Used with permission of ISA.

1.8 Logic Diagrams

Continuous process control is shown clearly on P&IDs; however, different presentations are needed for on-off control. Logic diagrams are one form of these presentations. ISA's logic diagram symbols are shown in ISA-5.1. (Note: With the inclusion of logic symbols and use examples in ISA-5.1, ISA-5.2 has been withdrawn and archived.)

Figures 1.7 and 1.8 show ISA symbols AND, OR, NOT, and MEMORY (FLIP-FLOP) and explain their meaning. Other sets of symbols and other methods may be used to document on-off control, for example text descriptions, a written explanation of the on-off system, ladder diagrams, and electrical elementary diagrams or drawings. Figure 1.9 is an example of logic and elementary diagrams for simple start-stop motor control.

1.9 Location Plans (Instrument Location Drawings)

No ISA standard defines or describes a location plan or an instrument location drawing. Location plans may show the ordinate location, X and Y, and, if the user chooses, the elevation, Z, of control components on plan drawings of a plant.

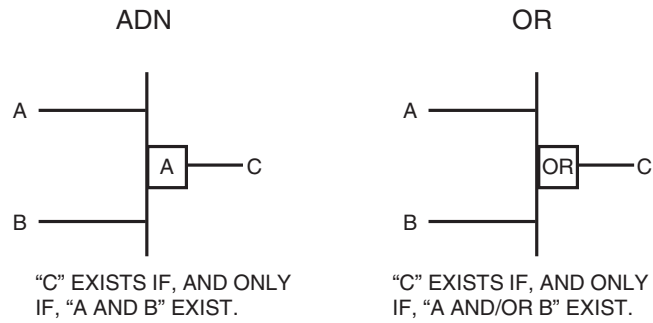


Figure 1.7 Basic binary logic symbols.

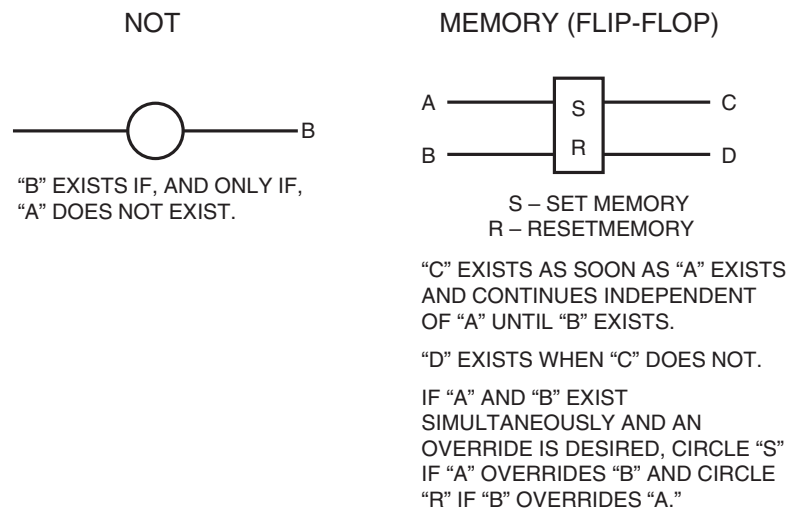


Figure 1.8 Binary logic symbols NOT and MEMORY (FLIP-FLOP).

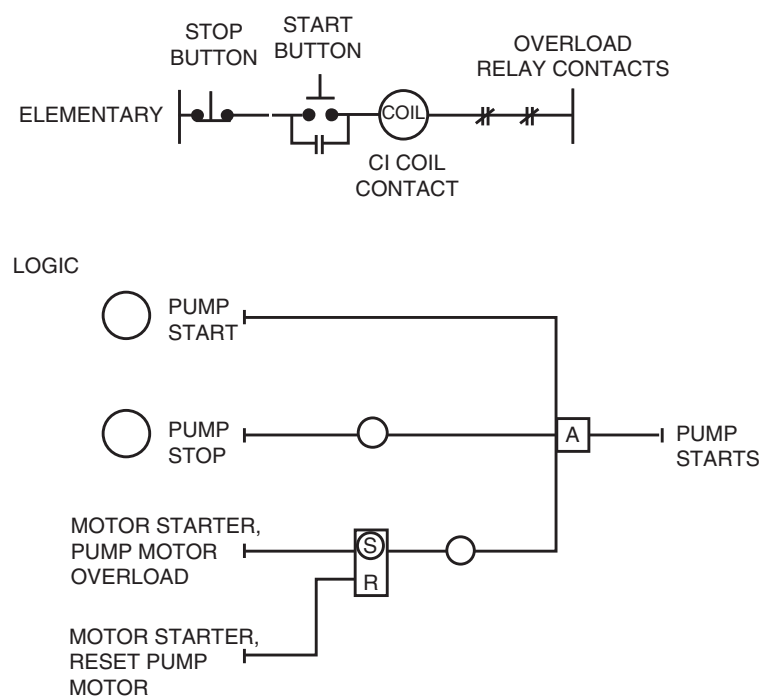


Figure 1.9 Motor start logic.

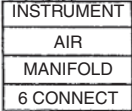


Figure 1.10 Excerpt from a location plan. The final drawing of the equipment in an area must include a “Plant North” arrow.

Orthographic drawings may also be developed for complex installations to aid in construction, future maintenance, and operations.

Figure 1.10 illustrates one approach for a location plan. It shows the approximate location and elevation of the tag-marked devices included on the P&ID (see Figure 1.3), air supplies for the devices, and the interconnection tubing needed to complete the pneumatic loop. Other approaches to location plans might include conduit and cabling information and fitting and junction box information. The I&C or the electrical group develops location plans. Maintenance personnel use them during construction and after the plant is built to locate the various devices.

1.10 Installation Details

Installation details define the requirements for properly installing the instrumentation. The installation details show process connections, pneumatic tubing, and conduit connections; insulation and even winterizing requirements; and support methods. No ISA standard defines installation details. However, libraries of installation details have been developed and maintained by engineering contractors, I&C device suppliers, plant owners, installation contractors, and individual designers. They all have the same aim – successfully installing the device so that it operates properly and can be maintained.

Figure 1.11 shows one approach. This drawing includes a material list to aid in procuring and allocating installation materials.

Installation details may be developed by the I&C group during the design phase. However, they are sometimes developed by the installer during construction or by an equipment supplier.

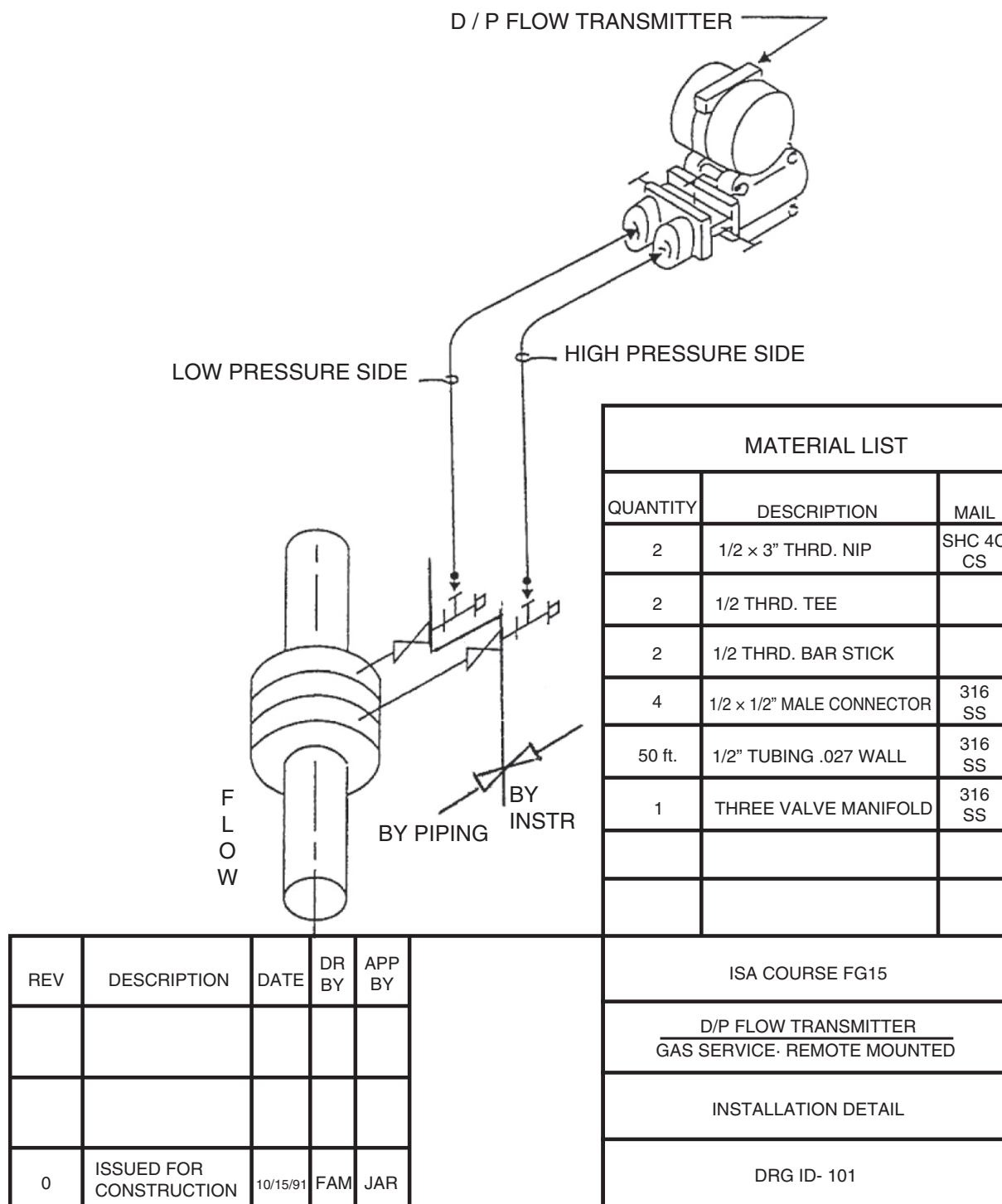


Figure 1.11 Flow transmitter installation detail.

1.11 Loop Diagrams

ISA's *Automation, Systems, and Instrumentation Dictionary* defines a *loop diagram* as “a schematic representation of a complete hydraulic, electric, magnetic, or pneumatic circuit” [2]. The circuit is called a *loop*. For a typical loop, see Figure 1.4. ISA-5.4-1991, *Instrument Loop Diagrams*, presents six typical loop diagrams, two each for pneumatic, electronic, and shared display and control. One of each type shows the minimum items required, and the other shows additional optional items.

Figure 1.12 is a loop diagram for electronic flow loop FIC-301. Loop diagrams are helpful for maintenance and troubleshooting because they illustrate how the components are connected from the process to the control device, all on one 11 × 17 in sheet. The loop diagram is useful for troubleshooting as it shows all the elements that could interact in one drawing. Loop diagrams are sometimes produced by the principal project I&C supplier, the installation contractor, or the plant owner's operations, maintenance, or engineering personnel. They are arguably less helpful for construction because other, more efficient presentations are customized to present only information that supports initial construction efforts, such as cable and conduit schedules and termination lists. Sometimes loop diagrams are produced as needed after the plant is running.

Ultimately, a loop diagram is a maintenance document for the facility owner. As such, it must be efficient and pocket-sized. The originals are B-size drawings, 11 × 17 in format, that are easily stored on desktops and folded to carry to the field in a pocket. Often, operating versions of the drawing will be copied half-size and maintained in three-ring binders on bookshelves. The operative intent is for them to be legible even when reduced to 8 1/2 in × 11 in.

1.12 Operating Instructions

Operating instructions, also known as *control narratives*, are necessary to operate a complex plant. They range from a few pages describing how to operate one part of a plant to a complete set of books covering the operation of all parts of a facility. They might be included in a functional specification or an operating description. There is no ISA standard to aid in developing operating instructions. They might be prepared by a group of project management, process, electrical, and I&C personnel during plant design; however, some owners prefer that their own plant operations personnel prepare these documents for review by the design team to ensure that operations staff understand how the plant should work. The operating instructions guide plant operators and other personnel during normal and abnormal plant operations, including start-up, shutdown, and emergency operation.

The Occupational Safety and Health Administration (OSHA) requires operating procedures for all installations handling hazardous chemicals. Its requirements are defined in government document 29 CFR 1910.119 paragraphs (d) *Process Safety Information*, (f) *Operating Procedures*, and (l) *Management of Change*. The Food and Drug Administration issues Good Manufacturing Practices for many types of food processing and drug manufacturing.

1.13 Standards and Regulations

1.13.1 Mandatory Standards

Federal, state, and local laws establish mandatory requirements: codes, laws, regulations, and requirements. The Food and Drug Administration issues Good Manufacturing Practices. The National Fire Protection Association (NFPA) issues Standard 70, the *National Electrical Code* (NEC). The US government manages about 50,000 mandatory standards. OSHA issues many regulations, including government document 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals* (PSM). Three paragraphs in the PSM list documents that are required if certain hazardous materials are handled. Some of these documents require input from the plant I&C group.

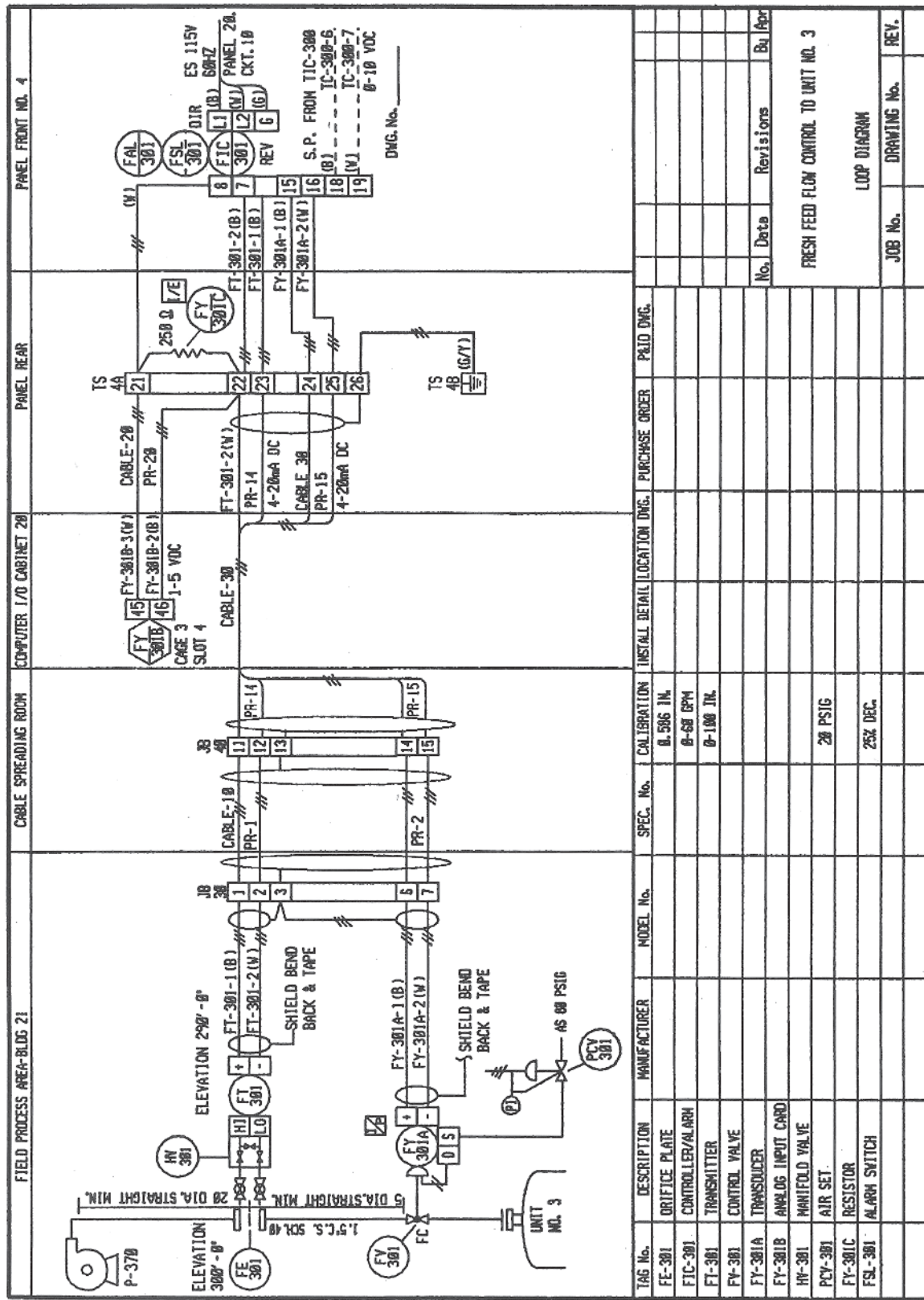


Figure 1.12 An electronic control loop diagram with the minimum required and optional items. ISA-5.4, *Instrument Loop Diagrams*, Figure 5. © International Society of Automation. Used with permission of ISA.

1.13.2 Consensus Standards

Consensus standards include recommended practices, standards, and other documents developed by professional societies and industry organizations. The standards developed by ISA are the ones used most often by I&C personnel. Relevant ISA standards include the following:

- ANSI/ISA-5.1-2024, *Instrumentation and Control Symbols and Identification* – Per the ISA website, “This standard establishes a uniform means of depicting and identifying instruments or devices and their inherent functions, instrumentation systems and functions, and application software functions used for measurement, monitoring, and control, by presenting a designation system that includes identification schemes and graphic symbols.” It applies to a wide range of drawing types.
- ISA-TR5.1.01/ISA-TR77.40.01-2012 (R2016), *Functional Diagram Usage* – This technical report provides advice and guidance in documenting application software through functional diagramming.
- ISA-TR5.1.02-2024, *Instrumentation and Control Identification System Guidelines* – Per the ISA website, “This technical report is designed to provide guidance, rationale, and examples of identification of instrumentation and control equipment and functions.”
- ISA-TR5.1.03-2024, *Instrumentation and Control Graphic Symbol Guidelines* – Per the ISA website, “This technical report is designed to provide guidance and examples of symbols for instrumentation and control equipment and functions.”
- ISA-TR5.1.04-2026, *Instrumentation and Control Content for PFDs and P&IDs* – This technical report provides guidelines for developing the I&C content for process flow diagrams and piping and instrumentation diagrams.
- ISA-5.2-1976 (R1992), *Binary Logic Diagrams for Process Operations* – This standard has been withdrawn and archived. The original content and additional and updated information are in ANSI/ISA-5.1-2024.
- ISA-5.3-1983, *Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems* – This standard has been withdrawn and archived. The original content and additional and updated information are now in ANSI/ISA-5.1-2024.
- ISA-5.4-1991, *Instrument Loop Diagrams* – This standard provides guidelines for preparing and using instrument loop diagrams in designing, starting up, operating, maintaining, and modifying instrumentation systems.
- ISA-5.5-1985, *Graphic Symbols for Process Displays* – This standard establishes a set of symbols used in process displays.
- ISA-TR20.00.01-2007, *Specification Forms for Process Measurement and Control Instruments – Part 1: General Considerations*. The standard contains PDF forms that cover a wide range of instrumentation and include operating parameters, device specifications, and general requirements as well as guidance for entering data and units. The forms are also available in an editable Word format. This TR replaces ISA-20-1981, which has been withdrawn.
- ANSI/ISA-61511-2018/IEC 61511-2016, *Functional Safety – Safety Instrumented Systems for the Process Industry Sector*, Parts 1, 2, and 3 – These standards provide requirements for safety instrumented system (SIS) specifications, design, installation, operation, and maintenance as well as guidance on applying safety integrity levels (SILs) and safety instrumented functions (SIFs).
- ANSI/ISA-88.01-1995 (R2006), *Batch Control – Part 1: Models and Terminology* – This standard shows the relationships between the models and the terminology.

In addition to ISA, other organizations develop documents to guide professionals. These organizations include the American Petroleum Institute, American Society of Mechanical Engineers, National Electrical Manufacturers Association, Process Industry Practice, International Electrotechnical Commission, and Technical Association of the Pulp and Paper Industry.

1.14 Summary

The control system document types described here represent a typical set that has evolved over many years and proven effective for both continuous and batch process applications. The referenced standards and regulations provide consistent terminology and symbols, helping ensure the documents are easily understood across all disciplines. To preserve clarity and maintain compliance throughout the system’s lifecycle, each discipline must routinely update and manage its portion of the documentation.

Abbreviations

ANSI	American National Standards Institute
I&C	instrumentation and control
NEC	<i>National Electrical Code</i>
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
P&ID	piping and instrumentation diagram
PFD	process flow diagram
PSM	<i>Process Safety Management of Highly Hazardous Chemicals</i>

References

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Further Information

Note: The dates and editions for standards and other references in this chapter are current as of publication. The reader is encouraged to check for later revisions or editions.

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