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TECHNICAL SPECIFICATION

HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

INSTRUMENTATION SYMBOLS AND IDENTIFICATION

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REFERENCE DOCUMENTS

- **ISA S5.1 (2009)**
  [Instrumentation Symbols and Identification]

1. GENERAL

Instruments shall be identified by a system of letters and numbers generally in accordance with **the Instrument Society of America (ISA) Standard S5.1-2009**, extracts from which follow.

Each instrument will be identified first by a system of letters used to classify it functionally. To establish a loop identity for the instrument, a number will be appended to the letters. This number will, in general, be common to other instruments of the loop of which this instrument is a part. A suffix is sometimes added to complete the loop identification.

Where **ISA Standards S5.1** offer alternate methods of presentation, Owner practice is to use the method requiring the fewest symbols.

Symbols will not be shown for the following:

a) Valve positioners.

b) Field mounted I/P transducers, when no solenoid valve or other device is in line between I/P and valve.

c) Balloons identifying flow and temperature primary elements.

d) Multiplexing, when used for panel mounted temperature indication only.

e) Local process variable indicators on transmitter outputs, unless it is intended to designate a special location for the indicator, as shown by a note next to the tagging balloon.

2. IDENTIFICATION SYSTEM GUIDELINES

2.1. Identification system

This clause describes an Identification System for monitoring and control instrument devices and functions that is logical, unique, and consistent in application with a minimum of exceptions, special uses, or requirements.

The Identification System provides methods for identifying instrumentation required to monitor, control, and operate a unit operation, boiler, machine, processing plant or any other system that requires measurement, detection, indication, control, modulation, and/or switching of variables or states.

A multi-component monitor or control loop consists of some or all of the following (as indicated):

a) Measurement or detection of process variable or state (monitor and control):

1) Measurement element, such as an orifice plate or thermocouple.

2) Measurement transmitter or indicator:

- With an integral-measuring element, such as a pressure-actuated transmitter or gauge.
- With a non-integral-measuring element, such as a thermocouple actuated temperature transmitter or gauge.

b) Conditioning of measurement or input signal (monitor and control):

1) Calculating devices.

2) Calculating functions.

c) Monitoring of process variable (monitor):

1) Indicating or recording device.

2) Application software display function.

d) Controlling of process variable (control):

1) Indicating or recording control device.

2) Application software control function.

e) Conditioning of controller or output signal (control):

1) Calculating devices.

2) Calculating functions.

f) Modulation of controlled variable (control):

1) Control valve modulation or on-off action.

2) Resetting another control loop setpoint.

3) Limiting another control loop output signal.

A loop number is assigned to each group of components required to perform the desired function of the monitor or control scheme.

A single component monitor or control loop consists of some or all of the following:

a) Self-acting measuring and control devices, such as pressure or temperature control valves.

b) Self-acting measuring and control devices, such as pressure or temperature safety valves.

c) Single point monitoring devices, such as pressure or temperature gauges.

Each single component may be assigned:

a) A unique loop number, indexed with the plant instrumentation.

b) An instrument tag number, indexed separate from the primary plant instrumentation.

c) A coded type number.

2.2. Instrument index

Loop Identification Numbers and Instrument Identification/Tag Numbers are recorded in an Instrument Index that should be maintained for the life of the facility for the recording and control of all documents and records pertaining to the loops and their instrumentation and functions.

An Instrument Index should contain references to all instrumentation data required by owner and/or government regulatory agency management of change requirements and contain, as a minimum for each loop:

a) Loop Identification Number.

b) Service Description.

c) Instrument Identification/Tag Numbers.

d) Piping and Instrumentation Diagram drawing numbers.

e) Instrument Data Sheet numbers.

f) Location Plan drawing numbers.

g) Installation Detail drawing numbers.

2.3. Loop identification and instrument identification/tag numbers

Loop Identification Numbers are unique combinations of letters and numbers that are assigned to each monitoring and control loop in a facility to identify the process or machine variable that is being monitored or controlled.

Instrument Identification/Tag Numbers are unique combinations of letters and numbers that are formed by adding letters to the Loop Identification Number to define the purpose of each loop device and/or function that comprises a monitoring or control loop.

Instrument Identification/Tag Numbers are also called Instrument Identification Number, Instrument Tag Number, Instrument Number, or Tag Number.

2.4. Loop identification number

A Loop Identification Number is a unique combination of letters and numbers that is assigned to each monitoring and control loop in a facility to identify the process or machine variable that is being monitored or controlled and should be assigned to each:

a) Primary monitoring and control loop.

b) Self-contained measuring or control device.

c) Secondary measuring or monitoring device if future primary loops are anticipated or if it is the standard practice of the User.

Loop Identification Numbers assigned, as the basis for Instrument Identification/Tag Numbers to auxiliary or accessory devices, should be the same as the loop for which the devices are required.

Loop Identification Numbers are assigned:

a) First Letters from Table 1 to identify loop Measured/Initiating Variables.

b) Numerals to form a unique loop identity.

c) Optional loop suffixes to identify identical loops on identical pieces of equipment or services.

2.5. Loop identification number letters

Loop Identification Number letters should be selected from Table 1 to identify the loop Measured/Initiating Variable according to one of the following methods selected by the end user:

a) Measured/Initiating Variable: only a Measured/Initiating Variable is selected, such as analysis [A], flow [F], level [L], pressure [P], temperature [T], etc.

b) Measured/Initiating Variable with Variable Modifier: a Measured/Initiating Variable and, when applicable, a Variable Modifier is selected, such as analysis [A], flow [F], flow quantity [FQ], level [L], pressure [P], differential pressure [PD], temperature [T], differential temperature [TD], etc.

c) First-Letters: a Measured/Initiating Variable and, when applicable, a Variable Modifier, only if the resulting First-Letter combination defines a loop variable that can be measured directly, such as pressure differential [PD] as opposed to one that is mathematically derived, such as flow ratio [FF].

A Measured/Initiating Variable in combination with the safety Variable Modifier [S] is always treated as a loop variable in each of the preceding selection methods to identify self-acting

devices intended to protect against emergency conditions that may be hazardous to plant personnel, plant equipment, or the environment.

A Measured/Initiating Variable is selected according to the physical or mechanical property that is being measured, derived or initiates an action and not according to the construction or mode of actuation of the measuring device or the property or the action it initiates:

a) A loop that controls pressure in a vessel by manipulating gas or vapor flow to or from the vessel is a pressure [P] loop and not a flow [F] loop.

b) A loop that measures pressure differential across:

   1) An orifice plate from which flow rate is calculated is a flow [F] loop and not a pressure [P] or pressure differential [PD] loop.

   2) A fluid interface in a vessel is a level [L] loop and not a pressure [P] or pressure differential [PD] loop.

   3) A filter bed or element is a pressure [P] or pressure differential [PD]-loop.

2.6. Loop identification number numerals

Loop Identification Number numerals should be assigned to loop measured variable letters according to one of the following methods selected by the end user:

a) Parallel: duplicated numerical sequences for each loop variable letter or first letter combination.

b) Serial: single numerical sequence regardless of loop variable letter or first letter combination.

c) Parallel/Serial: parallel sequences for selected loop variable letters or first letter combinations and a serial sequence for the remainder.

Loop Number numerical sequences are normally three or more digits, -*01, -*001, -*0001, etc. where the asterisk * can be:

a) Any digit from zero to 9.

b) Coded digits related to drawing numbers, unit numbers, equipment numbers, etc.

*00, *000, *0000, etc. should be used only for special, significant, or critical loops as defined by the User.

000, 0000, 00000, etc. should not be used

Loop Identification letters and numbers should be assigned in accordance with one of the following Loop Numbering Schemes:

a) No. 1 Parallel – Measured/Initiating Variable.

b) No. 2 Parallel – Measured/Initiating Variable with Variable Modifier.

c) No. 3 Parallel – First Letter(s).

d) No. 4 Series – Measured/Initiating Variable.

e) No. 5 Series – Measured/Initiating Variable with Variable Modifier.

f) No. 6 Series – First Letter(s).

g) No. 7 Parallel/Series – Measured/Initiating Variable.

h) No. 8 Parallel/Series – Measured/Initiating Variable with Variable Modifier.

i) No. 9 Parallel/Series – First Letter(s).

Gaps should be left in any sequence to allow for the addition of future loops.

2.7. Optional loop number prefixes

Loop Number Prefixes consisting of any combination of alpha/numeric characters that may be added to Loop Numbers to identify loop location, such as a complex, plant, or unit should be located before the Measured/Initiating Variable

Loop Number Prefixes should:

a) Not necessarily be shown on drawings or indexes but covered by a general note on a legend sheet or a note on each drawing or index sheet.

b) Be shown for all uses on drawings when more than one prefix is required by loops shown on the drawing.

c) Be shown when used in text.

2.8. Instrument identification/tag number

An Instrument Identification/Tag Number is a unique combination of letters and numbers that is assigned to define the purpose of each loop device and/or function that comprises a monitoring or control loop.

Adding a Variable Modifier, if needed, and Succeeding Letters to the Loop Identification Number letters forms an Instrument Identification/Tag Number.

Instrument Identification/Tag Numbers may also be called Instrument Identification Number, Instrument Tag Number, Instrument Number, or Tag Number.

2.9. Function identification letters

Instrument Function Identification letters should be selected from Table 1, Identification Letters, and added to the Loop Identification Number letters to form an Instrument Functional Identity.

The sequence of letters in a Functional Identification should be in the same left-to-right order as the columns in Table 1:

a) Measured or Initiating Variable, from Column 1.

b) Modifier, if required, from Column 2.

c) Passive Readout Function, from Column 3.

d) Active Output Function, from Column 4.

e) Modifier(s), if required, from Column 5.

Functional Identifications should use one Readout/Passive Function or one Output/Active Function to identify each device or function except, as is common for:

a) Indicating /recording controller/switch instruments or functions in which one Passive Function, indicate [I] or record [R] and one Active Function, control [C] or switch [S], is combined to form, for example, pressure recording controller [PRC], or low-pressure indicating switch [PISL].

b) Self-actuated control valves, in which two Active Functions control [C] and valve [V] are combined to form, for example, pressure control valve [PCV].

The number of letters in a Functional Identification should be sufficient to fully describe the functionality of the device or function being identified, but generally should not exceed eight.

Function Modifiers designate the relative value of the measured or initiating variable that actuates the instrument or function, for example for Function Modifier low [L]:

a) [PSL-*01] indicates actuation by a pressure below a setpoint, normally used to indicate a process level that requires operator intervention to prevent a process trip or other unwanted result.

b) [PSLL-*01] indicates actuation below a setpoint lower than the previous example, normally used to indicate a process level that resulted in a process trip.

A device or function common to two or more loops should be assigned a Loop Identification Letter for the loop which actuates the instrument:

a) A solenoid valve that is actuated by a high level switch [LSH] to trip a flow control valve [FV] is assigned to the level [L] loop as an [LY] and not to the flow [F] loop as an [FY].

b) A high signal select device or function that selects the higher signal from a flow [F] loop and a high level [L] override loop is assigned to the flow [F]-loop as an [FY] and not to the level [L] loop as an [LY].

TABLE 1
IDENTIFICATION LETTERS

	First letters (1)		Succeeding letters (15)		
	Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
	Measured/Initiating Variable	**Variable Modifier (10)**	**Readout/Passive Function**	**Output/Active Function**	**Function Modifier**
A	Analysis(2)(3)(4)		Alarm		
B	Burner,Combustion (2)		User's Choice (5)	User's Choice (5)	User's Choice (5)
C	User's Choice (3a)(5)			Control (23a)(23e)	Close (27b)
D	User's Choice (3a)(5)	Difference, Differential, (11a)(12a)			Deviation (28)
E	Voltage (2)		Sensor, Primary Element		
F	Flow, Flow Rate (2)	Ratio (12b)			
G	User's Choice		Glass, Gauge, Viewing Device (16)		
H	Hand (2)				High (27a) (28a)(29)
I	Current (2)		Indicate (17)		
J	Power (2)		Scan (18)		
K	Time, Schedule (2)	Time Rate of Change (12c)(13)		Control Station (24)	
L	Level (2)		Light (19)		Low (27b)(28)(29)
M	User's Choice (3a)(5)				Middle, Intermediate (27c)(28) (29)
N	User's Choice (5)		User's Choice (5)	User's Choice (5)	User's Choice (5)
O	User's Choice (5)		Orifice, Restriction		Open (27a)
P	Pressure (2)		Point (Test Connection)		
Q	Quantity (2)	Integrate, Totalize (11b)	Integrate, Totalize		
R	Radiation (2)		Record (20)		Run
S	Speed, Frequency (2)	Safety(14)		Switch (23b)	Stop
T	Temperature (2)			Transmit	
U	Multivariable (2)(6)		Multifunction (21)	Multifunction (21)	
V	Vibration, Mechanical Analysis (2)(4)(7)			Valve, Damper, Louver (23c)(23e)	
W	Weight, Force (2)		Well, Probe		

X	Unclassified (8)	X-axis (11c)	Accessory Devices (22), Unclassified (8)	Unclassified (8)	Unclassified (8)
Y	Event, State, Presence (2)(9)	Y-axis (11c)		Auxiliary Devices (23d)(25)(26)	
Z	Position, Dimension (2)	Z-axis (11c), Safety Instrumented System +(30)		Driver, Actuator, Unclassified final control element	

3. MEANING OF INDENTIFICATION LETTERS

The following notes, indicated in Table 1 by parentheses, are to be used as an aid in understanding the meanings of the letters when they are used in certain positions in Loop Identification Letter(s) or Functional Identifications.

(1) First Letters are a Measured/Initiating Variable and, if required, a combination of a Measured/Initiating Variable and a Variable Modifier that shall be referred to by the combined meaning.

(2) The specific meanings given for Measured/Initiating Variables [A], [B], [E], [F], [H], [I], [J], [K] [L], [P], [Q], [R], [S], [T], [U], [V], [W], [Y], and [Z] shall not be modified.

(3) Measured/Initiating Variable analysis [A] shall be used for all types of process stream composition and physical property analysis. The type of analyzer, and for stream component analyzers the components of interest, shall be defined outside the tagging bubble.

(a) “User’s Choice” Measured/Initiating Variables [C], [D], and [M] are assigned to identify conductivity, density, and moisture analysis, respectively, when it is the user’s common practice.

(4) Measured/Initiating Variable analysis [A] shall not be used to identify vibration or other types of mechanical or machinery analysis, which shall be identified by Measured/Initiating Variable vibration or mechanical analysis [V].

(5) “User’s Choice” letters [C], [D], [M], [N], and [O] that cover unlisted repetitive meanings that may have one meaning as a Measured or Initiating Variable and another as a Succeeding-Letter shall be defined only once. For example, [N] may be defined as “modulus of elasticity” as a Measured/Initiating Variable and “oscilloscope” as a Readout/Passive Function.

(6) Measured/Initiating Variable multivariable [U] identifies an instrument or loop that requires multiple points of measurement or other inputs to generate single or multiple outputs, such as a PLC that uses multiple pressure and temperature measurements to regulate the switching of multiple on-off valves.

(7) Measured/Initiating Variable vibration or mechanical analysis [V] is intended to perform the function in machinery monitoring that Measured/Initiating Variable analysis [A] performs in

process monitoring and except for vibration, it is expected that the variable of interest will be defined outside the tagging bubble.

(8) First-Letter or Succeeding-Letter for unclassified devices or functions [X] for non-repetitive meanings that are used only once or to a limited extent may have any number of meanings that shall be defined outside the tagging bubble or by a note in the document. For example, [XR-2] may be a stress recorder and [XX-4] may be a stress oscilloscope.

(9) Measured/Initiating Variable event, state, or presence [Y] is intended for use when control or monitoring responses are not driven by time or time schedule--but driven by events, presence, or state.

(10) Measured/Initiating Variable and Variable Modifier combinations shall be selected according to how the property being measured is modified or changed.

(11) Direct measured variables that shall be considered as Measured/Initiating Variables for Loop Numbering shall include but are not limited to:

a) Differential [D] — pressure [PD] or temperature [TD].

b) Total [Q] — flow totalizer [FQ], when directly measured, such as by a positive displacement flowmeter.

c) X-axis, y-axis, or z-axis [X], [Y], or [Z] — vibration [VX], [VY], and [VZ], force [WX], [WY], or [WZ] or position [ZX], [ZY], or [ZZ].

(12) Derived or calculated from other direct measured variables that should not be considered as Measured/Initiating Variables for Loop Numbering shall include but are not limited to:

a) Difference [D] — temperature [TD] or weight [WD].

b) Ratio [F] — Flow [FF], pressure [PF], or temperature [TF].

c) Time rate of change [K] — pressure [PK], temperature [TK], or weight [WK].

(13) Variable Modifier time or time schedule [K] in combination with a Measured/Initiating Variable signifies a time rate of change of the measured or initiating variable; [WK], represents a rate-of-weightloss loop.

(14) Variable Modifier safety [S] is technically not a direct-measured variable but is used to identify self-actuated emergency protective primary and final control elements only when used in conjunction with Measured/Initiating Variables flow [F], pressure [P] or temperature [T]. And because of the critical nature of such devices, [FS, PS, and TS] shall be considered as Measured/ Initiating Variables in all Loop Identification Number construction schemes:

a) Flow safety valve [FSV] applies to valves intended to protect against an emergency excess flow or loss of flow condition. Pressure safety valve [PSV] and temperature safety valve

[TSV] apply to valves intended to protect against emergency pressure and temperature conditions. This applies regardless of whether the valve construction or mode of operation places it in the category of safety valve, relief valve, or safety relief valve.

b) A self-actuated pressure valve that prevents operation of a fluid system at a higher-thandesired pressure by bleeding fluid from the system is a backpressure control valve [PCV], even if the valve is not intended to be used normally. However, this valve is designated a pressure safety valve [PSV] if it protects against emergency conditions hazardous to personnel and/or equipment that are not expected to arise normally.

c) Pressure rupture disc [PSE] and fusible link [TSE] apply to all sensors or primary elements intended to protect against emergency pressure or temperature conditions**.**

d) [S] shall not be used to identify Safety Instrumented Systems and components, see (30).

(15) The grammatical form of Succeeding Letter meanings shall be modified as required; for example, ‘indicate’ [I] may be read as ‘indicator’ or ‘indicating,’ and ‘transmit’ [T] may be read as ‘transmitter’ or ‘transmitting.’

(16) Readout/Passive Function glass, gauge, or viewing device [G] should be used instead of Readout/Passive Function indicate [I] for instruments or devices that provide a secondary view, such as level glasses, pressure gauges, thermometers, and flow sight glasses.

- Also used to identify devices that provide an uncalibrated view of plant operations, such as television monitors.

(17) Readout/Passive Function indicate [I] applies to the analog or digital readout of an actual measurement or input signal to a discrete instrument or a distributed control system's video display unit.

- In the case of a manual loader, it should be used for the dial or setting indication of the output signal being generated, [HIC] or [HIK].

(18) Readout/Passive Function scan [J] when used shall indicate a non-continuous periodic reading of two or more Measured/Initiating Variables of the same or different kinds, such as multipoint temperature and pressure recorders.

(19) Readout/Passive Function light [L] identifies devices or functions that are intended to indicate normal operating status, such as motor on-off or actuator position, and is not intended for alarm indication.

(20) Readout/Passive Function record [R] applies to any permanent or semi-permanent electronic or paper media storage of information or data in an easily retrievable form.

(21) Readout/Passive and Output/Active Function multifunction [U] is used to:

a) Identify control loops that have more than the usual indicate/record and control functions.

b) Save space on drawings by not showing tangent bubbles for each function.

c) A note describing the multiple functions should be on the drawing if needed for clarity.

(22) Readout/Passive Function accessory [X] is intended to identify hardware and devices that do not measure or control but are required for the proper operation of instrumentation.

(23) There are differences in meaning to be considered when selecting between Output/Active Functions for control [C], switch [S], valve, damper, or louver [V], and auxiliary device [Y]:

a) Control [C] means an automatic device or function that receives an input signal generated by a Measured/Initiating Variable and generates a variable output signal that is used to modulate or switch a valve [V] or auxiliary device [Y] at a predetermined setpoint for ordinary process control.

b) Switch [S] means a device or function that connects, disconnects, or transfers one or more air, electronic, electric, or hydraulic signals, or circuits that may be manually actuated or automatically actuated directly by a Measured or Initiating Variable, or indirectly by a Measured or Initiating Variable transmitter.

c) Valve, damper, or louver [V] means a device that modulates, switches, or turns on/off a process fluid stream after receiving an output signal generated by a controller [C], switch [S], or auxiliary device [Y].

d) Auxiliary device [Y] means an automatic device or function actuated by a controller [C]**,** transmitter [T], or switch [S] signal that connects, disconnects, transfers, computes, and/or converts air, electronic, electric, or hydraulic signals or circuits.

e) (e) The succeeding letters *CV* shall not be used for anything other than a self-actuated control valve.

(24) Output/Active Function control station [K] shall be used for:

a) Designating an operator *accessible* control station used with an automatic controller that does not have an integral operator accessible auto-manual and/or control mode switch.

b) Split architecture or fieldbus control devices where the controller functions are located remotely from the operator station.

(25) Output/Active Function auxiliary devices and functions [Y] include, but are not limited to, solenoid valves, relays, and computing and converting devices and functions

(26) Output/Active Function auxiliary devices [Y] for signal computing and converting when shown in a diagram or drawing shall be defined outside their bubbles with an appropriate symbol from Table 3.
Mathematical Function Blocks and when written in text shall include a description of the mathematical function from Table 3

(27) Function Modifiers high [H], low [L], and middle or intermediate [M] when applied to positions of valves and other open-close devices, are defined as follows:

a) High [H], the valve is in or approaching the fully open position, open [O] may be used as an alternative.

b) Low [L] the valve is in or approaching the fully closed position; closed [C] may be used as an alternative.

c) Middle or intermediate [M] the valve is traveling or located in between the fully open or closed position.

(28) Function Modifier deviation [D] when combined with Readout/Passive Function [A] (alarm) or Output/Active Function S (switch) indicates a measured variable has deviated from a controller or other setpoint more than a predetermined amount.

- Function Modifiers high [H] or low [L] shall be added if only a positive or negative deviation, respectively, is of importance.

(29) Function Modifiers high [H], low [L], and middle or intermediate [M] when applied to alarms correspond to values of the measured variable, not to values of the alarm-actuating signal, unless otherwise noted:

a) A high-level alarm derived from a reverse-acting level transmitter signal is an LAH, even though the alarm is actuated when the signal falls to a low value.

b) The terms shall be used in combination as appropriate to indicate multiple levels of actuation from the same measurement, for example high [H] and high-high [HH], low [L] and lowlow

c) [LL], or high-low [HL].

(30) Variable Modifier [Z] is technically not a direct-measured variable but is used to identify the components of Safety Instrumented Systems.

- [Z] shall not be used to identify the safety devices noted in (14).

TABLE 2
TYPICAL LETTER COMBINATIONS

INSTRUMENT FUNCTION / MEASURED VARIABLE	ANALYSIS	DENSITY	FLOW	LEVEL	PRESSURE	PRESSURE DIFFERENTIAL	SPEED	TEMPERATURE	TEMPERATURE DIFFERENCE

ELEMENT	**AE**	**DE**	**FE**	**LE**	**PE**	**PDE**	**SE**	**TE**	**TDE**
INDICATOR	**AI**	**DI**	**FI**	**LI**	**PI**	**PDI**	**SI**	**TI**	**TDI**
TRANSMITTER	**AT**	**DT**	**FT**	**LT**	**PT**	**PDT**	**ST**	**TT**	**TDT**
RECORDER	**AR**	**DR**	**FR**	**LR**	**PR**	**PDR**	**SR**	**TR**	**TDR**
CONTROLLER	**AC**	**DC**	**FC**	**LC**	**PC**	**PDC**	**SC**	**TC**	**TDC**
INDICATING CONTROLLER	**AIC**	**DIC**	**FIC**	**LIC**	**PIC**	**PDIC**	**SIC**	**TIC**	**TDIC**
RECVORDING CONTROLLER	**ARC**	**DRC**	**FRC**	**LRC**	**PRC**	**PDRC**	**SRC**	**TRC**	**TDRC**
CONTROL VALVE	**AV**	**DV**	**FV**	**LV**	**PV**	**PDV**	**SV**	**TV**	**TDV**
CONTROL VALVE-SELF ACTING	**-**	**-**	**-**	**LCV**	**PCV**	**PDCV**	**-**	**TCV**	**-**
SWITCH-LOW	**ASL**	**DSL**	**FSL**	**LSL**	**PSL**	**PDSL**	**SSL**	**TSL**	**TDSL**
SWITCH-HIGHT	**ASH**	**DSH**	**FSH**	**LSH**	**PSH**	**PDSH**	**SSH**	**TSH**	**TDSH**
ALARM-LOW	**AAL**	**DAL**	**FAL**	**LAL**	**PAL**	**PDAL**	**SAL**	**TAL**	**TDAL**
ALARM –HIGHT	**AAH**	**DAH**	**FAH**	**LAH**	**PAH**	**PDAH**	**SAH**	**TAH**	**TDAH**
SOLENOID VALVE	**AY**	**DY**	**FY**	**LY**	**PY**	**PDY**	**SY**	**TY**	**TDY**

BE	**BURNER FLAME DETECTOR**
BS	**FLAME DETECTION SWITCH**
CE	**ELECTRICAL CONDUCTIVITY PROBE**
EI	**VOLTAGE INDICATOR**
EL	**INDICATION LIGHT**
FG	**FLOW SIGH GLASS (FLAPPER ETC.)**
FO	**FLOW RESTRICTION ORIFICE**
FQI	**INDICATION OF INTEGRATED FLOW**
FQIS	**INDICATION OF INTEGRATED FLOW AND SWITCH ACTUATED BY INTEGRATED FLOW**
FY	**FLOW RELAY (EG. RATIO, LINEAIZING)**
HV	**HAND CONTROL VALVE**
HIC	**MANUAL LOADING STATION WITH OUTPUT GAUGE**
HS	**HAND SWITCH**
HLS	**HAND SWITCH WITH INDICATING LIGHT**
HIK	**MANUAL LOADING STATION WITH OUTPUT GAUGE AND PROCESS INDICATION**
LG	**LEVEL GAUGE**
PSE	**RUPTURE DISK**
PRV	**RELIEF VALVE**
ZSL	**POSITION SWITCH (LOW OR CLOSED)**
ZSH	**POSITION SWITCH (HIGH OR OPEN)**
ZLL	**LIGHT IND. LOW OR CLOSED POSITION**
ZLH	**LIGHT IND. HIGH OR OPEN POSITION**
UR	**TREND RECORDER**
W	**MULTIPLEXING UNIT, WHEN USED FOR GENERAL DATA ACQUISITION**

TABLE 3
SIGNAL PROCESSING FUNCTION BLOCK SYMBOLS

NO	Function	Symbol	Definition
1	Summation	Σ	Output equals algebraic sum of inputs
2	Average	Σ/n	Output equals algebraic sum of inputs divided by number of inputs
3	Difference	Δ	Output equals algebraic difference of two inputs.
4	Multiplication	X	Output equals product of two inputs
5	Division	÷	Output equals quotient of two inputs
6	Exponential	X^n	Output equals nth power of input
7	Root extraction	$\sqrt[n]{\ }$	• Output equals nth root of input • If 'n' omitted, square root is assumed
8	Proportion	a) K b) P	• Output proportional to input. • Replace 'K' or 'P' with '1:1' for volume boosters. • Replace 'K' or 'P' with '2:1', '3:1', etc., for integer gains.
9	Reverse proportion	a) -K b) -P	• Output inversely proportional to input. • Replace '-K' or '-P' with '-1:1' for volume boosters. • Replace '-K' or '-P' with '-2:1','-3:1', etc., for integer gains.
10	Integral	a) ∫ b) I	·Output varies with magnitude and time duration of input. ·Output proportional to time integral of input. ·T_I = Integral time constant.
11	Derivative	a) d/dt b) D	·Output proportional to time rate of change of input. ·T_D = derivative time constant.
12	Unspecified function	$f_{(x)}$	·Output is a nonlinear or unspecified function of the input. ·Function defined in note or other text.
13	Time function	$f_{(t)}$	· Output equals a nonlinear or unspecified time function times the input. · Output is a nonlinear or unspecified time function. · Function defined in note or other text.
14	Conversion	I/P	· Output signal type different from that of input signal. · Input signal is on the left and output signal is on the right. · Substitute any of the following signal types for 'P' or 'I': · A = Analog H = Hydraulic

			· B = Binary I = Current · D = Digital O = Electromagnetic · E = Voltage P = Pneumatic · F = Frequency R = Resistance
15	High signal select		Output equals greater of 2 or more inputs.
16	Middle signal select		Output equals middle value of three or more inputs.
17	Low signal select		Output equals lesser of 2 or more inputs.
18	High limit		Output equals the lower of the input or high limit values.
19	Low limit		Output equals the higher of the input or low limit values.
20	Positive bias		Output equal to input plus an arbitrary value.
21	Negative Bias		Output equal to input minus an arbitrary value.
22	Velocity limiter	a)  b) 	Output equals input as long as the input rate of change does not exceed the limit value that establishes the output rate of change until the output again equals the input.
23	High signal monitor		· Output state is dependent on value of input. · Output changes state when input is equal to or higher than an arbitrary high limit.
24	Low signal monitor		· Output state is dependent on value of input. · Output changes state when input is equal to or lower than an arbitrary low limit.
25	High/low signal monitor		· Output states are dependent on value of input. · Output changes state when input is equal to or lower than an arbitrary low limit or equal to or higher than an arbitrary high limit.
26	Analog signal generator		Output equals a variable analog signal that is generated: a.Automatically and is not adjustable by operator. b. Manually and is adjustable by operator.
27	Binary signal generator		· Output equals an on-off binary signal that is generated: a. .Automatically and is not adjustable by operator b. Manually and is adjustable by operator
28	Signal transfer		· Output equals input that is selected by transfer. · Transfer actuated by external signal.

4. SYMBOLS

It is not the intention of this standard to list all symbols or combinations. **ISA Standard S5.1** lists many more.

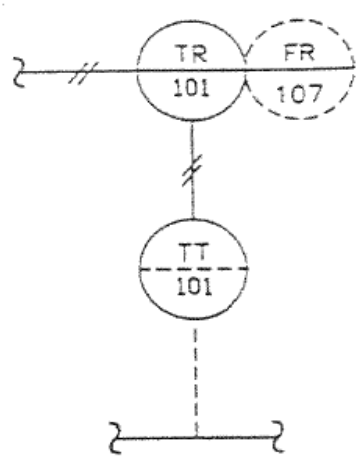
Control valve positioners and control valve electric-to-air converters will not be shown. Therefore, with an electrical system, the controller output (electrical) signal will be schematically shown connected to the valve diaphragm, while the actual installation will have a converter.

Various expedients may be used on individual contracts. For example, the letter "V" just outside the circle can indicate an item supplied by a Package Vendor.

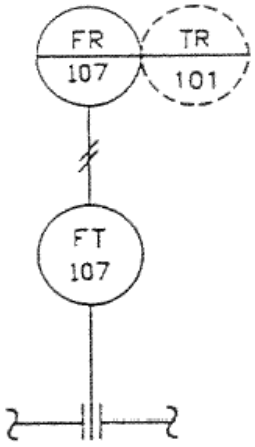
The actuator action in the event of actuating medium failure shall be shown on control valves (see typical control valve symbols).

Software alarms shall follow **ISA Standards section 5.1.** Letter designators shall be placed on the input or output signal lines of controls or other specific system function.

When dual pen instruments are shown on different flow diagrams, a note can show "To second pen on TR-101" or the tangential circle can be shown in phantom as follows:



P/I DIAGRAM No.1



P/I DIAGRAM No.2

Computer functions will be shown as a hexagon. Use modifying letters only since the measured variable "UJ" is implied by the hexagon.

The symbols used to depict instrumentation on flow diagrams and other drawings are shown on **Appendix 1.**

5. ATTACHED DOCUMENTS

1. Appendix 1

[Instrument Symbols]

APPENDIX 1

Line symbols: instrument-to-instrument connections

No	Symbol	Application
1	(1) IA ———	• IA may be replaced by PA [plant air], NS [nitrogen), or GS [any gas supply]. • Indicate supply pressure as required, e.g., PA-70 kPa, NS-150 psig, etc.
2	(1) ES ———	• Instrument electric power supply. • Indicate voltage and type as required, e.g. ES-220 Vac. • ES may be replaced by 24 Vdc, 120 Vac, etc.
3	(1) HS ———	• Instrument hydraulic power supply. • Indicate pressure as required, e.g., HS-70 psig.
4	(2) —//—	• Undefined signal. • Use for Process Flow Diagrams. • Use for discussions or diagrams where type of signal is not of concern.
5	(2) —//—	• Pneumatic signal, continuously variable or binary.
6	(2) – – – – –	• Electronic or electrical continuously variable or binary signal. • Functional diagram binary signal.
7	(2) ———	• Functional diagram continuously variable signal. • Electrical schematic ladder diagram signal and power rails.
8	(2) —⊥—	• Hydraulic signal.
9	(2) —×—	• Filled thermal element capillary tube. • Filled sensing line between pressure seal and instrument.
10	(2) —∿—	• Guided electromagnetic signal. • Guided sonic signal. • Fiber optic cable.
11	(3) a) ∿ ∿ b) ⩘ ⩘	• Unguided electromagnetic signals, light, radiation, radio, sound, wireless, etc. • Wireless instrumentation signal. • Wireless communication link.
12	(4) —o—o—	• Communication link and system bus, between devices and functions of a shared display, shared control system. • DCS, PLC, or PC communication link and system bus.
13	(5) —●—●—	• Communication link or bus connecting two or more independent microprocessor or computer-based systems. • DCS-to-DCS, DCS-to-PLC, PLC-to-PC, DCS-to-Fieldbus, etc. connections.
14	(6) —◇—◇—	• Communication link and system bus, between devices and functions of a fieldbus system. • Link from and to "intelligent" devices.
15	(7) –-o-–-o-–	• Communication link between a device and a remote calibration adjustment device or system. • Link from and to "smart" devices.

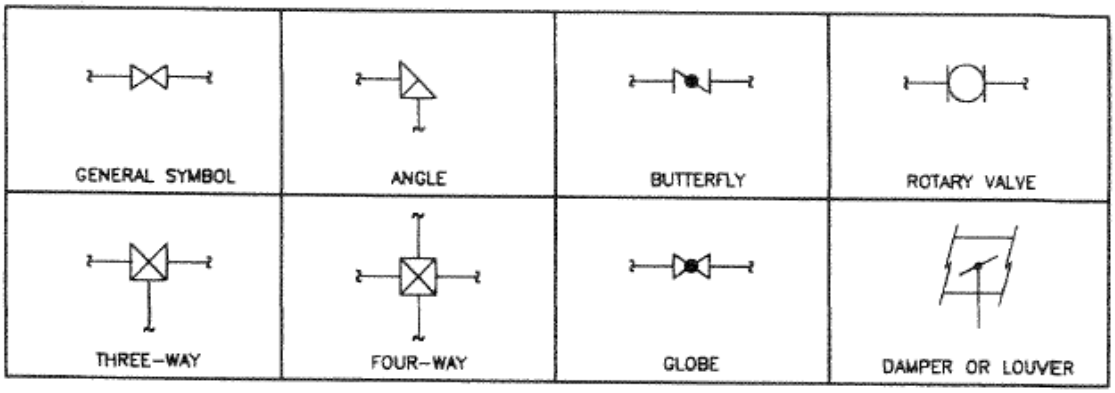
Instrumentation device and function symbols

No.	Shared display, Shared control (1)		C	D	Location & accessibility
	A	B			
	Primary Choice or Basic Process Control System	Alternate Choice or Safety Instrumented System	Computer Systems and Software	Discrete	
1					• Located in field. • Not panel, cabinet, or console mounted. • Visible at field location. • Normally operator accessible.
2					• Located in or on front of central or main panel or console. • Visible on front of panel or on video display. • Normally operator accessible at panel front or console.
3					• Located in rear of central or main panel. • Located in cabinet behind panel. • Not visible on front of panel or on video display. • Not normally operator accessible at panel or console.
4					• Located in or on front of secondary or local panel or console. • Visible on front of panel or on video display. • Normally operator accessible at panel front or console.
5					• Located in rear of secondary or local panel. • Located in field cabinet. • Not visible on front of panel or on video display. • Not normally operator accessible at panel or console.

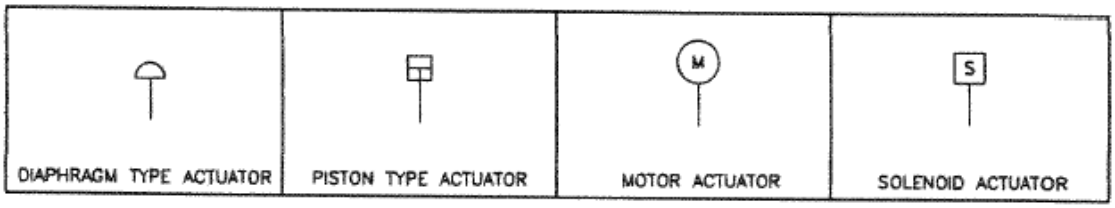
Instrumentation device or function symbols, miscellaneous

No	Symbol	Description
1		• Signal processing function: • Locate in upper right or left quadrant of symbols above. • Attach to symbols above where affected signals are connected. • Insert signal processing symbol from Table 5.6 • Expand symbol by 50% increments for larger function symbols.
2		• Panel-mounted patchboard plug-in point. • Console matrix point. • C-12 equals patchboard column and row respectively, as an example.
3	(7) (8) 	• Generic interlock logic function. • Undefined interlock logic function.
4	(7) (8) 	• 'AND' interlock logic function.
5	(7) (8) 	• 'OR' interlock logic function.
6		• Instruments or functions sharing a common housing. • It is not mandatory to show a common housing. • Notes shall be used to identify instruments in common housings not using this symbol.
7		• Pilot light. • Circle shall be replaced with any symbol from column D in Table 5.1.1 if location and accessibility needs to be shown.

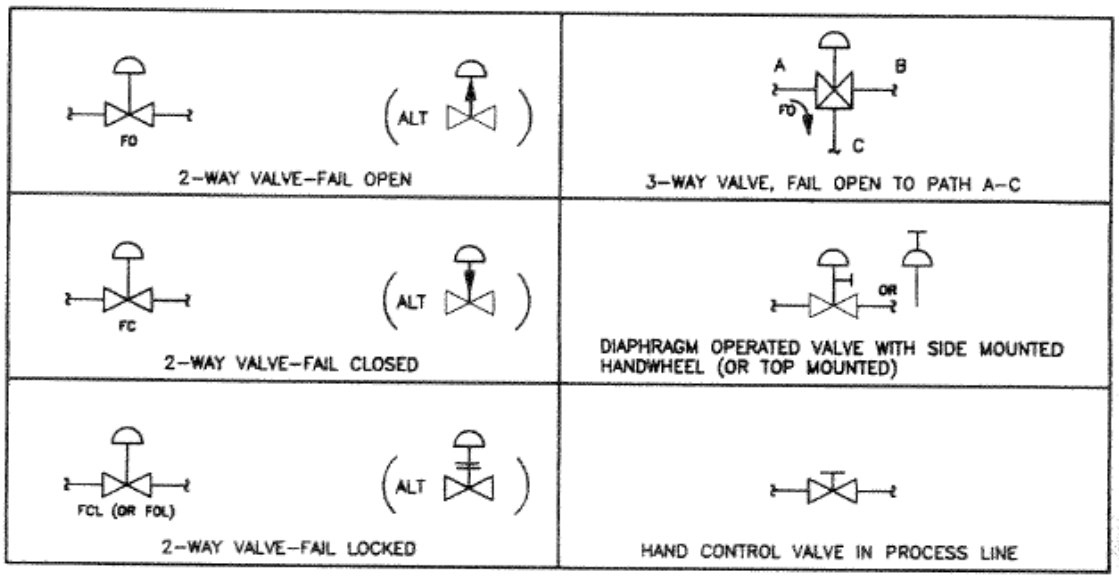
CONTROL VALVE BODY SYMBOLS, DAMPER SYMBOLS



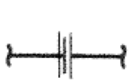
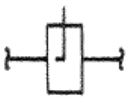
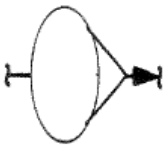
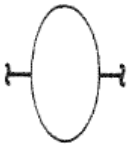
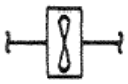
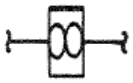
ACTUATOR SYMBOLS

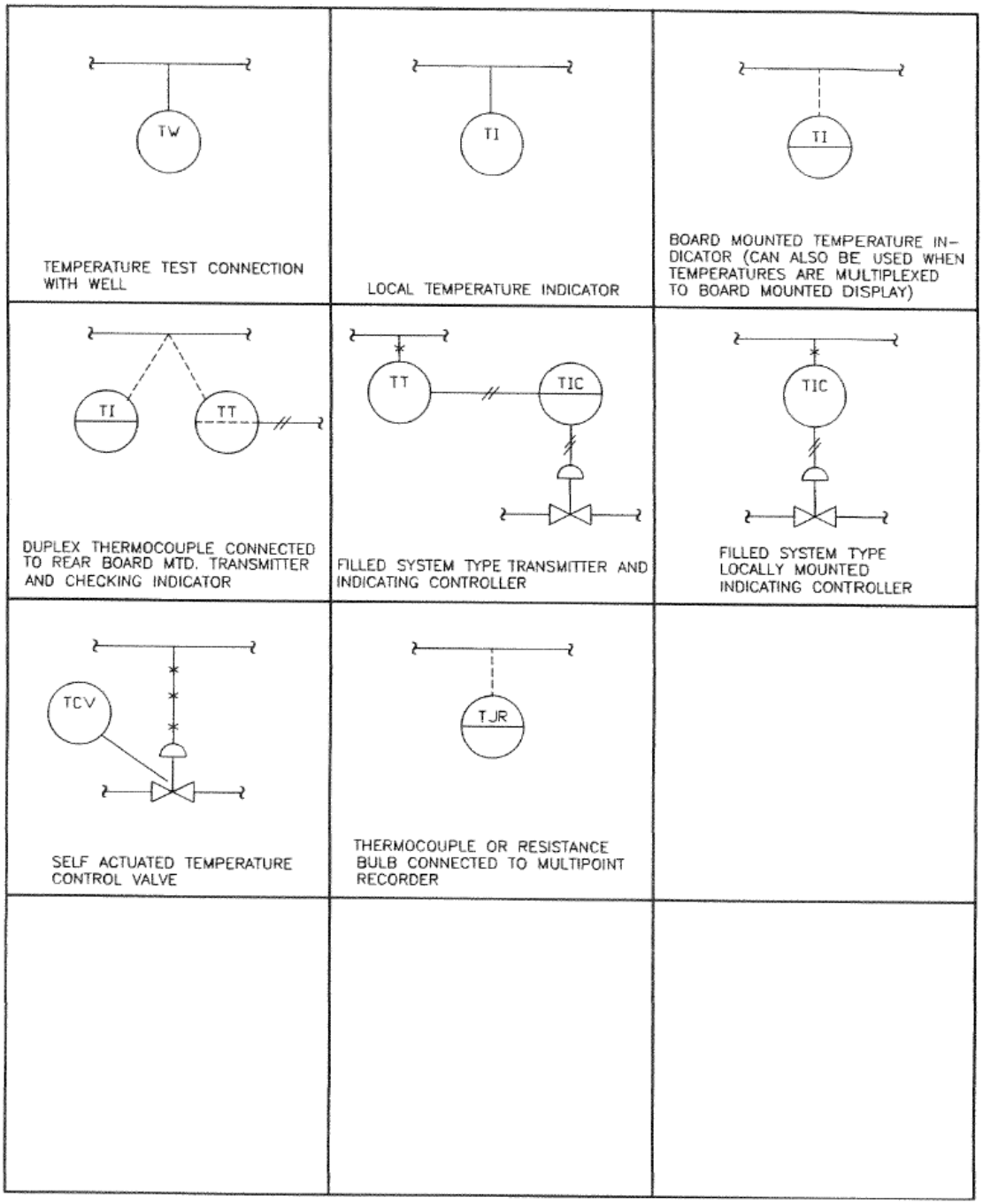


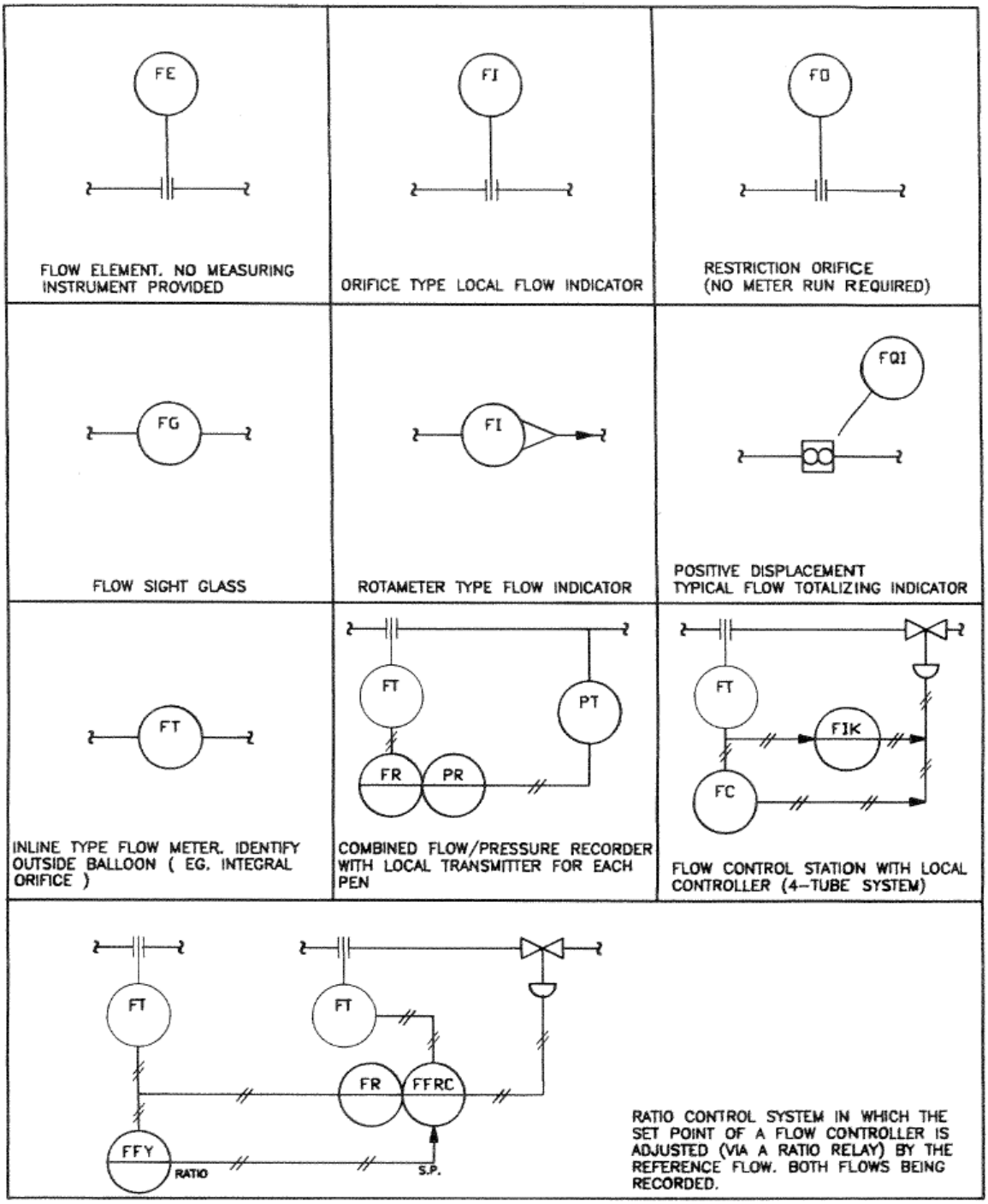
TYPICAL CONTROL VALVE SYMBOLS

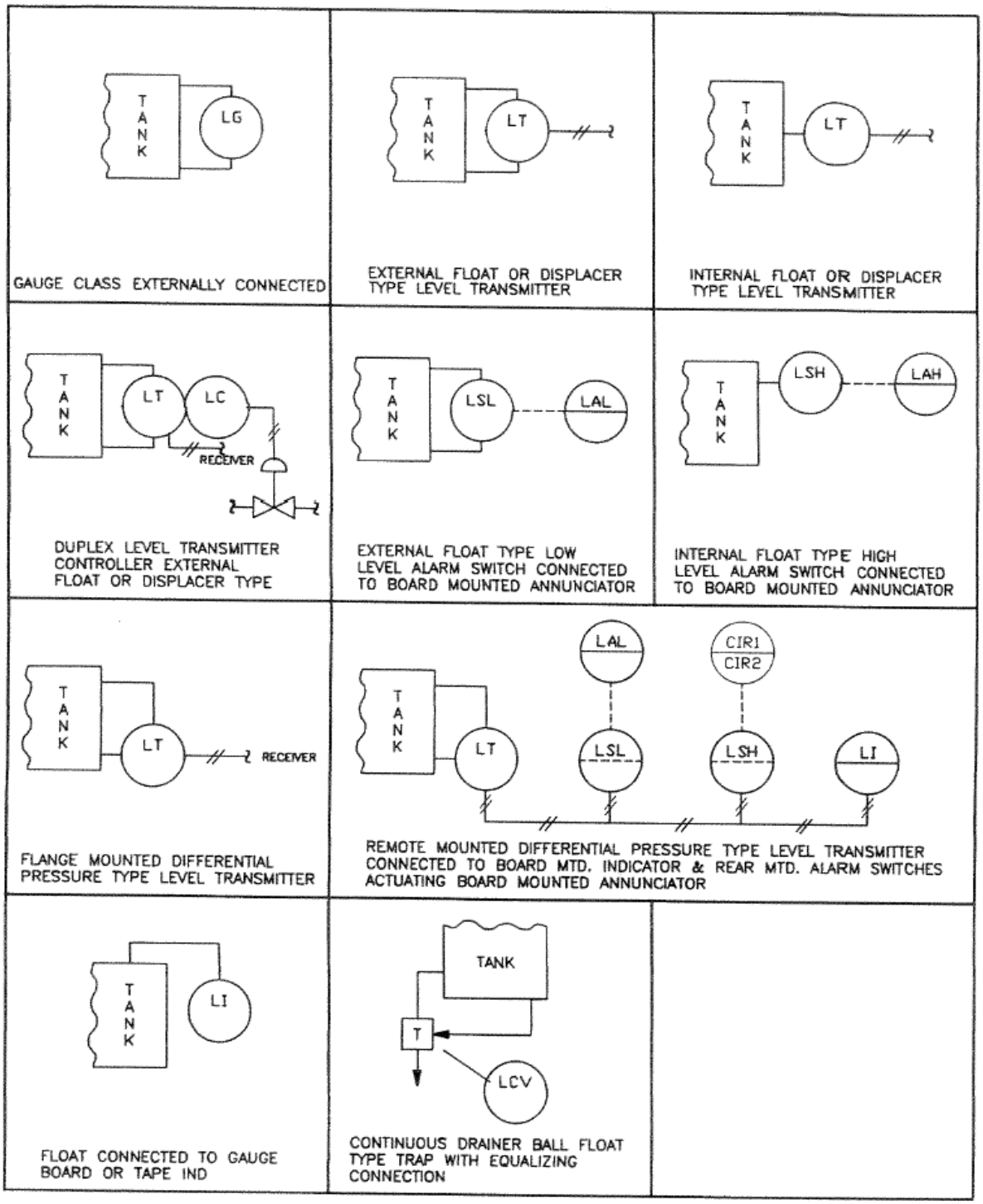


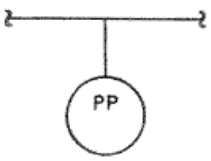
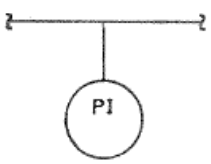
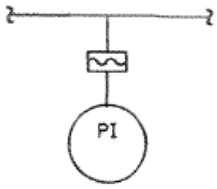
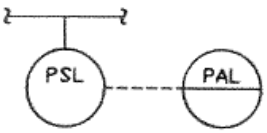
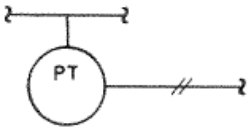
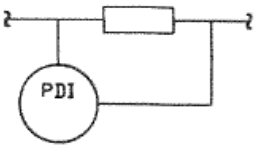
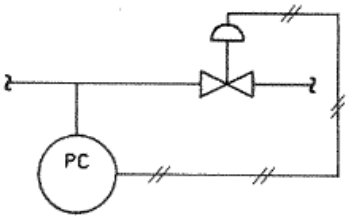
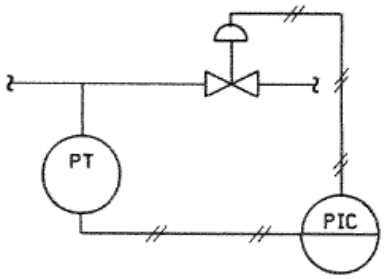
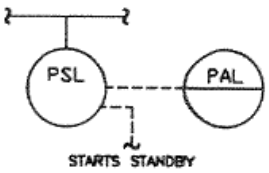
PRIMARY ELEMENT SYMBOLS

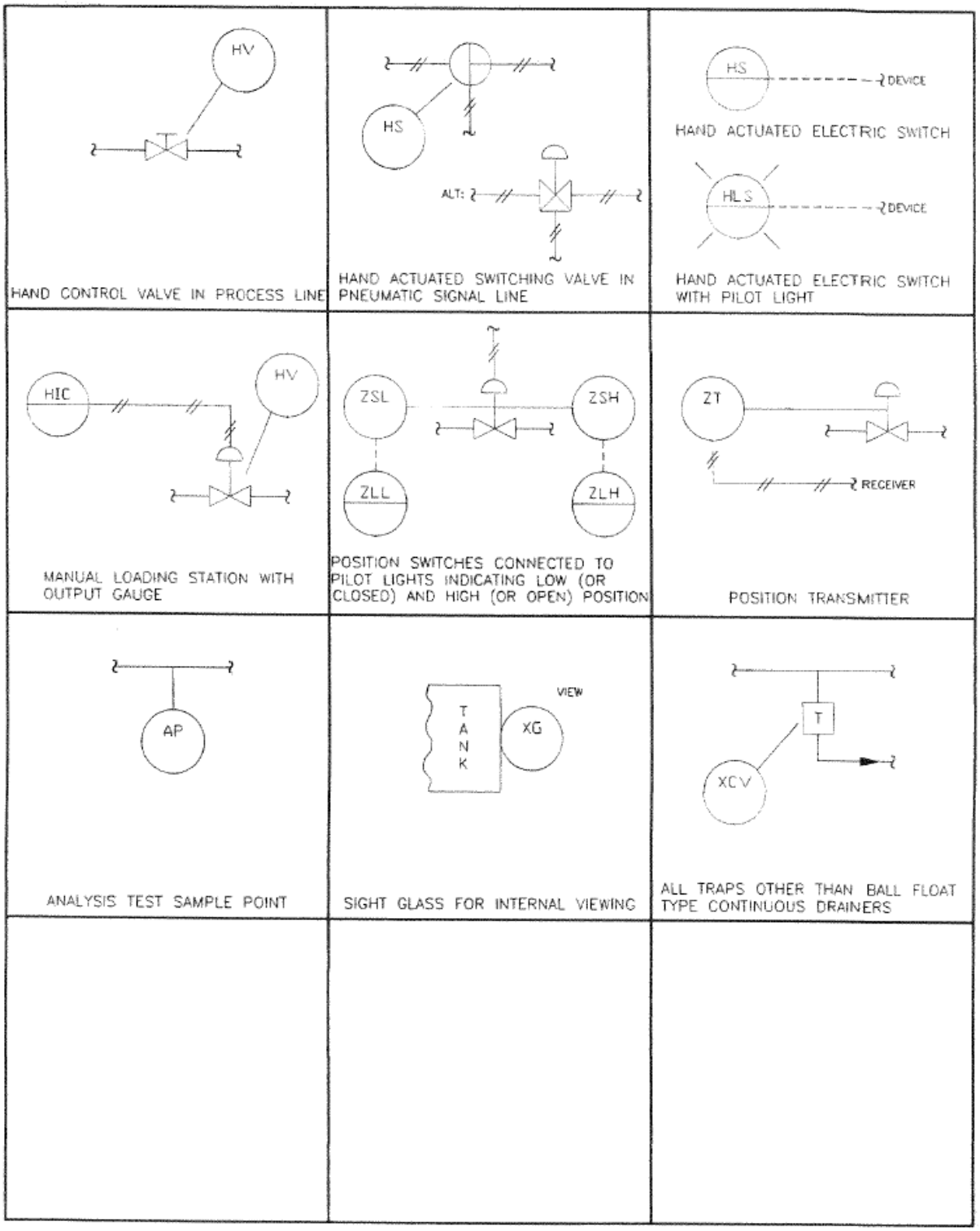
 ORIFICE PRIMARY ELEMENT	 PITOT-TUBE OR ANNUBAR	 VENTURI TUBE OR FLOW NOZZLE	 ROTAMETER TYPE FLOW METER
 LINE TYPE FLOW METER	 VORTEX FLOW METER	 TURBINE METER	 POSITIVE DISPLACEMENT-TYPE FLOW TOTALIZING INDICATOR

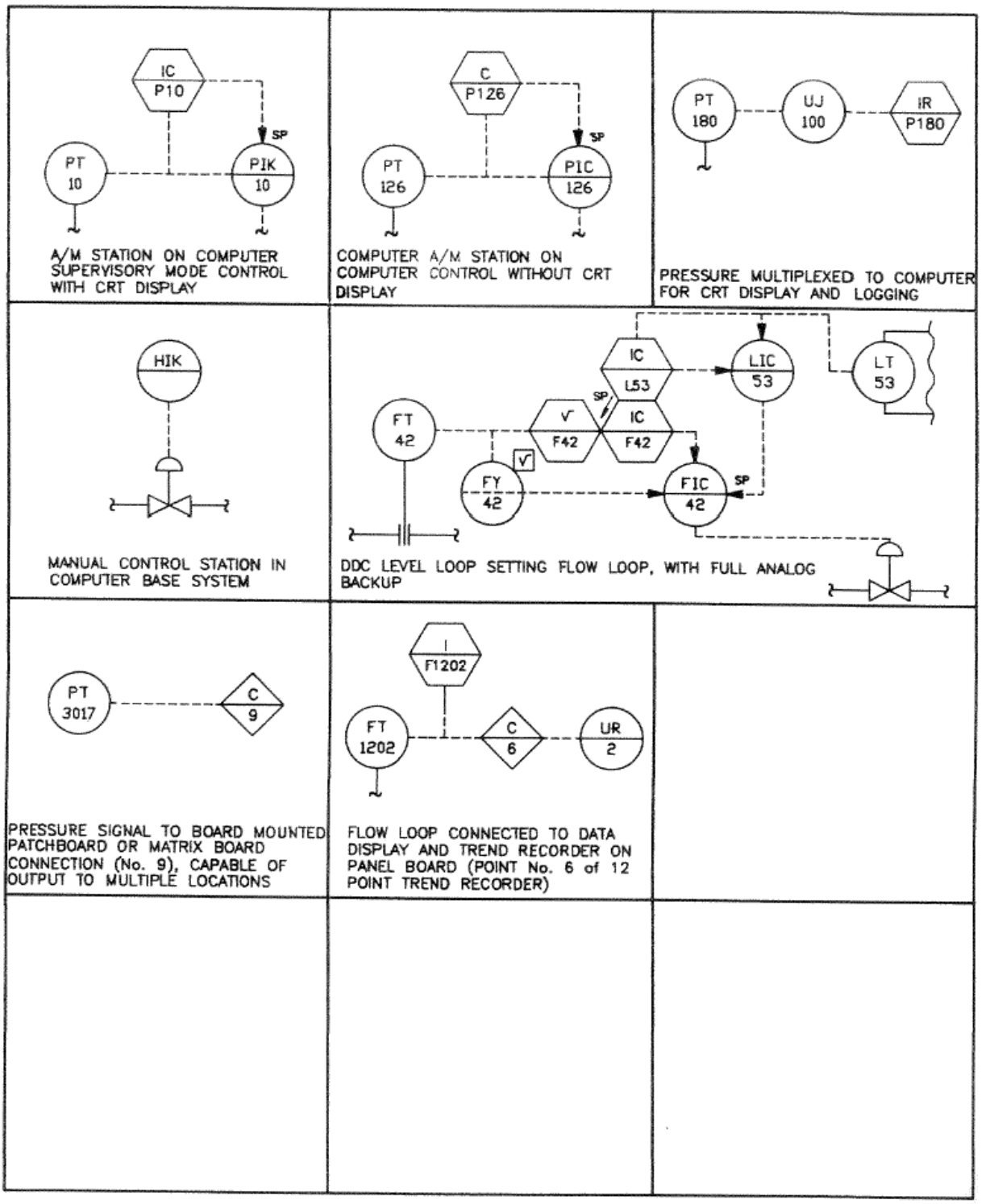

TW
TEMPERATURE TEST CONNECTION WITH WELL
TI
LOCAL TEMPERATURE INDICATOR
TI
BOARD MOUNTED TEMPERATURE INDICATOR (CAN ALSO BE USED WHEN TEMPERATURES ARE MULTIPLEXED TO BOARD MOUNTED DISPLAY)
TI
TT
DUPLEX THERMOCOUPLE CONNECTED TO REAR BOARD MTD. TRANSMITTER AND CHECKING INDICATOR
TT
TIC
FILLED SYSTEM TYPE TRANSMITTER AND INDICATING CONTROLLER
TIC
FILLED SYSTEM TYPE LOCALLY MOUNTED INDICATING CONTROLLER
TCV
SELF ACTUATED TEMPERATURE CONTROL VALVE
TJR
THERMOCOUPLE OR RESISTANCE BULB CONNECTED TO MULTIPOINT RECORDER


FE
FLOW ELEMENT. NO MEASURING INSTRUMENT PROVIDED
FI
ORIFICE TYPE LOCAL FLOW INDICATOR
FO
RESTRICTION ORIFICE (NO METER RUN REQUIRED)
FG
FLOW SIGHT GLASS
FI
ROTAMETER TYPE FLOW INDICATOR
FQI
POSITIVE DISPLACEMENT TYPICAL FLOW TOTALIZING INDICATOR
FT
INLINE TYPE FLOW METER. IDENTIFY OUTSIDE BALLOON (EG. INTEGRAL ORIFICE)
FT
PT
FR
PR
COMBINED FLOW/PRESSURE RECORDER WITH LOCAL TRANSMITTER FOR EACH PEN
FT
FIK
FC
FLOW CONTROL STATION WITH LOCAL CONTROLLER (4-TUBE SYSTEM)
FT
FT
FR
FFRC
FFY
RATIO
S.P.
RATIO CONTROL SYSTEM IN WHICH THE SET POINT OF A FLOW CONTROLLER IS ADJUSTED (VIA A RATIO RELAY) BY THE REFERENCE FLOW. BOTH FLOWS BEING RECORDED.

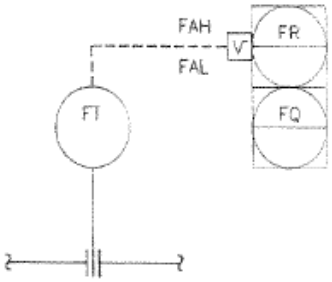

TANK
LG
GAUGE CLASS EXTERNALLY CONNECTED
LT
EXTERNAL FLOAT OR DISPLACER TYPE LEVEL TRANSMITTER
INTERNAL FLOAT OR DISPLACER TYPE LEVEL TRANSMITTER
LC
RECEIVER
DUPLEX LEVEL TRANSMITTER CONTROLLER EXTERNAL FLOAT OR DISPLACER TYPE
LSL
LAL
EXTERNAL FLOAT TYPE LOW LEVEL ALARM SWITCH CONNECTED TO BOARD MOUNTED ANNUNCIATOR
LSH
LAH
INTERNAL FLOAT TYPE HIGH LEVEL ALARM SWITCH CONNECTED TO BOARD MOUNTED ANNUNCIATOR
FLANGE MOUNTED DIFFERENTIAL PRESSURE TYPE LEVEL TRANSMITTER
CIR1
CIR2
LI
REMOTE MOUNTED DIFFERENTIAL PRESSURE TYPE LEVEL TRANSMITTER CONNECTED TO BOARD MTD. INDICATOR & REAR MTD. ALARM SWITCHES ACTUATING BOARD MOUNTED ANNUNCIATOR
FLOAT CONNECTED TO GAUGE BOARD OR TAPE IND
T
LCV
CONTINUOUS DRAINER BALL FLOAT TYPE TRAP WITH EQUALIZING CONNECTION

 PRESSURE CONNECTION WITH PROCESS CONNECTION BLOCK VALVE AND INSTRUMENT BLEED ONLY (TEST POINT)	 LOCAL PRESSURE INDICATOR (INCLUDES PRESSURE VACUUM AND DRAFT)	 LOCAL PRESSURE INDICATOR WITH CHEMICAL SEAL
 LOCALLY MOUNTED LOW PRESSURE ALARM SWITCH CONNECTED TO BOARD MTD. ANNUNCIATOR	 PRESSURE TRANSMITTER (INCLUDES PRESSURE VACUUM & DRAFT). IF ABSOLUTE IDENTIFY OUTSIDE BALLOON	 DIFFERENTIAL PRESSURE INDICATOR
 LOCAL PRESSURE CONTROLLER BLIND TYPE, PILOT OPERATED	 PRESSURE TRANSMITTER CONNECTED TO BOARD MTD. INDICATING CONTROLLER	 LOW PRESSURE SWITCH WITH TWO OUTPUTS OPERATING AT SAME TIME FOR ALARM AND CONTROL

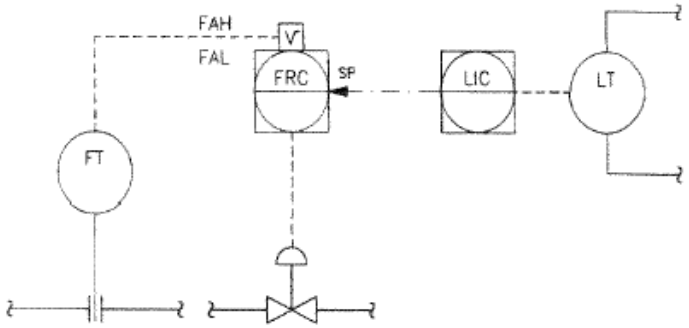

HV
HAND CONTROL VALVE IN PROCESS LINE
HS
ALT:
HAND ACTUATED SWITCHING VALVE IN PNEUMATIC SIGNAL LINE
HS
DEVICE
HAND ACTUATED ELECTRIC SWITCH
HLS
DEVICE
HAND ACTUATED ELECTRIC SWITCH WITH PILOT LIGHT
HIC
HV
MANUAL LOADING STATION WITH OUTPUT GAUGE
ZSL
ZSH
ZLL
ZLH
POSITION SWITCHES CONNECTED TO PILOT LIGHTS INDICATING LOW (OR CLOSED) AND HIGH (OR OPEN) POSITION
ZT
RECEIVER
POSITION TRANSMITTER
AP
ANALYSIS TEST SAMPLE POINT
TANK
XG
VIEW
SIGHT GLASS FOR INTERNAL VIEWING
T
XCV
ALL TRAPS OTHER THAN BALL FLOAT TYPE CONTINUOUS DRAINERS


IC
P10
SP
PT
10
PIK
10
A/M STATION ON COMPUTER SUPERVISORY MODE CONTROL WITH CRT DISPLAY
C
P126
SP
PT
126
PIC
126
COMPUTER A/M STATION ON COMPUTER CONTROL WITHOUT CRT DISPLAY
PT
180
UJ
100
IR
P180
PRESSURE MULTIPLEXED TO COMPUTER FOR CRT DISPLAY AND LOGGING
HIK
MANUAL CONTROL STATION IN COMPUTER BASE SYSTEM
IC
L53
LIC
53
LT
53
SP
FT
42
√
F42
IC
F42
√
FY
42
FIC
42
SP
DDC LEVEL LOOP SETTING FLOW LOOP, WITH FULL ANALOG BACKUP
PT
3017
C
9
PRESSURE SIGNAL TO BOARD MOUNTED PATCHBOARD OR MATRIX BOARD CONNECTION (No. 9), CAPABLE OF OUTPUT TO MULTIPLE LOCATIONS
I
F1202
FT
1202
C
6
UR
2
FLOW LOOP CONNECTED TO DATA DISPLAY AND TREND RECORDER ON PANEL BOARD (POINT No. 6 of 12 POINT TREND RECORDER)

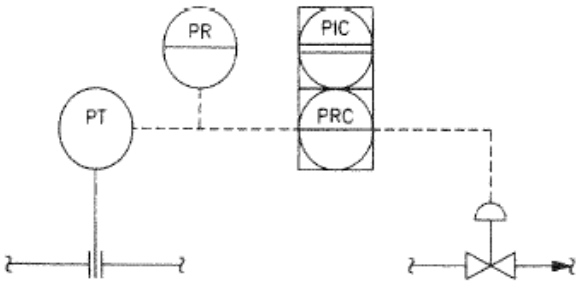
Shared display.
Flow indicating and Totalizing Loop, Showing √ Signal Conditioning Function, Alarms On Measured Variable, Trend Recording Available (Not all System Signals have Trending Available)



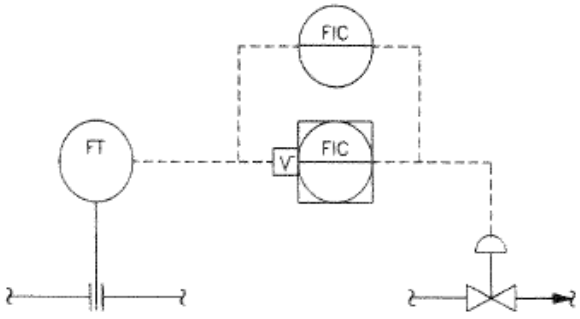
Shared Display
Shared Control
No Backup.
Cascade Control Loop, Showing √ Signal Conditioning Function, Alarms on Measured Variable Trend Recording Available (Not all System Signals have Trending Available)

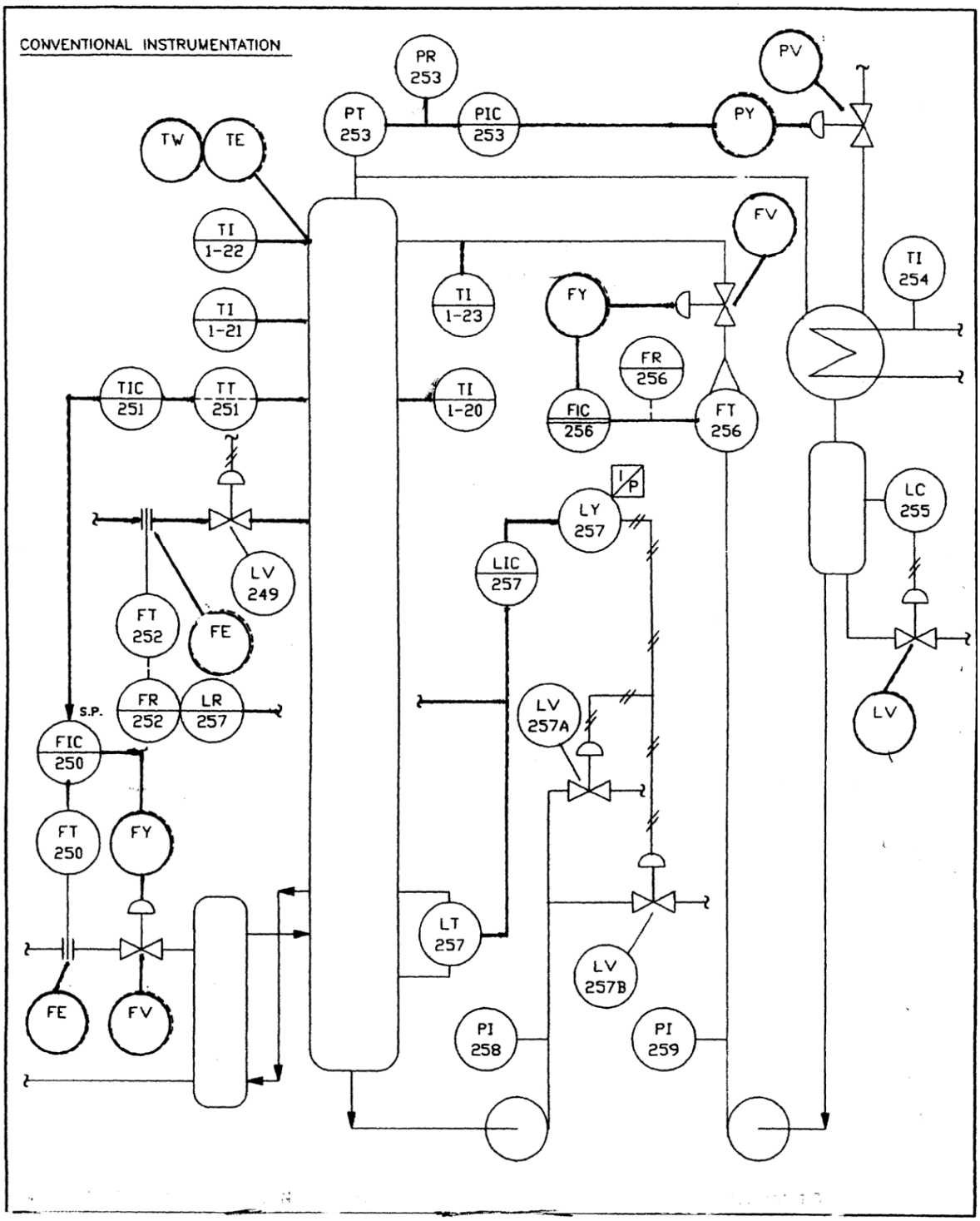


Shared display
Shared control
Analogue back-up station interfaced with the system.
Hardwired continuous analogue recorder.
Trend recording available (Not all System Signals have Trending Available)



Shared display
Shared control.
√ signal conditioning system function, analogue control station independent from the system.




CONVENTIONAL INSTRUMENTATION
PR 253
PT 253
PIC 253
PV
PY
TW
TE
TI 1-22
TI 1-21
TIC 251
TT 251
TI 1-23
TI 1-20
FV
FY
FR 256
FIC 256
FT 256
TI 254
LC 255
I/P
LY 257
LIC 257
LV 249
FT 252
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LR 257
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FIC 250
FT 250
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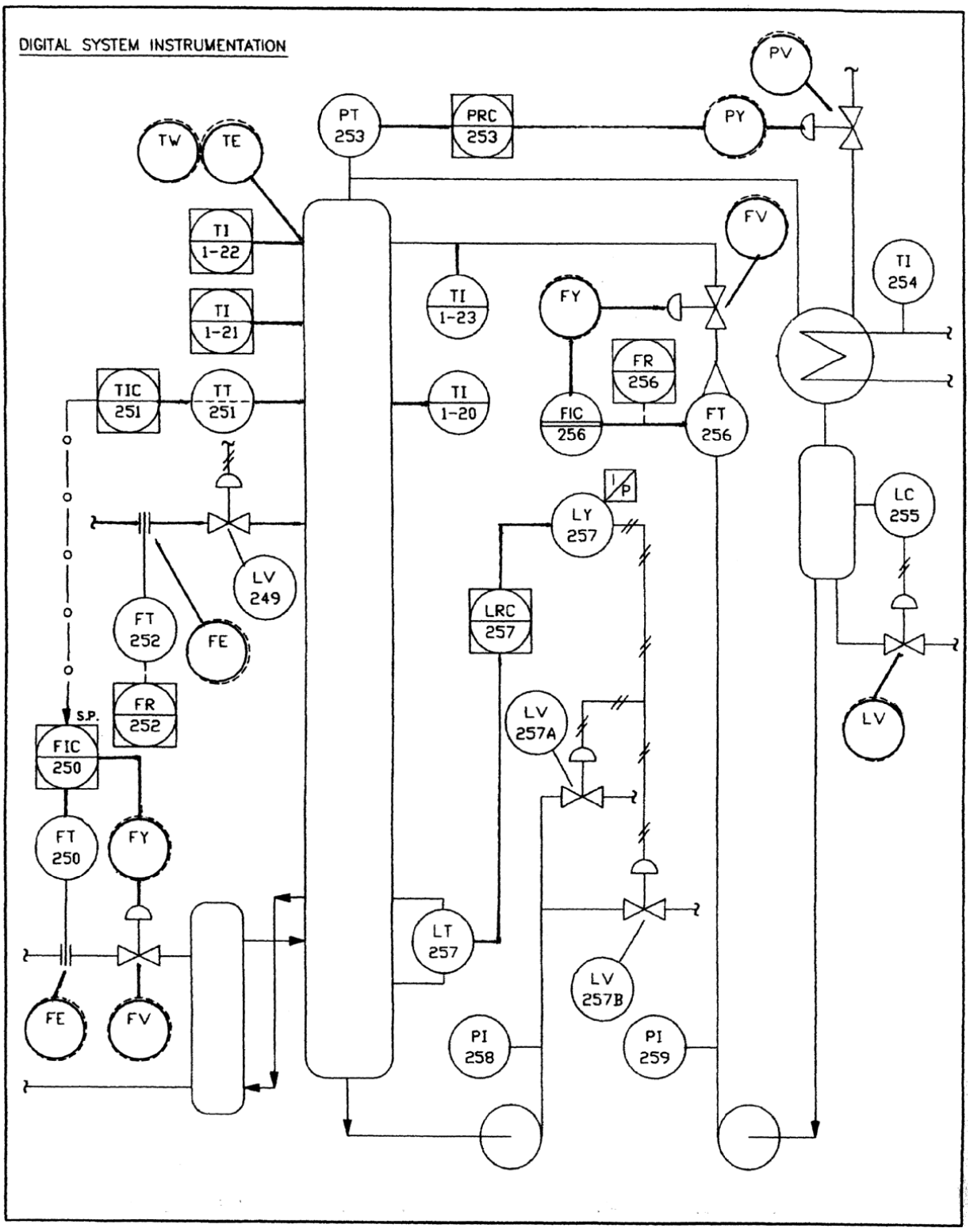
LV 257A
LV
LT 257
LV 257B
PI 258
PI 259
FE
FV


DIGITAL SYSTEM INSTRUMENTATION
PV
PT 253
PRC 253
PY
TW
TE
TI 1-22
TI 1-21
TI 1-23
FY
FV
TI 254
FR 256
TIC 251
TT 251
TI 1-20
FIC 256
FT 256
I/P
LY 257
LC 255
LV 249
FT 252
FE
LRC 257
S.P.
FR 252
FIC 250
LV 257A
LV
FT 250
FY
LT 257
LV 257B
FE
FV
PI 258
PI 259